ALSTOM: the global specialist in Transport Solutions.

ALSTOM is a global leader in the fields of power generation and rail transport. We design, build and service technologically advanced products and systems for the world’s energy and transport infrastructure. In the fiscal year 2004, we have announced forecast sales of approximately €17 billion. In 2004 we will employ approximately 76,500 people in over 70 countries.

Within its five business sectors, ALSTOM Transport is a leading solutions provider to the rail industry world-wide, offering its customers a complete range of products and services, from integrated transport systems, rolling stock of all types through signalling and train control systems to complete customer service packages.

Within the Transport sector, ALSTOM Transport Information Solutions business embraces new technologies and partners to provide an array of products which provide not only signalling solutions, but all the information resources required to operate, control and manage railways and keep the travelling passenger informed, entertained and “connected”. The aim is integrated information communications systems with complementary applications:-

- trainborne information networks
- wayside information networks
- train – wayside wireless communication systems
- control centres for the human and management interface

Our systems allow easy, fast access to information, which can then be used for a wide range of value-adding functions and products.

ALSTOM Transport Information Solutions world-wide employs over 3,500 people in 23 research, production, project delivery and maintenance units.

In the UK, we have offices in Borehamwood, Birmingham and Swindon. Through these facilities, with support from engineering centres of excellence world-wide, ALSTOM delivers projects throughout the UK. We have ISO 9001 accreditation and are qualified as a supplier for a large number of product groups under the industry’s Link-Up scheme. In addition, we hold Network Rail’s Contractor Assurance Case certification.

Recent project delivery successes include Norton Bridge – the re-signalling of a major part of the West Coast Main Line and the introduction of Tilt Authorisation and Speed Supervision “TASS”, an ALSTOM developed system controlling the operation in tilt mode of Virgin’s Pendolino trains – these also developed and supplied by ALSTOM.

Career Opportunities

Against the background of existing and emerging major new projects, we are currently recruiting talented Railway Systems, Safety, Signalling Design and Test Engineers to join our team. As a major international business in the forefront of new technology, ALSTOM provides excellent career opportunities with challenging project assignments, participation in new international technology development programmes and a supportive professional development environment. We are an approved Assessing Agent for the IRSE Licence scheme and take a proactive approach to ensuring that our Engineers are appropriately licensed for the work they undertake.

If you are interested in opportunities with ALSTOM, please click on the Careers button on our website at:

www.alstom.com
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C H PORTER
PRESIDENT 2003/2004

Photo: Claire Porter
Colin Porter BSc(Eng) CEng FIRSE FIEE

Colin was born in Prestbury, Cheshire, just outside Manchester, in 1950, the son of Joseph, a joiner, and Gladys. He was educated at Old Moat Primary School, and then at William Hulme's Grammar School in Manchester, leaving in 1968 to join the London Midland Region of British Railways as an Engineering Scholar, to do a 1-3-1 thick sandwich Electrical Engineering degree at Queen Mary College, London University. He became interested in photography at the early age of 11, doing his own black and white developing and printing, and his career in signalling was generated from doing electrical wiring and timetabling for his school's model railway society.

It was expected that students should spend their summer holidays gaining practical knowledge about S&T engineering, and Colin was able to persuade BR to send him to the USA for a three-month summer student placement with the Penn Central railroad in 1970. There he met Bill Scheerer, then a young graduate just out of CASE University, becoming a lifelong friend. Most of his initial training during the five years took place at Warrington, Tyldesley, Guide Bridge and Tower Block and then Rail House at Manchester Piccadilly, finishing off at Stoke-on-Trent and Crewe. Appointed as a supernumerary STO on completion of training in 1973, he worked in the S&T Laboratory at Crewe on electronic equipment faulting and was involved in the early immunisation testing of the first thyristor locomotive, 87 101, before being inserted into the Manchester Divisional Drawing Office in 1975. His first management post in 1977 was in charge of W36 section (train describers and power supplies) at Carlow Street, Euston. The work there involved the implementation of the first microprocessor-based train describer fringe box systems at Saltley, as well as the electronic systems involved in the West Hampstead resignalling scheme. A short spell in Management services in 1980 was followed by a move to the BRB at Marylebone in 1981 as S&T Engineer (Works/General), his first senior management role. Rationalisation of the S&T workshops and the development of a new S&T Service Centre and York coupled with the development of a common, national set of signalling maintenance specifications were key interests during this period.

In 1984, in a move to Croydon, Colin became the Telecomms Engineer of the Southern Region, enjoying a unified and simple clear reporting structure from maintainers and installers through to the Regional S&T Engineer, Cliff Hale. Significant projects were the widespread introduction of new customer information systems, including large Solari flap-based systems at London Victoria and Charing Cross, and the Brighton Line, Hastings, and Waterloo resignalling projects, coupled with the first introduction of electronic telephone exchanges at Three Bridges, Waterloo, and then throughout the Southern Region. Transferring back to signalling in 1987 as the Signal Engineer of the Southern Region, responsibilities were for signalling maintenance and resources such as training and IT, and Colin was acting Regional S&T Engineer on that fateful day of 12th December 1988, the day of the Clapham Junction train crash, the worst ever crash caused by a technical failure of the signalling system. Back to the BRB in 1991 as Assistant Director (Resources), and then in 1992 with the restructuring of British Rail into a business led railway (prior to any plans for privatisation), Colin was appointed as the S&T Engineer of InterCity to lead, with his colleagues Chris Thompson, David Wilkinson and Quentin MacDonald in the other businesses, S&T Engineering into the future! Not for long though, as the Government's privatisation plans required a complete U-turn in organisation, and in 1994 as the Group S&T Engineer for British Rail Infrastructure Services, Colin helped prepare for the eventual safe transfer of all of the S&T engineering resource into the private sector.

He joined the private sector himself in April 1996, working as European Business Development Director of the American signalling company, Harmon Industries, and was instrumental in their acquisition of the Ware-based Vaughan Systems later that year. He became the Managing Director of Vaughan Harmon Systems in 1999, where he played a significant role in the introduction of the first non-UK electronic interlockings, the Harmon VHLC, on the Cromer line in 2000. This resignalling project also saw the first implementation in the UK of constant warning time level crossing predictors, the Harmon HXP3 at all automatic half barrier crossings on the line. Other projects were a set of replacement train describers for a number of large signal-boxes throughout the UK, including London Victoria, Edinburgh, Motherwell, and Glasgow, together with the slightly more problematical implementation of automatic customer information systems.

Leaving Vaughan Harmon shortly after the acquisition of Harmon Industries by the American GE company, Colin joined MHA Systems as Business Development Director in 2001, and after their acquisition by Lloyd's Register, subsequently became the Engineering Director of the renamed company, Lloyd's Register Rail, which is his current role. He now spends part of his life providing consultancy advice to the complex web of railway authorities and companies that now make up the UK railway industry.

He joined the IRSE as a Student in 1969, passed the IRSE examination in 1974 winning the Thorowgood Scholarship, became a Member in 1981 and a Fellow in 1986. He joined Council in 1983 in the class of Member, and has been on it ever since in a variety of roles. He was the Institution's Treasurer between 1986 and 1993, played a key role in establishing the IRSE Licensing Scheme chairing the first working party in 1991 which led to the introduction of the scheme in 1994, and is still the Institution's Assistant Treasurer.

In his private life, Colin has two children from his first marriage, Clare, a Chartered Physiotherapist, and Andrew, a young graduate civil engineer. He married Claire Henley, an IRSE Council Member and organiser of a number of Aspect Conferences, in November 2001. He retains a keen interest in photography, camping, MGB GTs, and more recently, a passion for canals and narrowboats. He wishes he could do more cycling.
The Institution of Railway Signal Engineers
INCORPORATED 1912

SESSION 2003/2004
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John Corrie (Senior Vice-President), Colin Porter (President), Claire Porter, Martin Govas (Treasurer), Ken Burrage (Chief Executive)

2nd Row (left to right):

Wim Coenraad, Fraser Wilson, Frans Heijnen, Clive Kessell, John Francis, Bob Barnard, Rod Price, Ian Allison

3rd Row (left to right):

Keith Walter, Paul Jenkins, David Weedon, Daniel Woodland, John Haile, Karen Gould, Denys Dyson

Back Row (left to right):

Ian Mitchell, Peter Stanley, Mark Watson-Walker, Derek Edney, Jim Irwin, Nick Wright
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Institution Announcements

(The price and subscription rates and other information given in these announcements are current at the date of publication – August 2004)

CHANGE OF ADDRESS

Considerable inconvenience is created by members failing to notify changes of address. Will members please inform the Institution office immediately of any such alteration and so ensure prompt delivery to themselves of notices, etc.

TRANSFER TO HIGHER CLASS OF MEMBERSHIP

Members sometimes remain in one class of membership when their professional standing has become such as to entitle them to transfer to a higher one. The Council invites any such person to make application for transfer, for which purpose a form can be obtained from the Institution office, and so take a position in the Institution consonant with his attainments and responsibilities.

TECHNICAL PAPERS

The Council invites members of all classes to submit papers for presentation at technical meetings in London or at local meetings in the United Kingdom or overseas.

Papers should consist of between four thousand and six thousand words and while no limit is placed on the number of illustrations an author uses during his reading of the paper, the number printed as part of the advance copy and published in the Journal of Proceedings must not exceed twelve.

The Institution office will be pleased to provide full particulars upon application.

COPIES OF TECHNICAL PAPERS

Copies of the technical papers read in London will be published in IRSE News and circulated to all members. The cost of this service is included in the Annual Subscription.

SUBSCRIPTIONS AND REMITTANCES

Members are reminded that in accordance with the Articles of Association subscriptions are payable on election or by the 1st July each year. The subscription rates applicable for 2004/2005 have been determined by Council. Members have been circulated with details.

Members are reminded that prompt payment of subscriptions is required. The Institution is grateful to the vast majority of members who keep administration costs down by paying at the time requested. The Treasurer is obliged to send out notices of arrears to members who have not paid by that date.

Subscriptions should be sent to the Institution office in London, unless you belong to either the Southern African or Australian Section. Local arrangements apply to members of these Sections.

All cheques and money orders, especially those from overseas, should be crossed.

The attention of members is directed to the clauses in the Articles of Association under which neither notices nor copies of Proceedings may be sent to those who are in arrears with their subscriptions beyond a certain time.

Income Tax – the annual subscription to the Institution of Railway Signal Engineers is treated as an allowance expense under Section 16 of the Finance Act 1958 and should be included in your Tax Return in the section headed “Expenses in Employment – Fees or subscriptions to professional bodies”.

Members of the Institution who have retired and have paid full subscriptions for at least ten years are entitled to continue membership of the Institution at half the full rate applicable to their class of membership. Similar arrangements are available to others in special need on application to the Treasurer. Members of 50 years standing are not required to pay subscriptions.

LIBRARY

The Institution Library is incorporated with the Library of the Institution of Electrical Engineers, by kindness of the Council of the latter body. It is situated at the Institution of Electrical Engineers’ building at Savoy Place, Victoria Embankment, WC2. Members of the Institution of Railway Signal Engineers have been granted the same privileges with respect to it as those enjoyed by members of the Institution of Electrical Engineers, and the entire collection is open to them on equal terms.

The Reference Library, which contains a Reading Room in which a great number of technical periodicals are always available, as well as a large general collection, is open as follows:

Monday to Friday 9.00 am to 5.00 pm

Any member of the Institution of Railway Signal Engineers entering the Library must sign his name in the book provided for that purpose.

The use of the Lending Library, which is open during the same hours as the Reference Library and which contains the principal works relating to electrical engineering, its applications and allied subjects including, of course, railway signalling, is governed by the following rules, which must be strictly adhered to:

When applying for a book by post a member of the Institution of Railway Signal Engineers must state their class of membership. All communications should be addressed to the Secretary, Institution of Electrical Engineers, at the address already given.
Anyone desirous of making a presentation to the collection should forward it to the same address, when its receipt will be suitably acknowledged.

Similar facilities also exist at the Scottish Engineering Centre, The Teacher Building, 14 St Enoch Square, Glasgow G1 4DB.

**SCOTTISH LIBRARY FACILITIES**

The Scottish Engineering Centre Library in Glasgow provides extensive library and information services, including on-line databases and the Internet. IRSE material is now available, including the new IRSE Professional Examination Reading List.

The IRSE library is situated in the information centre in The Teacher Building, 14-16 St Enoch Square, Glasgow G1 4DB, Tel: 0141 566 1871. Access is restricted so please check opening times and arrangements by telephoning before hand.

**SIGNAL AND TELEGRAPH TECHNICAL SOCIETIES**

The following S&T Technical Societies are affiliated to the Institution:

The Signal & Electrical Engineers’ Society –
General Secretary: M B Simmonds
Tube Lines Ltd, 4th Floor (4/091), 15 Westferry Circus, Canary Wharf, London E14 4HD
Email: mathew.simmonds@tubelines.com
Tel: 020 7088 5517

**IRSE PROFESSIONAL EXAMINATION REQUIREMENTS FOR CORPORATE MEMBERSHIP**

The aim of the examination is to establish the professional competence of educationally qualified electrical, electronic and communications engineers in railway signalling and communication engineering.

It is intended to test the main concepts of the subject material without bias to any one railway practice and is designed to demonstrate that the student has reached the necessary professional educational standard required by a signalling or telecommunications engineer for Corporate Membership of the Institution.

This standard is typified by the exercising of judgement in the preparation, assessment, amendment or application of specifications and procedures, and is applicable to personnel engaged in the following activities:

- Signalling/telecommunications principles, practices, rules and regulations for the safe operation of railway traffic.
- Design and development of signalling/telecommunications equipment and systems.
- Preparation and understanding of equipment drawings and specifications and/or design.
- Planning, site installation and testing of signalling/telecommunications equipment and systems.
- Practices related to assembly, wiring and testing of signalling/telecommunications equipment and systems.
- Maintenance and servicing of signalling/telecommunications equipment and systems.

In order to meet the examination requirements for corporate membership, candidates must, within a period of five years, obtain a pass in Module 1, plus three of the remaining six optional modules.

It is possible to obtain exemptions from individual modules where you can demonstrate that you have passed an examination by a recognised body, which has substantially covered the syllabus of a particular IRSE examination module. Due to the specialised nature of the IRSE Examination, the scope for exemption is fairly limited.

Claims for exemption must be made within five years of obtaining the particular qualification for which recognition is being claimed. The reason for this condition is that the exemption is based on information that may not be available where a qualification has been discontinued or changed.

**MODULE 1**
- Safety of Railway Signalling and Communications – No exemptions will be given.

**MODULE 2**
- Signalling the Layout – Please apply, no exemptions currently agreed.

**MODULE 3**
- Signalling Principles – Please apply, no exemptions currently agreed.

**MODULE 4**
- Communications Principles – This is the most commonly sought after exemption. Many of the applicants for exemption claim that telecommunication has been part of their Degree course and that, on this basis, exemption should be granted. Unfortunately it has been clear that the content of the telecommunications element within a typical university Engineering Degree is, at best, a basic overview. Occasionally, students study a telecommunications topic for their final year project, but these tend to be a research topic narrowly specialising in a particular field and the Council is not convinced that such study justifies module exemption. As a basic guideline, therefore, please do not ask for exemption to this module unless: your university study has predominantly been in telecommunications; or your university study has included telecommunications and your present career is railway telecommunications engineering.

**Module 5**
- Signalling & Control Equipment, Applications Engineering – Please apply, no exemptions currently agreed.

**Module 6**
- Communications Equipment, Applications Engineering – Please apply, no exemptions currently agreed.

**Module 7**
- Systems, Management & Engineering – Please apply, no exemptions currently agreed.

The examination is generally held in October of
each year and the regulations are available from the Head Office. The following support materials are also available to students:

- Information for Students
- Examination Syllabus
- Reading List
- Past Papers
- Model Answers
- Examiners Reports
- Updates of Examination Material (fee applies)

THE THORROWGOOD SCHOLARSHIP AWARD

The Thorrowgood Scholarship is awarded annually to a student member excelling in the Institution's Professional Examination. The award consists of the Institution's Thorrowgood Scholarship Medallion, and a cheque in the region of £1,000, that is presented at the Annual General Meeting of the Institution in the April following the examination.

The terms of the Thorrowgood bequest require that it should be utilised to assist the development of young engineers employed in the railway signalling and telecommunications field. A requirement of the award is that it is used to finance a study tour of railway and/or signalling installations or manufacturing facilities, usually in a foreign administration, and that the award holder presents a report about the study tour to the Younger Members' Section.

To be eligible for the award students are usually expected to have sat the required four modules in the same year, and achieved outstanding results.

Institution Sales

All items are available from the Institution office and postage and packing is not included.

INSTITUTION TIE

An Institution tie bearing a single motif of the Institution crest in light blue on a navy background is available, price £10.00.
### TEXT BOOKS

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<td>British Railway Signalling Practice – Electrical</td>
<td>£8.00</td>
<td>£8.95</td>
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<tr>
<td>British Railway Signalling Practice – Signalling Instruments</td>
<td>£7.00</td>
<td>£7.95</td>
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<tr>
<td>European Railway Signalling</td>
<td>£35.00</td>
<td>£36.00</td>
</tr>
<tr>
<td>Fifty Years of Railway Signalling – O S Nock (reprint)</td>
<td>£10.00</td>
<td>£11.95</td>
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<tr>
<td>Introduction to Signalling (+ p&amp;p £8 UK and £15 overseas)</td>
<td>£25.00</td>
<td>£60.00</td>
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<tr>
<td>Metro Railway Signalling</td>
<td>£35.00</td>
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<tr>
<td>Railway Control Systems</td>
<td>£35.00</td>
<td>£60.00</td>
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<tr>
<td>Railway Signalling</td>
<td>£35.00</td>
<td>£60.00</td>
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<tr>
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<td>£35.00</td>
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### TECHNICAL REPORTS

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Institution Awards

DELL AWARD

The Dell Award is made annually under a bequest of the late Robert Dell OBE (Past President). It is awarded to a member of the Institution employed by London Underground Ltd (or its successor bodies) for achievement of a high standard of skill in the science and application of railway signalling. The award takes the form of a plaque with a uniquely designed shield being added each year with the recipient’s name engraved on it and a cheque for £300 to spend as the recipient wishes.

The winner of this year's Dell Award is George Clark, of Tube Lines Ltd, and Mr Porter presented Mr Clark with the Dell Award amidst applause.

Colin Porter presents George Clark of Tube Lines with the Dell Award

THORROWGOOD SCHOLARSHIP

The Thorrowgood Scholarship is awarded annually under a bequest of the late W J Thorrowgood (Past President) to assist the development of a young engineer employed in the signalling and telecommunications field of engineering, and takes the form of an engraved medallion and a cheque to be used to finance a study tour of railway signalling installations or signalling manufacturing facilities. The award is made, subject to satisfactory interview, to the Institution young member attaining at least a pass with credit in four modules in the Institution's examination.

The Thorrowgood Scholar for 2003 is James Carney, a Signal Engineer at Cardiff with Mott MacDonald.

Mr Porter presented Mr Carney with the Thorrowgood Scholarship medallion and a cheque for £1,000 amidst applause.

Colin Porter presents James Carney of Mott MacDonald with the Thorrowgood Scholarship

YORK SECTION GOLDEN JUBILEE

The President explained that the York Section of the Institution had been in existence for 50 years this year, having been formed in 1954 following a petition to Council by York members. To celebrate its Golden Jubilee a specially engraved medallion on a crimson ribbon was presented to the York Section Chairman, Mr D Dyson, amidst congratulatory applause.

Colin Porter presents Denis Dyson with the specially engraved medallion in celebration of the Golden Jubilee of the York Section
J PETER CUNLIFFE PE

Peter Cunliffe passed away on 6th December 2002. He was educated at Trent College and Crewe Technical College in Great Britain, and trained as a professional engineer by the former London, Midland & Scottish Railway (subsequently part of British Railways), in whose employment he entered as a trainee in 1935. This experience took him through manufacturing, the design office, new works, field construction, maintenance and supervisory levels. On 1st September 1939, immediately before World War II, he was mobilised with the Railway Supplementary Reserve of the British Army, Royal Corps of Signals, in which he was commissioned in 1937. He subsequently saw service in Europe and the Middle East as Commanding Officer of Railway Units in the field. He was awarded the Emergency Reserve Decoration by the Queen.

In 1946, following demobilisation, he rejoined British Railways, serving in London and Derby in various technical capacities before being appointed to a Section Head position at the Headquarters of the Scottish Region in Glasgow.

In 1953, he was selected for service with the Malayan Railway, Kuala Lumpur, where he became a Chief Engineer. In this capacity, he was responsible for maintenance and new works throughout the network (from Thailand to Singapore) and developed new systems (including the control of trains by means of Relay Auto Block with Magnetic Tail Checking – the first of its kind in the world). He was also involved in the reconstruction of the East Coast line, which had been torn up by the Japanese for removal to Burma during their occupation of South East Asia.

In 1963, Peter returned to Europe to join Frederic R Harris Inc, Consulting Engineers, in The Hague, Holland, where he handled railway and communications engineering projects as well as deep-water oil ports in Kuwait and Bantry Bay, Ireland. Subsequently, he moved to the United States to join the firm’s consolidated Transport Division in Connecticut. During that period he became an Assistant Vice-President and one of his projects was significant contribution to the awareness of track safety in his business.

The Wing Award for Safety this year had been made to Barry West, Amey Rail, nominated by Network Rail, for his unselfish dedication and total commitment for over 20 years to obtaining trackside safety improvements in Devon and Cornwall. The retiring President, Mr C H Porter, presented him with the award at the National Railway Engineering Safety Awards at the International Conference Centre in Birmingham on 29th April 2004.

Obituaries

WING AWARD FOR SAFETY

The Wing Award for Safety was introduced in 1994 to commemorate the life and work of the late Peter Wing, a Fellow of the Institution and employee of British Rail, who during his career made a major contribution to the cause of lineside safety. The award takes the form of a certificate and an amount of £500 to be devoted to personal development, and is made to an individual who it is considered has made an outstanding contribution to railway track safety by, for example, coming forward with a novel idea for improving safety, is a long-term champion of improving track safety standards or has made a major contribution to the awareness of track safety in his business.

The Wing Award for Safety this year had been made to Barry West, Amey Rail, nominated by Network Rail, for his unselfish dedication and total commitment for over 20 years to obtaining trackside safety improvements in Devon and Cornwall. The retiring President, Mr C H Porter, presented him with the award at the National Railway Engineering Safety Awards at the International Conference Centre in Birmingham on 29th April 2004.
Concurrently, he was a Vice-President of Impact General Inc, a forensic sciences company, as well as a Faculty Member of its subsidiary, the National Institute of Forensic Studies.

Peter held a Bachelor of Science degree in Industrial Management, a Master of Science in Engineering and a Doctor of Philosophy in Engineering and Technology. He was a Registered Professional Engineer in the States of California, Connecticut, Maryland and Nevada and was a Certified Safety and Security Director of the World Safety Organisation (of which he was a Member and Chairman of its Rail Transport Safety Committee). He was a Diplomat of the American Board of Forensic Engineering & Technology.

His professional affiliations included the American Railway Engineering & Maintenance Association, the American Society of Safety Engineers and the American Arbitration Association. In addition, he was a Fellow of the IRSE, a Fellow of the Chartered Institute of Transport and a Fellow of the Permanent Way Institute.

Peter gave many presentations and seminars at various universities and colleges on transportation systems and related technology and has to his credit 40 published papers on similar subjects.

Peter held dual American and British Citizenship. He is survived by his daughter, Melissa, who is resident in Southern California.

YVES GRUÈRE
1939 – 2003

It is with great sadness that we learn of the death of Yves Gruère, who passed away on 27th July 2003.

Yves, a Fellow of the Institution, was born in 1939. After tertiary studies at the Ecole Spéciale de Mécanique et de l'Electricité in Paris, where he graduated with majors in electronics in 1962, he undertook research work for a year in the field of physical astronomy, at the Paris Observatory of CNRS, the French National Research Centre.

He was then called up for military service, on completion of which he joined Alsthom in 1965, where he spent three years in the rolling stock division, before transferring to signalling in 1968.

In 1973, Yves joined CSEE, where he was to spend the rest of his career, nearly all of which involved him in innovation and the implementation of new technology. From 1973 to 1975, he was part of the team constituted by SNCF (French National Railways) with industry (CSEE, Alsthom and Télémécanique) in its trials of the then new A-46 ATP standard, which in later developments in Germany and Canada gave rise to the LZB and Seltrac systems.

From the mid 1970s, Yves participated actively in the development and trials of the TVM-300 continuous ATP system, first used by STIB on the Brussels Metro and then by SNCF, which adopted this technology for its first high-speed line from Paris to Lyon which opened in 1981.

In parallel to this project, the Paris Transport Authority, RATP, was pressing ahead with its project to interconnect two suburban commuter railway lines east and west of Paris, thereby traversing the entire city with five strategically placed interchange stations. This line, RER “A”, by allowing fast and convenient access to the business centre from outer suburbs, rapidly became a victim of its own success. The easiest solution to the problem of saturation was to attempt to increase the throughput from 24 to 30 trains per hour.

The result was the SACEM sub-sectionalised block ATP system, the first railway use of a fail-safe computer application in France, using coded data and coded operations and processing.

Yves, along with Pierre Chapront, was a founding member of the team made up of RATP, SNCF, CSEE, Interelec, Jeumont-Schneider and Matra. SACEM was certified in 1988. The system lived up to its expectations and enabled the anticipated increase in line capacity on the RER and was subsequently adopted by a number of commuter railways overseas, including Hong Kong and Mexico City.

From 1985 to 1987, Yves was involved in the consortium which produced the world's first driverless heavy metro, the MAGGALY system, a moving-block derivative of SACEM, developed by Matra Transport and used on line 4 of the Lyon metro.

Due to his involvement in leading-edge technology which was subsequently exported, Yves was to spend more and more time abroad. The Korean TGV contract was no exception and Yves spent months at a time in Seoul in the early 1990s in close collaboration with old friends from GEC-Alsthom.

He also made numerous trips to Hong Kong at this time. One memorable event (albeit less amusing for Yves than for his colleagues) was a site inspection on the KCR at Sheung Shui station. Grease from the point rodding, on which he had inadvertently trodden, lodged between the sole and the heel of his shoes. And stayed there, as long as he walked on the paved corridors and floors of the KCR and MTR systems. Unfortunately, the deep-pile carpet of his hotel room proved altogether more receptive to a “transfer”, and the ever-conscientious Yves spent most of the night – and all of the paper he could find – in attempting to undo the damage.
Yves was always an anglophile and he never lost his early interest in locomotives and rolling stock. He occasionally recounted the lasting impression which the complexity of the London suburban train system had made on him during his first visit to England. It was 1953, the year of the Coronation, and he was all of 14 years old.

But it was his involvement with the Channel Tunnel project which first led him into close contact with members of the Institution, to which he was admitted as a Fellow, an honour for which he was both extremely proud and grateful.

He later collaborated with Jacques Catrain and Jacques Poré in preparing the French section of the Institution’s textbook on European signalling.

Yves was involved in the development of ERTMS from the beginning and participated in many of the programmes launched by the UIC, ERRI and UNISIG, which resulted in the specifications which we know today. He was actively involved in the Vienna-Budapest pilot project, the drafting of the CENELEC standards and was also involved in the EMSET trials in Madrid with Jaime Tamarit and Denis Duhot. He was an active supporter of this project from the beginning right up to the tests in Spain on the Madrid-Seville line in June 2000.

His last research work, before retiring, was in the field of low cost radio-based signalling systems.

Yves retired in May 2001. Tragically, within a year he fell ill and passed away shortly after his 64th birthday but he will not be forgotten. No one who knew him could fail to be impressed by his professionalism, his immense general railway culture, his patience, the importance he ascribed to and the time he spent in teaching the younger engineers and, above all, his modesty and great kindness.

We extend our sincere condolences to Mme Claude Gruère and family, who are in our thoughts at this sad time. Andrew Price and Jacques Poré

PETER RAYMOND GEORGE GUYATT
1918 – 2003

Peter Guyatt died in hospital after a short illness on 16th December 2003 aged 85.

Peter was born on 5th February 1918 and upon leaving school followed in his father’s footsteps by joining the Signalling Department of the Southern Railway Company at Wimbledon. The early years of his career were soon interrupted by the outbreak of the Second World War in September 1939. He served in the Royal Air Force from the start of the war until its end in 1945, and during this time was responsible for supervising the maintenance of electrical equipment on aircraft. Returning to the railway after the war Peter pursued a distinguished career at the headquarters of first the Southern Railway at Wimbledon and later at Croydon for British Rail, Southern Region, progressing to become deputy to the Chief S&T Engineer of the Southern Region. He retired from the railway in 1978 but continued his association with the signalling profession by providing specialist advice to the Mott MacDonald engineering consultancy.

I first met Peter in 1956 when I joined the Southern Region S&T Department as an engineering student. Peter was then, for those days at the relatively young age of 38, the South Eastern Area Assistant (later called the SE Divisional Signal Engineer). He became a role model and mentor to me and many other trainees on the Southern. His helpfulness and good-natured tolerance of our faltering steps to understand the intricacies of the profession knew no bounds. He was always ready to explain, to clarify and to give examples of good S&T practice.

Peter’s career in the S&T Department of the Southern was hallmarked by a conscientious devotion to his duty, to the signalling profession and to helping and supporting his colleagues. His capacity to manage a very heavy workload and at the same time to serve the needs of railway commuters on the Southern was epitomised by his leadership and skill in managing the massive workload that followed such accidents as the Lewisham St John’s collision in 1957, and again later the disastrous fire at Cannon Street that totally destroyed the signal-box controlling that busy London terminal. Within a few days temporary signalling arrangements had been installed to permit a limited service into Cannon Street and a complete new signal-box interlocking frame was provided and installed in a matter of weeks!

Peter also had an incredibly enquiring mind. He took a lively interest in many things, in current news topics, in sport, in nature, in the arts. His handwriting and printing style was a joy to behold and letters from Peter were masterpieces of composition and anecdote. He was possessed of an impish sense of humour, which he frequently used to brighten the lives of those with whom he came into contact. He was a witty storyteller and his family and friends have many fond memories of his tales.

Peter was a member of the Institution for 66 years. He joined the IRSE as a Student member in 1937, became a Member in 1942 and a Fellow in 1959. He served on the Institution’s General Purposes Committee for many years and was also an active supporter of the Southern Region S&T Technical Society.

His wife Julie, who died in 2001, supported him...
throughout his career and our sincere condolences go out to Peter’s surviving family; to his sister on the Isle of Wight, to his brother John, another former Southern S&T Department man, and to his two daughters Sheila and Liz and their families. We shall all recall with fondness, respect and affection a man whose example in his family life, in his professional life and love of life in general was one to which many would aspire and which will be long remembered by his family, friends and colleagues.  

K W Burrage

ALISTAIR McKILLOP

Alistair Neil McKillop, who died in December 2003, took a keen interest in railways, particularly signalling, from an early age. He was encouraged by his father, who himself spent the first five years of his working life in the Goods Manager’s office at St Enoch Station, Glasgow Terminal of the G&SWR.

Alistair was born in Glasgow in May 1921 and in his formative years, through reading and discussions with his father, who was knowledgeable about block working and bell codes, picked up a considerable knowledge of railway lore. Together they became friendly with a signalman at Crookston, who allowed them into his box during quiet periods. It was there that Alistair learned about signal-box working.

His secondary education was at Allen Glen’s School in Glasgow, and during this time he used holiday periods and his hobby of cycling to visit signal-boxes within a 30 mile radius of Moss Park where he lived. He soon compiled a list of friendly signalmen who allowed him into their boxes during quiet periods.

With the end of his schooldays approaching Alistair decided that he wanted to join the railway, and after interviews with Mr William Bryson, the then LMS Divisional S&T Engineer, and his staff he started his railway career as an apprentice in late 1938. This meant an early morning start, as he had to be on the 6.45 am train from St Enoch to the signal works at Irvine in Ayrshire. He particularly enjoyed working in the locking frame shop, especially when he went with a fitter to make modifications to a working lever frame. He also enjoyed being in the instrument shop, where he helped with the repair and overhaul of block instruments, tablet instruments, relays, train describers, etc.

After Irvine he moved outside and joined the signal gangs. During his apprenticeship he attended evening classes at the Royal Technical College in Glasgow studying for ONC and HNC in Electrical Engineering.

About this time Alistair met up with Bill Murray, then Lineman at St Enoch, who further encouraged him and introduced him to terminal working controlled by a miniature lever frame. They became firm friends and a few months before Alistair died he visited Glasgow with his wife, son and youngest daughter to visit Bill, then in his 99th year. Alistair completed his apprenticeship when he was 21 in 1942, becoming a technical assistant and then supervisor in Scotland.

In 1948 he left the railway and joined the Siemens & General Electrical Signal Co at Wembley. At that time SGE was very much involved with the resignalling of Liverpool Street and Bethnal Green, in connection with the electrification to Shenfield and Alistair had some involvement with this work.

In December 1951 he presented the first of his three papers to the IRSE in London, “Non-Token Methods of Single Line Working”.

From 1952 to 1954 he was very involved with the signalling of the Yonge Street Subway, Toronto’s first subway: firstly in the design at Wembley, then as Site Engineer for about 18 months until commissioning in summer 1954.


The second half of the 1950s saw him working on Scottish Region contracts, the resignalling of Glasgow Central low level lines and resignalling of North of the Clyde lines between Airdrie and Kelvinhaugh, in connection with electrification.

INTERNATIONAL CAREER

Circa 1967 Alistair left SGE to join De Leuw Cather Canada Ltd. He was based in Manchester and heavily involved in many schemes and feasibility studies, including road/rail feasibility studies in the Birmingham area, South-East Lancashire/North-East Cheshire (SELCNEC) PTE, Manchester Area Rapid Transit Studies (MARTS), Piccadilly-Victoria Railway Tunnel Scheme, Bus/Train interchange at Altrincham and Mass Rapid Transport for Dublin. Also during this period he advised on various aspects of Rapid Transit Operation in Helsinki.

In November 1971 Alistair presented his third paper to the IRSE “Automatic Operation of Rapid Transit Trains”.

In 1976/77 he returned to SGE, now GEC-General Signal Limited, as Sales Director.

But 1978 saw him back in Toronto working for the Urban Transport Development Corporation where he was responsible for Systems Planning and Transit Maintenance etc. He led a Canadian multi-
disciplinary team providing specialist advisory services to Brazilian cities.

In 1980 Alistair moved to Washington DC, back again with De Leuw as Senior Signal Engineer Manager working on the Washington-Boston North East Corridor Railway Improvement Project.

After Washington he moved to Singapore in 1982, firstly with De Leuw working on the Mass Rapid Transit Project and then directly with the Singapore MRT Authority as Senior Design Engineer, Signals, until 1989.

In September 1984 he presented, jointly with S M Scott, a paper to the IRSE International Railway Safety Control and Automation Conference, “Command Control and Communication for Singapore Mass Rapid Transit”, in London.

Much travelled, Alistair also visited Ireland, Mexico, Hong Kong, Libya and Finland on business. Jim Waller recalls that Alistair was his mentor on his first business trip abroad, to Spain.

Returning to the UK in 1989 he and his wife, Olwen, settled in Long Buckby, Northamptonshire, not to retire, but to set up a consultancy which he practised for nearly 10 years with many clients at home and abroad.

Alistair joined the IRSE as a Student in 1939, became a Fellow in 1960 and an Honorary Fellow in 1999: he was a registered Professional Engineer (Electrical) of Ontario, Canada, and a member of the Association of American Railroads. He obtained HNC in electrical engineering with additional qualifications in telecommunications.

Alistair met Olwen dancing at Wembley Town Hall and they married in 1950. They had a son, Neil, and two daughters, Lynn and Jill, six grandchildren and one great-granddaughter, all of whom survive him. Olwen was a very supportive wife, and accompanied Alistair abroad, to Canada twice, to Washington DC and Singapore.

He had a flair for languages, including Welsh, and was fluent in German. He enjoyed poetry and prose of all kinds, particularly Robert Burns. He was good at writing poetry and prose himself. He was an avid reader of The Guardian, interested in current affairs and was, for a time, a Parish Councillor in Long Buckby.

Alistair enjoyed walking, particularly in the Lake District and on the South Downs. In recent years he visited cathedral cities and enjoyed walks along the River Severn at Worcester, on the city wall at Chester and up and down the hill at Lincoln.

At the end of the day he enjoyed a chat over a glass or two of ale and the occasional wee dram.

Well respected and revered worldwide for his expertise in his field, and also well liked for his honesty, integrity and quiet strength, he remained a true gentleman to the end. A good companion, good humoured, he laughed a lot, and will be much missed. 

Geoff Whitehouse

Fifth Members’ Luncheon

The fifth Members’ Luncheon was held on 18th June 2003 when 90 members of the Institution, including 12 Past Presidents and 13 members with over 50 years’ membership, took luncheon at the Victory Services Club in Seymour Street, London. An enjoyable three-course luncheon with wine was consumed with pleasure.

The 79th person to serve as President since the Institution’s formation in 1912, Mr Colin Porter, addressed the members present with a brief speech and mentioned the forthcoming pro-
membership were represented at the lunch by Mr Ronald Post. Two members have over 70 years’ membership. Our longest serving member is now Mr Wilfred Hardman, residing in New Zealand, and aged over 90, with 74 years of membership. He corresponds regularly with the office and sent his best wishes to those present at the luncheon. Many other members who were unable to attend in person had also sent letters of apology and good wishes.

Regrettably 15 members had died since the lunch last year including Mr Harry Baldwin, a member for 70 years, Mr Armand Cardani, a member for 61 years and our oldest Past President and a regular attendee at these lunches since their commencement five years ago, and also more recently Mr Ron Hall, a valued member of our Membership Committee. The Institution is grateful for the service that all of these friends and colleagues performed for the Institution during their time with us.

The luncheon concluded in a most pleasant and happy atmosphere of friendship and camaraderie being thoroughly enjoyed by all present.

The sixth members’ luncheon has been provisionally arranged to take place on Wednesday 16th June 2004 at the same venue.

Members attending the luncheon on 20th June with over 50 years’ membership of the Institution were Messrs G Amoss, R Bugler, S Buttery, H Fensom, I Foster, B Grose, E Harris, H Jones, F Kerr, J Lethbridge, G Moppett, M Page and R Post.

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It is with enormous pleasure and not a little pride that I give this presidential address to the members of an Institution I have enjoyed belonging to for some thirty-four years. In this address I will cover my own career within the profession, my perception on the state of the profession and industry within which we all work, and my own views on our Institution. It is humbling to look back at the names of our former presidents. Amongst them are the movers and shakers of the railway and industry management over so many years. Not all were famous, and certainly not all the people who have been instrumental in shaping our profession have been a president, but I am sure they were all members of our Institution. In view of this past galaxy of talent, I decided not to read through previous presidential addresses until I have at least finished this one, although I have been at almost every AGM since the early 1970s, so I have heard most of the more recent ones.

I started writing this address on a 110 mph Virgin train travelling down the West Coast Main Line of Network Rail, a journey not unlike the one I undertook thirty-five years ago for my first interview to become a S&T trainee, on a 100 mph London Midland Region InterCity train on the route from Manchester to London, part of the British Railways West Coast route. The timing then was 2 hours 40 minutes. Some things do not change much. In principle, the signalling has not changed, largely 4-aspect MAS with AWS although some renewals have occurred on parts of the route.

YOUR PRESIDENT

Colin Howard Porter – what made me become a S&T Engineer. An early interest in stage lighting, sound effects and model railway wiring and timetabling propelled me into thinking about light-current electrical engineering as a career possibility. Just as early was my interest in photography and the world of developing and printing photographs. I was born and brought up in the Manchester area, an eight-mile bicycle ride from Ringway airport. I therefore knew more about planes than I ever knew about trains. Special treats were the night-time visits to Ringway to see a Swissair Convair Coronado, Iberia Super Constellation or, when Heathrow was fog-bound, a galaxy of diverse aircraft, especially BOAC De Havilland Comets. At the tender age of 16, I used to organise the finances of a group of aircraft enthusiasts chartering coaches to visit obscure airfields throughout the UK, an early sign of my interest in things financial. Looking for sponsorship for my degree, and despite an initial negative response to my query addressed to the station manager at Manchester Piccadilly, I chanced upon a small poster on our school careers noticeboard advertising Engineering Scholarships with British Railways. My second interview with Jack Tyler and Maurice Leach proved a landmark, and in 1968 I was off on a career I have enjoyed ever since. I do not remember having much choice about joining the IRSE, the IEE or the LNER Pension Fund, but they have all served me well. The basic training scheme equipped me with the need to have to communicate with all levels of the S&T department and an awareness of all aspects of the work from recovering redundant aerial pole routes to ensuring that excess stores were sent off in a van the day before the stores verifier arrived at the depot. The art of expense form completion with a similar style and artistic flair applied to timesheets was instilled in me from the beginning, with a similar flair I now see needed for strategic plans and budgets. What did
impress me though, and it is still with me today, is how the railway needed linemen, platelayers, signalmen, train crew and everyone else to co-operate to ensure trains ran as effectively as possible. It was and still is a most complex system where the railway culture of co-operation and having to make do and compromise were a vital necessity to make it all work. It always needed people. It would be quite wrong to say everything was wonderful – it is just that looking back, that is how it seems.

I was fortunate, prompted by others wiser than me, to be able to spend part of my training with the Penn Central Railroad in Philadelphia under the tutorship of someone who became a lifelong friend, Bill Scheerer. This provided my first exposure to cab signalling, with some wonderful cab rides on the Boston–Washington main line in GG1 electric locomotives, which had been fitted with cab signalling since the 1930s. Installing automatic grade crossings, level crossings to us, every 200 yards through a mid-west town centre also showed how things could be done differently. After graduating from Queen Mary College, part of London University, on a course shared throughout with Jim Irwin, I moved through electronic systems under Jim White at the Crewe S&T Laboratory, now the Atkins Technical Investigation Centre, was put into the Manchester Divisional Drawing Office by Fred Kerr in 1975 just after the completion of that successful trio of resignalling from Weaver Junction to Kirkpatrick, ie Warrington, Preston and Carlisle PSB schemes. Then back into electronic systems at Carlow Street thanks to Frank Smith, the then London Midland Region (LM) CS&TE, who gave me my first management post having interviewed for many such posts across the country without success. This was after a close shave having rejected a Personal Assistant role with a then BR Board member. I worked on the St Pancras–Bedford–Sharnbrook electrification and resignalling, ie West Hampstead, inspired by, amongst others, Cyril Yates who ran the “Mod” at BRHQ. I learned from Cyril how to sit in smoked-filled rooms and be successful with project budgets – always ensure there is plenty of contingency in the estimates! A short diversion with Management Services was followed by a call to greater things at the BRB HQ at Marylebone working for Bill Whitehouse, Ken Hodgson and Vivian Brown. Signal Engineer (General) meant what it said; workshops, maintenance, materials and quality assurance. The rationalisation of S&T workshops involving the construction of a new S&T Service Centre at York, and the development of a common set of signalling maintenance specifications were my main interests at the time together with the realisation that the mainframe S&T computer system, SATIS, was not likely to allow us to manage scheduling of maintenance tasks with any flexibility. Maintenance frequencies which were appropriate to frequency of use and condition of equipment were becoming acceptable, although, of course, maintenance technicians and supervisors had known and done this for very many years.

Then in 1984, off to the Southern Region with Cliff Hale, to the role of Telecomms Engineer, “the best job you will ever have” said my predecessor, Clive Kessell, with the luxury of having a command structure that linked telecomms design, project implementation and maintenance, not necessarily seamlessly, but with more certainty. I developed a further interest in customer information systems and clocks that showed the correct time. In 1987, I transferred back to signalling, still at Croydon, following in the wake of Chris Thompson, another long-time colleague and friend. The Clapham Junction accident in December 1988 happened whilst I was Acting Regional S&T Engineer – a distressing time for the whole railway and all those involved, which caused a shake-up in the department and a desire to ensure “it never happened again”. It reinforced the need for correct working practices, clear instructions, proper training and supervision and a robust audit system – in short “Quality”. At that time, the organisational development of the infrastructure engineering concept was starting; organisational change or evolution had been a feature of British Rail since I joined. It continues in the new companies today.

In 1990, I was drawn back by Ken Burrage to BRHQ which by then had further centralised a number of activities including signalling and telecomms projects, stores and service centres. I found myself chairing a working party in 1991 looking into the questions of qualifications and competency for S&T staff, which led to the introduction of the IRSE Licensing Scheme. In 1992, with the setting up of the business structure in BR, a project known as Organising for Quality, I became the S&T Engineer for the InterCity business, with an organisation split between York and Paddington. The business was headed by Chris Green and it seemed to me that with the linking of marketing, business, engineering and production anything was possible but with a common goal of getting the best for the end customer. It ended the years of angst between businesses and regions. With the political decision to privatise the railways in a rather different way, this was all broken up and I started two years with what became British Rail Infrastructure Services (BRIS) as Group S&T Engineer charged with trying to keep things safe and effective whilst the engineering organisation was turned upside down. With the transfer of the BRIS units into the private sector in 1996, I made my own exit and joined Harmon Industries, one of, if not the, most successful signalling companies in the USA. We bought Vaughan Systems in Ware in mid 1996 and I transferred there working with another two industry personalities, Andrew and Dina St Johnston, both Fellows of our Institution. Andrew was the ideas man with boundless energy and enthusiasm, and Dina, who had founded the company as a software house in 1959, acted as a restraining influence on the more fanciful ideas and making things actually happen. My particular enthusiasm was the first and at the time of writing though not necessarily publication, the only Railtrack project to implement novel overseas electronic signalling technology on that well-known main line in East Anglia, the Cromer
Branch. Fighting through the language barrier between English and American and the very different safety and contractual regimes in the two countries but with the fundamental benefit of a fairly common approach to signalling principles and methodology. The scheme was successfully commissioned in June 2000 by which time I had become the Managing Director of Vaughan Harmon Systems Ltd. Another renewed interest at the company was an involvement with complex and overly sophisticated passenger information systems. With the acquisition of Harmon by General Electric of the USA, I joined Michael Hamlyn in MHA Systems at the beginning of 2001. MHA were bought, by Lloyd’s Register of Shipping in mid-2001 to form Lloyd’s Register MHA, and that is where, as your President, I am now, as Engineering Director in an engineering consultancy organisation. That was a long description of my own personal history, but I have written it to help to explain some of the reasons why I hold some of the views I now have. In particular, I have highlighted some but by no means all of the people who have had a significant impact on my development and thinking over the years.

**OUR INSTITUTION**

Turning to our Institution, it has been an important part of my life for a long time. Joining as a Student, I well remember being presented by the staff section with my encyclopaedia of S&T Engineering, a complete set of IRSE green booklets. This was my sole written training aid for a number of years. Booklet No 14, Multiple Aspect Signalling by A A Cardani, provided the technical insight to help me with my third year university project, using the then novel concept of on-line terminals to do headway calculations in real time. For me and many others, the Institution provided many things at an early stage in my career:

- The opportunity to see and learn about signalling and telecommunications systems not only in Manchester and the rest of the UK but also throughout the world. This has been done by a combination of reading, attending lectures, seminars, conferences, technical visits and conventions.

- The opportunity to meet so many people at all levels of the profession and industry in a neutral and friendly setting.

- The opportunity to contribute to the development of the Institution through voluntary work as committee member, computeriser, treasurer, and leader of working groups such as licensing.

Having been involved with Council for about 20 years, I have seen most styles of leadership, many initiatives and changes in the approach taken. Some things do not appear to change – it is rare to hear a raised voice at a Council meeting and it is even rarer to hear a full-blown argument. The processes developed over 90 years to ensure that difficulties are overcome at the committee stage before going to Council lead to this result, many times with great benefit, other times, perhaps less so.

The IRSE has provided a necessary safe haven for discussion and argument about the science and practice of train control since its incorporation in 1912 and it has seen off most forms of railway and supplier organisation in this country and elsewhere in the world. It started in this country in the days of a somewhat fragmented railway in the UK with many different railway companies and a desire to formulate standards, determine good practice and facilitate education and training. The Institution has always had an outward looking approach to practices from “overseas” having had members from outside the UK from its earliest days. Its Proceedings provide the most complete record of the history of signalling and railway telecommunications readily available today. In addition, it has always been a vertically integrated organisation welcoming members from all levels – the interested observer, the operator, the skilled technician, the professional engineer and the non-engineering trained leaders of the industry.

Is this enough? Should we not be more involved in setting the pace of change? Perhaps in our own way we have, at least at a technical level, with work in the last century to standardise signal aspects, miniature signalling relays, recognising the need for independent certification of competence to recognised standards, the work of the international technical committee and, more recently, the signalling philosophy review. The responsibility for implementation rests with the operating railway companies and their suppliers, as it should, and the IRSE has to recognise that. However, it has perhaps had a lower profile than many would like, and we ought to do something about that, so that members know where we, or should I say they, stand on issues of current relevance. The operating companies should know that also. We have been clear for a number of years about the need to have competent people to carry out S&T work but it has been an uphill struggle to get that recognised across industry and push through licensing as a means of proving this. Whilst complete acceptance is yet to be achieved, there are now more than 4,000 current licensed practitioners of S&T Engineering principally in the UK, but also in Asia and Australasia. This is more than there are members of our Institution. In fact, a relatively small proportion are members, so there is scope for additional recruitment if the people and their employers can be persuaded of the benefits of membership.

The Institution has moved in recent years from one being organised and administered solely by volunteers doing the work mostly in their free time, but with active support from their employers, to one where we now have an enthusiastic full-time administration staffed with people who share the values of our Institution, steered by a Council which represents all areas of the membership and a Chief Executive of whom we can be proud, one of the many “non-President” movers and shakers in the profession which I referred to earlier. There is still much work carried out by volunteers in organising papers, seminars, technical visits, conventions, technical committees, IRSE News, recruitment, finance and support to licensing and
training and development. The volunteer effort is dominant in the running of the local UK and overseas sections. I think this is good and is of the essence if the Institution is to continue to prosper and be relevant to its membership and the profession. Other railway institutions envy our capability to get things done and the commitment of senior people in the industry to support it, which is fairly remarkable for our size. A sister but much younger institution, the Institution of Railway Operators, whose presence and purpose we can only applaud, is at the starting blocks of trying to achieve the same and we should wish them every success.

OUR PROFESSION

Turning now to our profession and industry. What can I say looking back over my time in it and trying to predict what might happen in the future as I am sure many of my predecessors have tried to do. Here it is difficult for me not to appear to betray “dinosauristic” tendencies which would be unfair as I believe it comes from examining facts and observing performance. There is no doubt in my mind that in the UK, both underground and over-ground, S&T Engineering if nothing else, is in a less satisfactory state today than it was a number of years ago. It would be quite wrong to infer that all was good in the past, and that now it is all bad – far from it – but the overall perception and reality is not one of continuous improvement. Where do we, as S&T Engineers, fit within the industry. Train control systems are ONE of the vital parts of the railway system. They are perhaps a more vital part than some others, but they are still only a part. The economic, reliable and safe operation of S&T systems is core to the operational and business performance of the railway. The costs and consequences of getting it wrong are horrendous. Good, cost-effective engineering practice is the key to success, something which is not a new-found vision but has been known for years. I need not remind you of the old saying about what an engineer can do for tuppence….. However, this is not how others see us, and it is not always how we behave, but the balance of performance, risk and cost is one which has exercised the minds of engineers from all disciplines for centuries. We seem to have managed to move to a position where the perception of the great and good is that we have got it wrong. It is the politicians and their advisers that have helped get us into this mess, and they will have to help us get out of it. If public perception is that all is not well, and if a large number of people within the profession think all is not well, then probably all is not well.

Evolution and development of train control systems have existed for a long time. Not all developments have been sure fire successes and not all technology has been problem-free on its introduction (has any?) in the past, but our ability to reliably and cost-effectively introduce new developments today is not something with which we should be satisfied. We are not alone as a profession with this topic – you only need to consider some of the defence and software project cost overruns – but that is no excuse. Why does this seem more of a problem today? Is it the complexity of new technology? Is it the unwillingness of engineers to make risk judgements? Is it naïvety about timescales, ineffective project management, pressure on delivery, organisational indecision and lack of focus, or perhaps a combination of many of these factors with different forces at play on different projects? We must strive to do it better otherwise we will not have a railway industry to practise in. I do not have a magic wand, some would say thank goodness, but organisations, their senior management, their engineers, and their accountants need to work hard to retrieve the situation.

With the emergence of Network Rail in the UK from the ashes of Railtrack, there seems to be the willingness to reflect on things that were unhelpful before and to try to do it better. It will not be easy but I am encouraged that at least some of the inherited problems have been recognised and something is being done to improve them. The changes to the structure of London Underground with the implementation of the Public Private Partnerships and the increased involvement of private sector companies pose both great risk and great opportunities. Which way it goes will depend fundamentally on the behaviour of the people involved coupled with the necessary amount of good luck. If the emphasis is on short termism, half-yearly and yearly financial results, sticking to the letter of the contract, lowering of engineering and operational standards, organisational complexity, muddle and indecision, it will surely fail. If the emphasis is on partnership, the long term care of the railway, the companies, the customers, the need for good performance and reasonable value for money, it will succeed.

It probably seems to our non-UK members that I have concentrated too much on the state of the industry in the UK. They are right, and I know that it is not only in the UK that railway S&T engineers face similar challenges. The drive for efficiency, change of organisation and improved performance without at least any detriment to safety is a route that all railways are following. In most developed countries, railways are very safe. Accidents do and will continue to occur, and it will always be possible to spend even more on preventing them. The need for a balance between risk, cost and performance is one which railway professionals and regulatory authorities the world over need to embrace together with the public they serve. We have seen the consequences of getting the balance wrong, with rail becoming less competitive than other transport modes.

MY VISION

If I could wave a magic wand, what would I want?

- A well maintained railway, cared for by people with an interest in the end customer, which provided a level of safety and performance that was acceptable to those paying the bill.
- Affordable and appropriate signalling and telecommunications systems to control the
railway, with the widespread provision of in-cab signalling and train protection systems installed in a sensible timescale commensurate with the renewal of older systems.

- Engineers and others having the drive, wisdom and understanding to be able to effectively implement new systems that provided an overall benefit to the end customer.
- An encouragement to young people that a career in engineering is a worthwhile option, with a particular emphasis on the interest and excitement of railway engineering.

- The acceptance by all concerned that it is people who make things happen. Organisations provide an enabling framework to facilitate people achieving things, and not vice versa.

We all have the opportunity and responsibility to help make my wishes come true.

Thank you.
Communication-Based Train Control

W J Scheerer HonFIRSE and J K Baker MIRSE

INTRODUCTION

North American interest in communication-based train control (CBTC) dates back more than 20 years. Government, notably the National Transportation Safety Board and the Federal Railroad Administration, have viewed this technology as an enabler of cost-effective positive train control systems. Both transit systems and mainline freight railroads have viewed this technology not only as a means toward improved safety, but as a means of increasing the capacity of existing infrastructure at lower capital and maintenance costs than can be achieved through conventional signaling technology.

A BRIEF HISTORY OF CBTC IN NORTH AMERICA

Many will remember the advanced train control system (ATCS) project that began in 1981. At the time, it was envisioned that an all new radio frequency-based train control system built around a common set of interoperable specifications for the mainline freight railroads could be defined and fielded in a time frame of five years or less. The backers’ optimism was apparent in a 1983 letter soliciting railroad representatives to define ATCS operational requirements and take part in the development of the common functional specifications, “which should not amount to more than four or five days meeting time”. Unfortunately, the reality was that many years and millions of dollars were spent developing these requirements and specifications.

The system that was ultimately specified is based on 900MHz radio for data transmission, a transponder/tachometer train location scheme, wayside interface units and onboard computers. Control of safe train separation and wayside devices is to be accomplished from a central computer. Existing track circuits and signalling were to be eliminated under this scheme. In the end, the high cost of investment required, the lack of an evolutionary implementation scheme, the lack of certainty as to the nature of the return on investment, and no regulatory mandate to install such a system has resulted in no ATCS implementations with the exception of a few limited trial installations. The ATCS specifications did lead to the allocation of six channel pairs to the railroads in the 900MHz spectrum, standards for data radios and standard data protocols that are in use today, albeit not in the way they were envisioned when the specifications were written.

CBTC INSTALLATIONS AND DEVELOPMENTS ON FREIGHT RAILROADS

In the post-ATCS era, freight railroads have articulated the desire for train control system interoperability among railroads and suppliers. Curiously, however, the three major CBTC development efforts presently under way are each unique in their approach and architecture.

The first effort, known as the North American Joint Positive Train Control Program (NAJPTC), is jointly funded by the Association of American Railroads, the Illinois Department of Transportation and the Federal Railway Administration (FRA). The purpose of this project is to install a system to support revenue-service high speed operations, to demonstrate flexible-block operation using movement authorities, commands radiod to each train on a 200km track segment of Union Pacific Railroad’s Chicago – St Louis Corridor and to establish
industry-wide standards for control system interoperability. The system is vital and the architecture is similar to ATCS but with two key differences. The first is the use of the global positioning system (GPS) coupled with an inertial navigation package to determine train location. The second is the system’s ability to be overlaid on a conventional signalling system. When the CBTC system and a signal system are both present, the CBTC system is the method of train operation and all movement authority is conveyed by it. The system consists of four subsystems: a central office segment; a locomotive segment; a field interface segment and a work vehicle segment. All communication between the segments is via a 900MHz ATCS Spec 200 data radio network. Overall control of the system resides in the central office computer. This project is currently under development with revenue service start-up anticipated in the second quarter of 2004.

The second effort, known as communication-based train management (CBTM), is a non-vital system that is overlaid on an underlying method of train operation such as track warrant, direct traffic control, or conventional signalling. When overlaid on a conventional signal system only Stop signal indications and diverging speeds are enforced. The intent is to improve safety through the prevention of collisions, enforcement of speed limits and protection of work authorities. It is also the intent to improve operation by reducing operating delays, by increasing velocity due to more efficient meets and passes and by saving time for dispatchers and crews. Inherent in such a system is the fact that operational safety is provided by the underlying method of operation, while the CBTM system acts as a safety net. The risk is of course that the train drivers become dependent on the safety net and fail to follow the required procedures, which are the underpinnings of the safe method of operations. This privately funded project has equipment currently installed on over 160km of railroad and the system is being tested and refined.

The third effort is known as the incremental train control system (ITCS) and is funded by the FRA, the Michigan Department of Transportation, Amtrak and the system supplier. The architecture of this vital system is intended to overcome the economic barrier associated with the “big bang” transition from existing methods of operation, including conventional signalling, to CBTC. The idea is to implement the technology in small steps, realise the savings, and then invest the savings in furthering the implementation. This approach is in revenue service on 130km of Amtrak’s Detroit to Chicago corridor in Michigan. Speeds are limited to 145 km/h until final safety verification and validation is completed allowing the planned 180 km/h operation. ITCS and its innovative method of train positioning will be treated in detail later in this paper.

CBTC INSTALLATIONS AND DEVELOPMENTS ON MASS TRANSIT SYSTEMS

Unlike the freight railroads, the transit industry initially took a more conservative route toward adopting CBTC with technology that had already been developed and proven in Europe. This approach was likely driven by an urgent need to expand the capacity of existing systems and to install new systems that made maximum use of the track or guideway structure in order to minimise project capital costs. In taking this approach, the transit industry has moved to implement systems much faster than the freight railroads. However, transit properties do enjoy the benefits of captive rolling stock and reasonably sized closed systems not involved in the general interchange of traffic, which definitely facilitates the change to new technology. Two examples of this approach are San Francisco’s Muni and Vancouver’s Skytrain. Both employ the inductive loop crossover method of train location. These two systems are in service today, with Muni expanding its capacity far beyond that which was possible using the conventional signal system that CBTC replaced. Skytrain is now expanding its system to further serve the Vancouver area.

As time has passed, the transit industry has followed the freight railroads in looking toward train control systems that are evolutionary and reach beyond currently available technology. Two major initiatives are underway on opposite coasts of North America. On the East Coast, New York City Transit embarked on its Canarsie Line CBTC project. This project involves resignalling the entire 35km of the Canarsie Line and furnishing 212 railcars with onboard equipment. The system is radio-based, employs an optical positioning and speed sensing system and works as an overlay to the newly rebuilt conventional wayside signal system. The system will be interoperable in the sense that the system specifications will be published and open to all who wish to comply. The development of the specifications is not open to all.

On the West Coast, the Bay Area Rapid Transit Authority (BART) has embarked on a CBTC project intended to improve the capacity of its system, particularly the double track tunnel under San Francisco Bay. The system is built around an advanced vital train control and train-positioning system based on a cost reduced and railroad focused version of the enhanced position location reporting system (EPLRS) radio ranging technology which was battle proven in Operation Desert Storm. It is in limited service after having received a safety certification from the California Public Utilities Commission. This technology is known as advanced automatic train control (AATC) and will also be treated in detail later in this paper.

INCREMENTAL TRAIN CONTROL SYSTEM

During the mid 1990s, North American railways were investigating incremental approaches to enforcement that could be implemented with fiscal responsibility. Also, a technology gap existed in the emerging high-speed passenger rail market in the United States. Operators wanting to move trains at more than 127 km/h faced a large hurdle for implementation. Since regulations mandate that some form of in-cab signalling and speed/signal enforce-
Differential corrections were considered. The system at the rover receivers, located on board trains, GPS receivers, resulting in more accurate positions in pseudorange for every visible satellite. These location, that receiver can calculate sub-meter errors or fail-safe, application.

Axle speed sensing system suitable for use in a vital, dual-differential GPS system integrated with simple the rail industry. The final architecture incorporates a out to create the first safety-critical implementation of the incremental train control system (ITCS).

The concept of ITCS is a simple one. Give the locomotive (and in turn, the train driver) full awareness of the railroad in front of the train. The system would need to contain a database which was a map of the permanent features of the railroad (including tracks, curves, speed limits, switches, grades, road crossings, signals and mileposts), as well as the condition of these items (signal indications, switch positions, and crossing status), which are wirelessly collected and transmitted to the train. ITCS as an overlay system operates with the capabilities of ETCS Level 2. While it is still fixed block, the flexible-length blocks can be sufficiently small to provide the capacity and throughput of a proper moving block system. The block size is now defined by the database only, not braking distance or traditional signal spacing.

After the locomotive had awareness of the condition of the entire railroad, action could be taken based on signal conditions, speed limits and crossing activity. Using a safety-critical onboard device, full positive train control could be implemented.

This positive train control system could now enforce (onboard) any signal indication, any civil or track speed limit, and could activate crossings wirelessly. These are the core functions of ITCS.

**LOCATION DETERMINATION SYSTEM**

To round out the capability of the onboard computer drawing this “map”, the locomotive needed to have a location determination system to continuously establish exactly where the train was located, and at what speed the train was travelling. Existing location systems such as balises and loops were discounted because of the need to install and maintain between-rail infrastructure.

With the emergence of GPS, the partnership set out to create the first safety-critical implementation of a GPS-based location determination system for the rail industry. The final architecture incorporates a dual-differential GPS system integrated with simple axle speed sensing system suitable for use in a vital, or fail-safe, application.

Differential GPS is a technique which uses fixed-location devices to determine GPS satellite errors and correct them. Using a GPS receiver in a known location, that receiver can calculate sub-meter errors in pseudorange for every visible satellite. These corrections are then wirelessly transmitted to mobile GPS receivers, resulting in more accurate positions at the rover receivers, located on board trains.

To implement ITCS, several options for receiving differential corrections were considered. The system deployability of ITCS across multiple rail networks and the worldwide usability of ITCS were central to the strategies chosen. ITCS was not designed as a single solution for high-speed rail for Amtrak, but as a product which could do high-speed rail, signal enforcement, and increase throughput and capacity on any rail line, anywhere in the world. The choices available to provide differential GPS corrections to every train are:

- commercial carriers supplying differential corrections (available outside of the US in some areas);
- national differential GPS programs (available in the US from several agencies);
- satellite-based augmentation of GPS (such as wide area augmentation systems or EGNOS);
- ITCS could supply its own GPS differential corrections.

Each of these options was considered, weighing initial and subscription costs, availability of coverage (especially dual coverage), and flexibility. The design decision which was most appropriate was for ITCS to supply its own GPS corrections from wayside installations. This allowed for use anywhere in the world, with a low initial investment and no subscription fees.

The most important aspect of the differential GPS is not accuracy however. GPS accurate to 100m would be usable by a train control system, if it were known that the GPS were always accurate to within 100m. A 100m buffer could be added to the front of every train and, with high-speed trains and long braking distances for intercity passenger and freight service, a 100m buffer is a relatively insignificant parameter.

The lack of knowing position accuracy using GPS, not the accuracy itself, drives the necessity for differential GPS. As such the integrity of the location system is the key parameter, not accuracy. Always knowing that the position accuracy is within a defined bound is most crucial for this type of system. The accuracy parameter used in ITCS for a 6-sigma certainty is 20m. This indicates that 99.99999% of the time the GPS component of the location system is accurate within 20m. This value was determined by both simulation and field results, incorporating accumulated variances in GPS receivers, differential corrections, locomotive antenna positions, and multipath effects.

To achieve the actual position of the train, the path shown in Figure 1 is followed. The location determination system is incorporated using a dual-path technique which includes independent measurements and processing to achieve a safe result:

- dual independent wayside differential GPS corrections are calculated independently, and transmitted to the
- dual independent GPS receivers used onboard the train, which use
- dual independent copies of the track map to calculate track locations, for the
COMMUNICATION-BASED TRAIN CONTROL USING INNOVATIVE TRAIN POSITIONING

• dual independent Kalman filters, which incorporate
• dual independent wheel speed sensors or axle tachometers for speed input, as well as
• dual independent predictive results from the previous Kalman filter operations, to provide a single, final determination of actual train location and speed.

In addition, each of the software paths used to incorporate the above activities is also dual-channel, to account for any transient or processing errors which could occur. The entire process operates on a 500ms loop, so the system's location is updated twice per second.

Since the components of the system are dual for safe, not redundant, operation a robust system must be implemented so that a failure will not falsely limit the availability of the system. The 4-state Kalman filter determining train position can operate for approximately 20km without one of its inputs. To explain further, if GPS is not available (through tunnels, urban canyons or mountains, or due to receiver failure) the system will still operate continuously for 20km, and re-include those measurements when available again. So, if in a series of multiple tunnels, as long as GPS is available every 20km for at least one minute, the system will continuously operate using the speed inputs from the axle tachometers. The system also provides automatic wheel calibration, so as wheels wear over time, the size of those wheels is continuously and safely determined by the location system, calibrated using the GPS speed inputs. No operator input is required to adjust or calibrate the speedometer.

TRAIN AWARENESS AND SIGNALLING

Using this continuous update of train position, the onboard computer now has awareness of both where the train is and what is around the train. The entire feature set of the railroad is contained in the onboard database. The onboard computer now has the ability to "see" all of the signals, speed restrictions, switches, and road crossings which the train will traverse. By continuously listening to the wayside devices, which have been monitored with a wireless capable device, the train creates braking curves to every restriction which it will cross. By doing so, the train is only restricted by the actual condition of the railroad, not potential dangers. Where block signalling is present, since a train can see past a yellow signal when approaching a red, the braking curve for the red signal can be enforced, and the need to slow down at a yellow signal can be removed.

As a logical next step in block signalling where CBTC is present, the concept of the approach signal can be eliminated. Since there is a vital onboard system to stop the train and alert the driver of an upcoming red signal, the advance notice of a yellow signal for approach is unnecessary. The braking curve for the specific train may also be more permissive than the fixed signalling in place, so increases in train throughput, speed, and line capacity can all be realised using ITCS, without requiring any resignalling of a given line. Even if the braking distance is increased beyond the signal spacing, ITCS will "look ahead" and determine proper train handling, regardless of speed, as shown in Figure 2.

One logical extension of using a system like ITCS now removes multi-aspect signalling logic, and provides essentially a 2-aspect (stop/red or go/green) for automatic signalling. Additional aspects can be used for special situations or diverging routes over switches. The communication of the signal aspect to the train also removes the speed restrictions imposed by the design of the signalling system. Even if signal spacing is designed for 50 km/h operation, ITCS removes all restrictions based on signal spacing because of the signal look-ahead function.

OTHER FEATURES AND FUNCTIONS OF ITCS

Similarly, ITCS wirelessly activates highway grade crossings for a similar increase in speed. To do this, the onboard computer wirelessly notifies crossing controllers of the approaching train and subsequently activates the crossing for constant warning (gate-down) time, based on train speed. A crossing that is installed for constant warning time at train speeds up to 100 km/h can be upgraded with ITCS.
and allow for constant warning time for any speed up to 250 km/h with no changes in logic or track circuit leads. This has been successfully implemented in a failsafe manner and has been activating road crossings on the Amtrak ITCS corridor since 1998.

In the Michigan implementation, ITCS operates over an ATCS radio network in the 900MHz frequency range. However, this is flexible for each installation, according to availability of spectrum and bandwidth needs. Networks such as GSM-R, Tetra, MeteorComm and others are certainly appropriate to satisfy the communication needs of the system. ITCS enhancements since its inception have included the ability to completely signal “dark” or signal-less territory with the use of virtual signals, and operate a segment of railroad exactly as if it were centralised traffic control (CTC) at a fraction of the cost, since the track circuit and signal installations are not required, achieving the equivalent benefits of ETCS Level 3.

The challenge, as with any CBTC system, is to ensure that equipped locomotives and trains travel through the territory, thereby receiving the benefits in safety and productivity. This hurdle can be solved by sheer financing (equip all trainsets), running a captive fleet (can be cumbersome), or optimising the locomotive fleet to ensure availability of lead locomotives equipped with the advanced technology.

METRO TRAIN CONTROL

Similar train control developments have occurred in the transit arena over a longer period of time. With the introduction of Alcatel’s SelTrac for the Vancouver SkyTrain in the early 1980s, CBTC, moving block, wireless control and automatic train operation (ATO) have become phrases synonymous with new metro properties building lines, and also for metros interested in line resignalling.

The benefits of CBTC (or transmission-based train control) have been proven. They are:

- reduced headway;
- reduced installation and maintenance costs over traditional signalling;
- greater operational flexibility and changeability;
- increased train speed;
- increased track utilisation;
- greater passenger comfort.

For resignalling projects, CBTC has been largely regarded as the only method to increase throughput and train speed through infrastructure upgrades without disrupting service. Installing a CBTC overlay can be a relatively simple task, depending on the interlocking replacements and maintenance and track access windows. After the overlay is in place and operating, the metro agency can decide whether the underlying system need remain in place, or the CBTC-only system can be the sole method of operation.

Until the last 8-10 years, the reliability, availability and commercial viability of CBTC systems was not yet accepted by the metro community at large. That has quickly changed with the emergence of systems from all the major signalling suppliers.

In 1998, GE Transportation Systems entered into a partnership with BART to deploy a radio-only based overlay system which would increase line capacity and alleviate traffic needs in the Oakland Wye and in the Trans-Bay Tube which runs under San Francisco Bay. As ridership increased in the late 1990s, three options existed to improve capacity:

- install a new trans-bay tube at a cost of US$2+ billion;
- resignal the line with conventional signalling (which would shut down the line for a period of time);
- develop a new system to move trains faster and closer together through the wye and the tube.

For the sake of ridership and cost, the third option was chosen. Originally, BART had partnered with Hughes Aircraft for the development of AATC. Subsequently, GE acquired the technology from Hughes, and the partnership with BART continued. AATC is a wireless, full moving-block control system that is designed to improve all aspects of train operation, including train speed, headway, line capacity, and rider comfort.

RADIO NETWORK

The backbone of AATC is a robust radio network that is designed to perform two main functions:

- continuous data communication to and from every train;
• radio-ranging based train location determination.

The radio network, based on technology developed for the US military and used throughout the 1990s, is a system which uses spread spectrum and time division multiplexing to communicate messages to trains every half second, even in the presence of interference or in tunnels.

These messages are synchronised to allow the time it takes the message to reach the receiver to be measured. These time-of-arrival measurements are processed to determine train location, speed and direction. Trains are typically equipped with both head-end and tail-end radios, both to provide redundant onboard communications, and so that train integrity and train length can be monitored.

Zone controllers (also called station computers), located throughout the rail network, are the brains of the radio network. During operation of AATC, station computers determine train locations and statuses, and return safe speed commands to each of the trains. Speed commands indicating a maximum allowable train speed are continuously updated by the station computer and transmitted to the train. The onboard train computer receives the speed command for each train every half second, the station computer provides basic ATO within a vital closed-loop control system.

The radio network has been tested extensively in San Francisco, New York City and London Underground subway systems. The radio network achieved excellent reliability and throughput results (demonstrated successful first-attempt message delivery in excess of 99.9%).

The radio network, as depicted in Figure 3, is designed as a store-and-forward (or “bucket brigade”) architecture that provides trains with multiple copies of every message, so that delivery is very robust. The vehicle radios listen in on wayside communications to receive messages that are outbound from the station computer and launch train status messages to multiple wayside radios to send messages inbound to the station computer.

Each station computer is connected to two station radios, which serve as the master radios in the radio network. The station radios then communicate with multiple wayside radios on each side of the station, forming a network that follows the track topology. The vehicle radios listen in on wayside communications to receive messages that are outbound from the station computer and launch train status messages to multiple wayside radios to send messages inbound to the station computer.

Each station computer is based on off-the-shelf hardware (Motorola PowerPC processors) configured in a checked redundant architecture for safety. In addition, a standby set of processors is configured as a hot standby unit for very high system availability. Transfer of control to the stand-by system is accomplished “on the fly”.

There are three sub-systems in every station computer:
• the Vital Station Computer;
• the Non-Vital Station Computer;
• the Network Management System.

Figure 3 – The AATC Radion Network
Vital Station Computer

The vital station computer is a two-processor set configured in a checked redundant architecture to check each other’s calculations. The vital station computer sub-system calculates each train’s location, direction and speed, monitors train integrity, and sends speed and acceleration commands to all trains. The vital station computer calculates the status of fixed wayside obstacles and rear safety location of other trains in a true moving block fashion to enforce the correct safe speed for all trains.

Non-Vital Station Computer

The non-vital station computer provides diagnostic and logging functions, provides a local display of the status of trains in the area, and reports errors in the wayside or train equipment to central monitoring for scheduling maintenance activities. In addition, the non-vital processor can supply speed request information to the vital station computer to help coordinate the movements of trains within the zone to implement schedule recovery or energy management algorithms.

Network Management System

The network management system choreographs the entire communication network. Since AATC is based on communication principles that have been operating in combat situations for over 15 years, the radio network is designed and deployed for extreme reliability and availability in the presence of interference. Being the backbone of the system, the AATC radio network is designed as a fully-redundant and fault-tolerant communications solution which virtually guarantees delivery of every message.

If any radio in the network fails, that radio is simply removed from the network and a maintenance alert is issued. Communication operates normally, skipping over the failed radio until corrective action can be taken. With the network management system alerting central maintenance of a radio failure, a new radio can be deployed quickly and easily when track access is convenient. The system is configured so that no programming or special software is required. Upon power-up, the new radio joins the existing network and seamlessly begins transferring messages to and from neighbouring radios, as well as passing trains.

RADIO RANGING

Instead of costly maintenance of inductive loops or balises, AATC employs a vital location system implemented directly by the radio network. The plug-and-play nature of the radio network virtually eliminates maintenance requirements and exacting specifications of loops and balises. All radios in the system contain the same software, so there is no need for extensive spares inventory and asset management.

Since the communication network is also the positioning system, fewer subsystems are present in the architecture, allowing for increased reliability. Additionally, since communication (and positioning) is fully redundant, communication outage occurrences are virtually non-existent (5+ years mean time between system shutdowns).

Creating a safety case around this innovative positioning technology for the rail industry proved to be a daunting task. Thousands of simulation and testing hours have been included to ensure that the position (and specifically, again, the position uncertainty) is always known and bounded by a safe margin. Position uncertainty is added as a bubble in front of each train to ensure the moving blocks always contain a small amount of safety buffer, to avoid train collisions. Safety case approval in the State of California was achieved in July of 2002.

Train-borne radios communicate with wayside radios every 0.5 seconds, allowing the system to continually calculate a location to within 5 meters 99.9% of the time, and speed to within 2.5 km/h.

INSTALLATION

When resignalling a subway or light rail system, the cost of installation can be enormous. Conversely, with AATC, the costs of wayside installation are only those of the radio network and the station computers. Radio installation consists only of antenna installation and radio power. All other installation configuration and programming is done automatically by the system. The station computers are designed to interface to existing signalling systems for tracking unequipped trains, but can also be operated as a standalone control system without underlying track circuits.

AATC offers mixed-mode operation, meaning that AATC equipped and unequipped trains can operate simultaneously in the same region. Not every line or section of a transit system need be equipped with AATC. AATC can hand over trains to and from traditional signalling systems for tracking unequipped trains, but can also be operated as a standalone control system without underlying track circuits.

TESTING COMPLETED SO FAR

Beginning in 1999, AATC has been deployed and tested in portions of the BART system. Initial test results have demonstrated the capability of the system as:

- positional accuracy of <5 meters 99.9% of the time;
- speed accuracy of <2.5 km/h;
- network availability of >99.9%;
- positioning availability of 100%.

THE FUTURE OF CBTC IN NORTH AMERICA

Twenty years have passed since 1981 when the concept of CBTC really became a topic of conversation in North America. Many “test beds” have come and gone, but only a few full revenue installations are in place. It is notable that all of the full revenue installations are in the transit industry, and that they are not based on technology that has been developed as a result of the many millions of dollars spent on CBTC since 1981, but rather on proven technology that existed prior to that date. Yet it is
also notable that all the major development projects presently underway are based on new and unproven technology that has the potential to be “the home run ball”. Why is this the case? Why not stay with proven CBTC technology, or time tested conventional signalling?

There is no single answer. The first, most important and overriding requirement is economics. Should it not be safety, you ask? The answer if stated in terms of total perfection is, Yes, safety should be the overriding requirement. However it is true for both the transit and railroad industries in North America that the number of accidents that have the potential of being prevented by a CBTC system (that is vital and provides full enforcement) is very small. This means that the safety justification must be made on the basis of social justification, which is very difficult in an environment where everything must pay its own way.

Conventional signalling is a technology that is viewed as having reached its full potential relative to the benefits it can deliver. It is also viewed as an expensive life cycle investment due to the amount of wayside equipment that must be installed and the cost of periodic maintenance and testing associated with it. This does not mean that such systems will not be installed in the future, however new conventional signalling systems will become fewer and fewer in number as CBTC technology matures. CBTC systems installed to date have been justified on the basis of improved capacity and operational benefits versus conventional signalling. Like conventional signalling they require a considerable amount of wayside equipment and related maintenance. One need only look at the systems currently under development for both freight and transit applications to see that future systems aim to eliminate wayside equipment and cable plant by use of radio frequency communications. These systems also aim to deliver substantially more benefits in order to justify the cost of implementation. In every case, business issues have or will be the justification for installing CBTC systems, and the very real improvements in safety that are delivered with the package are “tagging along”. While this is difficult to accept by those of us who have dedicated our careers, in fact our lives, to perfecting the safety of railroad operations, we must learn how to confront and leverage the economic realities of the industry as we try to justify the next step toward our ultimate goal, which is – and always must be – flawless safety performance.

COST JUSTIFICATION AND INTEROPERABILITY

Application of CBTC systems will most likely move forward in an ever-accelerating fashion in the years ahead. Safety will be improved in dramatic ways, but will still be a byproduct of systems that will be justified for operational and capacity improvement reasons. In a peculiar turn of events, it appears that the improved safety that CBTC inherently can provide in the form of positive enforcement will become the factor that provides the economic benefit that ultimately justifies the cost of installing CBTC. That benefit is the possibility of one-person train crews, or possibly even no train crews at all.

While interoperability and open architectures will remain a much discussed and noble cause, the systems that will blaze the way forward will be proprietary. Of the projects currently under development, only the NAJPTC and the Canarsie Line projects have stated goals of establishing interoperability specifications as part of the project. In the case of the Canarsie Line there is already much discussion around proprietary RF communications, and the final results will likely hinge on what the definition of interoperability will be. The NAJPTC project remains “open” but, like most systems developed to be all things to all people, it is behind schedule. The final system will likely be un economical due to inefficiencies introduced by the need to meet multiple and duplicative requirements.

It is the opinion of the authors that, because of the huge economic benefits associated with one-man train crews, the goal of establishing interoperability standards early in the CBTC cycle will be overcome by events. Instead of waiting for interoperability standards to be developed, any system – proprietary or not – that delivers the savings related to a reduction in train crew size will become the industry standard. By definition, this means that the system is interoperable among users. The marketplace will then demand that the system become interoperable among suppliers, at least as far as form, fit and function are concerned. Components that incorporate improved features and functionality will quickly become available as suppliers work to differentiate their products. Regulatory mandates are also a possibility once viable systems are fielded, and will also influence the direction of the technology. Thus CBTC systems in North America will ultimately be interoperable among both users and suppliers, but after wide scale movement toward deployment occurs rather than before.

THE FINAL HEADACHE

There remains one final challenge for the radio-frequency communication that is being embraced as the future for CBTC. That challenge is frequency spectrum availability over the long haul. Will the bandwidth of the currently assigned 900MHz channels, commonly known as the ATCS frequencies, be adequate for the future needs of the Industry? Will the high cost of low-volume proprietary radios be too high to meet investment hurdles? And finally, will the popularity of low-cost high-volume radios that conform to the IEEE 802.11 standards be the undoing of this option?

Only time will answer these questions, and it will no doubt generate new ones. What is sure is that CBTC will be widely implemented in North America; that future CBTC systems will be wireless and that new radio technology will emerge to create workable solutions to spectrum and bandwidth issues.
Discussion

The discussion was opened by J Poré (Alstom) who asked if true interoperability of the systems had been achieved from the point of view of a specific manufacturer's on-train equipment working with another manufacturer's trackside equipment. He also questioned why the US had so many different suppliers when, in comparison to Europe, there were few different infrastructure constraints together with a common language and was also interested on the speakers' views of future developments.

W Scheerer informed that the systems were all different to cater for the differing requirements of each application dependant upon environment, mobility of fleet and size of system. He also observed that there are only a limited number of suppliers who would eventually be forced to manufacture interoperable equipment.

J Baker noted that in the US, even though interoperability is specified, the tendering process generally awards the contract to the lowest bidder who cannot then comply with this requirement.

W Scheerer explained that he believed that the system that would deliver a saving in train crews would eventually prevail and the market would follow; at present the existing signalling is the most economical method of train control. He further observed that, whereas in Europe the integration of the various networks is driving the solution, in the US cost is the driving force.

M Paverd (GETS) asked if the two GPS receivers were from different manufacturers to prevent common mode problems.

J Baker confirmed that they were.

R Harding (DLR) questioned the speakers on how the position of trains was established following failure of a communication-based system and what would happen once the driver was removed.

J Baker advised that failures don’t happen!! However, BART has back-up utilising either the existing systems or (voice) dispatching via radio communication; ITCS reverts to dispatch control. In both cases the previous systems’ procedures have been left in place in case of system failure.

W Scheerer explained that the levels of in-built redundancy ensured that the system continued to run until repairs were effected.

D Nottingham (Halcrow) wondered if the economic case could be strengthened by considering the cost savings from civil engineering components, ie IBJ's and wanted to know if the system was used for staff lockout purposes to increase safety in possessions.

W Scheerer confirmed that occupancy of the line by staff is treated as a zero speed restriction, authority being obtained from the signalman. He advised that some savings result from civil engineering components; a minimal number of IBJ's are required as track circuiting is only provided for broken rail detection (not train occupancy) and are up to three miles in length whilst level crossings utilise audio track circuits that do not require IBJ's. He reiterated that the real cost benefits are to be gained from train crew savings.

J Corrie (Mott MacDonald) asked how trains were proved complete.

J Baker outlined the various methods used. On AATC, a train line loop with radio positioning of front and rear ends is utilised to prove train length and integrity, With ITCS, NAJPTC are developing an “end of train device” with GPS and a wireless link to the locomotive, monitoring brake pipe pressure at the rear of the train and using track circuits as an auxiliary method of train detection.

W Scheerer clarified that abolition of cabooses resulted in a “box” coupled to the air-line detecting movement of the rear of the train.

A Fisher (Bombardier) questioned the philosophy behind allowing tachometry to determine train position for up to 20 km without receiving GPS information.

J Baker explained that the system can tolerate an uncertainty of 1,000 feet except when stopping a train and this is significant for a stopping distance of over one mile. This method is not, however, applicable to metro-style systems where precision stopping is required.

R Barnard (Alstom) commented on the problems and complexities of fitting driver's displays in European trains compared with the non-sophisticated, simple display provided in the US. He also noted that very few trains on BART were fitted despite the supposed ease of retro-fitting the rolling stock.

J Baker informed that the initial, proposed driver's displays were complex but discussions involving the Regulatory Authority and Unions resulted in the display as provided today; simply alerting the driver when he needs to act. He explained that problems with retro-fitting the BART rolling stock were due to non-availability of the radio equipment at the present time. He also advised that it took only two three-hour night-time windows to fit the necessary equipment; similar times taken to fit freight locomotives.

W Scheerer expanded on the philosophy of the development of the driver’s display; incorporating all of the information that a driver requires to safely drive his train into a display that simply advises the driver of the current maximum authorised speed, next speed restriction and the distance to that restriction. A countdown is initiated as a restriction is approached informing the driver how long till he must act and experience has shown that optimum braking results.

A Howker (retired) enquired as to what information is provided on the driver's display under moving block conditions and how are special orders issued.

J Baker explained that BART is fully ATO but not driverless, the drivers shutting the doors; the driver's display simply showing “Commanded Speed” and
W Scheerer advised that “Distance To Go” is displayed on the “main lines” but noted that ITCS does not interface to the throttle but does interface with the braking if required. Special orders and speed restrictions are downloaded onto the terminal and transmitted on to the locomotive by the wireless link.

A Howker (retired) noted that this represented a form of ATP and further questioned if any processes were in place to ensure accuracy of track map data.

J Baker responded by stating that processes were in place to fully verify any changes made to the database both by on-site testing and confirmation from the locomotives that they had received the updated information.

F Hewlett (retired) wanted to know what was the spacing between the GPS differential receivers noting that utilising GPS required total reliance on a system that has deliberate degradation of the positional information.

J Baker informed that the receivers are spaced between eight and ten miles apart based on the existing infrastructure although this could be increased to 50 to 60 miles. Accuracy degradation also occurs naturally as trains move further away from the base station.

C A Porter (Independent Consultant) observed that the systems were reliant on “off the shelf” components and wondered how the problem of component obsolescence was being managed.

J Baker explained that there was a balance to be struck between commercially available sub-systems and developing and maintaining them in-house. As an example, the AATC computers utilise a product line that should be sustainable until the move on to the next generation of equipment but agreed it is still an area of risk.

W Scheerer further noted that customers are forcing compatibility upon manufacturers; comparing the costs of commercially available PCs with products specifically developed for a certain application with the realisation that building specific is expensive.

K Moxsom (Thales) asked if it was the speed and quality of data that specified the use of 900MHz radio and how easy it had been to obtain country-wide allocation of this frequency.

W. Scheerer informed that whilst the speed and quality of data was a factor, the ATC Steering Group, working with communication authorities in both Canada and the US, identified six channel pairs in the 900MHz spectrum that were available in both countries. Non-implementation of ATC resulted in ATCS specifications utilising the channels for signalling remote control to “hold” the frequencies at a time when they were being considered for other uses. However, the use of specialised radios is now making this option expensive.

A Love (Amey Rail) questioned the speakers on the time taken for layout changes on-site to be transmitted to trains.

J Baker advised that it is very dependant on the change but typically work is undertaken over two successive night-time possessions.

D McKeown (Independent Consultant) wanted to know capacity limits and response time of the system and how train detection is undertaken on initialisation and within complex layouts.

J Baker explained that capacity is governed by a summation of braking distance, overlap distance (of virtual block created) and time taken to get the message to the train. AATC utilises a 6-second cycle time plus an allowance for missed messages. He advised that initialisation relies on either an alternative form of train detection or occupancy of single line sections with detection in complex layouts being achieved by utilising point detection.

C Porter (IRSE President) thanked W Scheerer and J Baker both for their paper and for presenting a different perspective to communications based signalling developed in the commercially driven climate of the US.
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Technical Meeting of the Institution
held at
The Institution of Electrical Engineers, London WC2
Wednesday 12th November 2003

The President, Mr. C H Porter, in the chair.

136 members and visitors were in attendance. It was proposed by Mr A C Howker, seconded by Mr R Hurst and carried that the Minutes of the Technical Meeting held on 8th October 2003 be taken as read and they were signed by the President as a correct record.

The President gave apologies from Mr D Warwick and welcomed six members who were present at a meeting of the Institution for the first time since their election to membership and introduced them to the meeting amidst applause. The Chief Executive, in response to a query that had been raised, reported that he had decided to continue the practice of members and their guests signing the attendance book for ordinary meet- ings as it appeared to have little value. It was, however, intended to continue with the practice for the AGM when it might be necessary to ascer- tain those corporate members who were present and entitled to vote. The President then introduced Mr A Simmons of Network Rail and invited him to present his paper entitled “Network Rail Signalling Policy”. In making the presentation Mr Simmons explained the recent history since pri- vatisiation in 1994 and continued by setting out the long-term direction for Network Rail signal engineering and the opportunities and challenges that must be considered by the signal engineering industry in order to deliver cost-effective signalling for the national rail network in the UK.

Following the presentation Messrs J D Francis (WRS), G Callender (Parsons Brinkerhoff), E Hawes (Scott Wilson Railways), C A Porter (Independent Consultant), R McCulloch (Network Rail), P Bassett (retired), R Ford (Modern Railways), P Woodbridge (Lloyd’s-MHA) and R Barnard (Alstom) took part in an interesting and lively discussion. The presenter dealt with the questions comprehensively and the President then proposed a vote of thanks and presented the speaker with the commemorative plaque customarily awarded to authors of the London paper.

The President thanked members for the good attendance and their excellent questions and then reminded members of the need to register if they wished to attend the Metro Conference to be held on 27th November or the technical visit to Prague on 28th/29th November.

The President closed the meeting at 19.45 by announcing that the next meeting in London would be held on 10th December 2003 when Mr K Ford will present his paper entitled “LUL Connect – Radio and Transmission Networks”.

An Overview of Network Rail Signalling Policy
Andrew Simmons CEng FIEE FIRSE

ABSTRACT

The national rail network within the United Kingdom has been through a significant period of change since privatisation in 1994. Not only has the industry been required to adapt to privatisation, but within signalling it has also been necessary to consider the changing expectations of the system, particularly with respect to train protection arrangements.

During this period of change, it has been necessary to develop engineering policies that have a long-term strategic direction but can be sufficiently flexible to adapt to the emerging requirements as and when they occur. This paper sets out the long-term direction for Network Rail signal engineering and the opportunities and challenges that must be considered by the signal engineering industry in order to deliver cost effective signalling for the national rail network in the United Kingdom.

INTRODUCTION

On 1st April 1994 the national rail network within the United Kingdom entered the brave new world of privatisation. Much has been written about the benefits and dis-benefits of this decision. This paper does not intend to enter into the debate but outlines how the strategy for signal engineering within Railtrack and now Network Rail has developed since this date and the implications of this strategy.

Although the concept of privatisation was intended to provide freedom and flexibility for the various sectors of the industry, in itself the privatisation process imposed a number of constraints that limited opportunities. The early years of privatisation involved the industry coming to terms with the new structures and understanding how the industry operated according to the new interfaces and within the constraints of the individual safety cases.

Within Railtrack, the philosophy for signalling during the early years of privatisation concentrated on maintaining many of the practices and processes carried over from British Rail (BR), and examining ways of improving the performance of the existing signalling system. It was also considered that insufficient competition existed with respect to signalling renewals and therefore the introduction of new suppliers and new technology was encouraged. Examples of the new technology systems that were incorporated within the Railtrack strategy included Network Management Centres (NMCs), ERTMS Level 3 Train Control System and Computer-Based Interlockings (CBIs). Whilst these systems could each demonstrate a positive business case for the West Coast Route Modernisation (WCRM) as then envisaged, it is considered that risks associated with their introduction were considerably under-estimated with the given heroic timescales. The failure to deliver these systems has had a negative impact on the perception of others within the railway industry on the capability of the signalling industry to deliver new technology on to the network.

DEVELOPMENT OF A LONG-TERM ASSET STRATEGY FOR SIGNALLING

In 1999 Railtrack reorganised its Headquarters Engineering functions into an Asset Management Group, each discipline having its own asset engineering function. This reorganisation concentrated the majority of the Headquarters engineering functions within the same management control. At

1 Head of Signal Engineering, Network Rail
this time a review was undertaken to rationalise many of the business and engineering initiatives into a coherent strategy. Figure 1 shows the resultant asset management plan that resulted from this review.

Although this asset management plan was intended to provide a clear direction for the Headquarters engineering team, it also provided clarity in determining corporate activities that were required in the areas of maintenance and renewals.

The two main areas that the asset management plan depended upon were the technical policy for signalling, and asset information/performance. Neither of these areas was well-established, both having suffered previously from lack of ownership post-privatisation.

ASSET KNOWLEDGE

Railtrack had corporately recognised the deficiencies in asset knowledge and performance data, as a result corporate initiatives were being implemented to populate the Railtrack Asset Register (RAR). Although this initiative would provide a consistent asset register of all signalling assets, it was not intended to provide performance and failure information. These shortcomings were recognised and subsequent initiatives have involved the introduction of maintenance workbank management system, MIMS. It was also recognised that the failure management system FRAME was long past its prime, hence a replacement system known as FMS (Failure Management System) is being introduced. It is considered that by using a common data set for both MIMS and FMS, it will be possible to achieve a complete history of maintenance and faulting activities on every single signal asset on the network, as well as on other asset types.

THE DEVELOPMENT OF THE TECHNICAL POLICY FOR SIGNALLING

The other area that required significant development was the Technical Policy for Signalling. With the Railtrack corporate structure at the time, much of the decision making process associated with signalling strategy was made by the seven zones based upon their own needs. Such a situation not only created tensions between the zones and
headquarters but also sent mixed messages to the industry. The first issue of the technical policy therefore attempted to harmonise the various initiatives so that at least a common understanding could be achieved. At this point the technical policy did not contain long-term strategic direction for systems development and renewals, as this was considered inappropriate given that ‘The Southall and Ladbroke Grove Joint Inquiry into Train Protection Systems Etc’, had still to be issued and major decisions associated with the technology choices for the WCRM were still awaited. However, in many other respects the first issue did contain clear direction on issues such as maintenance and maintenance verification that has influenced company policy.

Issue 2 of the Technical Policy for Signalling has now been released. In general this sets out similar policies to that in issue 1, but is better informed in the area of strategic development, recognising not only the output of the joint inquiry into ‘Train Protection Systems’ but also the outputs from the joint industry ‘ERTMS Programme Team’.

NEW TECHNOLOGY AND THE APPROVALS PROCESS

The technical development strategy being pursued by Network Rail envisions low risk sustainable development of core systems such as control systems, interlocking systems, train detection and train protection. Notwithstanding this, it is recognised that we still have some unfinished business associated with the introduction of new systems. Whilst we have introduced new systems on to the network, these have not been without their fair share of problems, delays and cost overruns.

It must be recognised that before Railtrack embarked upon the introduction of new suppliers and their systems, no significant safety related signalling systems had been introduced on the network since SSL. Since this time the safety approvals process defined by European Standards, the Industry Yellow Book and the Systems Review Panel have evolved. Hence new systems or systems new to the UK have been subjected to the rigours of the Railtrack/Network Rail approvals process. For those systems new to the UK but with a history of safe operation in their native environment, a process of cross acceptance has been adopted. Whilst this has certainly streamlined the approvals process for certain systems, it does rely on identifying the similarities and differences between the native application and the proposed UK application. This in itself can be a major task that has certainly been underestimated in terms of timescales and complexity for a number of systems.

Not surprisingly many of the difficulties associated with the introduction of new interlocking systems have been with the interfaces between the core system and UK peripheral devices or demonstrating that non-UK peripheral devices are suitable for use in the UK operating environment. Different approaches have been adopted with different suppliers – however it is difficult to determine which has been the most successful approach. It is the long-term aspiration that standard interfaces between interlocking and peripheral equipment can be implemented as part of the Euro-Interlocking project, such that these types of issues can be minimised in the future.

Whilst I believe there are benefits that have been derived from the Railtrack/Network Rail approvals process, it is recognised that it is expensive, time consuming and in itself does not guarantee safety. The system still relies on professional engineering judgement, however it does provide an environment where decisions can be based upon facts. Presently one of the Network Rail action plans is reviewing the approvals process, the intention being to streamline the process such that those parts of the system that add value to the safe introduction of systems are retained whilst other areas are subjected to rationalisation.

Where new types of system impact significantly on the operation of the network, it is considered that concept safety cases will be developed before the introduction of the system on the network. The introduction of axle counters as replacement for track circuits followed the concept safety case route. The concept safety case for axle counters demonstrated that an overall safety argument for axle counters could be achieved, and having identified the key issues associated with their introduction, provided safety case templates for use on all future applications. In the case of the introduction of axle counters on the WCRM, these were being introduced simultaneously with the development of the concept safety case, this resulted in a number of iterations of system functionality as the pilot application was not fully aligned with emerging issues associated with the concept safety case. A key message prior to the introduction of future systems such as ERTMS is to ensure that as far as practicable, the concept safety case is completed prior to the first application and that all stakeholders are adequately consulted on the emerging safety considerations.

Having experienced many issues associated with the introduction of new technology, the Network Rail technical policy for signalling is centred on introducing new systems that are considered strategically important. Having decided to proceed with the introduction of a new technology system, as far as possible the system will be introduced in a low risk manner with pilot schemes identified that have minimal operational and delivery risk. Wherever possible a defined period of test running will be required prior to network roll-out or use on high risk projects.

An interesting feature associated with the introduction of new technology has been the reluctance of many engineers to accept change. In particular much attention has been given to minor negatives of new technology whilst not recognising the many benefits that are being introduced. In many instances the negatives are actually a result of meeting current standards, whereas existing equipment with grandfather rights does not have these features. It is recognised that the implement-
tation strategy for new technology may in itself be a factor for individuals not to embrace new technology. In particular, supporting documentation and training that is sufficient for steady state support of the system may require enhancement for the initial introduction of the system.

TECHNOLOGY STRATEGY

The Signalling Technical Policy now sets out the defined company strategy for various types of systems. It recognises the current status of systems within the UK and elsewhere and is aimed primarily at an evolutionary process building on that which is in use or being installed on Network Rail infrastructure. However, this strategy has to also recognise that there will be a requirement for the future installation of ERTMS and also the desire of our operating colleagues for a proactive control system that manages and optimises the running of the railway in real time.

In the area of train detection the preferred system is axle counters, but it is recognised that a number of issues associated with their introduction have to be considered in order that an overall positive business case can be justified. However, experience to date suggests that they are delivering the reliability that will allow them to be implemented on parts of the network demanding high reliability. In addition to their benefits on those parts requiring high reliability, they also provide a cost effective solution to rural and secondary lines.

The interlocking technology strategy builds upon the CBIs now installed or shortly to be installed. Within the strategy the use of Solid State Interlockings (SSI) is still recognised as the benchmark for which the costs of CBIs must aspire. However, it is presently recognised that SSI is not best suited for large complex interlocking due to cross-boundary issues, therefore presently CBIs are being targeted at those areas where SSI is not best suited. However, Network Rail is actively participating with our SSI suppliers in the development of second generation SSI (known as Westlock and Smartlock). Such systems provide Network Rail long-term benefits in addressing obsolescence issues associated with SSI, and allow the majority of lessons learnt with the use of SSI to be retained. These systems also have the capability to handle larger and more complex interlockings and will therefore be able to challenge CBIs in this market area. It is envisaged that there will be a convergence of costs between CBIs and second generation SSI as the coverage of Network Rail signal principles within the CBI data set is increased as a result of ongoing applications. It must also be recognised that for rural and simple secondary lines there is a specific market that can be adequately covered by either route relay interlockings or small CBI systems.

The train protection strategy currently builds upon the existing systems of AWS and TPWS. However, the strategy recognises that newly installed systems should have the provision for the implementation of ERTMS at a later date. This passive provision allows for sufficient power supplies and space for the addition of radio block centres. Prior to the introduction of ERTMS it is envisaged that a range of TPWS solutions will be implemented that provides a more comprehensive protection arrangement than that provided by the basic arrangements implemented with the regulated fitment programme. We are currently on target to satisfy the regulated fitment programme and this will be completed by the end of 2003.

The Control Centre strategy is still evolving in conjunction with Network Rail operations. The vision is for pro-active management and optimisation of train running recognising the present and future planned state of the network. In essence this operating vision is not dissimilar to the 1997 strategy for NMCs. However, the development of the current strategy envisages a longer implementation programme based upon signalling renewals with appropriate re-control of existing installations where this is cost effective.

While the above strategy is based primarily on those installations requiring total re-signalling, Network Rail like its predecessor organisations has difficulty in justifying from a business case perspective the re-signalling of rural and secondary routes, especially those with mechanical signalling. However, it is becoming clear that from an asset management perspective the strategy of life extension and targeted renewal is contrary to the desire to reduce operational costs. Network Rail is therefore investigating the possibility of a low cost signalling system based upon the capabilities of an open communications network such as GSM-R or the supporting fixed telecomm network being implemented by our colleagues in telecomm engineering. Presently high level target costs for re-signalling mechanically signalled areas are being validated. It is the intention to engage various stakeholders in this initiative shortly, as it is considered that any such system should recognise that the risk profile of this type of line is not identical to that of the primary network – hence some reduced standards requirements may facilitate a cost effective solution for the introduction of new technology. This will give the opportunity for an overall safety, performance and costs benefit when compared to existing installations. The architecture for such a system is considered similar to that envisaged for regional ERTMS, making the migration to this type of system far easier in the future.

RENEWALS AND THE CHALLENGE FOR GREATER EFFICIENCIES

With the technology strategy setting the way forward for the types of technology to be used in renewal schemes, the major challenge facing the industry is how to cost-effectively deliver the renewals volumes required to sustain the network. Following a review in 2002 to determine if the continued use of CBIs on the Network was viable, it was recognised that many of the causes of delays and cost overruns of the CBI pilot schemes were not specific to the technology introduction but symptomatic of difficulties associated with signal renewals.

The review findings suggested that whilst technically it was possible to adapt CBIs to Network
Rail’s requirements, initial unit costs would be higher than that achieved for SSI. It was recognised that the pilot schemes for CBIs were being implemented according to the methods and procedures for SSI and route relay interlockings and that in many instances this restricted the benefits that could be obtained by the use of CBIs.

As a result of this review it was decided that it would be necessary to implement actions that would:

a) address inefficiencies in the delivery of signalling projects; and

b) address the constraints within existing standards that would prevent the full benefits of CBIs from being realised.

**SIGNALLING NEW WORKS PROGRAMME TEAM (SNWPT)**

It was recognised that difficulties existed within the complete renewals life-cycle including the identification and prioritisation of renewals, through the project development phase and into the delivery and hand-back phase. It was also recognised that many of the issues associated with project delivery were a result of process failures in the earlier part of the project development. To overcome this, the concept of the SNWPT was evolved. The main objective of SNWPT is to manage the front end of the project development and produce scheme plans and functional requirements to allow the delivery phase of the project to proceed according to a fixed scope.

In order to provide a realistic and sustainable renewals programme, the SNWPT will collate the individual regional renewals requirement into a prioritised long-term national programme. This initial activity will provide target dates for renewals; wherever cost-effective it will be based upon a Line of Route renewals concept. The overall resulting programme will then be examined within overall network financial and resource constraints. With target dates defined it is then possible for the asset stewards and maintainers to plan life extension works where possible and appropriate and also for the various stakeholders in the renewals project to define their requirements in advance of detailed design.

Whilst on an individual installation basis additional costs may result from the adoption of CBIs. However, progress is being made at these workshops, but this is seen as a continuing process.

**SYSTEM AND IMPLEMENTATION COSTS**

Notwithstanding the changes being made by Network Rail to achieve efficiencies in the development of projects, much further work is required to reduce both system and project implementation costs. Organisational changes are being made within Network Rail to facilitate improved project delivery arrangements. However, Network Rail is also challenging industry to produce affordable systems that can be introduced on the network. It must be recognised that the rail industry in the UK is under intense scrutiny in terms of the cost of maintaining and renewing the network. It is therefore necessary that Network Rail in conjunction with the main signalling suppliers and hand-back phase. It was also recognised that a widespread transfer of staff from other parts of the supply chain to SNWPT may not be in the best interest of Network Rail. It is the intention to have a balanced recruitment policy, involving both the recruitment of key experienced signal engineers and the development of engineers from outside the industry.

Network Rail in conjunction with the main signalling suppliers is identifying areas where efficiencies can be obtained in the delivery phases of projects. Workshops have been held to determine areas where Network Rail could modify processes and standards to facilitate efficiency improvements. Progress is being made at these workshops, but this is seen as a continuing process.

In support of the quest for affordable technology, Network Rail has been working with the main signalling suppliers to develop affordable technology for the network. Network Rail is challenging industry to produce affordable systems that can be introduced on the network. It is therefore necessary that Network Rail in conjunction with the main signalling suppliers is identifying areas where efficiencies can be obtained in the delivery phases of projects. Workshops have been held to determine areas where Network Rail could modify processes and standards to facilitate efficiency improvements. Progress is being made at these workshops, but this is seen as a continuing process.

In terms of systems costs, Network Rail is also requiring a better understanding of our suppliers’ costs and overheads to ensure that only appropriate costs are being allocated to Network Rail projects.
Figure 2 – SNWPT Signalling Renewals ‘V’ Diagram demonstrating Engineering Integrity
MAINTENANCE STRATEGY

Following privatisation, the maintenance of the network including signalling was contracted out to Infrastructure Maintenance Companies (IMCs). Under the initial contracts the IMCs were responsible for defining the maintenance activities required to satisfy the various contract requirements. This type of contract arrangement gave the IMCs, as competent engineering companies, the flexibility to adapt existing maintenance regimes to best suit their business requirements. Within Railtrack a number of initiatives were being implemented simultaneously concerned with achieving greater efficiencies from maintenance activities. One of these initiatives involved modifying existing Signalling Maintenance Standards (SMSs) to highlight which tasks were specifically carried out to address safety, performance or life. When this particular exercise was completed, the resultant SMSs were considered by both Railtrack and the IMCs as inappropriate for use by technicians. In addition, the original intention of the exercise was considered of little benefit as the vast majority of maintenance activities contained tasks that were considered as safety tasks, and hence the original intention to reduce maintenance activities where safety tasks were not involved had little benefit. However, the process did highlight that the original SMSs that were still being used in some contract areas required substantial updating from both a technical and presentation viewpoint. Following consultation with the IMCs, it was agreed that Railtrack would re-issue a new suite of updated SMSs. In agreement with all IMCs it was agreed that overall, the SMSs that had been developed by Carillion represented industry best practice. Railtrack purchased the Intellectual Property Rights for the Carillion SMSs and re-badged them as Company Standards. In addition, a contract was also let to Carillion to expand the scope of equipment types covered by the SMSs and also to update any of their original SMSs in line with improvements identified by other IMCs. The intention was for the new suite of Company Standard SMSs to be mandated for use for all contract areas and that a common approach to signalling maintenance would be achieved throughout the network. Although this still remains the intention, delays in rolling out the SMSs have occurred due to the interaction with the MIMS programme. It is now anticipated that the Network Rail SMSs will be mandated for use by December 2003.

With consistent maintenance standards it is now possible to develop consistent competence standards, standard training courses and standard workplace assessments. Network Rail has recently consulted with industry about its intention to mandate a common licensing system covering all signalling activities, starting with maintenance activities. The generic licensing requirements will be defined and administered by the IRSE according to the well-established IRSE licensing scheme.

With the fundamental building blocks of consistent maintenance activities, consistent competency requirements and the maintenance workbank scheduling system (MIMS) it is now possible to start planning a new process of maintenance verification. This revised process will focus more on the competency of the maintenance technicians and more accurate monitoring of the actual maintenance carried out. This system of verification will then partially replace the present regime of ‘end product checking’ that samples the output of maintenance. The verification process is considered as a proactive method of monitoring maintenance activities whereas ‘end product checking’ is reactive.

Whilst there are significant benefits from having standard maintenance tasks, it is recognised that different maintenance regimes can be applied to certain types of equipment dependent upon their use. Railtrack initiated a programme using a Decision Support Tool known as MACRO to determine optimal maintenance tasks and frequencies for key assets. The early results of this initiative, which was based upon previous Reliability Centred Maintenance activities, demonstrated that improved performance and cost reductions could be made with an overall increase in safety as a result of the adoption of risk based maintenance.

Initial difficulties were experienced with the approvals process defining risk based maintenance arrangements. Although these difficulties have delayed the full benefits of risk based maintenance, pilot trials within the constraints of the approvals process have nevertheless demonstrated the predicted benefits. New company standards known as Signalling Maintenance Works Instructions (SMWIs) incorporating the risk based maintenance regimes are now published for key asset types, facilitating introduction across the network. However, the introduction is subject to integration within other corporate network initiatives such as the ‘New Maintenance Programme’ and the transfer of certain maintenance contract areas to Network Rail. All these initiatives are designed to allow Network Rail to gain better control over what maintenance is carried out when.

The concentration on achieving consistent and appropriate maintenance of the existing system has been based on the notion that a compliant system in terms of maintenance will deliver performance and safety requirements. Feedback from audits suggests that this notion is correct. However, other initiatives associated with performance have been carried out. Generally, these double benefits as train delays are reduced and faulting maintenance is also reduced. Examples of such initiatives include the introduction of long life signal lamps, LED Ground Position Light signals and event logging to allow fault finding to be more focused and to allow quicker recovery following alleged and actual incidents. There has been much debate within Network Rail about the benefits of the retrospective fitment of Condition Monitoring to signalling equipment. Analysis carried out on the back of the risk based maintenance initiative suggests that maintenance carried out to the
requirements of SMSs and SMWIs should highlight the majority of degradation issues that Condition Monitoring would also expose. In addition actual random faults of components may also not be able to be highlighted by Condition Monitoring prior to failure, hence the benefits of Condition Monitoring are limited to those degradation mechanisms that cannot be exposed by implementing appropriate maintenance regimes. Whilst the costs of Condition Monitoring equipment itself may show benefits, the ability to communicate this information effectively is a primary consideration in the overall cost of the system. Further trials are ongoing in conjunction with the West Coast Management Unit to determine if an integrated approach to Condition Monitoring will deliver cost-effective benefits when retrofitted to existing equipment.

In some of the more modern systems, Condition Monitoring forms an integral part of the system. Such arrangements assist in achieving both safety and performance targets.

STANDARDS
Within the privatised industry, standards are the basis for ensuring safety and performance criteria are specified and implemented appropriately. The evolution of standards to their current status has not been according to a long-term plan, but more of an ad hoc reaction to incidents and changes in the industry. Much debate has occurred within Network Rail and the industry into whether the current standard set is fit for purpose. This applies to engineering in general and not just signalling standards.

There is no doubt that improvements can be made to existing standards in terms of ongoing support and rationalisation to avoid duplication and discrepancies. Also many are prescriptive to an extent that they are no longer appropriate for use with modern technology systems. However, it is recognised that significant changes to standards also introduce risk. Network Rail as part of a corporate initiative is carrying out a review of standards and their structure. It is anticipated that this will result in a requirements database arrangement. Each requirement will be clearly defined with acceptance criteria in order to reduce any ambiguity associated with compliance. Prior to any significant changes to the current set of standards, a full consultation and briefing process will be undertaken in order that the various stakeholders are aware of the changes that will be made and the process by which the changes will be achieved, this being a result of the lessons learnt from the last significant standards change.

CONCLUSIONS
Network Rail is pursuing a strategy towards ‘Engineering Excellence for Britain’s Railways’. This policy is aimed at producing cost-effective asset stewardship of the network that delivers the safety and performance criteria required by our stakeholders. Signalling strategies are in place to deliver the overall Network Rail strategy and are based upon good engineering practice. Many involve close co-operation with our stakeholders and suppliers if they are to be delivered effectively. It is recognised that most of the initiatives within the signalling strategy are long-term. A period of stability is therefore considered essential for the full benefits to be achieved.

Discussion
The discussion was opened by J Francis (Westinghouse Rail Systems) who asked if there was a Network Rail Technical Strategy for the renewal and modernisation of level crossings. He also wondered if it was recognised that, despite all the differing contractual arrangements in place, Network Rail’s own standards and requirements were responsible for preventing cost reduction. He finally questioned if Network Rail’s signalling policy provided both sufficient diversity and a sustainable workload to support acceptable standardisation taking into account the broadening supply base and technology that has been encouraged.

A Simmons responded by advising that similar processes do exist for level crossing renewals as for other signalling renewals and a technical strategy is also being pursued to investigate the new and emerging technologies associated with level crossings such as “Predictor” and ERTMS. With respect to costs, the consequences of Network Rail’s own activities are recognised and actively being addressed with processes such as SNWPT, Task Forces and Product Development Groups. With regard to the supply base and emerging technology, Network Rail are trying to understand the implications of regulatory reviews but it is the intention to package up work with larger areas of similar technology within a route based strategy that encompasses whole life benefits to the renewals programme.

G Callender (Parsons Brinkerhof) commented that there were as many Network Rail managers as there were designers across all railway disciplines and also observed that possessions were often determined prior to contract award resulting in missed commissionings. He questioned if there were any links between signalling and P Way renewals and wondered if consideration had been given to the provision of ERTMS Level 1 on existing high-density lines due for imminent renewal.

A Simmons acknowledged that he was fully aware of project management costs and informed that the planned organisational changes would develop project management teams tailored to project scope. SNWPT is also part of the process looking at
S&C Renewals and the track engineers have systems similar to signal engineers to enable integration of signalling projects and track renewals. The Network Rail renewals programme is independent of ERTMS implementation although Network Rail have provided inputs to the National ERTMS Programme; planning processes will assist in determining roll-out plan when deemed appropriate.

E Hawes (Scott Wilson) wondered if Network Rail should declare a policy for the renewal of interlockings that will be both compatible with ERTMS and in line with the National ERTMS Programme.

A Simmons advised that this is the general policy although Network Rail have their own business constraints and have to take into account other factors such as whole life issues and most efficient method of renewal at the time. Part of the development process for interlocking renewals is that they can be upgraded to be ERTMS compatible in the future.

C A Porter (Independent Consultant) referred to the Asset Management Plan and asked if the link between the maintenance and technical strategies implied that the separate strategies did take account of one another. Additionally, he questioned if there was a deficiency in staff training issues together with a difficulty in retaining trained signal engineers who are useful to outside industry and frequently leave upon completion of their training.

A Simmons explained that the two strategies are linked and processes are defined but there was often no consideration or awareness between them of the relevant issues; it was incumbent on the maintenance organisation to inform renewals of their requirements and vice versa. Feedback is getting better, as has been evidenced with the introduction of new technologies and critical reviews, with information now being fed back following implementation. He outlined that the strategy for training is to provide capabilities to deliver as an industry but this does require developing to incorporate the IMC’s and industry investment. He also cited the successful example of the ongoing Network Rail “conversion courses” for mature entrants from outside industry.

R McCulloch (Network Rail) voiced concerns that time was running out for some of the older signal-boxes on the Great Western Zone and questioned if there was sufficient time for renewals to take place before these signal-boxes “fall-over”.

A Simmons noted the concerns but advised that Network Rail are looking at a total programme taking into account age profile and asset condition based on national priorities and critical resource availability; in some cases remedial life extension work is planned but the programme has been discussed with the asset stewards.

P Bassett (retired) queried both the approvals process and suitability of some of the new technology, particularly with respect to new signals being perceived as a retrograde step by the end user.

A Simmons responded by stating that the approvals process had allowed low maintenance signals to be brought in to use on the network in the optimum position for sighting purposes whilst providing a total improvement in the overall system. He also stated that trials had been undertaken and discussions held with end user staff representatives and no adverse comments had been received.

R Ford (Modern Railways), P Woodbridge (Lloyd’s-MHA) and R E Barnard (Alstom) also contributed to the discussion and at the conclusion of the evening C Porter (IRSE President) thanked A Simmons for presenting his paper in advance of the originally planned date.
LUL Connect – Radio and Transmission Networks

Kevin J Ford CEng MIEE MIRSE

The new systems to be built provide services across all the LUL lines with high availability, and are highly resilient. They consist of a new TETRA radio system (Terrestrial Trunked Radio – a European standard), and a new voice, data and video transmission system based on SDH and ATM technology.

BACKGROUND

During the 1990s, LUL commissioned a number of studies into the future requirements for telecommunications services, and had considerable forward vision into the many potential benefits that a modern communications infrastructure would bring to LUL operationally. Much more was involved than a simple like-for-like renewal of ageing infrastructure. One of the studies reviewed the technical options, and concluded that an integrated radio system would bring the most operational and safety benefits. The most significant unresolved issue was the type of radio technology to implement – initially between analogue and digital; then, if digital, between GSM-R and TETRA. It was quickly realised that, to provide a new radio system, a new transmission network would be required to act as the bearer system, and that the most cost-effective solution would be to integrate all LUL’s voice, data and video requirements on to a common fibre optic-based solution.

The existing radio systems were disparate in nature. Basically they consisted of station radio systems, mainly on section 12 stations that met the requirements for safety as well as normal staff communications. These were isolated systems. Separate systems were used in depots where rolling stock was stabled. The most complex was the train radio system which enabled communication between the train driver and the line controllers. This

ABSTRACT

This paper describes the new telecommunications systems being provided throughout London Underground (LUL) as part of the Connect Project. These new digital systems include a TETRA radio system for trains, stations and depots; and voice, data and video transmission systems based on optical fibre with ATM and SDH technology. They provide significant safety benefits, and opportunities for LUL to improve business processes.

The systems detailed are part of a 20-year Private Finance Initiative (PFI) Service Provision contract, where whole-life modelling and associated risk management are key issues. Fundamental re-engineering of the operations and maintenance régime, for both existing and new systems, has been required to meet stringent service requirements.

INTRODUCTION

On 19th November 1999 the largest contract ever known in railway telecommunications was let. The press releases at the time spoke of a £1.2 billion, 20-year contract that would revolutionise the provision of telecommunications on LUL. The contract was let under the Government’s PFI scheme, and is a service-based contract. The contract is structured to:

- operate and maintain existing systems;
- improve existing systems;
- build new systems;
- operate and maintain new systems;
- refresh new systems;
- hand back at the end of contract.

1 Technical Director, Thales Telecom Services
included specific functionality to enable One Person Operation. The systems were of considerably different technologies and ages on the different lines, with different levels of operational constraints. The situation for the transmission systems was similar. A variety of systems had been installed at different times, in small islands with negligible integration. The majority of circuits were carried on copper cable and most of the transmission systems had negligible capability to deliver digital circuits.

**PRIVATE FINANCE INITIATIVE (PFI)**

At this time LUL were in the forefront of setting up contracts under the Government’s PFI scheme (later to evolve into Public-Private Partnerships (PPP)). LUL already had three PFI initiatives:

- Northern Line train service provision;
- Power;
- Prestige – a new ticketing system.

Connect was therefore set up as the telecommunications PFI. Clearly it required a level of integration with all the systems detailed above as well as with the LUL infrastructure. It has to be remembered that, while the setting up of these contracts can be a lengthy process, the benefits to LUL are considerable. At the time that the Connect contract was awarded, the three PPP contracts as we knew them today were being developed within LUL but were still some way in the future. When bidding for the Connect contract, suppliers were not only bidding against each other but also against a Public Sector Comparison. This was to enable LUL and the appropriate public bodies to confirm that it is cheaper to let the PFI contract in whole-life terms than for LUL to fund and build the systems themselves.

PFI has a number of principles, including transferring considerably more risk to the contractor than a conventional design and build contract. It usually requires the contractor to fund the build programme and to recover its costs over the life of the contract. The outputs are a range of tightly defined services that have to be delivered to a wide-ranging set of service levels, with appropriate service credits for non-performance.

It is common for the contracting entity to be a Special Purpose Company, either with a single shareholder or with a consortium holding shares. Funding is provided by a mixture of bank lending and equity from the shareholders.

**CITYLINK**

Connect is being delivered by a consortium set up specifically for this purpose. The responsibility for operation and maintenance for the full 20 years is undertaken by Thales Telecom Services, and the extensive new build programme by Fluor Global Services. Fluor provide the programme management and installation skills, with Motorola providing the new radio systems and Thales Telecom Services the new transmission systems. To enable the consortium to progress the Connect contract, a Special Purpose Company called Citylink Telecommunications Ltd was formed.

The shareholders are:
- Thales Telecom Services;
- Fluor International;
- Motorola;
- Laing Investments;
- HSBC.

Citylink has contracts for operations and maintenance with Thales Telecom Services, and with Fluor Global services for the build programme. All the obligations and risks flow down to Thales and Fluor through these contracts. The teams are co-located where possible, with the LUL Connect team, Citylink and Fluor all located in the same office block in London, and Thales close by at its Network Management Centre.

**WHOLE-LIFE DESIGN**

When developing asset management strategies, renewal business cases and so on, people often refer to the whole-life cost of ownership. This should also be considered during the procurement phase of a major project, and is particularly important when new technology is introduced as part of the project. In my view, the rigour of this analysis and the follow-through can sometimes be deficient. With a service-based contract such as Connect however, the whole-life issues are critical to the profitability of the consortium, which carries all the risks and does not have an opportunity to go back to the customer if the performance or life of specific sub-systems are less than planned.

This environment forces the consortium to concentrate on an integrated design that is optimal in terms of whole-life costing. The operations and maintenance régime has to be designed at least as carefully as the new systems, and a high level of integration and iteration has to be incorporated into the design process. The services have to deliver a contracted availability and fix time, as well as other complex parameters, such as radio coverage levels and quality of service, for the full contract period. All engineers have to consider trade-offs between the cost of designing and building new systems, the life of individual elements and the cost of maintenance.

This contract forced these issues to be considered in a more formal way, with complex reliability and cost models being developed to produce optimised whole-life costs. Iterations of this process enabled views to be taken on issues such as the level of duplication and resilience to be included in the new systems as a trade-off with maintenance staff costs. Figure 1 describes the interrelationships of the models.

**OPERATIONS AND MAINTENANCE**

The key aspect associated with delivering services from the existing systems is an extensive régime to provide operations and maintenance of all existing radio and transmission system assets on LUL. One advantage of this is that potential disruptions during the construction of the new build, asset reuse and migration of services on to the new systems are all contained within the Citylink structure, so reducing
risks to LUL and disruption of services. Mobilisation to take on this task was a significant challenge on Day 1 of the contract. Prior to contract start, a Network Management Centre was set up, along with a Customer Service Centre, both located on Thales’s premises at Waterloo. This was designed to handle all fault reports, identification of the problem and tasking of the appropriate technicians. The Institution should note that one aspect of the régime is that IRSE licensed staff are used for fault rectification. To support setting up the centres, a range of IT systems was developed, based on industry standard packages such as Clarify, Axarte and Business Objects, configured specifically for this requirement. As well as facilitating the centres, the IT systems also enable cable/transmission allocations, asset data, spares and maintenance to be managed. A range of legacy network management systems was relocated into the Network Management Centre at Waterloo to enable proactive management of the networks.

The staffing strategy was to rationalise the many small contractors that existed, many without any formal service level targets, into two main organisations: Thales’s own staff, and one other incumbent maintainer for radio on a small number of lines. The safety case associated with these changes was rigorous, in order to ensure that no additional risk was imported.

The age of a number of systems made the spares issue a significant challenge. The first steps were to centralise and identify current holdings, then to identify the actual requirements and obtain additional units. In a number of instances this involved reverse engineering of critical elements with modern components.

Initial requirements included baselining the quality of current radio coverage, and implementing coverage improvements in areas of the District Line and Bakerloo Line north of Queens Park, along with a number of other interim improvements. These, with a much improved and focused maintenance régime, enabled the service level of existing systems to be improved significantly.

NEW RADIO SERVICES

The new radio system will deliver radio services to replace the existing station, depot and train radio systems across the whole of LUL. The digital system technology chosen is TETRA, which is more appropriate than a system such as GSM-R for a metro type environment. The trunked radio network is designed initially for around 12,000 users, with approximately 290 base station sites.

The system is connected to the LUL voice network and allows anywhere-to-anywhere connectivity, with group and point-to-point calls. For example, the radio allocated to a station supervisor at King’s Cross can be contacted either by placing a call directly to him, or by simply selecting the appropriate talk-group and pushing the transmit key. Radios can switch between talk-groups, allowing users to contact the appropriate functional groups easily. The planning and allocation of talk-groups is called fleet mapping, and a well designed fleetmap provides users with extensive flexibility. The system has a range of priorities built in, and a pre-emption régime with emergency call arrangements. In addition to group calls, the system provides true broadcast calls, defined for specific user groups.

Communications are enhanced by having dispatcher terminals located with line controllers,
signal operators and at a large number of stations. This provides additional functionality for controllers and other operations staff. Two types are provided: an enhanced functionality unit connected over fixed links, and a mobile one that uses the TETRA radio system to communicate with the central system. At any one time, the system knows where a train is located by use of a cell-based addressing system. This capability uses the fact that there is a base station located at every station and depot typically, and each of these forms a cell. This enables calls from trains to be directed to the correct signal operator. Where the control boundary is not the same as the cell boundary, trackside transponders are proposed to notify the system of the train’s location.

The system is based around five resilient core nodes, with data circuits to each base station. Calls are recorded, with comprehensive logging of calls and associated data. The resilience inherent in the TETRA radio technology allows hand-portables to talk to each other if they are out of range of a base station or if the base station is not functioning. Similarly there is a capability for the base station to operate in local mode should connection with the core nodes be lost as the result of an incident.

Radio coverage is provided by use of radiating cable installed in tunnels and stations (including disused sites). This is a shared propagation infrastructure that provides coverage not only for the LUL TETRA system but also for the radio systems of the emergency services, British Transport Police and London Fire & Civil Defence (LFCDA). Plans are currently being considered for the introduction of Airwave, this being the national TETRA radio system being rolled out for the emergency services. These systems operate in different frequency bands, so the combining and amplification arrangements can become complex. The coverage is quantified by a bit error rate, and different performance targets exist.
for different applications. One of the most significant issues is provision of adequate coverage for LUL staff on board trains such as travelling ticket inspectors. The system operates in the TETRA frequency bands 383 – 395MHz. Where the existing radiating cable is not life-expired and has the appropriate characteristics it is being reused, but Citylink accepted that some of this cable would require replacing later in the contract life-cycle.

The train mobiles provide voice calls and short data message facilities. These are being fitted into all drivers’ cabs and require integration with the range of stock currently in use. Some of these have more complex management systems and present considerable challenges. The driver has simplified calling to the appropriate line controller, signal operator and rolling stock depot. The system has the intelligence to route calls to different locations depending upon train location. The train radio can receive short messages from the controller, to simplify and standardise communication.

The migration strategy for the radio is tailored round the particular operating requirements and physical constraints for each line, and takes into account the fact that trains roam between lines, for example when running to depots. This can include dual fitting of the train, the infrastructure or both. Human factors affecting the operational impact, engineering issues and space constraints are all significant challenges when developing migration strategies. The TETRA network being provided has the capability to deliver many new features. The methodology of introducing them requires careful planning because of the requirements for procedural change and user training. The Connect project is incorporated within the LUL Safety Case, the approvals regime associated with the changes being a critical element in the programme.

NEW VOICE AND DATA TRANSMISSION

The vision is that the new voice and data transmission system should be at the heart of LUL’s operations and business. Where the requirements are identified as of the highest business or safety importance, enhanced performance is designed into the network. This can deliver availability figures of 99.999% for key service groups. The new radio system requires a considerable number of digital circuits to connect the radio switch sites and the base stations. Requirements exist for many thousands of circuits, and a number of additional requirements are currently being developed. Applications identified by LUL include:

- automatic fare collection;
- power control;
- signalling data (non-vital);
- passenger information (displays, public address);
- passenger security (help points);
- staff information;
- station and building management (access control, ventilation, lights, escalators, energy, environment etc);
- fire system monitoring;
- asset monitoring and management;
- LAN/WAN interconnection;
- telephony (extensions and interswitch);
- operational telephones (direct lines, tunnel telephones etc).

The network architecture is a central ring of optical fibre cable with dual SDH systems running at 2.5Gbit/s (STM16), with separate networks along each line at 155Mbit/s (STM1). The line networks are configured into small rings to optimise capacity, improve performance and minimise propagation delays. These all have alternative backhaul routes, some running along Network Rail wayleaves or along roads to other LUL lines, so as to form rings. The network has over 400 SDH nodes, which enables all stations and all main sites such as offices and depots to have transmission nodes to feed local services. In parallel with this exercise the existing LUL Ericsson telephone exchanges are being altered to feed remote extensions directly into the new transmission network at 2Mbit/s for 30 circuits, which optimises the space requirements.

The new network is designed to deliver approximately 25 different types of service. They extend from the humble telephone up to a 155Mbit/s ATM cell stream for the latest data applications. In most instances the copper cable has been reused for local delivery from the transmission node, but selected renewals are required, particularly of terminations and cable frames.

The design concepts include a modular base design for stations, the node being constructed off-site in a factory environment. It utilises a trackside cabinet suitable for the environment, including the harsh EMC environment. One of the most significant design constraints in the LUL environment is space, and the modular nature of cabinets provides maximum flexibility. Existing LUL equipment rooms (CERs) are used in a number of instances. This also provides a more consistent quality, and minimises time on site. Figure 4 shows typical trackside radio and transmission cabinets.

A comprehensive suite of element and network management tools is provided in the Telecomms Network Management Centre. They are an integral part of the commissioning strategy prior to being brought into service. Synchronisation, for both the transmission and radio networks, is derived from the satellite GPS system, with back-up systems and the ability to free-run in the event of the loss of signal.

VIDEO TRANSMISSION

LUL, like most metro railways, makes extensive use of CCTV video for security and safety purposes. Most stations have considerable numbers of cameras, with local monitoring and recording. The requirement is to be able to view any camera on any station from the central British Transport Police control room and from the LUL Network Control Centre, and also to view any station camera from its associated Line Control Centre (LCC). In some
instances a group of stations are managed from a local control room or group station control room. This creates additional requirements, because local viewing and recording are not available. The system is designed to provide over 2,500 video ports, covering 150 stations initially.

The system designed for Connect uses Digital M-JPEG Codecs at the stations to convert the analogue video signals into digital form. The digital signals are then connected on to dual ATM switches located at the station. These are then connected, either over the SDH network or directly over fibre, to central transmission core nodes, where they are connected into the core ATM network. The network has approximately 350 ATM switches. ATM has many advantages in terms of its flexibility for switching high-bandwidth video signals. One in particular is that a single video input can be viewed at all the control offices and viewing terminals at the same time. This is an advantage, for example, in incident management. Other advantages include a confidence level in terms of quality and guaranteed performance. New terminals are being provided for control of the video CCTV signals at the control offices and, in some instances, integration is planned with existing terminals. The system architecture is designed to enable migration to IP-based CCTV systems when the technology becomes mature enough to meet LUL’s stringent security and safety requirements. The ATM system is designed to be non-blocking, an important attribute during emergencies.

The different users of the CCTV video transmission network have different requirements for the quality of service of the pictures, and in some instances this can vary depending on what the user is viewing. The solution developed enables the video streams to be compressed to different bit rates depending upon requirement. The quality of service and associated bit rates supported are:

<table>
<thead>
<tr>
<th>QoS</th>
<th>Frames per second</th>
<th>Bit rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveillance</td>
<td>6</td>
<td>1 Mbit/s</td>
</tr>
<tr>
<td>Standard</td>
<td>12.5</td>
<td>2 Mbit/s</td>
</tr>
<tr>
<td>High</td>
<td>25</td>
<td>4 Mbit/s</td>
</tr>
<tr>
<td>Premium</td>
<td>25, non-interlaced</td>
<td>8 Mbit/s</td>
</tr>
</tbody>
</table>

The methodology for agreeing the appropriate compression ratios, compression schemes (Wavelet, MPEG), frame rates and so on involved user groups from different LUL operations groups, with British Transport Police and other users undertaking viewing trials in order to determine what was acceptable to them. This involved a range of typical scenes with different lighting levels, crowds etc.

The video transmission network has the capability for providing a number of additional features including slow scan, local switching/viewing, and centralised digital recording. Separate trials have
been undertaken of image recognition, for automatic interrogation of the picture and identification of out-of-course events. This offers many security and safety opportunities.

CONCLUSION

From this overview it can be seen that the new Connect radio and transmission systems being built will revolutionise the provision of telecommunications services throughout the LUL network. Connect will provide the backbone for all LUL’s business and operational requirements, as LUL goes through the massive programmes of change currently planned.

The PFI approach has harnessed the resources of industry and LUL to deliver high-quality services within a financially beneficial framework.

Discussion

The discussion was opened by C A Porter (Independent Consultant and formerly of LUL) who explained that the Private Finance Initiative (PFI) presented an opportunity to overcome the problem of guaranteed funding for communications developments on LUL that has previously resulted in piecemeal development of the existing network. He then asked the speaker what allowances had been made for expansion, the proportion of existing equipment that was either retained or re-used and finally wanted to know the reliability of the handhelds.

K Ford responded by advising that an expansion of 30% was specified although in reality the principle has been to equip in the most cost-effective manner for present-day requirements with the ability to expand easily when required. Retained assets included copper cable, leaky feeders and transmission systems. He was unaware of reliability statistics for the hand-portable devices.

D Coles (London Metropolitan University) was interested in both knowing why IP communication protocols had not been used and the capacity and utilisation of the installed cables.

K Ford explained that at the time of system development, IP communication protocols could not be used to transmit video and voice data to meet the required specifications. Signalling data transfer is possible but is not considered resilient enough to be recommended for this purpose. Forty-eight fibre cables are installed with utilisation dependent on system requirements at that point in the network and sufficient capacity for maintenance provision and possible expansion.

R Shenton (Network Rail) questioned if the migration strategy had influenced system design.

K Ford responded by outlining some of the areas where integration with legacy systems had been considered including train mobiles, emergency systems and re-use of cabling. Ultimately the situation was problematic and had still to be resolved.

C Kessell (Centuria Comm Rail) observed that Citylink pays for the radio and transmission systems and wondered where the responsibility for connecting and charging for other systems such as CIS, CCTV, PABX lay. He also questioned if Transport for London (TfL) had any plans to utilise the spare capacity of TETRA for other transport systems within their area of influence.

K Ford stated that LUL had the responsibility for connection of any other systems onto the network but charging would be covered by provision of a service contract. Whilst TfL are looking at introducing a new radio system for London Buses, TETRA has insufficient capacity for this purpose although it could be used on the Docklands Light Railway (DLR).

P Bartholomew (Mott MacDonald) asked if the needs of the emergency services were considered in design of the radio network and enquired what the biggest challenges had been in installing equipment in the environment of the underground.

K Ford informed that it was a requirement that the emergency services had radio coverage underground and therefore the system was designed to give coverage for both TETRA and the emergency services. He regarded the biggest challenge as the practicalities and logistics of installing equipment in a harsh environment against the background of organisational change within LUL.

J Corrie (Mott MacDonald) enquired of the experience of meeting the competence requirements using the IRSE Licensing Scheme and asked how it could be improved.

K Ford replied that the scheme had been fully supported, the main challenge been the paperwork and bureaucracy involved. He also noted that not all areas of telecommunications work were covered by licence categories at the present time.

B Cooper (Cubic) asked how the equipment was protected from environmental effects.

K Ford advised that the equipment was designed to cope with the majority of problems together with routine testing to mitigate against undetected damage.

C Porter (IRSE President) questioned the mechanism for dealing with technical and contractual issues in a long-term contract where there is an element of instability.

K Ford explained that, with the ongoing installation of equipment, change management architecture is in place that includes planning, bidding for new works and maintenance; any organisational changes require discussions.

T Foulkes (Network Rail) wanted to know how the testing was structured and configuration of the nodes undertaken.
K Ford replied that the generic nodes were built and factory tested prior to installation on site with final commissioning testing undertaken once nodes configured and installed within the system.

M Govas (Network Rail) asked to what extent exploitation of the spare capacity is allowed for non-LUL purposes and questioned the handback arrangements at the end of the contract.

K Ford informed that there is an agreement in place that commercially benefits both LUL and Citylink, however, the present fibre-optic capacity within London means there is no market to sell off any spare capacity. At handback, Citylink stops providing the service and the asset is handed to LUL for continued operation. In addition, an exit programme starts four years before assets become life expired.

C Enoch (Bechtel) enquired of the percentage of installation completion at the present time and was interested in knowing the performance and reliability of the system.

K Ford was not in a position to quote specific figures for either installation completion or performance and reliability.

I Creishman (Infotechnologies) wondered if the spare capacity could be utilised for public mobile telephony.

K Ford informed that it was still an option to provide a public GSM in the underground; the real problem was how to justify the expenditure.

S Hailes (Network Rail) noted that the paper made reference to the bidding process whereby Connect had to bid against a public sector comparison and he questioned how PFI could actually be cheaper than a build and maintain in-house. He also asked if there were any ineffective areas with PFI.

K Ford explained that all PFIs have a public sector comparison; LUL calculate how much it would cost to undertake in-house although the figure is not revealed. A cheaper price can be quoted because of synergies with other contracts, finance initiatives, passing risks on and exploiting opportunities. Some of the disadvantages are the differing requirements within the consortia between the build and operate elements, the time taken to reach a decision and communication chains between operator and client, however, these can generally be mitigated against by managing out the problems.

C Porter (IRSE President) thanked the speaker both for his paper and his contributions to the subsequent discussion.
INTRODUCTION

This paper gives some background to telecommunications in the railway. It outlines Network Rail's strategy for telecommunications and the main factors behind it. It describes the major works that are currently in progress to renew the fixed and radio telecommunications networks. These are a new fibre-optic based synchronous digital transmission network, and a national GSM-R radio network. The paper describes some of the opportunities that arise from these projects for improving the performance and reducing the cost of railway signalling. His paper also introduced some of the issues that need to be resolved in order to ensure that signalling derives the maximum benefit from the telecommunications strategy. Following the presentation Messrs K Ford (Thales), A Jones (Thales), P Robins (SRA), R Hurst (retired), D Feather (Thales), C H Porter (President), C A Porter (Past President), P Bartholomew (Mct MacDonald), P Halliwell (Network Rail), A C Howker (Past President), R Cooper (Carillion), L Giles (Rail Radio Solutions), K Moxsom (Thales), I Findlay (First Engineering), R Smith (retired), D McKeown (Independent Consultant), S Goodland (Network Rail) and L Allen (Alcatel) took part in an interesting and lively discussion. The presenter dealt with the questions in a comprehensive and good-humoured fashion and the President then proposed a vote of thanks and presented the speaker with the commemorative plaque customarily awarded to authors of the London paper. The President thanked members for the good attendance and their probing questions and then issued reminders to register if they wished to attend the Interlocking Conference to be held on 26th February 2004, the technical visit to the Dorset Coast on 27th/28th February 2004 or the Annual Convention to Dublin in June 2004. The President closed the meeting at 19.45 by announcing that the next meeting in London would be held on 11th February 2004 when Mr M Stubbs will present a paper entitled “Dorset Coast Resignalling”.

BACKGROUND

HISTORICAL CONTEXT

The first commercial use of telecommunications was on the railways. Cooke and Wheatstone's electric telegraph was first installed between Euston and Camden in 1837, and subsequently on the GWR between Paddington and West Drayton in 1839.

The introduction of the telegraph revolutionised the operation of the railway. The complete dependence on time intervals between trains and the signalman’s view of his station or junction area was removed. The concept of block signalling was born, and the telegraph enabled a huge improvement in safety and a dramatic increase in the capacity of the railways.

Even so the railways were slow to take on this new development, and it was not until 80 lives were lost in the disastrous accident at Armagh in 1889 that an Act was passed to enforce block telegraph on all passenger lines. The Board of Trade set time limits for compliance.

In the late 19th century the telegraph companies were nationalised and the railways lost their rights to run public telegraphs. Because of the vital importance of telegraphs to railway operations the railway companies retained the right to operate telegraphs for railway use. The railway's special status as a telecommunications operator remains today, reflecting the continued reliance on telecommunications as a vital part of railway infrastructure.

RAILWAY TELECOMMUNICATIONS PRIOR TO RAIL PRIVATISATION

By the early 1990s the railway had developed an extensive telecoms network. It had been built piece-meal as demand for telecommunications arose from resignalling and electrification schemes. In addition, national schemes delivered national teleprinter, telephone and radio networks, and high-speed and very-high-speed data networks. A backbone of coaxial, copper and fibre-optic cables had evolved over the years. The resulting telecoms network consisted of a huge variety of equipment, of varying age. This all remained under the direct control and ownership of British Rail (BR), which had a directly-employed telecoms maintenance and fault management organisation.

RAILWAY TELECOMMUNICATIONS AFTER RAIL PRIVATISATION

As part of the rail privatisation process, BR's telecoms business was sold to Racal Telecom in 1994. A large proportion of British Rail's telecommunications equipment was made the subject of a finance lease agreement, which gave Racal "quiet
enjoyment" of the equipment in return for a lease fee, and Railtrack was obliged to purchase its telecommunications services from Racal, through a series of hastily drawn up contracts.

The leased assets were broadly the cables, transmission and telephone exchanges, whilst the remaining “operational” equipment included telephone concentrators at signal-boxes, signal post telephones and certain radio systems. Operational equipment was left in Railtrack’s control, with maintenance procured through the infrastructure maintenance contracts.

The contracts are very complicated and were based on an incomplete understanding of the nature and condition of the equipment and services.

In 2000, Racal sold part of its telecoms business to the newly-formed, Bahamas-based Global Crossing. This was done without reference to Railtrack, and introduced further complications into Railtrack’s supply chain for telecoms. Inter-trading contracts were set up between Global Crossing and the remaining part of Racal, which retained much of the economic interest in Railtrack’s business. Railtrack was subsequently sold to Thomson CSF, now known as Thales.

Railtrack had no direct access to a large proportion of its telecoms assets. In practice, the contracts gave little incentive for the suppliers to manage the condition of the leased assets or to improve their performance. The overall cost to Railtrack increased while the performance deteriorated, and Railtrack was even obliged to take enforcement action to ensure compliance with basic standards. The financial collapse of Global Crossing’s parent company meant that Railtrack had rapidly to create a contingency plan for the potential loss of its network services.

Railtrack had lost direct control of the telecommunications on which it depended to operate the railway.

NETWORK RAIL’S TELECOMMUNICATIONS STRATEGY

In order to address the deteriorating performance of telecoms on the railway, a new central team was created to manage it. Unlike other headquarters engineering functions, this team managed national service and maintenance contracts directly, with support from the Regions. This allowed effective integration of the many engineering and commercial issues inherent in the supply arrangements.

This team continues to evolve, and it owns Network Rail’s telecoms strategy, which is to procure, operate and maintain its telecommunications equipment and services to meet the safety and other operational requirements of the modern railway, at lowest whole life cost, as far as is possible within the available funding.

The two key initiatives to deliver this are:

• to gain direct control of the existing services and equipment by changing the maintenance contracting arrangements and removing the legacy outsourcing arrangements at the earliest opportunity;
• to renew the life-expired assets in modern form, as Network Rail owned and controlled assets, where it is economic to do so.

GAINING DIRECT CONTROL OF EXISTING SERVICES AND EQUIPMENT

The maintenance of operational telecoms assets has been included in the 26 Infrastructure Maintenance Contracts (IMC) since 1994. Telecoms represents only about 5% of the IMC work and, as a result, it has not been possible to get sufficient priority. Management attention is largely directed at track and signalling. The majority of IMCs have sub-contracted the telecoms work out, in most cases to Thales.

This arrangement is not ideal, and will be changed at the earliest economic opportunity to give much better alignment of incentives with railway performance and safety. Now that the IMC arrangements are being brought in-house we are considering our options for the future maintenance of our telecoms equipment.

Network Rail has been working with Global Crossing to get better exposure of the underlying maintenance of the finance leased assets. For example, we found that the cable records available to technicians were, in many cases, incorrect. Remedial work was eventually agreed, and has been prioritised on a safety basis, placing mechanically-signalled areas first, where the railway risks arising from misconnection are the highest.

The maintenance of finance leased equipment cannot be directly influenced until the finance lease expires and repossession takes place. For most equipment this will occur in April 2005. Network Rail will then operate the equipment, and will have the option of contracting the maintenance out or doing it in-house.

RENEWING LIFE-EXPIRED ASSETS

Many of the telecoms assets are life-expired. The network is based on cables and transmission systems of which some date back to the 1960s. The National Radio Network (NRN) and some cab secure radio systems will be more than 20 years old when they are replaced.

A new project office has been created to deal with the main renewals, with a contracting strategy designed to give us direct relationships with our suppliers. Most of the design and integration is being done in-house, and levels of supervision of contractors’ work are considerably higher than has recently been the norm in other rail projects.

The new networks will be owned and operated by Network Rail, in common with the other elements of the railway infrastructure.

FIXED TELECOMS NETWORK OVERALL DESIGN REQUIREMENTS

The network has been designed to meet all Network Rail’s existing operational, business and information technology (IT) needs, and also to allow for the support of the GSM-R system and future
expansion of the IT systems.

The network is arranged in rings to provide diversity. If a cable is cut, circuits can automatically be re-routed around the ring. Very high availability rates will be achieved, with a direct impact on railway performance and safety.

The network is based on international synchronous digital hierarchy (SDH) standards, which were established in the early 1990s and which have been successfully used in the railway environment. This technology increases the available bandwidth whilst significantly reducing the amount of equipment in the network. SDH is far more reliable than the existing mix of arrangements, and will be much cheaper to run. The high level of standardisation allows a greatly reduced spares holding, and a reduction in the number of operators and maintainers. The sophisticated network management facilities give a radical improvement in the control of the network. This enables fast recovery from failures, most of which can be accommodated without affecting service to the end user. SDH allows for great flexibility, being scalable and adaptable to the future requirements of the railway. New connections to the network can be made at 2 Mbit/s with the minimum amount of equipment and transmission delay.

Figure 1 shows the national fixed telecoms network (FTN). It will have the following main features.

- All regional offices, general managers’ offices and large- and medium-sized signal-boxes will be connected with an optical network.
- The network will be fault-tolerant and designed to be repaired with minimal potential delay or cancellation of trains.
- The network will provide capacity for the present and forecast future requirements of Network Rail.
- Existing copper cables will be re-used or refurbished where it is economical to do so.
- Digital subscriber line (DSL) technology will be used on non-fibred lines.
- Transmission sites will generally be located at GSM-R sites.
- Public telephone operator (PTO) circuits will be used where required for additional resilience, and elsewhere where economical.
- The installed life of the cable route and cable will be 30 years minimum.
- The transmission elements will last at least ten years with full support, maintenance and spares available.
- Exchanges will later be provided to support all Network Rail office and lineside ‘dial’ telephones.

The equipment being provided for FTN consists of six broad elements:

- telecoms engineering control office;
- transmission equipment;
- telephone exchanges;
- fibre-optic cable;
- copper cable;
- cable route.

These are interconnected as shown in Figure 2. An overview of each of the elements follows.

**Telecom Engineering Control**

A network control (telecom engineering control (TEC)) will be provided to allow Network Rail to configure circuits, monitor alarms and direct fault rectification of both the FTN and GSM-R systems. All records and allocations will be accessible across a wide area network. Although read-only access will be generally available, updating will be strictly controlled. In particular, rigorous controls will be put in place for circuit allocations, to ensure that all relevant design criteria (including diversity) are maintained.

Network Rail’s national control currently uses a number of windowed applications running on separate machines. This approach works well and will be copied for use in the TEC. This will reduce the expense and the potential safety implications of an integrated system. By distributing the databases and providing a dedicated operational WAN, control can be achieved from anywhere in the country, subject to appropriate security arrangements. A dedicated back-up control is, therefore, unnecessary since any available office on the network could be used.

The TEC is being established in an existing building provided by the WCRM project. It will be populated in stages, to allow commissioning of the first transmission nodes in early 2004, with expansion as other geographical areas and GSM-R come on line.

Consideration is being given to the efficiencies that may be achievable by moving existing legacy system monitoring to the TEC.

**Transmission Equipment**

The network has been designed using a modular approach. This gives a high degree of standardisation, making installation and maintenance as efficient as possible. The transmission systems will be configured so that, in general, the failure of a single item of transmission equipment or fibre-optic cable will not cause loss of service. The alternate routes will be pre-configured and automatically used when the equipment identifies a failure.

**Core Network**

The core network, shown in red on the network diagram (Figure 1), provides the communications for the national applications, which include IT and business communication between HQ, regional offices and other strategic sites. It also distributes telephone and GSM-R circuits from the core locations to nodes throughout the country where they then transfer to the appropriate blue rings. The availability of the core rings is dependent on their size and the time to repair faults. In order to allow cable faults to be repaired quickly the number of fibres in the cable has been limited to 24 and the availability assumptions allow for this to be done at
Figure 1 – FTN National Network Diagram
Figure 2 – FTN Block Schematic
night, when there will be minimum disruption to train services. Core nodes on the red rings provide interconnections between the rings.

**PTOs in the Core Network**

Some diversity will be provided using circuits or dark fibres leased from PTOs. The PTO circuits form an integral part of their ring and therefore the design rules take account of their performance parameters in the same way as for any other part of the network. Other opportunities to use PTOs and avoid installation costs are under consideration.

**Access Rings**

The access rings have a capacity of 155 Mbit per second, which is the lowest-rate building block of the SDH and is known as STM-1. These rings are shown in blue on the network diagram (Figure 1). They are supplemented by DSLs, shown in black, where distances and capacity are within defined limits, or by additional SDH (STM-1) subtends shown in green. If reliability requirements demand it then additional PTO circuits may be required to complete the access rings on branch lines. Primary and secondary alternative routing is only provided within access rings, to ensure that circuit delay is controlled within the current limits for signalling circuits.

Access rings provide interconnections for GSM-R base stations; dial phones and low-capacity IT systems back to the core network. Access nodes on these rings will be co-located with GSM-R base stations using shared relocatable buildings. These nodes will provide communications to the GSM-R base station and to lineside circuits supported by copper circuits in the vicinity. Access nodes will also be sited at electrical control rooms and large- and medium-sized signal-boxes, to provide direct connection to some signalling circuits, for example SSI long distance terminals (LDTs).

The reach of the access network is currently under consideration in line with the initiative to reduce the railway’s costs by allowing different standards on lightly used and rural railways.

**Telephone Exchanges**

Part of the telecoms strategy is to have a common numbering plan, based on the European EIRENE specification, and hence consistent with other European railways. This will allow a call to a given number to be routed to the same destination irrespective of whether it is established on a mobile or a fixed lineside dial telephone. In particular, national short codes are planned to connect a caller to the controlling signaler, controlling ECR and the relevant regional control. In order to achieve this it is planned to co-locate an ‘operational’ exchange at the two GSM-R MSC locations to support all lineside telephones. These will be configured as main and standby.

In addition, many staff in regional, HQ and ECR offices require the additional facilities of feature telephones. In order to support these, exchanges will also be provided at local offices.

All these exchanges will be interconnected to each other, to PLOs and to GSM-R via the FTN transmitted mission systems. International calls to other railway administrations will be routed via the GSM-R links to Eurotunnel and France. It will also be possible to provide connections to train operators’ telephone networks if this is required.

**Fibre-optic Cable**

A new company standard was drawn up to ensure that the network was based on the most suitable fibre-optic cabling practice. A single 24-fibre cable is being provided on lines shown in green, blue and red in the network diagram, where this is more economical than a third-party provider. These cables will run between core nodes and provide interconnection at all access nodes in the section. Generally, access nodes will be supported from a local joint from where a single cable will then connect to the site, via an under-track crossing (UTX) where required. The connections to this local cable will be arranged so that core ring bearer systems will not be routed via the access nodes.

Outside the core node buildings a minimum separation of 10m is being provided to minimise common mode failures between links.

Fibre-optic cable will also be used to support some circuits directly. At present these include optical repeaters for GSM-R in tunnels, and level crossing CCTV pictures. No diversity or alternative routing is provided for circuits supported in this way.

**Copper Cable**

Some of the existing copper cables are life-expired as a consequence of their age and, in part, poor maintenance. For example, there are many paper-insulated cables that have had no air supply for several years, either because insertion lengths of polyethylene cables have been installed, blocking the airflow, or because pressurisation equipment has not been maintained. Other copper cabling gives poor performance because of problems with terminations and cable joints.

Where new copper cables are being run, they are generally between transmission access nodes. These will provide the medium for connecting trackside circuits into the network. In ac-electrified areas without booster transformers, only short lengths of copper cable are allowed, because of the risks of high-induced voltages. These will, therefore, be arranged to spur services from the transmission sites and will not provide diversity at the copper level. Copper circuits will not be connected through directly at transmission nodes, so that maximum circuit lengths are not compromised.

The lineside circuits include signal post telephones, point zone phones, electrification SCADA and signalling circuits, all of which have diversity requirements so that a single cable cut has minimal impact on railway operations. Other circuits include immunisation testing pairs in ac-electrified areas, and DSLs. Some rationalisation will take place to minimise the copper requirement. For example, lineside plug points will not be renewed.

Local lineside distribution cupboards are being provided to allow connection into the network. All
copper pairs will be terminated, to simplify installation, maintenance and testing and to give maximum flexibility.

The existing arrangements for copper terminations include a large number of different practices, none of which was considered suitable for a new national standard. After extensive consultation and testing it was decided to introduce a new cable termination practice, based on the Mondragon VX, a robust device with an integral test point. This product is currently on trial.

New screening cables and earths will be provided where the existing ones are missing or not able to screen the copper cables acceptably.

Records of circuit allocations will be created by the project, and stored and controlled by the TEC.

In the longer term, once GSM-R is operational and in widespread use, it is hoped that the resistance from operators, safety regulators and trades unions to the removal of lineside telephony will disappear, to allow radical rationalisation of the lineside facilities.

**Cable Route**

On the majority of lines cable routes exist. These have generally not been well maintained and so a significant amount of refurbishment and component replacement is necessary. The requirement is driven by the need to:

- provide access and space for all FTN cables;
- protect all S&T cables in the existing route, including those currently outside it;
- allow for the future installation of at least three additional cables.

On rural lines, where there may not be an existing route, alternative solutions are being developed. These may include using more robust cables or providing a less robust and smaller route. The use of novel materials, such as plastics, is under consideration, and any new components will be approved through the normal company procedures. Records for cable routes will be created by the project and managed and controlled from the TEC.

In the current financial climate a review is taking place to determine the extent to which the route refurbishment and provision of spare capacity can be afforded.

**CURRENT STATUS**

Implementation of FTN began in January 2003, since when 4,500 kms of survey have been completed and 1,500 kms of cable laid. Transmission equipment has completed its factory acceptance testing, the TEC equipment has been installed and the first 100 integrated equipment buildings are in production.

**FUTURE PROGRAMME**

The programme is currently being re-planned following the Rail Regulator’s recent Interim Review.

**RADIO NETWORKS**

The existing train radio systems are being replaced with a new national GSM-R radio system compliant with the European standard and providing secure voice and data communication over the whole of Network Rail’s infrastructure. This is driven by:

- obsolescence and life expiry of the NRN;
- accident inquiry recommendations for secure signaller-to-driver communication;
- the requirement of the DTI for frequency changes to avoid continental interference;
- compliance with the European interoperability directive.

GSM-R will replace the NRN, cab secure radio systems and the radio elements of the radio electronic token block (RETB) systems.

It is currently designed as a national system, providing 100% coverage of the entire railway. This design is also under review as part of the work on differentiated standards for lightly used railways.

**GSM-R: GSM FOR RAILWAYS**

Railways require a number of facilities that are not provided in public GSM networks. GSM-R systems provide the following specialised features for railway use:

**Functional Addressing**

Calls may be made using a functional identity rather than a phone number. For example, a signaller can call a driver by the train running number.

**Location Dependent Addressing**

This allows, for example, a train driver to call his local signalmen without knowing which signaller he needs or his number.

**Priority and Pre-emption**

This allows non-essential calls to be terminated by higher priority calls, for example emergency calls.

**Group Calls**

Various callers can be combined together into groups. For example, the system can be configured to allow an emergency call from a driver to be heard by other drivers in the area, as well as by the relevant signalmen.

**Broadcast Calls**

This allows, for example, a signaller to broadcast a call to a number of trains in a specific area.

**GSM-R NETWORK DESIGN**

The network design (see Figure 3) consists of about 2,000 trackside base stations served by about 20 base station controllers, with two mobile switching centres arranged to provide a disaster recovery facility in the event of a catastrophic failure. A switching arrangement will provide connections to about 850 fixed terminals, located in all signal-boxes and regional control offices. Facilities will be provided for central voice and call data recording, and for data output suitable for input to a billing system. Connections will be provided to other networks, including other GSM-R networks. A brief overview of each element follows.

**Network Sub-System (NSS)**

The NSS forms the heart of the GSM network and
includes the mobile services switching centre (MSC), the equipment databases that manage the subscriber data and mobility management.

The NSS is responsible for setting up calls between GSM users. The NSS also interfaces with other networks, such as fixed line networks and other GSM networks via gateway MSCs.

Home and visitor location registers (HLR/VLR) provide the means to identify the location of subscribers if they are on the home network or visiting (roaming) on other networks. This function includes authentication and details of the range of services available to subscribers.

Base Station Sub-System (BSS)

The BSS consists of the radio base transmitting stations (BTS) and their base station controllers (BSC), together with a transcoder. The digital speech path over the air interface runs at 13 kbit/s and data runs at 2.4 kbit/s, 4.8 kbit/s and 9.6 kbit/s, whereas on a fixed network a standard channel uses 64 kbit/s. Hence, a rate adapter is necessary to meet the ISDN standards on the fixed network.

The BTSs are housed in re-locatable equipment buildings along the track. The BTS is connected to an aerial, typically a pair of panels at 30m giving a beamwidth of 30°. Lower sites and smaller cells are provided in urban areas. The BTSs are connected in rings to one of 20 BSCs via 2 Mbit/s fixed links.

Operational Sub-System (OSS)

The OSS is not a part of the call path but provides the means to manage operation and maintenance. It monitors performance and failures over the entire network and allows subscriber management, call charging and billing. The OSS manages the equipment databases and the issue of subscriber interface modules (SIM).

The OSS is linked to all the elements within the GSM system in order that the system may be managed in real time.

Fixed Terminal Sub-System (FTS)

The FTS enables signallers to communicate directly with train drivers and other GSM-R users. The FTS enables drivers to contact trains using the UK’s alphanumeric train numbering system. The FTS includes functionality to support the unique operational requirements of Britain’s railway and is designed to minimise the need for customisation of the core GSM-R system and the mobile.

LAYER MODEL

Figure 4 shows the GSM-R layer model.

MOBILE TERMINATION

This may be a mobile phone or a train radio mounted in the driving cab. It allows the usual suite of GSM features as well as the railway-specific ones. The mobile termination includes a SIM card that identifies the mobile to the network and allows configuration over the air.
The train radio equipment consists of a driver’s control panel, a radio unit, a power supply and an externally mounted aerial. There are connections to various control functions in the train such as the driver’s safety device, on-train data recorder and public address.

FITTING THE TRAINS

There are about 8,500 driving cabs to be fitted, including about 200 belonging to Network Rail. At the time of writing, a decision has not been taken as to how this activity will be managed. Discussions are continuing with the Strategic Rail Authority and the GSM-R Stakeholders Board to determine the most efficient and practical way to undertake this significant task.

SPECTRUM

Because the GSM-R system is intended as a European interoperable system, allowing trains to cross international boundaries more easily, it is necessary for the European railways to use the same radio channels. This meant obtaining the same radio spectrum across all member states. A UIC project team achieved this difficult task, and 19 channels in the 900 MHz band, adjacent to the public GSM900 frequencies, are reserved for railway operational use (see Figure 5).

COVERAGE

The new Railway Group Standards for radio call for national radio coverage. Cab secure radio systems are designed to provide 100% coverage within their limits of deployment, but NRN has many coverage gaps.

The current design for GSM-R includes 100% coverage of all 16,000 kms of railway route. We are working with the Railway Safety and Standards Board (RSSB) to determine whether the requirement for 100% radio coverage on all lines is a justifiable cost.

Coverage Design

The cell and frequency plan is produced to ensure that the required level of radio signal is present along the railway, and to ensure that interference is minimised.

The field level is mandated by the European EIRENE specification. A link power budget is determined by reference to the transmitter power, various system losses, propagation path loss and the sensitivity of receivers. Figure 6 shows a sample link budget.

The cell plan was produced using proprietary computer modelling. This method is used in the design of many public GSM networks, and predicts radio propagation using a terrain database with some additional data to cater for the railway environment. Sample testing was done using temporary transmitters along the track, with measurements taken aboard a radio test train. This data was fed back to the model in order to calibrate it. Further verification tests were run to improve confidence in the planned coverage. Modifications to the cell plan frequently arise because compromises must be made between the most efficient radio design and local conditions.

Tunnels

There are 666 tunnels over 50m long, of which 88 are longer than 1,500m. A set of standard solutions has been developed using free space propagation in preference to radiating feeder cables. In the longer tunnels we expect to use repeater systems connected over fibre-optic cables, and shared with other users.
GSM-R ON THE WEST COAST MAIN LINE AND CHANNEL TUNNEL RAIL LINK

A GSM-R system is being implemented as part of the West Coast Route Modernisation project. As part of this an interim GSM-R system is already in operation in North Staffordshire and in Dorset. It will be integrated into the national GSM-R system, in order to extract best value from the investment already made.

The Channel Tunnel Rail Link (CTRL) project is also implementing a GSM-R system. Discussions are continuing to determine how it can become part of the national GSM-R system, since this is likely to be the most efficient outcome from economic, technical and operations perspectives.

CHANGES TO OPERATING PRACTICES

GSM-R will bring changes to operating practices. The RSSB has produced a new outline concept of operations, and two new Railway Group Standards have recently been published. The new Railway Group Standards include some new requirements arising from accident inquiry recommendations.

Work is continuing to refine the operating concept and to draft the changes that will be necessary to the rulebook.

MIGRATION STRATEGY

The current working plan is to commission the fixed GSM-R infrastructure and to bring lines into service as rolling stock fitment is completed, allowing the old radio systems to be withdrawn. There are emerging demands for earlier service, in particular to support the introduction of axle counters. This necessitates a detailed migration plan that will have to be worked up in conjunction with a detailed programme for rolling stock fitment.

MANAGING INDUSTRY INTERFACES

The structure of the railway industry means that many different parties are affected by the introduction of GSM-R. Railtrack and the Association of Train Operating Companies (ATOC) held an industry-wide seminar in January 2001. As a result the GSM-R Stakeholders Board was set up in February 2001 to ensure that all those interested in, or affected by, the system had an appropriate involvement. Various seminars and discussions have been held, including a visit to Germany to see GSM-R in use.

The Stakeholders Board

The Board includes representatives of:

- the Rail Regulator and the Strategic Rail Authority as funders;
- the Association of Train Operating Companies (ATOC);
- freight operators;
- rolling stock owners;
- the Railway Industry Association (RIA);
- RSSB;
- HM Railway Inspectorate (HMRI);
- the ERTMS programme;
- notified bodies;
- Network Rail.

The Board has been chaired by Network Rail, and has met regularly for two and a half years. To date, approximately 180 documents have been produced. Agreement to commercial terms between duty holders is necessary to enable the system to be brought into service, and with this aim a network change document was issued in December 2002. It is still under discussion.

PROGRESS TO DATE

The overall design, cell and frequency plan and initial site identification has been completed. We have contracts in place for most of the equipment and construction has recently started. The new core node building is currently being fitted out.

PROGRAMME

Following the recent interim review of expenditure a new roll out programme is being produced. At the time of writing, it is expected that NRN on the primary routes can be renewed by 2008, CSR

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Figure 5 – UIC Spectrum
by 2010 and RETB and the remaining NRN by 2012.

**OTHER TELECOMS RENEWALS**

Operational railway communication systems with known high-risk failure modes or performance impact, such as some selective telephone systems and level crossing telephone systems, are being replaced as a priority. Certain telephone concentrator systems which are obsolescent or life-expired are also being renewed.

Some work on existing radio systems is also taking place as an interim measure to maintain services until GSM-R is commissioned. CCTV systems for driver-only operation are being renewed to comply with more stringent optical standards, and some customer information systems are also being renewed.

**TELECOMS AT THE HEART OF RAILWAY SIGNALLING**

**OPEN NETWORKS AND DEDICATED LINKS**

Signalling systems have tended to use dedicated point-to-point copper links, with the notable exceptions of time-division multiplex (TDM) and remote SSI links. Dedicated links are expensive, inflexible and often have limited or no resilience against failure.

The use of open telecoms systems reduces the need for such expensive dedicated signalling links. By sharing capacity in telecoms systems the cost of the signalling data becomes marginal. The numbers of copper cores required is dramatically reduced, giving savings in installation and maintenance costs for copper cables and cable routes. Performance and reliability can also be radically improved because modern telecom networks are highly reliable, being arranged in rings to minimise single mode failure points, and with automatic re-routing around failures.

However, moving to open telecoms networks means that safety integrity must be provided by the application rather than the transport mechanism.

**BANDWIDTH**

The bandwidth requirements of signalling circuits are very low when compared with the capacity of modern telecoms networks:

- signalling remote control systems, Reed FDM

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### Table: Sample Link Budget

<table>
<thead>
<tr>
<th>Component</th>
<th>Uplink Train to Base</th>
<th>Downlink Base to Train</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Station Tx Power</td>
<td>44.8 dBM</td>
<td></td>
</tr>
<tr>
<td>Combiner loss (Duamco 2:2)</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Feeder cable loss</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Power splitter</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>BS panel antenna gain</td>
<td>17.0 dBi</td>
<td></td>
</tr>
<tr>
<td>Isolation transformer Insertion Loss</td>
<td>-0.5 dB</td>
<td></td>
</tr>
<tr>
<td>Base Station EIRP</td>
<td>52.3 dBM</td>
<td></td>
</tr>
<tr>
<td>EIRENE specified level (95%) at real antenna output</td>
<td>-98.0 dBM</td>
<td></td>
</tr>
<tr>
<td>Fading margin (95% to 50%)</td>
<td>-11.4 dB</td>
<td></td>
</tr>
<tr>
<td>Required Receive Signal Level at train antenna connector (50%)</td>
<td>-86.6 dBM</td>
<td></td>
</tr>
<tr>
<td>MS antenna gain (EIRENE)</td>
<td>0.0 dBi</td>
<td></td>
</tr>
<tr>
<td>Additional margin (rooftop and foliage)</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Required output (50%) from planning tool</td>
<td>-83.6 dB</td>
<td></td>
</tr>
<tr>
<td>Maximum Allowable Pathloss (at 4.5m and 50%)</td>
<td>135.9 dB</td>
<td></td>
</tr>
<tr>
<td>MS transmit power</td>
<td>39.0 dBM</td>
<td></td>
</tr>
<tr>
<td>MS cable loss</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>MS antenna gain (EIRENE)</td>
<td>0.0 dBi</td>
<td></td>
</tr>
<tr>
<td>Aging factor (EIRENE)</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Additional margin (rooftop and foliage)</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>MS EIRP</td>
<td>30.0 dBM</td>
<td></td>
</tr>
<tr>
<td>Fading margin (95% to 50%)</td>
<td>-11.4 dB</td>
<td></td>
</tr>
<tr>
<td>BS panel antenna gain</td>
<td>17.0 dBi</td>
<td></td>
</tr>
<tr>
<td>Isolation transformer Insertion Loss</td>
<td>-0.5 dB</td>
<td></td>
</tr>
<tr>
<td>Power splitter</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Feeder cable loss</td>
<td>-3.0 dB</td>
<td></td>
</tr>
<tr>
<td>Duplexer loss</td>
<td>-1.4 dB</td>
<td></td>
</tr>
<tr>
<td>Polar diversity gain</td>
<td>3.0 dB</td>
<td></td>
</tr>
<tr>
<td>BS sensitivity</td>
<td>-110.0 dBM</td>
<td></td>
</tr>
<tr>
<td>Maximum Allowable Pathloss (at 4.5m and 50%)</td>
<td>134.7 dB</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6 – Sample Link Budget
and TDM, dating from the 1960s, work at rates of 1200 bits per second.

- remote SSI links to LDTs work at rates of 64,000 bits per second, the same rate as used for a single voice telephone circuit.

In telecoms terms this is very small beer indeed:

- the access rings in the new telecoms network will run at STM-1, that is 155 Mbit/s (the equivalent of 1,890 telephone circuits);
- the core will run at STM-16, that is 2,488 Mbit/s (the equivalent of 30,240 telephone circuits);
- the new telecoms network can be easily expanded to STM-64, that is 9,953 Mbit/s – 9.9 Gigabits per second. This is the equivalent of 120,960 telephone circuits or 1,600 broadcast-quality TV pictures. This can be achieved bi-directionally on one fibre.

So there is plenty of space in the fixed telecoms network for error checking, security coding and any other overheads necessary to provide the safety critical controls necessary for railway signalling.

EUROPEAN TRAIN CONTROL SYSTEM

GSM-R is the bearer for the European Train Control System (ETCS), Levels 2 and 3. GSM-R is an open network, and hence the security layers need to be applied by the signalling application. Work is taking place in various teams across Europe to determine how to make ETCS work reliably over GSM-R. There are two main issues: quality of service and performance; and capacity.

QUALITY OF SERVICE AND PERFORMANCE

The GSM standard is stable and the basic quality of service (QoS) parameters are fixed for practical purposes. The signalling application must, therefore, be designed to work with them. These parameters include:

- call set-up times;
- the probability of unintentional call dropout;
- delays in data transfer;
- data interference rates;
- network registration times;
- data transfer rates;
- bit error rates, especially at cell handovers.

It would obviously be quite wrong to expect a radio link to a moving train to behave in the same way as a pair of copper wires.

SYSTEM CAPACITY

The main practical constraint on the traffic capacity of a GSM-R system is the radio spectrum. In the UK, as in Europe, we have 19 radio channels. This will allow us to provide eight traffic channels in the average cells, and 24 in the busier ones.

The current proposal for ETCS in the UK entails the use of a dedicated traffic channel for the entire journey of each train, right up to the buffer stops. This is an extremely inefficient use of the capacity, since ETCS only requires a 250 byte word every 10 seconds.

Consideration is being given to the use of the General Packet Radio Service (GPRS.) This would radically improve the efficiency in use of capacity. There are, however, a number of significant issues that need to be resolved before ETCS can be made to work over a packet switched system.

MAXIMISING THE BENEFIT

There is a major opportunity to reduce costs and improve performance. The challenge is to make as much signalling equipment as possible compatible with open systems. At least initially there will still be a need to retain local signalling cable between transmission access nodes, but all the long-haul interfaces should be designed for open bearers. As far as possible we should co-ordinate the location of key signalling and telecoms equipment, so that the system architectures of FTN, GSM-R and signalling can be aligned. In particular:

1. Future signalling circuits need to be designed to be compatible with ITU-T international telecoms standards, and with the protocols and approach set out in BS EN 50159 part 2 (2001), Railway applications – Communication, signalling and processing systems – Part 2: Safety related communication in open transmission systems.

2. Future signalling systems need to be approved for connection to (public) telephone networks.

3. ETCS must be designed to work over GSM-R as it is, with a reasonable quality of service requirement and with efficient use of the radio spectrum.

CONCLUSIONS

Railway telecoms started life at the heart of the signalling system, with the telegraph and the block instrument. Telecoms has been at the heart of railway operations ever since. In all but the last ten years the railway operator controlled this vital infrastructure.

Network Rail’s telecoms renewals present a major opportunity to improve the efficiency and performance of the railway in general and the signalling system in particular. We must not allow the inertia of slow signalling development, the historical reluctance of signalling suppliers to embrace open standards or excuses about the safety approval regime to prevent the railway industry from taking maximum advantage of the telecoms network.

In a modern, efficient railway, telecoms must be at the heart of the signalling system.

ACKNOWLEDGEMENTS

With thanks to Network Rail for permission to publish, to the telecoms engineering team for their determination and support, and to my father, for introducing me to S&T in the first place.
Discussion

The discussion was opened by C Kessell (Centuria Comm Rail) who observed that several other countries were “back-pedalling” over privatisation and wondered what the situation was in the rest of Europe. He also questioned why Network Rail believed it was essential to have complete control of bandwidth, that is cheap to acquire, and how it was economically justified in laying optical cables on branch lines and providing own GSM-R; he finally wondered if there were any plans to abolish lineside furniture.

P Jenkins advised that in Germany the whole network was sold off but has now been bought back by Deutsche Bundesbahn; in Holland the infrastructure supplier is building their own network whilst in Switzerland the private operators are in the lead. The speaker agreed that bandwidth is cheap; it doesn’t need complete control and Network Rail would consider using a third parties’ bandwidth if economical. He agreed that it was difficult to justify both the laying of optical cables on secondary lines and provision of GSM-R; on the secondary lines, the network will have more relaxed standards and lower availability whilst GSM-R will utilise public networks if lower standards can be accepted. Abolition of lineside furniture would require agreement from the relevant safety authorities and, with the provision of GSM-R, there would be a communications system available for use by all lineside workers.

K Ford (Thales) asked both for an explanation of the GSM-R migration strategy and when the first legacy system would be switched off.

P Jenkins explained that it was the intention to have the infrastructure dual-fitted, rather than the rolling stock, although discussions are taking place with the train operators. On WCML, dual mode train fitment is being undertaken with a single driver interface but this is an expensive option. He informed that Strathclyde CSR would be the first legacy system to get switched off in 2-3 years’ time.

A Jones (Thales) wondered if Network Rail had considered using duplicated point-to-point links rather than FTN.

P Jenkins advised that point-to-point microwave links were being looked at but they were not yet economical.

F Heijnen (Invensys) questioned if the infrastructure would be available if GPRS became standard and when the change request would be submitted.

P Jenkins answered by stating that the network was being built to allow for GPRS to be added later. He was unable to say when the change request was likely to be issued.

P Robins (SRA) clarified that the SRA was reassessing ERTMS roll-out, which would effectively push back GPRS implementation.

R Hurst (retired) quizzed if the electrical controls would also be taken over by the network within the next five years.

P Jenkins replied that it was the intention of FTN to fulfil this role.

D Feather (Thales) observed that a very “black” picture of the existing network was being painted and, with FTN/GSM costing £800 million, wondered if purchase of the existing SDH network had been considered.

P Jenkins agreed that the cost was very expensive but it was still uneconomic to use the existing SDH network. He also believed that, politically, purchase of the existing network was impractical.

C Porter (President) noted that signal engineers were being pressured to make use of “open” telecommunication networks but were nervous about putting high integrity data links in the hands of outside parties and asked what safeguards were in place to prevent unauthorised interference with these circuits.

P Jenkins explained that FTN is designed to be totally under Network Rail control with no external parties involved.

F Heijnen (Invensys) advised that systems with in-built layers of security are currently being developed.

C A Porter (Past President) asked what is being done to future proof the system.

P Jenkins believed that the systems are as future proof as possible; the major part of the cost is in the route and cable works. Transmission equipment has been designed for technology refresh whilst a solid European customer base will develop for GSM-R and standard telecomm components will undoubtedly evolve over time.

P Bartholomew (Mott MacDonald) questioned to what extent other aspects of railway engineering controls are to be integrated into FTN.

P Jenkins indicated that opportunities exist to combine with all types of railway control systems although initially only telecomm components will be integrated.

P Halliwell (Network Rail) wondered if there was either any likelihood of telecommunications maintenance being carried out in-house, in line with Network Rail’s decision to undertake all of its own signalling maintenance, or sell off any spare capacity within the new network for outside parties to use.

P Jenkins responded by stating that no decision had yet been made about the future of maintenance resources and it was not the intention to sell-off any of the network.

A C Howker (Past President) asked why the industry continues to use troughing routes and doesn’t use either ducting or buried routes.

P Jenkins replied that buried routes were expensive but they were investigating the use of surface ducting pinned to the ground.

An unknown speaker wanted to know if Network Rail would mandate the use of GSM-R for
P Jenkins advised that this was likely to happen; trackside staff would then be easily able to contact the correct signal-box.

R Cooper (Carillion) questioned the decision to defer TEMC2003 at this stage.

P Jenkins explained that the strategy is being revised following the decision to bring (other disciplines) maintenance in-house.

L Giles (Rail Radio Solutions) asked if there was a possibility of using public networks on rural lines, taking into account the history of the Digital Advanced Radio for Trains (DART) project.

P Jenkins replied that it was unlikely although the economics mean the possibility has to be considered.

K Moxsom (Thales) requested an expansion on the technical and management control of train mobile implementation.

P Jenkins explained that the detail has still to be determined with ATOC, ROSCOs and TOCs; funding through Network Rail has only recently been agreed.

C Porter (President) observed that there are a considerable number of legacy systems in use today such as TDM, block circuits, electrification etc, and questioned if it was really the intention to transfer completely into the new network or “mix and match” with the existing.

P Jenkins informed that it would probably be “mix and match” as the existing network in some areas does not need renewing. He noted that migration is a difficult task, especially record updates.

I Findlay (First Engineering) wondered who would be maintaining all of the high-technology equipment that is being installed.

P Jenkins replied that this has not yet been decided.

R Smith (retired) remarked that the discussion recalled to mind the 1980’s report “Transmission of Safety Information” which set out the principles for the use of open-systems and package switched networks that are still valid today.

P Jenkins agreed that the specifications have been around for a long time.

D McKeown (Independent Consultant) questioned the speaker’s thoughts on his vision for the future when the network is in place and what strategy is in place to achieve this. He was also interested in knowing about the cost issue of cables radiating from Nodes and the necessity for UK specific GSM-R requirements.

P Jenkins speculated that it would be nice to see more signalling circuits routed through a properly set up, resilient, SDH network with a lot less lineside cabling and to achieve this, telecomms need to play a bigger role in the overall strategy for signalling renewals. He also advised that cable distribution is based on Nodes and is a trade-off between all factors at that particular site.

Finally he stated that special facilities are required in GSM-R as there is no common set of operating rules or specific features such as “Train Waiting at Signal”.

S Goodland (Network Rail) wondered how on-call engineers would be called out if GSM-R were the only radio medium for operational telecommunications. He also raised the issue of recovering SPTs and asked if platform located emergency telephones on the Southern Region would be included.

P Jenkins informed that there would be an agreement with public operators so that on-call engineers would still be in radio contact even when out of railway coverage. He also reiterated that there were no plans in place to recover any lineside phones until GSM-R was firmly established.

L Allen (Alcatel) questioned what would were the plans for the voice network in 2005; would the returned equipment be re-used.

P Jenkins replied that whilst most equipment is to be returned, there were no firm plans at the present time for equipment such as the ETD network that is reliant on Global Crossing-owned components.

C Porter (IRSE President) thanked the speaker at the end of the evening for his paper and his contributions to the subsequent interesting and lively discussion.
INTRODUCTION

The introduction of Siemens signalling into the UK was largely driven by the objective on the part of the customer (that is, Railtrack) at the time to bring additional signalling suppliers into the UK market. Siemens, already a global player in the field, was clearly seen by the customer to be an obvious target for introduction. In this way competition would be increased, so that costs would be driven down. In addition, Railtrack held the view that the then standard practice in the UK needed to be challenged. There were efficiencies to be gained, and the introduction of non-UK suppliers, with tried and tested solutions, was seen as the means of achieving these objectives.

From Siemens’s perspective, privatisation offered an open door into the UK market – a market that had, in BR days, been very much a closed shop to them. For the same reason, Siemens were also poorly represented in those parts of the world that use UK signalling practice. Access to the UK market was therefore seen as a gateway to other global markets.

So it was that in 1998 the Dorset Coast project, one of three partnership projects, was chosen as a suitable vehicle for the introduction of Siemens technology into the UK. On Monday 15th December 2003 the scheme was successfully commissioned.

EARLY AGREEMENTS

It has to be stated at the outset that this project could not have been delivered successfully by conventional means. The customer did not know in any detail what benefits the Siemens products could bring, and Siemens did not have a clear understanding of what the UK would require of them. Fortunately the senior decision-makers in both organisations believed that both parties would gain substantial benefit from working in close partnership. Solving problems together and sharing knowledge without blame was recognised to be the best way for all. Hence a Joint Project Team (JPT) without man-for-man marking was formed.

Initially, the JPT was based in Siemens’s office in Braunschweig, Germany.

COMMON OBJECTIVES

A joint Railtrack/Siemens senior-level partnering workshop was held in Berlin, and the following high level common objectives were agreed:

• to deliver the Dorset Coast Resignalling (DCR) scheme;
• to bring Siemens into the UK signalling market;
• to use Siemens’s standard products with minimum change;
• to challenge UK standards;
• to gain UK product approvals.

In order to support these objectives, the following companies were selected to join the partnership:

• Atkins (testing, product approval support, and power supply design);
• Interserve (installation).

The four companies (Railtrack, Siemens, Atkins and Interserve) formed the Dorset Coast Resignalling Alliance.

In addition, Mott MacDonald was sub-contracted, to provide civils design and fringework and stage-work design.
A number of further partnering workshops took place. These helped to establish the required best-for-project culture, as well as ensuring that all parties understood the scheme objectives fully and bought into them.

Lloyd’s-MHA undertook the role of Independent Safety Assessor (ISA).

THE SCHEME

The scheme covers approximately 16 route miles of railway, from Parkstone in the west to Hinton Admiral in the east. The headline statistics are:

<table>
<thead>
<tr>
<th>Main signals</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point ends</td>
<td>32</td>
</tr>
<tr>
<td>Axle counter sections</td>
<td>83 (using 98 heads)</td>
</tr>
<tr>
<td>Maximum line speed</td>
<td>90 mph</td>
</tr>
<tr>
<td>Electrification</td>
<td>750V dc third rail</td>
</tr>
<tr>
<td>Existing signal-boxes</td>
<td>2</td>
</tr>
<tr>
<td>Number of routes</td>
<td>69</td>
</tr>
</tbody>
</table>

The core scope of the scheme was:
- replacement of life-expired signalling equipment;
- new control centre at Bournemouth station (east end);
- new fringes at Poole and Brockenhurst;
- upgrade of operational telecommunications;
- recovery of redundant equipment.

SYSTEM CONFIGURATION

The system configuration for the DCR is shown in Figure 1.

The following Siemens products were selected for this scheme:

<table>
<thead>
<tr>
<th>Interlocking</th>
<th>SIMIS-W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control &amp; Information</td>
<td>VICOS (OC 111)</td>
</tr>
<tr>
<td>Train Detection</td>
<td>AzSM(E) Axle Counter</td>
</tr>
<tr>
<td>Point Machine</td>
<td>S700V</td>
</tr>
<tr>
<td>Interfaces</td>
<td>see below</td>
</tr>
</tbody>
</table>

THE SIMIS-W INTERLOCKING

SIMIS-W is a computer-based interlocking using type 486 microprocessors. The “W” denotes that it was developed as a “World” product, specifically structured to enable it to be configured for application in any country, that is to suit any operational rule set. It is a centralised system and uses a two-out-of-three hardware configuration. Furthermore, it is based on the geographical data principle.

Other features are:
- containerised construction (factory assembled and pre-tested);
- control and monitoring of up to 800 elements (point ends, signals, axle counter sections etc);
- direct driving of elements at distances of up to 6.5km (that is, containers can be spaced at 13km intervals);
- compliance with CENELEC standards;
- approval by the Eisenbahn Bundesamt (EBA);
- application design tools:
  - GRACE (for operating and signalling rules);
  - SICOSS-W (for data preparation and hardware configuration);
- layered software, with the following layers:
  - system – including “COSPAS”, a real-time, multi-tasking operating system providing hardware drivers, timers, interrupt, on-line tests and restart;
  - basic – including communications protocols, software updating, safety functions, system specific logic, data preparation interface for layout changes, field elements interface;
  - logic and operating and display (operator interface logic);
  - user specific – operating and signalling rules;
  - application configuration – geographical data.

The software architecture is illustrated in Figure 2.

CONTROLS AND INDICATIONS

SIMIS-W control and indication connections, to outdoor elements such as points and signals, are achieved via area control components (ACCs). Every ACC contains the complete UK rules set, and hence all ACCs are identical.

The ACC is connected to the outside world via element operating modules (EOMs). Each ACC can manage approximately 75 elements. As a general rule, outdoor elements can be positioned up to 6.5km from the container (that is, from their EOM).

There are several types of EOM – POM, SOM, UNOM and INOM. The type selected is determined by the local environment. The general specifications are as follows.

Points Operating Module (POM)

Connections to point machines:
- enables both controls and indications;
- suitable for operating four-wire, three-phase machines;
- feed at 380V ac, three-phase;
- detection at 60V dc;
- one POM connects to one PAM (point adaption module).

Signal Operating Module (SOM)

Connections to signals:
- controls and monitors up to eight signal lamp circuits.

Operating Modules UNOM and INOM

Connections to peripheral equipment such as fringe location circuits, TPWS, AWS etc.

THE VICOS (OC 111)

VICOS is a range of VDU-based train control products that covers the range from “small” to full management centre applications. The OC111 was selected as being the most suitable for the operational needs of the Bournemouth Control Centre.

The “111” uses PC-based hardware and a
Figure 1 – System Configuration for the Dorset Coast Resignalling
Figure 2 – SIMIS-W Software Architecture
Windows NT operating system. A train describer is integral to the system. A unique feature of the VICOS is “Safe View”. This enables the operator (signaller) to be confident that the VDU display reflects the current state of the railway accurately, and that he/she can rely on the indications being presented.

Other features are:
- high integrity commands (protected by procedure);
- Visual C++ application software modules;
- compliance with CENELEC standards;
- EBA approval.

THE AzSm(E) AXLE COUNTER
The AzSm is an axle counter product that is designed for multi-section application. The AzSm(E) is utilised on the Dorset Coast project, as it has a direct communications interface with the interlocking bus. The AzSm(R) is a stand-alone version.

The AzSm(E) also has the following features:
- up to 16 detectors per evaluator;
- up to 32 detection sections per evaluator;
- train speeds up to 350 km/hr (220mph);
- up to 6.5km between counting heads and interlocking;
- SIMIS (2-out-of-3) principle;
- application design tool (SICOSS-W);
- compliance with CENELEC standards;
- EBA approval.

THE S700 POINT MACHINE
The S700 was identified initially as a product that would be included in the Dorset Coast project. However, it was realised at an early stage that UK permanent way standards were historically significantly different from those of mainland Europe, and the project specifically excluded bringing the switch and crossing work up to contemporary standards. It was, therefore, decided that the S700 was not suitable for the Dorset Coast project, and hence the ALSTOM type HW1000 point machine was used. The latter machine was selected because it compares most closely with the point machines that usually interface with a SIMIS interlocking, so that the adaptation requirements were simpler than alternative options.

The S700 remains a potential product for the UK market when and where UIC switches are installed (particularly 60kg/m).

INTERFACES
The adoption of the type HW1000 point machine necessitated the provision of an interface between it and the interlocking. Furthermore, as other indigenous products were required to be utilised (TPWS, AWS and main line signals) a number of other UK-specific interface products had to be developed.

The principal interface units are as follows.

The PAM
This unit converts the type HW point machine to suit the SIMIS-W and, likewise, converts the SIMIS-W to suit the type HW machine. Hence the PAM obviates the need for either the SIMIS-W or the point machine to be re-engineered or modified specially.

The PAM’s principal features are:
- ability to drive both type HW 1000 point machines and clamp locks;
- four-wire control and detection to/from the point machine;
- compatibility with up to two supplementary detection units;
- integral earth leakage detection on point machine cables;
- ability to operate point machines at up to 200m from the PAM;
- location up to 6.5km from the interlocking container;
- operation in conjunction with POM card in the interlocking container.

This unit is sited at the lineside.

The Signal Switching Box (SSB)
This unit is used to interface the SIMIS-W interlocking to signals – primarily in order to enable filament changeover.

The SSB’s principal features are:
- ability to operate UK mainline signals and associated junction indicators or route indicators;
- main/auxiliary filament switching;
- inclusion of signal TPWS control;
- location up to 6.5km from the interlocking container;
- operation in conjunction with SOM card in the interlocking container.

This unit is sited at the lineside.

POWER SUPPLIES
Dedicated sub-stations have been provided at Bournemouth and Hinton Admiral. These are fed from Network Rail’s high voltage (33kV) traction supply, with two independent sources, and from Southern Electric, the regional electricity company. This ensures a highly available supply. This is used to power the uninterruptible power supplies (UPSs) for the interlocking and the telecommunications, as well as domestic equipment such as lighting and air conditioning (see Figure 3).

In the event of a supply failure, the interlocking UPS will feed all loads, including trackside elements, for a minimum of ten minutes. This is sufficient time to allow for a changeover to an alternative supply. This arrangement virtually guarantees continuous supply.

Existing CSR and telecommunications UPSs are retained. These supplies provide for a minimum of 12 hours of cover. Thus the telecommunications power supplies are independent of the signalling UPS.

PROJECT PROCESS
The DCR project was progressed in two distinct work packages – “One-Off” and “Regular”. This
Figure 3 – Power Supply Arrangement
enabled the parties to focus on the two key deliverables: getting the products approved for UK use; and application of the chosen products to the specific scheme.

**ONE-OFF**

This work package included the activities associated with adaptation of the products to the needs of the UK market, as well as the associated approval activities.

As already stated, the software structure includes a “layer” for signalling rules, this being the definition of the UK operational requirements. Approximately 80% of the identified rules have been included in the delivered system, though many of them are not required for the Dorset Coast scheme itself. The Siemens interlocking rules development process is supported by a complete tool-set that enables the specification, development, production and verification of software and target code. Determination of the UK rules was by far the most significant element of the product application development. However, as this involved work that was essentially generic, subsequent UK projects will benefit from it – further development work will only be needed when and where special cases are encountered, or when new rules are introduced.

The approvals process is discussed below.

**REGULAR**

This work package included all the activities associated with the particular topographical application of the products, that is the Dorset Coast requirements. Hence these activities (engineering production) will be repeated on subsequent projects. Of course, this project being the first UK application of the SIMIS technology, much of the Regular engineering was dependent upon progress with the One-Off activities. For example, rules and principles had to be verified before the topographical data could be produced.

**PRODUCT APPROVALS**

Reference has already been made to the objective of challenging UK standards. In the main this objective applied where existing standards (more specifically, embedded specifications derived from other products or technologies) were judged to be inappropriate for the Siemens technology. The approvals process, in contrast, is technology independent. This is not to say that there is no need for further challenges to the current UK standards, simply that changes need to be determined by the benefits that can be gained from them.

The approvals process is thorough, but it is not flawed. Our approach, therefore, was to be active in satisfying the requirements of the process laid down – in large part, demonstrably to support the process. This enabled us to win client support – including the tacit support of the various approval bodies.

All the products for which approval was sought and gained were previously approved by EBA, the approval body for Deutsche Bahn (DB), and were developed to, or were compliant with, CENELEC standards. Hence a strategy of cross-acceptance was adopted. The key process standards followed were:

- RT/LS/P/029, Product Acceptance;
- Engineering Safety Management System (to CENELEC);
- Yellow Book.

The methodology used was to produce Product and System Safety Plans, and to have them endorsed at the outset by the Safety Review Panel (SRP). This then led to the following approvals being gained:

- general (that is, for the UK market);
- application-specific (that is, for the DCR);
- and eventually generic approval (as further evidence is gathered).

Although it would be an exaggeration to claim that we found the process to be problem-free, given the complexity of the task and the many bodies involved, a successful outcome was achieved. Perhaps the most difficult aspect of gaining approval was with regards to the understanding and acceptance of the cross-acceptance baseline. As the baseline is, in essence, a result of the engineering process of product development, it does not relate to operational application. Hence the determination of the delta was difficult.

Approvals will always be one of the final ticks before any installation is commissioned, and the interaction between the approvals team(s) and the engineering production team(s) is critical for success. Hence a close working relationship, and a clear understanding of the needs of each, is essential – together, of course, with a close working relationship with the client and associated approval bodies.

**STANDARDS CHALLENGES**

In the main, challenges were progressed on the principle of “equivalence of result/outcome”. Many of the UK’s existing standards and practices are product-dependent. Challenges were made where the Siemens technology offered other means to achieve the same outcome. In some cases they were made as a result of facilities inherent in the technology which were determined to be an improvement over current requirements. Generally, challenges were evaluated by consideration of the risks, both to the delivery of the system and to the intended commissioning date. Challenges must offer the customer something better than, or at least equivalent to, what he/she already has. Examples of the challenges are the following.

**FLANK PROTECTION**

This is accomplished within the aspect process. Hence a route can be set (no proceed aspect) without the flank being locked. This permits the interlocking to select the most appropriate flank protection, and hence enables substitutional flank protection to be provided. This means, for example, that a point failure in the primary flank protection would initiate a search for alternative (that is,
substitutional) flank protection. If such an alternative is available, then the signal would be permitted to clear to a proceed aspect.

**AWS ECONOMISING**

Many automatic signals display a green aspect normally, so that the associated AWS magnet is energised almost continuously. The SIMIS-W energises the magnet only when an approaching train is detected. Note that although this is not a UK-wide standard, it is standard practice on the Southern Region.

**AXLE COUNTER RESET**

This is accomplished by procedural means, by the signaller alone. On wishing to normalise an axle counter section that has failed or has been left in the occupied state, the signaller carries out the following procedure.

1. The first step is for the signaller to apply a Track Block command to the affected axle counter. This cannot be removed until the restoration procedure has been completed. The track block prevents any routes from being set over the failed axle counter section, and holds automatic signals at red.

2. Then, once the signaller is assured that the axle counter section is clear, he/she applies the Permit Restore (or “Perm Res”) command.

3. Finally the Restore command is used, to reset the axle counter section to the “clear” (that is, not occupied) state. When the signaller applies the Restore command, the axle counter will reset to a zero count only if the conditions for reset are valid (the last count was an “out” count, failure of the axle-counter head has not been detected, etc). Each restoration is uniquely numbered and must be documented on the Axle Counter Reset Restore Form.

4. Once the signaller has reset the axle counter section, the procedure then requires him/her to send another train through the section under caution. This is achieved by the signaller issuing a Track Block Override, then setting the route and authorising the first train to pass the relevant protecting signal. The signal will be restricted to red by the interlocking.

The reset/restore procedure has been developed in compliance with Network Rail’s Concept Safety Case for axle counters and with GE/RT8217. The procedure has been subjected to detailed human factors analysis and to scenario-based failure modes and effects analysis.

**ENHANCED ROUTE RELEASING**

In the event of a wrong-side failure of a track circuit under a train, the route locking will hold if the correct sequencing of operation is lost, so ensuring that route locking cannot be released if a track circuit wrong-side failure occurs. Clearly this feature is important in areas fitted with axle counters rather than track circuits.

**STEPPING DOWN OF ASPECTS**

A blank (dark) signal will automatically revert to a lower, lit, aspect. Hence, a failed green aspect will be stepped down to double yellow.

**LESSONS LEARNED AND RECOMMENDATIONS**

One of the key objectives for Railtrack and Siemens was to introduce products with minimal change. This objective was determined as being of benefit to both Siemens and the customer. The reasoning behind this is that Siemens have a corporate “global product” philosophy – not only in the transportation business. We prefer not to have to introduce unique products for unique markets. Similarly, the customer wants the cost advantages of being able to purchase global products – a “win/win” situation. Nevertheless all situations have their own unique circumstances to be addressed, and so some degree of engineering application is inevitable.

- Careful optimisation of technical solutions is necessary, to minimise adaptation, but ensure the solution is the best fit.
- A systems engineering approach is essential. A clear understanding of the customer’s requirements can only be achieved robustly if they are fully defined (and agreed, and understood) at the outset.
- Culture affects the process! And it creates expectations and misunderstanding. Do not underestimate its importance. Not only nations, but companies, disciplines and geography. The UK process for undertaking signalling projects is highly structured in parts (such as prescriptive design, installation and testing standards) but not in others (such as overall logic requirement definition and tracing). The UK approach is not universal, and this creates difficulties when unfamiliar parties are introduced to the UK. For example, the German culture places much more reliance on the expertise of the individual – both engineer and operator.
- Standards – many standards are not stated formally. There is a need in the UK, for example, to state the operational rules, and also to simplify them and state which apply in a specific application.
- The current testing process is generic – and hence is a “catch-all” which is inappropriate for many technologies. Testing (more accurately, validation) requirements are best determined by the system designer. For the DCR the existing UK process was generally adhered to, as we were all learning and all parties needed to gain confidence in the new system. However, that will not be the case on future UK projects.
- The current testing process encourages testing personnel to undertake installation checking work. There is a need for clear separation between quality assurance and testing.
- Control tables. The current standard is generic (free-wired). This enforces requirements that do not apply to many technologies.
- The approval process is NOT the problem. Knowing the end game is! Product approval is made more difficult than it needs to be because
the deliverables are not well defined. The product approval process needs to have a clearly-defined “end game”. All parties in the industry would benefit if the customer, working with the suppliers, could define the outputs that would enable the final “tick in the box”.

- Work with the process, not against it!
- The design process (control tables etc), and the associated testing process need to be product orientated.
- An integrated, best-for-project culture is essential. In particular, approvals teams and engineering teams need a close working relationship, in order to ensure common understanding of what is required.
- Product Safety Plans – have them approved by the Approval body (or bodies) – and work to plans that you have agreed!
- Cross Acceptance. There is a need in the UK to improve the definition of the “baseline”. This will aid all future approval proposals.

FUTURE PLANS

The Dorset Coast project has provided the necessary approvals for the fundamental products that Siemens aspired to introduce into the UK market. However, further products (and adaptation of products) will be introduced as, and when, suitable opportunities arise.

SIMIS-W

Most of the portfolio of the UK operational rules set (about 80%) has been built in to the DCR solution; the final 20% will be implemented wherever they are required.

AXLE COUNTERS

The stand-alone version will be approved.

SIGNAL HEADS

The SSB interface will be eliminated.

POINT MACHINES

The PAM interface will be simplified, and perhaps eliminated.

LEVEL CROSSINGS (SIMIS-LC)

A level-crossing controller driven directly from the interlocking will be introduced.

VICOS

Other products in the range will be approved as opportunities arise.

REVIEW

The successful commissioning into service of the system, on Monday 15th December 2003, demonstrated completion of a major milestone toward achieving the original strategic goals of both Siemens and Network Rail.

Did the DCR scheme achieve its agreed objectives, as stated earlier?

- Deliver the DCR scheme
  **Achieved** – with some good lessons on the way
- Bring Siemens into the UK signalling market
  **Achieved** – with follow-on projects in place
- Use Siemens’s standard products, with minimum change
  **Achieved** – though some adaptation has been necessary
- Challenge UK standards
  **Achieved** – with more improvements anticipated
- Gain UK product approvals
  **Achieved** – with more products to come!

ACKNOWLEDGEMENTS

The author wishes to record his thanks and appreciation to:

- Kevin Tutton (Managing Director of Siemens Transportation Systems);
- John Newton (General Manager of Signalling, Siemens Transportation Systems).
The discussion was opened by J Francis (Westinghouse Rail Systems) who initially asked if the interlocking containers could be made to blend in with their surroundings. He also asked if the objective of driving down costs had been achieved, how Siemens had felt in challenging UK standards and questioned if the bespoke interface, that had been developed to allow SIMIS-W to be utilised in a 3rd rail electrified area, would require modification to allow application in areas electrified at 25kV. He noted that a number of industry players assisted Siemens in delivery of the project and questioned if a similar strategy would be used for further SIMIS installations; finally he wondered if the speaker believed that the UK signalling market could support six major suppliers.

M Stubbs advised that the containers could be produced in any format. He advised that costs had still to be driven down, challenging of standards was a matter of principle and confirmed that the interface was limited to the equipment in use. He also confirmed that Siemens intended to build up their own capabilities and that it would be a struggle for the six suppliers to be supported by the stop/start UK signalling market.

A Howker (Past President) noted that the PAM could drive clamp locks and HW point machines and wondered if any other sort of point machine could be driven. He also asked how TPWS was driven, where the application design was undertaken and raised concerns with interference affecting the cabling radiating from central processors. He finally questioned if SIMIS-W could interface directly with in-built track circuit equipment and how the signalers actually ensured the line was clear under axle counter failure condition.

M Stubbs was unaware if SIMIS-W could drive any other type of point operating mechanism, he advised that TPWS is driven externally from the signal switching box and confirmed that the application design was essentially done in Germany with UK engineer’s involvement. He did not believe that there would be any interference issues; the interlocking is already in use on 25kV-electrified lines abroad. Confirmation was given that SIMIS-W can interface directly with Siemens track circuit equipment, although there are no track circuits on this scheme, whilst confirmation of state of line under axle counter failure is achieved in the same manner as for conventional track circuit failure conditions.

N Ivanov (Invensys) questioned if a direct connection to ATP was provided and the time taken to replace signals to danger under emergency conditions.

M Stubbs believed that a connection existed to ATP; he was unaware of signal replacement times.

C Bellett (Amey) highlighted some of the benefits to the maintainer including a technician’s terminal that could both lead technicians through failure scenarios and fault-finding processes.

C Porter (President) questioned the maintenance

Discussion

facilities and training provision.

M Stubbs informed that the scheme has been handed back to the maintainer who had assisted in the installation process and been trained on-site.

P Hingley (Lloyd’s Register Rail) wondered what control measures had been put in place to protect staff from the high voltages present in the interface modules.

M Stubbs advised that standard precautionary procedures are in place reinforced by training.

D Weedon (Amec Spie) asked if use of higher voltages had prevented an exemption been given against installation in accordance with IEE Wiring Regulations.

M Stubbs believed that an exemption had been granted.

J Batts (retired) also questioned the economics of providing more cabling rather than less lineside equipment.

M Stubbs explained that all factors have to be taken into account including safety, accessibility, equipment and testing costs.

P Bartholomew (Mott MacDonald) highlighted the necessity for clear project requirements and asked how long it took the project to achieve this.

M Stubbs agreed that an understanding evolved as the project progressed and the requirements were realised; he believed that the UK standards need to be clearly defined.

C Porter (President) asked what the major differences were between the German and UK interlocking principles.

M Stubbs advised that complexity and compression of the layout together with swinging overlaps.

P Vandermark (ex-driver) enquired if use of axle counters applied any restrictions on the type of rolling stock allowed.

M Stubbs relied there were no rolling stock restrictions.

C Bellett further explained that the axle counter test site had been at Paddock Wood and HMRI approval for their use had been given.

R Wyatt (Independent Consultant) wondered if the use of a CPU with the axle counters enabled logic application to correct system failures and glitches.

A Stringer (Lloyd’s Register Rail) confirmed that this was the case.

D McKeown (Independent Consultant) questioned how undertaking alterations compared to other CBIs, which situations the SIMIS was most economically suited to and questioned the basis for challenging the standards.

M Stubbs replied that alterations depended on scale of change but operation is efficient compared to other CBIs. SIMIS is most economical in complex areas where there is a concentration of equipment. Standards were only challenged either where the
technology offered an alternative method of achieving something or provided an additional facility.

A Salisbury (Thales) enquired if there was sufficient evidence yet to show that axle counters were more reliable and if it was easier to recover from failure conditions than with conventional track circuits.

M Stubbs believed evidence showed they were more reliable and therefore failure situations do not occur in the first place. He couldn’t see any difference in actual recovery.

J Poré (Alstom) wanted to know if any attempt had been made to bring European rules into the UK and also questioned perceived reliability of axle counters.

M Stubbs advised that no attempt was made to bring continental practice into UK. The speaker still believed the performance of axle counters was better with the evidence proving this to be the case.

C Porter (President) enquired of the speaker what lessons had been learnt from this project that would be applied in further schemes and how interpretation of standards in different parts of the UK would be approached.

M Stubbs believed the learning process was about the process of production and only difference for future schemes would be resources. He believed that resolution of standards interpretation was necessary and would bring benefits to all parties.

P Humphries (Lloyd’s Register Rail) wondered if, rather than having developed the PAM to interface with the standard HW point machine, it would have been possible to use the 3-phase HW point machine. He was also interested in knowing if, in the data preparation, the system could generate “free-wire” data or whether rules had to be written.

M Stubbs informed that the 3-phase point machine could have been utilised but the information was not available at the time. He further advised that the data preparation relied on writing rules; although this doesn’t always have to be the case, it is often easier.

D Weedon (Amec Spie) questioned if Siemens had been contractually obliged to provide facilities to allow other companies to undertake alterations to SIMIS and asked the speaker to comment on any problems that had manifested themselves to date.

M Stubbs replied that they were not obliged to provide facilities for alterations. He was aware of some axle counter mis-counts on terminating trains, possibly as a result of “roll-back”, and also as a result of cable problems.

At the end of the evening, C Porter (President) thanked M Stubbs for presenting his paper and taking part in the subsequent discussion.

Some technical questions were asked and responded to in email correspondence following the presentation of the paper and these are also included for completeness.

R Barnard (Alstom) noted that the Dorset Coast has equipment at a remote site connected by duplicated optical fibre links in the interlocking bus. What protocol and data rate are used on the optical fibre links and Interlocking Bus itself.

M Stubbs advised that the protocol in both is proprietary and is transmitted over a closed network. The data rate, if copper is used, is approx 10 Mbyte/sec, however, when fibre is used the data rate is much faster.

B Chohan (Thales) asked what are the physical and electrical characteristics (including constraints) of the equipment interfaces to which the bus is connected, what speed and protocol does the interface bus run at and what propagation delays on the interface bus are acceptable to the end equipment. He also questioned what standards, if any, are followed.

M Stubbs replied that there is no “interface bus”, as such, however, we do have a Profibus and an interlocking bus, of which the dark fibre transmission between containers is an extension. The bus system runs at approx 10 Mbyte/sec if copper is used; the interlocking bus protocol is proprietary. The System has been designed and developed to CENELEC standards.

A James (Ansaldo) asked about flank protection and the example that had been illustrated during the presentation; with 101 points in the route, 102 points at the other end of the crossover and 103 points further down the line, when will 103 be called reverse. Is it at time of route setting, ie if 102 are locked reverse (for instance on the 'keyswitch') or is it after 102 called normal but unable to make normal detection (preventing the signal to clear) or is 103 called (if available) by 102 not initially making normal detection. He also noted that the relevant standards state that operation of the emergency signal on control (ESOC) shall not rely on the correct functioning of hardware, software or data within the central interlocking or the control centre and wondered if Siemens successfully challenged this standard.

M Stubbs replied that 103 will only become an “alternative” flank if 102 is detected and locked reverse, ie 103 is NOT an option (alternative) if 102 is out-of-correspondence. This sequence of events will be initiated at route set. The aspect will only clear when the necessary flank protection has been put in place. He confirmed that the standard for ESOC was challenged; the system incorporates both ESOC and SGRC. The benefit with SIMIS application of ESOC is that the system maintains a log of what happens after the ESOC has been initiated.
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Railways in Ireland can be traced back to 1834 with the opening of the Dublin Westland Row to Kingstown line. One hundred and fifty years later, in 1984, Dublin Pearse to DunLaoghaire was reinvigorated as the central portion of the 1500 volt dc electrified Dublin Area Rapid Transit (DART) network. This was visited by the IRSE during the annual Summer Convention of that year. Now, another 20 years on, the same piece of railway is, along with the rest of the DART network, being upgraded to accommodate eight-car trains in what has been called the DASH Project. Phase 2 of this project will, when approved, see signalling alterations in the central area to permit closer headway operations. The net effect at the end of Phase 2 will be a 70% increase in track capacity through the Dublin suburban central core.

HISTORY

That short introduction spans a considerable history, some of it deserving of more revelation. The original Dublin to Kingstown line was laid at the standard gauge of 4ft 8½ins, but it was not long before Ireland adopted a broad gauge of 5ft 3ins, which has been retained to this day and probably saved us from a legacy of pre-owned rolling stock in the cash-starved 1950s, 60s and 70s. Contrary to popular belief, the DART was not the first electrified railway in Ireland, as there was a railway in Bushmills, County Antrim, which used hydroelectric power as early as the 1880s.

An earlier interesting experiment was conducted when an extension southwards from Kingstown was opened as an atmospheric railway in 1844. This was based on developments by Charles Vignoles which were subsequently also applied in Devon, England. Traction vehicles on this piece of railway were equipped with a piston below the car body, which fitted into a pipe laid centrally between the rails. The slot, which was required along the top of the pipe to accommodate the securing arm between vehicle and piston, was covered by a weighted leather flap. When this flap was in place it was possible, using a large steam-driven pump at Dalkey, to create a vacuum in the pipe ahead of the piston and the attached train. Releasing the brakes resulted in the train being, literally, sucked the three kilometres up the hill to Dalkey. Gravity was relied upon for the return journey to Kingstown. It is alleged that the conditions of ticket issue (i.e. the “small print”) required that, in the event of insufficient vacuum or, strictly speaking, atmospheric pressure, first-class passengers could remain in the train, second-class could get out and walk, whilst third-class passengers were expected to push the train (and the first-class passengers) to the summit. This method of operation was short lived, and the line was converted to conventional operation within ten years and extended further down the east coast.

Signalling, and other railway features, were developed in line with conventional UK practice. The explanation is in that introductory paragraph. Kingstown is now named DunLaoghaire, and Westland Row station was renamed Pearse in 1966 on the fiftieth anniversary of the Easter 1916 uprising. That event culminated in the creation of the Irish Free State as a nation independent of the British Empire, but Ireland’s railways were virtually complete by then, and they had been engineered to British standards.
Semaphore signalling was predominantly lower quadrant, but exceptions did exist, such as the use of somersault semaphore signals on the LMS-NCC route to the north-west of Belfast. Although double track routes were developed, and still exist along a central spine between Bangor–Belfast–Dublin–Cork and Cobh, the predominantly rural nature of the country means that Ireland has had extensive experience in operating single lines with passing loops. In the south of the country, single line block control has predominantly been by means of electric train staff. Originally, large Webb & Thomson staffs and instruments were employed, but, over time, these were all replaced by Railway Signal Company miniature train staffs. Tablet instruments tended to be employed on the northern lines.

Ireland made an unfortunate, but significant, contribution to British railway safety on 12th June 1889, when 80 people died in a collision near Armagh. This was the final event which provoked the passing of the Regulation of Railways Act in 1889. That Act required the adoption of block control on all public passenger railways, the provision of interlocking between points and signals, and the use of continuous automatic brakes on all passenger trains. These requirements, summarised as “Lock, Block and Brake”, are still the foundations of railway safety engineering the world over.

The events of 1916, and the subsequent Civil War, which stretched into the 1920s, had another impact on the railways. At that time, railways were in the enviable position of being regarded as a premier strategic target for civil disruption, similar to the role now filled by airlines and airports. As a result, many Irish signal cabins were destroyed, as well as bridges, with the effect that much of our infrastructure now dates from the 1920s.

**EARLY POWER SIGNALLING INNOVATIONS**

During the late 1920s and 1930s innovation was evident in Irish railway signalling. Much of this was thanks to John Hedley Nicholson. Having joined the North-Eastern Railway, in Britain, at Newcastle Upon Tyne in 1889, Nicholson was responsible for the installation of a large amount of electropneumatic signalling on Tyneside. He joined the Great Southern & Western Railway in Ireland in 1909 as Signal Superintendent, and became the Signal & Telegraph Engineer of the Great Southern Railway upon its formation from the GSWR and other railways in January 1925. In these roles, he was responsible for the introduction of the Nicholson and Roberts hand-generator system, used for the remote control of points at Charleville in 1924 and subsequently at other locations. One such installation remains in service at the approaches to Sligo.

Nicholson was also the driving force, in the 1930s, behind the quite radical introduction of power signalling using full track circuiting, searchlight signals and electric point machines, all controlled from miniature lever frame mechanical interlockings of Irish manufacture. These were introduced at Amiens Street (now Connolly) in 1934, Westland Row in 1935 and Kingsbridge (now Heuston) in 1938. The former cabins were closed as part of the DART project in the early 1980s, but the Heuston installation, which appears, from photographic evidence, to have been the subject of an early IRSE visit, was only closed in September 2002, having given 64 years’ service. Its replacement is discussed later in this paper, as are some of the measures taken to support its ongoing integrity.

In order to reduce payments to mechanical locking frame manufacturers, which were charged on a per-lever basis, there was extensive use of economical (“Eco”) facing point locks. In this arrangement, a single lever is used to operate both the facing point lock plunger and the point blade movement. By employing an escapement mechanism at the points, the initial lever movement is used to withdraw one lock dog from the lock stretcher. Further movement of the lever throws the points, whilst the final lever movement engages the other lock dog in the stretcher.

**CENTRALISED TRAFFIC CONTROL (CTC)**

What could be termed “modern” signalling was introduced in the mid-1970s, when the application of CTC to the Cork line saw a new CTC room employing a NX pushbutton panel used to control eight route relay interlockings, covering about 120 route-kilometres of double and single track routes to the south and west out of Dublin. In the intervening 30 years, the NX panel has been replaced, first by WABCo Union Switch VDU-based consoles, and subsequently by workstations from Vaughan (now GE Transportation).

The CTC building was extended in the early 1980s to include control of Connolly-based services – initially the DART – also by WABCo Union Switch VDU-based consoles, and subsequently by Vaughan workstations. At the trackside, the electro-mechanical interlockings installed by Westinghouse on the original CTC were modified to accommodate the introduction of cab signalling at the time of the DART project. DART introduced automatic train protection (ATP) for electric trains and continuous in-cab signal aspect display (continuous automatic warning system – CAWS) for other rolling stock. These systems both use the same set of low frequency codes injected into the track circuits and, since all traction was fitted for operation over the DART lines, CAWS was extended to the existing and new main line CTC in the 1980s and 90s. During that period, resignalling was completed to Cork, Limerick, Athlone and northwards to Dundalk and the border with Northern Ireland Railways. The latter project, which was carried out as part of a very successful EU-funded initiative to enhance the Dublin-Belfast route, saw the introduction of SSI technology on Irish Rail for the first time, with the novelty of controlling cab signal coding. All the resignalled routes achieved cab signalling and train radio coverage.

**THE 21st CENTURY**

With the substantive introduction of modern centralised power signalling on the core intercity and
suburban routes, attention turned to the next priorities. To the west of Dublin Connolly, the inner portion of the Mullingar and Sligo line was seeing a rapid growth in demand from Maynooth and intermediate stations. Part of this route was still single track and presented serious capacity and reliability problems. A double tracking and associated resignalling project was initiated and has been completed. The scheme was installed by Westinghouse Rail Systems (WRSL), Glasgow, employing Westrace interlockings at Clonsilla, Maynooth and intermediate CTC level crossings. The two signalling interlockings are currently being operated under local station control from WRSL Westcad workstations, pending their connection back to CTC. The provision of local control panels or workstations is standard practice on Iarnród Éireann (Irish Rail), not only for ease of phased commissioning but also as a fall-back control facility.

HEUSTON PROJECT

At this time, WRSL was also replacing the signalling at Heuston (formerly Kingsbridge) and at Inchicore, using three SSIs and a Westcad local workstation. This scheme would connect into the original mid-1970s CTC, coincidentally also supplied by Westinghouse. Although primarily promoted as a response to the age, and declining condition, of the 1938 electromechanical interlocking, the Heuston project was much more extensive. The 117m Euro project has seen an increase from four full-length and one short platform to nine full-length intercity platforms. There are now three approach lines to the station, all fully bi-directional from Inchicore. This allows locomotive movements between Heuston and Inchicore, which is the location of the running shed, to be unrestricted by other train movements. Four of the new platforms are linearly offset from the others because of site topographical features, not least of which is the River Liffey! As a result, one of the three approach lines is separated from the other two by a carriage valeting shed. The bi-directional signalling, which is reinforced by full CAWS cab signalling, allows for great flexibility in station operation.

This divided layout greatly facilitated a three-phase staged construction, at seven-month intervals, with extensive green-zone working whilst retaining full train services. Heuston is the major intercity station for Dublin, the Irish capital, and alternative rail termini were not available. During the entire project, and despite a total reconfiguration of track, signalling and platforms, train services at Heuston were only suspended twice, with bus transfers to the first suitable station from 09:00 on the Saturday to 13:00 on the Monday of a bank holiday weekend. The first closure was to permit the renewal of a three-track underbridge at Inchicore on the approaches to Heuston, and the second was to allow for the first SSI and Westcad commissioning, which involved 17 turnouts and 44 signals on the 10km of approach lines. The other signalling commissionings were carried out with minimal disruption to train services.

MANAGING A 63-YEAR-OLD INTERLOCKING

The original Heuston signal cabin had been identified as a degraded asset. There were two principal areas of concern. The installation depended on a significant quantity of shelf-mounted relays, and it was believed that wiring insulation was at risk of degradation. A minimal intervention approach was adopted. Non-invasive visual inspections were carried out at frequent intervals, but trunking, principally of wooden construction, was not interfered with. Exposed relay terminals were sheathed, without disturbing attached wiring. Access to the equipment room was heavily restricted, recorded and monitored.

The other cause of concern was the mechanical interlocking. During a system-wide check carried out by W S Atkins, locking defects were revealed in the frame. Being a miniature frame, the lock boxes were behind the levers at operating floor level, and work on them would not impinge on the restricted access equipment room. However, it became very evident that a relocking of the 76-lever frame could not be achieved without prolonged, serious locking disarrangement. Given that the cabin was already scheduled for closure, another pragmatic approach was sought to provide independent improved locking integrity for the remaining life of the installation. Two of our signal engineers developed a completely independent interlocking monitoring arrangement. This utilised a Siemens S5 dual-processor PLC, which is certified to SIL 3, to monitor lever positions as detected by new micro switches fitted to the front and back of each quadrant and released as each lever was moved from the N or R position. On monitoring each change of state, the PLC confirmed if the moved lever was free to be moved, by monitoring through a programmed version of the dog charts. If the move was legitimate, a confirmatory “click” was heard by the signalman, providing feedback that the system was still working. An invalid lever pull resulted in a full audible and visual alarm. In addition, all lever movements were logged by the PLC for post-incident analysis, and the signalmen were aware of this logging. Given that this interlocking supervisory system was triggered by parts of the mechanism (the levers) completely independent of the suspect components (the locks and tappets), IE were satisfied that it was an appropriate risk mitigation measure. When compared against the risks of either attempting a complete relocking or of carrying out invasive surgery to provide some protective measures at the degraded electrical level, the benefits were self-evident. The equipment performed satisfactorily up to the time of cabin closure, although, due to an operating strategy of retaining experienced signalmen, it was not called on to shout in genuine anger.

LIGHTLY USED LINES

During the 1990s, it was decided to resignal the next tranche of rural lines, those serving the secondary provincial cities after Belfast, Cork and Limerick. This would involve resignalling the single
track routes branching from the previously resignalled core. The lines chosen were:

- Athlone to Galway;
- Athy to Kilkenny and Waterford;
- Mallow to Killarney and Tralee;
- Maynooth to Mullingar and Sligo.

An initial contract was entered into which envisaged individual interlockings at each passing loop. These would be controlled by the workstations at the CTC building, but, because of the lighter traffic levels, a solution without cab signalling was proposed. This would permit the use of axle counter technology for the long inter-loop sections. This project ran into commercial difficulties and was terminated.

Resignalling of the four routes has now been restarted, but as an IE in-house project. The reconfigured scheme utilises one interlocking location per route, rather than the original solution of an interlocking per station. This can be achieved because enhancement of the national railway optical fibre network, and the SDH system it supports, will allow a sufficiently robust communication between the interlockings, the trackside modules and the axle counter elements. Full route diversity will be available, allowing high reliability and a confidence level sufficient for the operators to put all of their interlocking eggs in one basket on a long, single-line route such as Maynooth to Sligo. A further benefit is that, on three of the four lines, the interlockings will be placed adjacent to existing interlockings and power supplies (at Athlone, Mallow and Waterford), and on all four lines they will be adjacent to existing maintenance technician locations. This allows for fault diagnosis and analysis before travelling to the trackside.

The Galway route has been commissioned, and work on the Waterford line is at an advanced stage.

**ATP AND CAWS**

ATP and CAWS have been referred to above and, as they are features of Irish signalling practice which may not be familiar to many, they deserve a more detailed explanation.

When the Dublin suburban area was resignalled for the introduction of the electrified service in 1984, the new electric multiple units (EMUs) were to be driver-only operated. This gave rise to the necessity for ATP.

The ATP system fitted to the EMUs, which is applied extensively in the USA, uses low-frequency codes transmitted to the train by modulation of the 83.3Hz track circuit power source. The modulated track circuit current, flowing in the rails ahead of the train due to the train shunt, is picked up by induction coils mounted in front of the leading bogie. The on-board equipment demodulates and filters the signal, activating the output corresponding to the received code rate. Six code rates are used, as shown in Table 1, with their corresponding permissible speeds.

The driver's speedometer has two displays, one showing the permitted speed and the other the actual speed. If the actual speed exceeds the permitted speed or the permitted speed falls below the actual speed, due, for example, to a signal aspect change or a permanent speed restriction, the driver is alerted by an audible tone and the display flashes. If the driver responds within three seconds by putting the controller into the coast or brake position, the train will be braked to the new permitted speed and the brakes then released. If the driver fails to respond within the time allowed, the train will be braked to a stand.

An increase in permitted speed is signalled to the driver by a different tone, and no acknowledgement is required.

ATP codes are only provided for running signals. Shunting is facilitated by a "running release" button beside the speedometer. When this button is pressed, a permitted speed of 15 km/hr is displayed on the speedometer. This display is latched for as long as the driver holds down the "dead man's" handle, which is combined with the power/brake controller.

As the Dublin suburban is a mixed-traffic area, the new driver-only trains had of course to be protected from other vehicles as well as from each other. Locomotive-hauled stock could not however be fitted with ATP due to variability in braking rates, and so a different on-board system was used to provide in-cab signalling for these vehicles. This system, named CAWS, used the same code rates but, instead of displaying them as speeds, displayed them as signal aspects in the cab.

The CAWS aspect display unit (ADU) in the locomotive cab consists of five lamps mounted vertically: a red, three yellows (to provide single and double yellow) and a green. The unit displays the aspect of the last running signal passed by the train, until the berth track of the next running signal is reached. No codes are provided for shunt signals.

The impact of CAWS was described by one observer as though the system reached out of the cab window as the train approached a lineside signal, pulled the signal into the cab and put it in front of the driver until he came in view of the next signal, at which point the previous signal was thrown out the window and the new one pulled in!

A downgrade in the display to a more restrictive aspect is accompanied by a warning tone, and must be acknowledged within seven seconds by the

```plaintext
<table>
<thead>
<tr>
<th>Code Rate codes/minute</th>
<th>ATP Speed km/hr</th>
<th>CAWS Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>420</td>
<td>100</td>
<td>Green</td>
</tr>
<tr>
<td>270</td>
<td>75</td>
<td>Double Yellow</td>
</tr>
<tr>
<td>180</td>
<td>50</td>
<td>Green</td>
</tr>
<tr>
<td>120</td>
<td>50</td>
<td>Yellow</td>
</tr>
<tr>
<td>75</td>
<td>30</td>
<td>Green</td>
</tr>
<tr>
<td>50</td>
<td>30</td>
<td>Yellow</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>Red</td>
</tr>
</tbody>
</table>
```

Table 1 – CAWS and ATP Code Rates
driver pressing a button on the ADU. Acknowledging the downgrade silences the warning tone but has no further effect on the system, the acknowledgement being a statement by the driver that he has noted the signal aspect, after which he has full responsibility for controlling his train appropriately. An upgrade in aspect is accompanied by a “warble” tone, and requires no acknowledgement. If a downgrade is not acknowledged, the train is stopped by means of a fixed time-penalty brake application.

The reason for the use of seven code rates in the Dublin suburban area, even though there are only three permitted speed bands, is to allow the same codes to be interpreted by ATP-fitted vehicles as speed commands and by CAWS-fitted vehicles as signal aspect information. Hence, a 420cpm code, a 180cpm code, and a 75cpm code are all interpreted by CAWS as green aspects, while they are interpreted by ATP as 100 km/hr, 50 km/hr and 30 km/hr speed commands respectively.

A feature of the period over which the locomotive fleet was being fitted with CAWS was an automatic vehicle identification (AVI) system, which was installed on all approaches to the Dublin suburban area. Although only CAWS-fitted locomotives were scheduled to work in the suburban area and its approaches, it was not unknown for non-fitted locomotives to stray into the territory.

The AVI system consisted of a track-mounted transmitting/receiving antenna and associated electronics, and a train-mounted transponder. When a CAWS-fitted locomotive passed over the antenna, the transponder was interrogated and returned a signal confirming that CAWS was operating on the locomotive. This, in turn, allowed the signal controlling entry to the suburban area to clear. A non-fitted locomotive would be held at the signal until a second man was put up in the cab.

The AVI system continued to operate until the fleet was fully fitted and procedures had been put in place to ensure that CAWS was working on each locomotive before departure from its depot. It was then decommissioned.

Following the DART project, CAWS was extended to the Dublin–Cork and Dublin–Belfast main lines, but using a 50Hz carrier superimposed on to ac-immune dc track circuits and using only three code rates, namely 180cpm (green), 120cpm (double yellow) and 50cpm (yellow).

THE FUTURE

Those of us working in Iarnród Éireann are fortunate in many respects. The much-vaunted “Celtic tiger” economy has driven an unprecedented public debate about national infrastructure, with transport being high on the list. Significant demand growth is anticipated, and the Government recently received the Strategic Rail Review report commissioned by them from Booz Allen Hamilton. This gave a strong endorsement to a policy of going for growth in terms of rail network utilisation. Significant investment is under way in both intercity and commuter rolling stock. Senior railway management have completed their own strategic development programme to meet the demands of the external environment better, and new thinking is abroad within the organisation.

To return however to the opening theme of this paper Iarnród Éireann, whilst modelled strongly on UK practice by historical precedent, shared language and neighbourliness, is still a vertically-integrated railway company. Moreover, in the absence of an indigenous railway manufacturing industry, visitors can experience a truly international equipment environment. Together with our colleagues in Translink – Northern Ireland Railways, we look forward to welcoming our friends in the IRSE for the 2004 International Convention.
Ireland Rail Network

IE Power Signalling in Service

IE Power Signalling under Construction
Discussion

The discussion was opened by J Corrie (Mott MacDonald) who questioned the speaker on the Irish Railway's views on European Standards, asked if research into use of LED signals had been undertaken and wanted to know about the safety acceptance process for the introduction of new rolling stock.

P Cuffe advised that the Irish Railways wished to retain the coded track circuits, that they have heavily invested in, and believed that ATP functionality could be achieved by addition of the Eurobalise. He also informed that consideration had yet to be given to the use of LED signals and explained that the process for acceptance of new rolling stock consisted of night-time testing to ensure compliance with laid down parameters.

C Porter (President) wanted to know why cab signalling was introduced in loco-hauled trains within the DART area.

P Cuffe informed that loco-hauled trains were fitted with cab signalling to protect the ATP and DOO fitted stock in the mixed traffic areas. This was initially just within the DART area but, with a small fleet, it made sense to roll-out the fitment to all locomotives.

D McKeown (Independent Consultant) wondered if any consideration had been given to “signalling” the passenger and questioned if there was any strategic thinking behind the rail and road expenditure.

P Cuffe highlighted that providing bigger concourses was an outcome and advised that whereas there was no real strategy at one time, this is now changing with a joint Minister for road and rail.

I Mitchell (AEA Technology) asked what happens on lines where no coded track circuits are fitted.

P Cuffe explained that a decision was made not to fit CAWS on (lightly used) CTC lines; it was believed that the transition from semaphore signalling with token working to colour light signals was a sufficient upgrade.

C Porter (President) questioned if a radio-based solution was being considered.

P Cuffe advised that GSM-R was being considered and would probably be undertaken at next resignalling although most lines are in the process of being upgraded at the present time.

T Foulkes (Network Rail) enquired how the SDH network was justified.

P Cuffe explained that CTC projects required a cable network and installation of fibre optic cabling for outside parties.

J Francis (Westinghouse Rail Systems) was interested in the speaker's views on the amalgamation of the IR and NIR Rule Books.

P Cuffe informed that the two Irish railways were the first in Europe to work to a common rule book and it was working very well.

At the end of the evening, C Porter (President) thanked P Cuffe for a most enthralling presentation and looked forward to the International Convention in Dublin.
SUMMARY
This paper describes a method of improving the determination of train positions that is particularly applicable in areas where track circuits are not available. The method uses multiple global positioning system (GPS) antennas for position and heading determination.

One of the key problems with standard GPS solutions is the difficulty in resolving the track that the train has taken at a junction. Parallel tracks may lie within the resolution ambiguity of standard GPS and DGPS position measurements. We propose that attitude determination be used to determine the path that the train has taken at a track junction. The document then explains the equipment and methods that were considered best for solving these problems.

INTRODUCTION
At any location where a train can change tracks, the heading of the train must change if it is to move from its current track. This suggests that with knowledge of the track geometry and train heading, we can unambiguously determine the position of the train.

Attitude determination using the GPS is based on carrier phase measurements. If multiple antennas are employed, the relative carrier phase can be determined. A signal travelling at the speed of light arrives at the antenna closer to the satellite slightly before reaching the other antennas.

The relative range between GPS antennas mounted on a locomotive can be determined by measuring the difference in carrier phase between antennas. (Four GPS satellites must be tracked in order to solve for the three components of Cartesian relative position and receiver clock bias.) When multiple antennas connect to the same receiver, each signal path shares a common time reference, the measurements are independent of the receiver clock bias, and the mechanical placement of the antennas is known. Only three GPS satellites are then required to solve for the attitude.

Using GPS for this kind of application has a great advantage over many other types of heading sensors. A GPS heading sensor has no moving parts, and hence a high resistance to shock and vibration. Stable measurements can be obtained due to the large mechanical and thermal inertia of the GPS system. An additional advantage of the GPS system (over systems that involve magnetic compasses) is its reference to “true” geographic north. GPS measurements have fast initialisation times, and are free of problems such as drift.

1 ANTENNA CONFIGURATION
The configuration chosen for the antennas can have an impact on the performance of a multi-antenna system. The ideal configuration should minimise the errors as much as possible. In practical situations, compromise is often necessary due to physical constraints.

The accuracy of the attitude measurements is inversely proportional to the distance from one antenna to the next. This would imply that the best configuration would have the longest baseline between antennas. However, the complexity of integer ambiguity resolution is increased as the baseline length grows.
An extra antenna can be used to improve attitude accuracy and reduce the complexity of the ambiguity resolution.

The optimal antenna configuration is one where the antenna baselines are equidistant and orthogonal. However, this can be difficult to achieve when working with the restrictions involved with mounting on a vehicle.

An alternative solution is to place the three antennas in a straight line. Two of these antennas are placed with a baseline less than one carrier wavelength long, and the third is placed with a longer baseline along the same straight line. This collinear restriction and spacing will reduce the number possible solutions that need to be tested for attitude determination.

2 ATTITUDE DETERMINATION

Although there are dedicated attitude determination systems on the market today, these systems tend to be expensive. Dedicated attitude determination systems have been developed generally for aircraft applications, and provide attitude information in three dimensions. The attitude needs of an aircraft differ from the needs of a locomotive, as two-dimensional attitude is adequate for a rail bound vehicle. For this application it seems feasible to use a number of low cost sensors configured so as to optimise their usefulness in the railways.

There are several methods for increasing the reliability of low-cost sensors. These methods include using a higher data rate, using a fixed angular constraint scheme and using Kalman filter estimation.

There have been investigations undertaken which examine the accuracy of low cost and high cost GPS receivers when used for attitude determination. The overall conclusion from these studies is that the accuracy of high cost and low cost systems for attitude determination is comparable.

The general process for attitude determination using multiple GPS receivers is as follows:

1. GPS measurements are taken (including Ephemeris Time, Pseudorange, Carrier phase and Doppler Measurements)
2. These measurements are then input to measurement equations (which consist of algorithms for processes such as double differencing and linearisation)
3. The output from the measurement equation is used as an input for the integer ambiguity resolution
4. The integer ambiguities are then input to the measurement equation
5. The output from the measurement equation is then input into some form of relative positioning algorithm (such as least squares, Kalman filter and so forth)
6. The output from the filter is then transformed in terms of the coordinate system
7. The transformed output is then input to the attitude determination algorithm

The output from the attitude determination algorithm is the final output.

3 GPS OBSERVATIONS

GPS observations used to determine positions include pseudorange measurements, carrier phase measurements and instantaneous Doppler frequency. Carrier phase measurements are generally used in applications that require greater precision than provided by pseudorange measurements.

In attitude determination systems, the pseudoranges are used to determine the platform position at each instantaneous point in time. The platform velocities are determined using the Doppler frequency measurements, and the attitude parameters are computed from the differential carrier phase measurements.

The pseudorange measurements can be summarised by the following equation:

$$P = \rho + c(dt-dT) + d_\rho + d_{\text{ion}} + d_{\text{trop}} + \varepsilon_{\text{pmult}} + \varepsilon_{\text{prx}}$$

where:

- $P$ = pseudorange measurement (m)
- $C$ = speed of light (m/s)
- $dt$ = satellite clock correction(s)
- $dT$ = receiver clock error(s)
- $d_\rho$ = orbital error (m)
- $d_{\text{ion}}$ = ionospheric correction
- $d_{\text{trop}}$ = tropospheric correction
- $\varepsilon_{\text{pmult}}$ = code multipath error
- $\varepsilon_{\text{prx}}$ = receiver code measurement noise

Carrier phase measurements can be used on short to very long baselines with high precision. The difference in phase between the transmitted carrier wave from the satellite and the receiver oscillator signal at a specified epoch is the phase observable. The initial and unknown integer ambiguity can be represented by a single bias term.

A cycle slip can occur when the tracking is interrupted due to blockage of the signals, weak signals or incorrect signal processing due to receiver software failure. Phase can generally be measured to 1% of the wavelength, for the civilian GPS frequency this translates to roughly 2mm.

The carrier phase relationship can be written as:

$$\Phi = \rho + c(dt-dT) + \lambda N + d_\rho - d_{\text{ion}} - d_{\text{trop}} + \varepsilon_{\text{pmult}} + \varepsilon_{\text{prx}}$$

where:

- $\Phi$ = carrier phase (in metres)
- $N$ = integer carrier phase cycles ambiguity
- $\lambda$ = carrier wavelength (m)
- $\varepsilon_{\text{pmult}}$, $\varepsilon_{\text{prx}}$ = carrier phase multipath error

Figure 1 – Antenna Configuration
\(a(\Phi_r) = \text{receiver carrier phase measurement noise}\)

As can be seen, there is an ambiguity in the number of integer carrier phase cycles, \(N\). The resolution of this ambiguity is one of the main challenges in GPS attitude determination.

With two receivers placed closely together, we can virtually eliminate errors due to the satellite clock, the satellite orbit, and ionospheric and tropospheric effects. This can be achieved through differencing and double differencing. Double differencing gives the following result:

\[
\nabla \Delta \Phi = \nabla \Delta \rho + \lambda \nabla \Delta N + \nabla \Delta_{\text{ref}} + \nabla \Delta_{\text{en}}
\]

where:

\(\nabla\) = differencing between satellites
\(\Delta\) = differencing between receivers
\(\nabla \Delta \Phi\) = double difference carrier phase measurement
\(\nabla \Delta \rho\) = double difference range
\(\nabla \Delta N\) = double difference ambiguity
\(\lambda\) = carrier wavelength (m)
\(\nabla \Delta_{\text{ref}}\) = double difference carrier phase multipath error
\(\nabla \Delta_{\text{en}}\) = double difference carrier phase receiver noise

Remaining errors, in particular the internal receiver errors and multipath cannot be cancelled, and are amplified through the differencing procedure. Multipath can be reduced through signal processing techniques and the use of hardware such as multipath rejection choke rings. The type of receivers used also has an effect on the severity of multipath and internal receiver errors.

The Doppler frequency is the rate of change of the carrier phase. The major function of Doppler frequency measurements is estimation of velocities, however in kinematic applications it can be used for identifying and approximating cycle slips.

### 4 OTHER NAVIGATIONAL OPTIONS

There are many navigational options available on the market today. These include not only GPS and differential GPS (DGPS), but also Doppler radar, inertial navigation systems, proximity beacons and tag readers.

GPS receivers are a cost-effective option. The errors for GPS do not increase with time, as many other systems do. If we can overcome the problem of GPS signal outages, this will clearly be the most feasible navigation option.

GLONASS is the Russian counterpart of GPS. If both these systems are integrated (GPS/GLONASS) then an improvement in the DOP is seen over either system used alone. When a GPS system is augmented by GLONASS there are improvements in overall satellite visibility and reliability. This method of GPS augmentation is cost effective when compared to augmentation via other means such as inertial navigation systems. The integration of these schemes is not straightforward. GPS and GLONASS use different reference frames for their time and coordinate systems, as well as different signal modulation techniques.

### 5 LOW SATELLITE VISIBILITY

We propose the use of the locomotive tachometer in addition to GPS where it is available. (While all locomotives are fitted with tachometers, it is only the more modern locomotives that have a readily accessible tachometer signal.)

If the GPS attitude determination calculations can be completed between GPS reports (typically one second), then it is not necessary to maintain a continuous lock on all of the satellites. A train could pass through a tunnel and regain attitude information shortly afterwards. Where there are no vital decisions to be made within or immediately after the tunnel (e.g., track junctions), this information is adequate.

However, there are situations where the satellites will not be in view and the complexity of the tracks will require attitude determination. Examples of this are switches or crossing loops that are within tunnels and deep cuttings, or in other areas of low satellite visibility. An example would be tracks that pass under shopping centre developments.

There are several options for maintaining GPS signals when the satellites are not visible. These include pseudo-satellites (pseudolites), synchrolites, and GPS repeaters. If the receivers can obtain GPS-like signals, they can still perform attitude determination. (The GPS repeater does not permit attitude determination.)

#### 5.1 Pseudolites

Pseudolites transmit a signal similar to the signal transmitted by GPS satellites. However, pseudolites are located on the ground. This location means that they act differently from GPS satellites. Pseudolites represent an additional satellite that is always in view, ensuring continuous availability. Pseudolites should only be necessary when the train is travelling in an area with both low satellite visibility and high complexity.

#### 5.2 Synchrolites

A synchrolite is similar to a pseudolite, however, instead of synthesising a GPS-like signal as a regular pseudolite does, a synchrolite effectively reflects the signal from a satellite. The position on the ground from which the signal is rebroadcast is known, and hence the direct and reflected signals can be used to compute differential measurements of the satellite signals, hence eliminating the spatially correlated errors that are present in the satellite signal.

#### 5.3 GPS Repeaters

Another possibility for ensuring coverage within tunnels and high multipath areas is the use of GPS repeaters. An antenna can be installed at each end of the tunnel and the received signal rebroadcast within the tunnel. While this obviously only provides the train with the location of the external antenna, the GPS receiver retains its synchronisation. As soon as the train leaves the tunnel, the GPS receiver can produce accurate data.

GPS repeaters are low in cost (<$1,000) and can
be easily installed. Many railway tunnels have radiating cable installations for mobile radio communications. A GPS repeater may be able to be connected to the existing radiating cable to provide extended distribution of the GPS signal at a very nominal cost. The losses along the cable will be high at the GPS frequency but at least a part of the tunnel will have adequate GPS signals.

5.4 Navigation Techniques

The table below summarises the information available and the techniques to be implemented under different conditions.

6 REQUIRED RESOLUTION

Let us assume that the minimum centre-to-centre spacing of tracks is 4 metres, that there are 2.4 metres between the inner rails and approximately 1.45 metres between the two rails of the same track.

For a speed of 60 km/hr (16.7 m/s) assuming a maximum radius of curvature for a turnout as 679.3 metres, we obtain a rate of change of angle, \( \frac{\Delta \phi}{\Delta t} = 0.0245 \text{ radian/s}, \) or 1.406°/s. At slower speeds, this change of angle with time will decrease. Integrating these measurements over time will give the same overall change in heading, for this example \( \phi = 2.648^\circ \).

At slower speeds, we will obtain more tangents to the circle. For example, if the train in the turnout is travelling at only 10 km/hr (2.8 m/s), and the angular displacement measurements are given at a rate of 1 Hz from the GPS attitude determination process, the train will take 11.3 seconds to traverse the first of the two arcs, and every second there will be a change in angle of \( \Delta \phi = 0.234^\circ \).

Assuming that the uncertainty in position is a zero-mean Gaussian distribution we can calculate the maximum uncertainty and the required accuracy.

With a heading change of 2.648°, and a confidence level of 99.9999%, the required accuracy of the heading angle is 0.557°.

Table 2 shows the heading and pitch accuracy available for different baseline lengths. As can be seen here, for an inter-antenna distance (or baseline) of 0.9 metres we can obtain a heading accuracy of

<table>
<thead>
<tr>
<th>Track Position</th>
<th>Procedure</th>
<th>Satellites Available</th>
<th>Info Available</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initialisation</td>
<td>Tachometer</td>
<td>&lt;3</td>
<td>Tachometer</td>
<td>None</td>
</tr>
<tr>
<td>Initialisation</td>
<td>≥3</td>
<td>GPS attitude potential</td>
<td></td>
<td>Integer ambiguity resolution</td>
</tr>
<tr>
<td>Just out of Tunnel</td>
<td>New satellites available</td>
<td>≥3</td>
<td></td>
<td>Integer ambiguity resolution</td>
</tr>
<tr>
<td>Travelling on well defined route</td>
<td>Map matching from GPS position and tachometer</td>
<td>&lt;3</td>
<td>Tachometer</td>
<td>Use distance travelled in combination with map information to maintain estimate of position</td>
</tr>
<tr>
<td>Travelling on well defined route</td>
<td>Map matching from GPS position and tachometer</td>
<td>3</td>
<td>Tachometer and GPS attitude</td>
<td>Can use distance travelled and attitude information for estimate of position</td>
</tr>
<tr>
<td>Travelling on well defined route</td>
<td>Map matching from GPS position and tachometer</td>
<td>≥3</td>
<td>Tachometer, GPS attitude and GPS position</td>
<td>Use GPS position in combination with track database to maintain rough position estimate</td>
</tr>
<tr>
<td>Train Stationary</td>
<td>Tachometer</td>
<td>&lt;3</td>
<td>Tachometer</td>
<td>None</td>
</tr>
<tr>
<td>Train Stationary</td>
<td>Tachometer</td>
<td>≥3</td>
<td>Tachometer, GPS attitude, GPS position if &gt;4 satellites</td>
<td>Integer ambiguity resolution validation performed, calibrate tachometer</td>
</tr>
<tr>
<td>Approaching point of interest</td>
<td>Tachometer, GPS position</td>
<td>≥3</td>
<td>Tachometer, GPS attitude, GPS position if &gt;4 satellites</td>
<td>Integer ambiguity resolution validation performed, begin map matching at higher resolution</td>
</tr>
<tr>
<td>At point of interest</td>
<td>Tachometer, GPS position, GPS attitude</td>
<td>≥3</td>
<td>Tachometer, GPS attitude, GPS position if &gt;4 satellites</td>
<td>Continue map matching with attitude information, verify position, set off appropriate alarms etc</td>
</tr>
</tbody>
</table>

Table 1 – Summary of Procedures Under Different Conditions
0.27°. Should the baseline be extended beyond 0.9 metres, a greater level of accuracy would be achieved.

<table>
<thead>
<tr>
<th>Inter-antenna Distance (m)</th>
<th>0.15</th>
<th>0.31</th>
<th>0.45</th>
<th>0.75</th>
<th>0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heading Accuracy (°)</td>
<td>1.67</td>
<td>0.70</td>
<td>0.46</td>
<td>0.40</td>
<td>0.27</td>
</tr>
<tr>
<td>Pitch Accuracy (°)</td>
<td>3.27</td>
<td>1.66</td>
<td>1.07</td>
<td>0.89</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Table 2 – Angular Accuracy and Baseline Length

7 PROPOSED SYSTEM

A block diagram of the concept is shown in Figure 2. Using this system, we obtain several basic sets of measurements.

1. Position data for each antenna taken from the standard GPS messages
2. Attitude data derived from the GPS carrier phase measurements
3. Distance information from the tachometer
4. Velocity information from the GPS measurements and speed information from the tachometer information differentiated with respect to time
5. Angular rate of change

Some of this information is only available when there are a certain number of GPS satellites visible, and others are calculated through differentiation. The tachometer information is assumed to be available at all times.

We can use all this information together to provide a robust position determination system. The position, distance and attitude data is processed and filtered then compared with a map database.

Since the train location is constrained by the track, aberrations in the position calculation may be discarded. The heading (attitude) information can be used to determine when the train has diverged from its previous track, thereby increasing the effective resolution of the train position.

A similar arrangement has been proposed in a recent IRSE technical paper. The technique described in that paper is based on DGPS receivers, which require continuous transmission of GPS difference data to the train. Our proposal obviates the need for differential data, using attitude determination to improve the accuracy and resolution of the standard GPS data.

CONCLUSION

There is ample evidence of the consequences of inaccurate position information for trains. The lack of position information can lead to accidents and inefficient operation.

Since the abolishment of selective availability the use of GPS seems an increasingly obvious solution to many of these problems. The solution proposed here has sufficient accuracy to overcome these problems in a simple and cheap manner.

It has been found in this study that the use of GPS carrier phase measurements, with the appropriate software algorithms, can provide accurate real time information about train location.

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Consultancy Services
Implementing a Compatible Automatic Train Protection Control System in the Hong Kong MTR

L Y Lam

ABSTRACT
The Hong Kong MTR, the railway division of the MTR Corporation, has successfully integrated a compatible automatic train control (ATC) system from a different supplier on its latest extension. This reduced the project cost of building the new extension and removed the MTR systems reliance from a single supplier. This paper describes the approach adopted to achieve the commercial and project goals.

BACKGROUND
The MTR started operating in 1979 and passenger demands on the system increased steadily year by year. The designed passenger carrying capacity of the system was exceeded in the early 1990's and a peak hour pricing policy had to be introduced to control the number of passengers using the system to an operationally acceptable level.

In 1991 train service headway studies were conducted on the network. The results showed that the passenger carrying capacity of the system could be increased by modification of the ATC system. This would, however, only be possible by replacing the existing ATC system by a new generation system. A worldwide search was undertaken to find a system that would meet the projected headway
requirements and which could easily be overlaid or which would be compatible with the existing ATC system. Four systems were identified as potentially suitable and it was decided in mid 1992 to go out to open tender for the provision of a new ATC system for the urban lines network (URL). The URL consists of three urban lines, the Kwun Tong Line, (KTL) the Tsuen Wan Line (TWL) and the Island Line (ISL). After a detailed assessment, the SACEM system was chosen and the contract was awarded in December 1993.

The SACEM ATC system is a French product, designed to the requirements of the Paris Regional Transport Authority (RATP). When conceived in the 1980s, RATP involved three contractors in the collaborative development of the system. This was to develop a system that all three contractors could implement thereby ensuring RATP had multiple suppliers. One project "RER Line A" went ahead and the system was installed in the mid 1980s. Only two contractors participated in this with one providing the trainborne equipment and the other providing the trackside equipment. RATP undertook no further projects using this technology for some years and each of the contractors moved on to other clients. To some of their clients they offered versions of the SACEM system with enhanced features. These later versions were developed in isolation and were not fully compatible with the original RATP concept.

OPERATIONAL NEED OF INTEROPERABILITY FOR THE NEW MTR EXTENSION

During the 1990s, The MTR implemented two major SACEM projects. The first was a newly installed system on the Lantau Airport Railway (LAR), a 34km railway connecting the central district of Hong Kong Island to the new Hong Kong International Airport at Chek Lap Kok and the new town development alongside the new airport at Tung Chung. The second, the ATC Replacement Project, replaced the then existing ATC system and included both trackside and trainborne equipment on the URL.

In 1997 the Quarry Bay Relief Project (QBR) went ahead. The purpose of this work was to alleviate the passenger congestion at Quarry Bay station by extending the KTL by one further station to North Point. The QBR signalling contract included the provision of a fully compatible ATC system with interlocking system to the URL system. As this was a relatively small contract comprising only one new station with the connecting tunnels to the Quarry Bay station it was awarded to the same equipment supplier through the process of contract negotiation. It was seen that as time progressed the contractor who was the sole equipment supplier was unable to provide a system in a reasonable timescale and at an acceptable cost.

In 1996, in response to the Hong Kong Government’s invitation to extend the MTR network to the new towns being developed in the eastern part of the Kowloon peninsula, the MTR put forward a technical proposal for the Tseung Kwan O extension. This new extension would stretch from a new station, Po Lam, in Tseung Kwan O new town, pass through four other new stations and connect to the existing Eastern Harbour Crossing on the Kwun Tong Line. In addition to this new line, a new branch line would divert the existing Kwun Tong Line from Lam Tin Station to the new Tiu Keng Leng station. When the decision was made in 1997 to proceed with the new Tseung Kwan O Line (TKL), it was decided to introduce competition for ATC system in order to ensure competitive prices.
The MTR took this opportunity to seek alternative suppliers for the provision of the signaling system for TKL in order to reduce their dependence on a single supplier. However, this extension could not be a standalone railway line as it would connect to the existing KTL via two connections, one at the East Harbour Crossing and one at Lam Tin Station. (see figure below for the line configuration). This, therefore, required an interoperable system, which could either be a compatible system or a dual system operation configuration, allowing existing trains to move onto the new extension in a continuous uninterrupted operation. Likewise, the new rolling stock for the TKL would be required to operate on the existing lines in the same manner.

**PRE-TENDER INTEROPERABILITY STUDIES**

Underlying the operational need for an interoperable system for this new extension there lay sophisticated technology involved in the new ATC system and the interfaces with it on both the new extension and the existing lines. In late 1997, a working group was set up within MTR to look into the best way of achieving a practical and cost effective implementation of the signalling system on TKL. Different alternatives were looked into and four options were considered in detail. These were:

- a compatible system;
- a dual system operation (both new and old systems in operation with switch-over at cross-system boundary);
- a completely new system;
- the same ATC system as used on the URL.

After detailed consideration it was decided that a compatible system would be most appropriate in terms of tendering/commercial advantages, operational consistency, project cost, system interoperability and stock manoeuvrability. It was decided that the best way to realise these objectives and achieve the interoperability requirements would be to return to the approach adopted by RATP when they first developed the SACEM system in the 1980s. A plan was drawn up to manage the system interoperability issues. This included pre-tender studies and post contract award management. For the pre-tender studies, it was decided to invite all three contractors who were originally involved in the RATP project as paid consultants to the interoperability studies.

A consultancy specification was written with the main focus areas based on the following critical components of system interoperability:

- identify system cross-compatibility elements;
- estimate the scale of development work required;
- the risk associated with full compatibility;
- develop outline system designs;
- identify interface requirements with new and in-service rolling stock, and other sub-systems and equipment;
- estimate the timescale to deliver the complete system.

The consultants were also requested to include proposals of a system capable of achieving these interoperability requirements. The consultancy study started in the second quarter of 1998 and was completed by the end of the third quarter of the same year. All suppliers confirmed that:

- a compatible system could be provided;
- new functions and interface developments could be managed within the project time-scale;
- work could be completed as required by the TKL project schedule.

A technical specification was prepared based on the consultancy reports and the qualifications they contained. This was put out to open tender for the Tseung Kwan O signalling works. In June 1999 Siemens Transport Systems (France) – formerly Matra Transport International – came out as the winner from three tenderers. The award was based on the contractor’s experience and proven capabilities in design, development, manufacture, installation, test and commissioning of similar systems. In addition to technical competence, the proposal for changeover management and the impact on train operations during the changeover, development of interfaces with other systems and the total project cost including MTR in-house costs were all taken into consideration in the tender assessment. The contract price for the work was significantly less per station and per kilometre of track than the Quarry Bay Relief Project. This massive saving in cost was proof positive that the procurement strategy was sound. On the technical aspects, the proposal showed a good understanding of the critical elements needed to achieve system cross-compatibility. The following approach was adopted in the development of the new system:

- same functional principles, based on the same application software;
- same hardware architecture, and identical data transmission format and protocols between trainborne and trackside sub-systems;
- same vital principles based on coded monoprocessor;
- short software development time based on B Method and using B tools to translate mathematical models into codes;
- engineers involved in the original SACEM development would participate in the project.

**POST-CONTRACT AWARD INTEROPERABILITY MANAGEMENT**

The post-contract award interoperability management contains technical interoperability aspects in addition to operational management aspects.

**TECHNICAL INTEROPERABILITY MANAGEMENT**

At the pre-tender interoperability study stage a number of assumptions were made. The fundamental building elements of the system design, both in terms of software and hardware, were assumed
not to require change from the SACEM system previously introduced. The focus of the study was, therefore, placed on the new functions to be added to the basic SACEM ATC system as developed by RATP. After the contract was awarded, MTR engineers worked with the contractor to formulate the critical compatibility elements of the project and a detailed interoperability management plan was drawn up. Apart from the functional aspects, particular attention was placed on the ATC system design and system cross-compatibility. In this regard, a structured approach was formulated to ensure that the system compatibility issues at the physical level, data level, transportation level, presentation level and application level were all properly addressed. It was considered that proof of interoperability should proceed in two ways, by physical and operational demonstration to prove the achievement of high level functional interoperability and by detailed system analysis to verify subsystems as well as low level system internal and external parameter compatibility.

**INTEROPERABILITY DEMONSTRATION TESTS**

It was a requirement that the final acceptance of the system should include, as part of the system acceptance, a successful system interoperability demonstration. However, to ensure efficient and timely completion of the system development, demonstration tests had to be carried out at various phases of the project to produce evidence proving that the development milestones were successfully achieved. In addition, this also provided design input as early as practicable to allow correction of any compatibility issues identified.

Not long after the contract was awarded, a series of interoperability demonstration tests were conducted at the MTR electronic workshop and on site. The purpose of these tests was to determine the compatibility of the hardware interfaces and data transmission between the URL and TKE ATC systems. The results were used as input to system design detail. In these tests, message format, communication protocols and electrical signal characteristics were collected.

From carrying out the tests it became apparent that the SACEM system, as implemented by the original supplier to URL, had deviated widely from the original RATP implementation and interoperability would not easily be achieved. It was also found that information on data transmission provided in maintenance manuals by the original supplier was incorrect and did not reflect the as-built status. More importantly, the safety coding for vital processes was not the same as the original RATP implementation. The issues of hardware interface and data transmission were easy to resolve but the safety coding proved a major problem to achieving system compatibility. Without the correct safety coding to ensure the safety integrity of message transmissions and data processing the system would not function. Help from the original supplier was sought but this proved difficult due to commercial consideration. To overcome this problem it was necessary for complex detailed analysis to be carried out on executable codes downloaded from the operating computer control units. Fortunately, the engineers involved in the original SACEM development were familiar with the software and were able to decipher the codes downloaded from the existing system over the next two months and the project schedule was not much affected.

After the safety codes had been successfully deciphered, the development of the application and functional software was fairly straightforward and within the control of the contractor. Further demonstration tests at the factory and on site revealed that everything was in order and all were confident that system compatibility would be achieved within the planned schedule.

**INTEROPERABILITY ANALYSIS**

The fundamental requirement of interoperability is to permit trains equipped by one supplier to operate safely in an ATC area equipped by another supplier. This requires that messages transmitted from trackside equipment to train be identical in format, content and signal levels and for both suppliers' equipment to be capable of inter-communication across the system boundaries so that seamless train operation is possible at every point on the railway line. The main objective of the interoperability analysis was to examine the overall system functionality and system cross-compatibility and to verify that the ATC system would be compatible through every aspect down to the lowest level in terms of safety and operational functionality.

The system functionality analysis mainly focused on the implementation of application and functional software. Early on in the project the MTR and the contractor's engineers worked together with the operator's input to produce the system requirement specifications. This ensured that the delivered system would perform in exactly the same way and in every aspect as the existing system. The
contractor’s engineers also carried out a cross-compatibility study and looked into the system parameters which were performance- and safety-critical. A report was produced listing all these parameters together with the matters, scenarios both systems must adhere to in order to achieve safe operations with mixed stock under interoperability. This report was put forward to MTR for cross-checking with the existing system as-built parameters. Clarification on some points from the original supplier was also sought. Whenever different parameters, both internal and external to the system, were used due to system configuration or design constraints of the individual system, this information would be forwarded to system designers for detailed analysis. Design changes would be initiated where needed to ensure safe operations and cross-compatibility were achieved.

It was found that most of the critical system parameters were the same. However, the new rolling stock from a different supplier would differ from the existing stock in many respects. The weight would be heavier as it was to be manufactured from stainless steel not aluminum. It would be much more powerful and would use the latest electronic traction power control system to control motoring and braking. It would accelerate much faster and maintain a high tractive effort to a higher speed. Consequently the equipment response times would differ from the existing rolling stock. All these factors would affect the dynamic behaviour of the rolling stock making it impossible to use exactly the same data construction for the existing system for both types of stock. A different approach needed to be adopted on the TKL ATC system for interoperability to be achieved.

To avoid major modification of the existing system it was determined that the trackside system on the new line would be implemented in accordance with the existing design to allow existing stock to operate on the new line. The new rolling stock would be embedded with all the new stock and ATC system characteristics so that it would only be required to pick up track related data to perform its functions, such as station stopping points, slope of the track, track boundary locations and signal position data. This meant that the new rolling stock would be capable of operating on any line on the railway network wherever the trackside related data was available, irrespective of the type of rolling stock and the ATC system installed on board.

**OPERATIONAL MANAGEMENT**

The operator and maintainer were involved early on in the project at the specification stage. The operating philosophy for the new extension was based on the existing URL system and a compatible system was called for. After the initial system configuration was approved, a training needs analysis was conducted and detailed requirements were included in the contractor’s training plan. Operator and maintainer were kept updated of the progress of the development throughout the project through monthly meetings and factory visits at which their input was fed back to contractor.

The TKL ATC system interfaces with more than 20 different systems, such as rolling stock, platform screen door system, main control system, radio and communication system, floodgate system etc. Throughout the design development, the emphasis was on making as few changes as possible to the existing man/machine interface and operations rules and procedures. When considering the man/machine interface the following aspects were covered:

- equipment/terminal and screen layout;
- screen display;
- normal operating conditions;
- degraded operation modes under equipment failure;
- alarms display;
- diagnostic guides;
- system reconfiguration.

**REVIEW OF OPERATIONS PROCEDURES**

It was inevitable that a new system would come with new functions/features. All the new functions/features pertaining to the new ATC system were identified in the early phase of the project. There were only minor amendments to rules and procedures (R&P) and safety documentation. The operations department of MTR has a procedures review working group comprising members from various sections within the department. They are responsible for reviewing and developing procedures for the operation of the railway. For the new extension, the group undertook a complete review of the R&P manual to identify areas that would be affected by the introduction of new equipment into the railway. Whenever areas of change were identified, the group made proposals for amendments to the R&P. During this review, reference was also made to the hazard log. Where mitigation of hazards requires procedural controls, the procedures would be developed to reflect these requirements. All changes made to the R&P were submitted to the safety committee for approval before implementation. Throughout the project there was close liaison between the operations and project teams.

The newly-developed procedures were verified and updated during the test running and trial operations, prior to the commencement of a full passenger service.

**IMPLEMENTATION**

Implementation of the Tseung Kwan O project was in three phases. The first phase was putting in the new trackside ATC system between Lam Tin and North Point stations. The second phase was to introduce the new trains on to the existing lines, and the final phase was to connect the new TKL tunnels to the KTL to achieve the final required configuration.

Once tracks and overhead power lines were commissioned to the new configuration it would be irreversible. Well before the first changeover took place, extensive tests were conducted between the
new and existing trackside systems using existing stock running on the new ATC section to prove that the existing train and new trackside systems were compatible. On the night of the changeover trains were only required to operate on the entire section to ensure everything was in order. The changeover took place in August 2001 and proved successful. Full automatic train operation was, therefore, available from day one.

The second phase was the introduction of the new rolling stock with the new trainborne ATC system on board in February 2002. Most of the problems encountered at this stage were associated with the rolling stock interface and the new trains could operate on the URL with no major interoperability issues encountered. However, some system fine tuning was required and, in some cases, this necessitated loading the train to simulate the actual operational conditions on the railway in order to get the system parameters right. The third phase of the work was to connect the new TKL to the KTL. As experience had been gained in the first phase changeover, this phase went very smoothly and was successfully achieved in July 2002.

LESSONS LEARNT

This was perhaps the first interoperable ATC project implementation in the world and no precedence reference could be made. The interoperability management approach adopted was based on the past experience gained from the original ATC replacement project and the combined knowledge of the existing and new systems. However, there were some learning points from this project, which are documented below.

- It is essential that early efforts should be made to define a clear approach to system compatibility and to prove that the basic elements are correct. Some basic elements are easily overlooked, such as the hardware interface and communication protocols.
- These were basic to the SACEM ATC system. Problems of this kind should be identified at the compatibility study stage and should not be left unidentified until contract award.
- Critical parameters to system operations must be available. As-built information is not only essential to maintenance but also critical to system modification after a system is handed over, in particular when modification work is to be carried out by another supplier. In addition, successful demonstration of system compatibility between systems should be put in as one of the criteria of pre-tender qualification to avoid any major hiccups.
- Source codes are essential to maintenance and to the modification of a system. Every effort must be made to obtain the source code listings from the supplier. Reverse engineering process of the executable codes is a painful exercise particularly when it is carried out under the pressure of a very tight project schedule.
- Interface capability with other systems should not be underestimated. Some of the interfaces are service critical and may impact on operations and project cost if not properly handled.
- Early stage teamwork between client and contractor’s engineers is essential. The system knowledge that can be passed on to the new contractor helps speeding up the learning
curves and shorten the system development time.

- Even though operators were involved early on in the project it was found that critical comments always came after the completion of hands-on trials on the system. The operator should be encouraged to play a more active role in making decisions on the operational aspects at the design stage to minimise delay and incurring additional project cost.

CONCLUSION

Interoperability was achieved in the record time of two years even though the contractor had to manage the work without accurate "as built" information. This achievement was mainly due to the early system demonstration tests identifying the compatibility issues and the close collaboration between the client and contractor in resolving the problems.

As-built information is not only critical to system maintenance but also to system expansion and modification.

Introducing an alternative supplier reduces the project cost and eliminates the reliance on single suppliers when supporting a system.

REFERENCES

1 Tseung Kwan O Extension Project System Assurance Plan, 1997 (MTR).
2 Consultancy Agreement No. 6024 Study of Compatible ATC Systems, 1998 (MTR).
3 Compatibility Statement Milestone 1, 2 & 3, 1998 (STS).
4 Specification of SACEM Inter-equipment Interface Interoperability Demonstration, 2000 (STS).
5 Interworkability Analysis of Technical Functions, 2001 (STS).
INTRODUCTION

A year in the life of a President of our Institution goes very fast. There is much to do during the year, although a lot of the planning work takes place in the previous year. My year has flown by. It seems only a few months since the excitement of being inaugurated as the President last April, with the traditional exchange of medallions between the newly installed President and my predecessor Peter Stanley. I said at the start of my President’s Address that I was very proud to become the President of an Institution I have enjoyed belonging to for over 34 years and I was also quite humbled. I still feel the same, perhaps only more so. That same evening, the Annual Dinner was held at the Savoy Hotel. I managed to lose one of the semi-precious stones (since replaced) in the Presidential chain-of-office between the IEE building and the Savoy next door. Not an auspicious start for someone who has spent a career leaving items on one train or another. The evening though was splendid. My top table consisted of my wife, Claire, the Managing Directors of most of the larger signalling and telecommunication companies in the UK together with the Heads of Signalling and Telecommunications for Network Rail, and the Signal Engineer for London Underground. A second table housed a number of the people who have had a significant impact on my career over many years. My main guest, the Chief Executive of Network Rail John Armitt, gave a thought-provoking speech challenging us all to get the costs of signalling schemes back under control. It tied in well with the theme of my address and some of the issues I feel strongly about.

Next, at the end of May, was the Convention, held in that great city Birmingham. It was a challenge to organise a convention in the UK given the myriad private companies now involved in running the railway, but I was very pleased with the support we received from everyone who was approached, particularly with the enthusiasm of Network Rail and Chris Green from Virgin Trains. We had a wonderful week, and saw and heard about some fascinating systems. During the “summer recess” we held a seminar on Licensing, I joined the inaugural technical visit of the North American Section near Chicago at the beginning of July, Claire and I visited the Southern Africa Section in Johannesburg with Peter and Carol Stanley and we had an Aspect Conference in London; then into the main session with a first paper by Bill Scheerer and Jeff Baker on American Train Control Development. My theme for the papers this year was a general “state of the nation in S&T engineering” for both Network Rail and London Underground, coupled with experiences from the USA and Ireland. The seminars on Resignalling Metros and Electronic Interlockings and their Support Tools were both well attended and interesting. We had technical visits to Prague, in the Czech Republic, to see some rather different signalling systems, and at the end of February we went to Bournemouth to see the recently commissioned Siemens Dorset Coast Resignalling Scheme. Having visited during my career Siemens signalling systems installed all over the world, it was a pleasure to see one installed in the UK.

I have visited all the UK sections during the year, covering diverse topics from point back-drives, air-traffic control, resignalling of the East London Line, to NRS Service Centres. By the time you read this, I will have completed my visits to all the overseas sections having travelled to Perth and Melbourne in Australia and Hong Kong in March.

There have been no major IRSE initiatives started during the year, but the decision by Network Rail and London Underground to make IRSE Licensing mandatory has made us aware of the need to be able to provide the necessary HQ support to ensure that we can provide the necessary service. Thanks to the initiative and drive of Clive Kessell amongst others, we have participated with the other railway engineering institutions in the Railway Engineering Forum in trying to raise the profile of engineers by making public comment on major topics such as the Regulatory Review and the in-house maintenance decision of Network Rail. Meeting with the senior members of these other Institutions, the PWI, IMechE Railway Division and the IEE in particular, together with representatives of the Railway Forum and the Institution of Railway Operators has convinced me that we all have some common goals and a great interest in making railways successful.

By the time of the AGM, I confidently expect our first textbook devoted solely to railway telecommunications will be available, and when coupled with the issue of the Body of Knowledge CD-ROM referred to elsewhere in this report, it represents a significant contribution to the availability of impartial technical information about S&T systems for both members and non-members.

During the year, thanks to our recruitment drive, we have seen a significant increase in membership numbers, which I hope we will be able to maintain, together with an increase of the number of people holding IRSE Licences. Many other institutions envy our success in these areas.
MEMBERSHIP

The table below gives the numbers in each class of membership at the end of the year.

The total membership at the start of the year was 3,088 and there has been a substantial and most welcome increase during the year to a total membership of 3,918 at 31st December 2003, i.e. an overall increase of 27%. All classes of membership either maintained their numbers or showed an increase. It was pleasing to see the increase in the number of Students after several years of falling numbers in this grade. It was particularly gratifying to see the success of the recruitment campaign referred to in the last annual report. The campaign was aimed specifically at Accredited Technicians and resulted in a substantial increase of 643 in this grade. Council is appreciative of the hard work of the Membership Manager, Mr Derek Edney, and the Recruitment & Publicity Committee for its efforts in implementing the recruitment campaign so successfully. The challenge for the future will be to provide benefits and services so that these new members are motivated to remain in the Institution and renew their membership.

The Membership Committee met 11 times throughout the year and processed in excess of 1,000 applications or transfers of membership. The significant increases being due to the IRSE licence holder recruitment drive which resulted in the recommendation to Council of some 600 new members to the class of “Accredited Technician”.

The Council is grateful to the members of Membership Committee for their work in consideration and recommendations to Council of applications for membership and/or registration.

Obituary

It is with regret that the Council records the decease of the following 17 members during the year: H S Buttery (Honorary Fellow); H O Baldwin, J P Cunliffe, Y Gruère, R C R Hall, D J O Kidd, A G Mayne, R Savareix (Fellows); F A Coultate, F A Fellows, R F Glossop, G Nichol, R B Nicholes, P Simpson (Members); B K Cooper (Associate); R W Pickering (Technician); and R D Clark (Student).

Council was saddened by the loss of all these members, a number of whom were strong supporters of the Institution for a considerable number of years and in their various ways had contributed significantly to the Institution’s work.

LONDON HQ OFFICE

The staff of the Institution continues to occupy modest office accommodation on the third floor in Savoy Hill House. The accommodation comprises four small offices. A small storeroom is also available to store the Institution’s publications, stationery, publicity stand, archives etc. The office is staffed continuously Monday to Friday, 0900 to 1800, UK time, and outside these hours messages can be left on an answering machine. Communication via email or fax is possible at all times. The telephone system is connected to the UK railway telecommunications network permitting calls to be made on this system as well as via the UK national telecommunications operators. The Institution’s new IT system introduced during 2002 to manage the Institution membership database and to make it easier to keep track of members’ changes of address details etc is also now being used to manage subscriptions, invoices and also the administration of conferences, seminars, technical visits and the Institution examination. It is intended to transfer the existing Licensing Scheme database and management information on to the new system during 2004.

Two recent significant changes in the Institution’s work for industry to develop and certify the competence of S&T engineers have led to alterations in the personnel and organisation at IRSE HQ in Savoy Hill House. The Open Learning Project, funded by the Strategic Rail Authority, and undertaken by the Institution’s T&D Department over the last three years has largely been completed. There is now comprehensive S&T information in the public domain suitable for the development of appropriate training schemes and courses by academia and the railway industry. This will assist the signalling industry to recruit, train and develop the S&T engineers needed for the challenges of the 21st century. Network Rail and LUL took a decision during 2003 to mandate the use of the IRSE Licensing Scheme to certify the competence of S&T staff working on their signalling infrastructures. This policy has significantly increased the demand for services from the Licensing Scheme.

These developments prompted Council to implement changes to the staff and their duties at HQ in November 2003.

Linda Mogford was promoted to the post of Administration Manager and, besides being the initial point of contact for requests and queries from members and non-members alike, is also responsible for keeping the membership database up-to-date and progressing membership subscription payments.

Karen Gould took over responsibility for the day-to-day management of the Licensing Scheme. Assisting her in this task are Alex Doy and Linda Collins plus temporary clerical help as required.
Richard Hobby is responsible for the Institution’s T&D activities as Training & Development Assistant.

Mark Watson-Walker was appointed to the new position of System Manager and is now responsible for ensuring that the IT systems on which management of the Institution’s membership and licensing activities heavily depend are maintained and further developed to provide members and licence holders with good quality services.

Derek Edney, continued his work as Membership Manager and deals with all membership and Engineering Council registration matters. He also managed the recent membership recruitment campaign.

Ken Burrage, as the Chief Executive Officer of the Institution, is responsible for managing the London office and for implementing the decisions of Council. He also provides the focal point of contact for other Institutions and external organisations, liaising with the Engineering Council (UK), Government departments and the Chief Executive Officers of other professional bodies to make certain that the IRSE viewpoint is heard. He is also responsible for ensuring that the legal requirements of the Institution’s Articles of Association, the Registrar of Companies, and the Charities Commission are met.

FINANCE

The Institution had a successful year financially making a surplus of £42,074 on the Main activities and £10,219 on Licensing. The turnover was a record at over £1,100,000.

A new finance software package was introduced at the beginning of the year and which is integrated with the membership system. Thus for the first time in the history of the Institution all financial activities are managed through one software system. Membership matters are also managed using the same system and it is proposed to add licensing processes during 2004.

Subscription income improved despite there being no increase in the rates payable. Newsletters etc are now routinely sent by airmail to overseas members and so the supplementary levy for this service has ceased. Also notable is the amount of arrears recovered but this is unlikely to yield so much in future years as the level of overdue subscriptions has been considerably reduced. Sales of textbooks were high following the launch of Metro Signalling at the ASPECT 2003 conference. The attendance at the conference itself was below the budget and a small loss was made on the event. Revenue from advertising was steady and the surplus on other activities, which mainly involved training and development, was good. However, the latter source of income and expenditure is set to decline with the conclusion of the Strategic Rail Authority project.

Expenditure at the London office was generally in line with 2002 although for the first time a Membership Manager was employed for a full year. Costs of producing IRSE News increased because of its enhanced size and ten editions were published instead of the previous norm of six. £20,000 was put into the development fund in preparation for the anticipated relocation of the London office and a provision of £10,000 was made for Railway Telecommunications textbook which is in an advanced state of preparation.

The Licensing Scheme had another busy year as is shown by the income from Licence fees. Increased costs were primarily due to UKAS accreditation and the introduction of an electronic documentation management system. A good start was made on scanning assessing agent records and other documentation. The overall level of debtors was considerably reduced following a special effort to obtain payments.

The award funds all had typical years and there is nothing special to report.

The future has some financial uncertainties. As mentioned above training and development income is expected to decline over the next two years. On the other hand, licensing activities look set to increase as the scheme is mandated on the majority of practitioners in the UK signalling industry. Overall the financial position of the Institution remains good.

TRAINING AND DEVELOPMENT

The year has once again been an extremely busy one for the Training & Development Department under the chairmanship of former President Bob Barnard. We continued to work with industry partners (SRA, CIIRS) and former T&D Manager
### THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS’
**MAIN BALANCE SHEET AT 31st DECEMBER 2003**

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<tr>
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<th>31st Dec 2003</th>
<th>31st Dec 2002</th>
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<td>Less expenditure</td>
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<td>New provision</td>
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<tr>
<td>Provision for future Conferences</td>
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<td>New provision</td>
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<td>Provision for future Conferences</td>
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</tr>
<tr>
<td>Development Fund</td>
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<tr>
<td>Balance as at 1st Jan 2003</td>
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<td>4,123</td>
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<td>Add surplus for year</td>
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<td>(100)</td>
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<td>Quoted Investments at Cost</td>
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<tr>
<td>Note: Mid-Market Value</td>
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<tr>
<td>2003</td>
<td>£1,632</td>
<td>271,724</td>
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<td>2002</td>
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### THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS’
**THORROWGOOD SCHOLARSHIP BEQUEST FUND**
**BALANCE SHEET AT 31st DECEMBER 2003**

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<td>Add surplus for year</td>
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<td>Current Account with IRSE</td>
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<td>Note: Mid-Market Value</td>
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<tr>
<td>2003</td>
<td>£1,632</td>
<td>271,724</td>
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<tr>
<td>2002</td>
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<tr>
<td>National Savings Investment A/c</td>
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<td>3,148</td>
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President: C H PORTER    Vice-President: J D CORRIE    Treasurer: M H GOVAS

### REPORT OF THE AUDITORS TO THE MEMBERS OF THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS

We have examined the accounts of the Institution of Railway Signal Engineers set out on pages 4-7, together with the annual accounts of the Institution prepared in accordance with the Charities Act 1960 and the Companies Act 1985 for the year ended 31st December 2003.

As auditors of the Institution we reported to the members on 10th March 2004 on the accounts of the Institution for the year ended 31st December 2003 prepared under the Charities Act 1960 and the Companies Act 1985 and issued an unqualified audit report thereon.

In our opinion the accounts set out on pages 4-7, which have been prepared from the full annual accounts, correctly reflect the state of affairs of the Institution as at 31st December 2003 and the results of the Institution's transactions for the year then ended.

Ian Katté & Co
Chartered Accountants
Registered Auditor
Pyrford

10th March 2004
### The Institution of Railway Signal Engineers' Main Income and Expenditure Account
#### For the Year Ended 31st December 2003

<table>
<thead>
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<td>Newsletter</td>
<td>44,909</td>
<td>29,450</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation of Fixed Assets</td>
<td>5,930</td>
<td>7,758</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Maintenance</td>
<td>7,410</td>
<td>2,635</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secretarial Expenses –</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia/South Africa</td>
<td>4,417</td>
<td>3,269</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institution Entertaining/Presidential Expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textbook</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>481</td>
<td>2,411</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provision</td>
<td>10,000</td>
<td>10,481</td>
<td></td>
<td>12,411</td>
<td></td>
</tr>
<tr>
<td>Development Fund Provision</td>
<td>20,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance being excess of Income over Expenditure</td>
<td>42,074</td>
<td>25,574</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>828,144</td>
<td>568,764</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### The Institution of Railway Signal Engineers’ Thorrowgood Scholarship Bequest Fund Income and Expenditure Account
#### For the Year Ended 31st December 2003

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scholarship Prizes – Current Year</td>
<td>150</td>
<td></td>
<td>Interest on Investments</td>
<td>152</td>
<td>185</td>
</tr>
<tr>
<td>Surplus Transferred to Capital Fund</td>
<td>2</td>
<td>185</td>
<td></td>
<td>152</td>
<td>185</td>
</tr>
<tr>
<td></td>
<td>152</td>
<td>185</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS’ LICENSING SCHEME BALANCE SHEET
## AT 31st DECEMBER 2003

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accumulated Fund</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As at 1st Jan 2003</td>
<td>45,587</td>
<td>31,392</td>
<td>29,369</td>
<td>18,667</td>
</tr>
<tr>
<td><strong>Surplus</strong></td>
<td>10,219</td>
<td>55,806</td>
<td>14,195</td>
<td>45,587</td>
</tr>
<tr>
<td><strong>Current Liabilities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sundry Creditors</td>
<td>525</td>
<td>24,392</td>
<td>85,110</td>
<td>109,502</td>
</tr>
<tr>
<td>Licence Fees Received in Advance of Issue</td>
<td>13,917</td>
<td>109,502</td>
<td>303,224</td>
<td></td>
</tr>
<tr>
<td><strong>Licence Fees – Years 2-5 Fund</strong></td>
<td>395,105</td>
<td>303,224</td>
<td>495,353</td>
<td></td>
</tr>
<tr>
<td><strong>Development Fund</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance at 1st Jan 2003</td>
<td>20,000</td>
<td>30,000</td>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td>New provision</td>
<td>10,000</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Fixed Assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer &amp; Office Equipment</td>
<td>At Cost</td>
<td>45,587</td>
<td>45,587</td>
<td>873</td>
</tr>
<tr>
<td>Less Depreciation</td>
<td>22,135</td>
<td>7,234</td>
<td>17,734</td>
<td>17,734</td>
</tr>
</tbody>
</table>

# THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS’ SCHOLARSHIP FUND BALANCE SHEET
## AT 31st DECEMBER 2003

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Fund</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance as at 1st Jan 2003</td>
<td>24,915</td>
<td>23,563</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Add surplus for year</td>
<td>24,910</td>
<td>24,915</td>
<td>24,915</td>
<td>24,915</td>
</tr>
<tr>
<td><strong>Quoted Investments at Cost</strong></td>
<td>Note: Mid-Market Value</td>
<td>3,765</td>
<td>3,765</td>
<td></td>
</tr>
<tr>
<td>National Savings Investment A/c</td>
<td>21,573</td>
<td>21,027</td>
<td>21,027</td>
<td></td>
</tr>
<tr>
<td>Current Account with IRSE</td>
<td>25,338</td>
<td>24,915</td>
<td>25,338</td>
<td>24,915</td>
</tr>
</tbody>
</table>

# THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS’ ROBERT DELL BEQUEST FUND BALANCE SHEET
## AT 31st DECEMBER 2003

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Fund</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance as at 1st Jan 2003</td>
<td>10,864</td>
<td>10,771</td>
<td>10,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Add surplus for year</td>
<td>108</td>
<td>93</td>
<td>17,992</td>
<td>17,232</td>
</tr>
<tr>
<td><strong>Quoted Investments at Cost</strong></td>
<td>Note: Mid-Market Value</td>
<td>10,972</td>
<td>10,864</td>
<td></td>
</tr>
<tr>
<td>Current Account with IRSE</td>
<td>10,972</td>
<td>10,864</td>
<td>864</td>
<td></td>
</tr>
</tbody>
</table>

# THE WING AWARD FOR SAFETY FUND BALANCE SHEET
## AT 31st DECEMBER 2003

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capital Fund</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance as at 1st Jan 2003</td>
<td>11,265</td>
<td>11,386</td>
<td>10,850</td>
<td>10,850</td>
</tr>
<tr>
<td>Add surplus for year</td>
<td>11,265</td>
<td>11,265</td>
<td>415</td>
<td>415</td>
</tr>
<tr>
<td><strong>Quoted Investments at Cost</strong></td>
<td>Note: Mid-Market Value</td>
<td>11,141</td>
<td>11,141</td>
<td></td>
</tr>
<tr>
<td>Current Account with IRSE</td>
<td>11,141</td>
<td>11,141</td>
<td>11,141</td>
<td>11,141</td>
</tr>
</tbody>
</table>
THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS’
LICENSED SCHEME INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED 31ST DECEMBER 2003

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Licensing Registrar's Services &amp; Office</td>
<td>143,864</td>
<td>111,158</td>
<td>98,030</td>
<td>57,738</td>
</tr>
<tr>
<td>Appraisal Engineer’s Fees</td>
<td>50,978</td>
<td>18,474</td>
<td>52,602</td>
<td>48,961</td>
</tr>
<tr>
<td>Engineer’s Fees</td>
<td>1,755</td>
<td>4,674</td>
<td>42,983</td>
<td>31,870</td>
</tr>
<tr>
<td>Logbook – Printing Costs</td>
<td>6,941</td>
<td>9,992</td>
<td>5,665</td>
<td>3,840</td>
</tr>
<tr>
<td>Printing &amp; Stationery</td>
<td>6,026</td>
<td>2,824</td>
<td>40,703</td>
<td>21,570</td>
</tr>
<tr>
<td>Postage &amp; Telephone</td>
<td>6,316</td>
<td>2,748</td>
<td>Additional Copies of Employers’</td>
<td></td>
</tr>
<tr>
<td>Audit Fees</td>
<td>475</td>
<td>500</td>
<td>4,880</td>
<td>3,991</td>
</tr>
<tr>
<td>Miscellaneous Expenses</td>
<td>7,197</td>
<td>1,726</td>
<td>32,597</td>
<td>35,138</td>
</tr>
<tr>
<td>Depreciation of Computer &amp; Office Equipment</td>
<td>4,401</td>
<td>1,617</td>
<td>452</td>
<td>143</td>
</tr>
<tr>
<td>Accreditation</td>
<td>22,002</td>
<td>9,417</td>
<td>7,738</td>
<td>5,175</td>
</tr>
<tr>
<td>Insurance</td>
<td>7,738</td>
<td>5,175</td>
<td>Donations</td>
<td>–</td>
</tr>
<tr>
<td>Testing Review Costs</td>
<td>–</td>
<td>1,000</td>
<td>Other Income</td>
<td>249</td>
</tr>
<tr>
<td>Development Fund Provision</td>
<td>10,000</td>
<td>20,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surplus</td>
<td>10,219</td>
<td>14,195</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>277,912</strong></td>
<td><strong>203,500</strong></td>
<td><strong>277,912</strong></td>
<td><strong>203,500</strong></td>
</tr>
</tbody>
</table>

Note: Licence Fees are taken into the income account equally over the five years a licence is valid.

THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS’
SCHOLARSHIP FUND INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED 31ST DECEMBER 2003

<table>
<thead>
<tr>
<th></th>
<th>31st Dec 2003</th>
<th>31st Dec 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scholarship Prizes – Current Year</td>
<td>850</td>
<td>–</td>
</tr>
<tr>
<td>Expenses</td>
<td>11</td>
<td>–</td>
</tr>
<tr>
<td>Surplus transferred to Capital Fund</td>
<td>(5)</td>
<td>1,352</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>856</strong></td>
<td><strong>1,352</strong></td>
</tr>
</tbody>
</table>

THE INSTITUTION OF RAILWAY SIGNAL ENGINEERS’
ROBERT DELL BEQUEST FUND INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED 31ST DECEMBER 2003

<table>
<thead>
<tr>
<th></th>
<th>31st Dec 2003</th>
<th>31st Dec 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scholarship Prizes – Current Year</td>
<td>300</td>
<td>308</td>
</tr>
<tr>
<td>Surplus transferred to Capital Fund</td>
<td>108</td>
<td>93</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>408</strong></td>
<td><strong>401</strong></td>
</tr>
</tbody>
</table>

THE WING AWARD FOR SAFETY FUND
INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED 31ST DECEMBER 2003

<table>
<thead>
<tr>
<th></th>
<th>31st Dec 2003</th>
<th>31st Dec 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Award</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Surplus transferred to Capital Fund</td>
<td>(124)</td>
<td>(121)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>376</strong></td>
<td><strong>379</strong></td>
</tr>
</tbody>
</table>
Karen Gould and Richard Hobby, T&D Assistant, have maintained regular contact with the industry to ensure the IRSE’s work remains relevant to its needs.

**SRA-FUNDED PROJECTS**

**Body of Knowledge**

The IRSE’s Body of Knowledge has been produced as part of the Institution’s commitment to promote for the public benefit the advancement of the science and practice of railway signalling and telecommunications and to maintain high standards of practice and professional care amongst those working within the industry. Commissioned by the Strategic Rail Authority, the Body of Knowledge has been produced to act as a reference for those seeking to gain and maintain competence in the profession within the UK context. It is derived from and combines the earlier work of the IRSE’s Examination, Licensing, and Training & Development Committees and draws on the experience of the Institution’s international membership. It is a handbook rather than a textbook and has been designed to be used by individuals and organisations alike, from initial entry into the profession, right the way through to the most seasoned of practitioners seeking to update and continue their professional development in an increasingly competitive, technology advancing and safety sensitive market place. It may be used by those providing initial training and education to new entrants to the profession or as a self-help tool for those wishing to maintain and improve their own professional competence as part of their continuing professional development. It may also be used to refresh or update members who are returning to the industry, or to a particular topic, after a break.

The Body of Knowledge is now available in CD-ROM format from the Head Office.

**IRSE Examination Student Resource Pack**

The production of the IRSE Examination Student Resource Pack has made great progress during 2003 and it is anticipated that Modules 1 and 5 will be available in CD-ROM format for purchase at the end of March 2004. Each module will consist of informative text that supports the examination syllabus, questions from previous year’s exam papers and examiners comments. It is hoped that Modules 2, 3 and 7 will be available by May 2004.

**BTEC Railway Signalling Teaching Resource Pack**

A working party comprised of industrialists and academics has been established and a project is well under way to provide a teaching resource pack for colleges offering the two Railway Signalling units as part of the BTEC National Certificate in Operations and Maintenance Engineering. The resource pack will take the form of a CD-ROM and will comprise of detailed information that supports the syllabus. The pack is expected to be ready for release in June 2004.

**Technician Training Scheme**

Participants at the Modern Apprenticeship Workshop in 2002 agreed that a common training scheme that fulfilled the requirements of the industry for basic level designers and testers as well as advanced installers and designers should be produced. The output will take the form of an employers manual and an employees logbook. The working party that was formed to undertake the production of the Technician Training Scheme is currently reviewing the employers manual. The production of the scheme is due for completion in June 2004.

**IRSE PROFESSIONAL EXAMINATION**

Again, there were a record number of over 130 candidates applying to sit the IRSE exams this year, with exam centres in Thailand, Hong Kong and Australia, as well as UK centres in Scotland, York, Birmingham, Bristol, North London and Croydon. In total 236 modules were sat with an overall pass rate of 45%. Lessons were learnt from the previous year and the examination generally ran very well again.

**T&D ANNUAL CONFERENCE**

Over 160 people attended the 2003 Training & Development annual conference that was centred on the decision taken by Network Rail and London Underground to make IRSE Licences obligatory for all employees and contractors working for them. The conference was a huge success and the IRSE Council thanks all those who helped to achieve this and to the sponsors of the conference: London Underground and Network Rail.

**AWARDS**

**Thorowgood Scholarship**

The Thorowgood Scholarship is awarded annually under a bequest of the late W J Thorowgood (Past President) to assist the development of a young engineer employed in the signalling and telecommunications field of engineering and takes the form of an engraved medallion and a cheque for a sum to be used to finance a study tour of railway signalling installations or signalling manufacturing facilities. The award is made to the Institution young member attaining at least a pass with credit in four modules in the Institution’s examination.

The Thorowgood Scholar for 2002 was Mr Matthew Lupton, Network Rail Manchester, and he was presented with his award at the annual dinner following the Annual General Meeting in April 2003.

**Dell Award**

Under a bequest made by the late Robert Dell OBE (Past President) this award is made to an employee of London Underground Ltd for achievement of a high standard of skill in the science and application of railway signalling. The winner of the 2003 Dell Award was Mr Matt Shelley, of Metronet Rail BCV Ltd, and he was presented with his award at the annual dinner following the Annual General Meeting in April 2003.

**Wing Award for Safety**

The 2003 Wing Award for Safety, commemorating the life and work of the late Peter Wing (Fellow), was presented by the President to Mr Aiden Nelson, a nominee of Railway Safety Ltd, at the National Railway Engineering Safety Awards held in Birmingham on 10th April 2003 for his contribution to improving track safety performance.
President's Award

The President's Award is made only rarely and is given personally by the President to recognise exceptionally meritorious service to the profession.

Mr Stanley made the award this year to Dr Peter Winter, of Swiss Federal Railways, in recognition of his leadership, personal commitment and efforts over a period of more than ten years in encouraging and supporting the many engineers in the railways and the supply industry who had contributed their efforts to the development of the European Train Control System.

The President presented Dr Winter with the President's Award medallion suitably engraved and a certificate of the award citation at the Annual General Meeting in April 2003.

LICENSING

The IRSE Licensing Scheme has seen a particularly busy year. The obligatory application of the scheme by Network Rail and London Underground, as announced at the June conference in London, has led to a significant increase in the number of Licence and Assessing Agent applications received, which continue to increase almost exponentially. One thousand five hundred and forty-four new and renewed licences were issued, which represents a 14% increase on the previous year and gives a total of 4,710 valid licenses at the end of the year. Sales of the IRSE Professional Development Folder and Licensing Scheme Logbook have also continued to be high with 1,141 being sold in 2003.

John Corrie continued as Chairman of the Scheme for a second year in order to provide some continuity for the scheme during this transition phase. Philip Wiltshire took on the role of Acting Minutes Secretary towards the latter half of the year, whilst this new position was advertised in IRSE News.

A total of 40 Assessing Agents are currently shown on the Licensing Scheme records, 28 of which currently have full approval. Eight new Assessing Agents applied during 2003, Atkins Danmark A/S, Balfour Beatty Rail Infrastructure Services at Ashford, Balfour Beatty Rail Infrastructure Services at Woking, Balfour Beatty Rail Infrastructure Services at Romford, Hawthorns Project Management Services, Serco Rail Maintenance Services, STS Lionverge and Nuthall Finchpalm. A total of 23 surveillance visits were carried out during the year, the remainder to be carried out in the early part of 2004. Two Assessing Agencies did not do well during their visits and join a third that had already been suspended after a previous visit. One company has cancelled its Assessing Agency status due to a reorganisation of companies and a further two are currently in abeyance. All Assessing Agencies are currently working towards the new criteria for Competence Assessors so that they may continue to operate as fully approved Assessing Agents this year. The new criteria mainly relate to the change to A1 certification, which replaced the old D32/33 assessor qualifications at the end of 2003. An extensive Competence Assessor interview programme was introduced at the latter end of the year and will continue into the early part of 2004.

The annual UKAS audit unfortunately gave rise to a number of non-compliance reports arising from the UKAS interpretation of EN 45013, the personnel accreditation standard that the Scheme has chosen to operate. These added to two NCRs that were still not closed from the previous audit and UKAS decided to impose a sanction on the scheme by not permitting the IRSE to continue to put the UKAS accreditation mark on the licences we issue. Part of the reason for this is a lack of understanding between the IRSE and UKAS about clauses relating to conflicts of interest between the IRSE Council (the scheme's governing body) and the Licensing Committee (the Certification Body). A subsequent meeting has helped both parties to better understand each other's interpretation. However, it was also clearly demonstrated that the scheme needed to expand and adapt both in terms of management and resources, specifically to better document the control of the Assessing Agents who are the scheme's sub-contractors.

In order to achieve this Karen Gould was promoted from her previous position of T&D Manager to head up the Licensing team in November. Alex Doy was also recruited to replace Gordon Thorne who left us, also in November. The scheme is now evolving to cope with the increased workload with the help of additional temporary staff as needed.

The scheme continues to base its new and revised competence standards on the National Standards produced by the Occupational Standards Council for Engineering (OSCEng) under the guidance of Mark Watson-Walker who had previously led the development of the scheme to its present high regard by our industry. Mark continues to provide his expert guidance to the scheme on standards and systems issues and 14 new or revised standards were issued at the end of the year as part of the latest amendment to the Licensing Scheme documentation.

The year ahead promises to be another exciting year for the Licensing Scheme as it continues to grow and adapt to our customers’ developing needs for competency management, and our major customers actually making a growing number of licence categories obligatory for certain tasks.

ANNUAL GENERAL MEETING

The 90th Annual General Meeting was held at the Institution of Electrical Engineers, London, on Friday 25th April 2003 when the composition of the new Council was announced, as follows:

President: C H Porter
Vice-Presidents: J D Corrie
J Poré

Members of Council from Class of Fellow:
W J Coenraad A J Fisher
J D Francis F Heijnen
F How J M Irwin
P A Jenkins I Mitchell
D Weedon J F Wilson
Members of Council from Class of Member:
D S Angill D W Crabtree
Mrs C Porter D N Woodland
N C Wright K L Walter

Members of Council from Class of Associate Member:
J Haile C Lake

The formal proceedings included a hearty vote of thanks to the following members, for their long and constructive association with the work of the Institution, who were retiring from Council:
- A Wilson, Fellow, Council member for 14 years and President in 1997/1998;
- H Uebel, Fellow, Council member for 9 years and President in 2000/2001;
- R Halse, Member, Council member for 12 years; and
- P Lane, Member, Council member for 10 years.

This was followed by the inauguration of the new President, Mr C H Porter, who gave his Presidential Address. A transcript of this will appear in the Proceedings.

COUNCIL MEETINGS

Seven meetings of the Council were held during the year when the business of the Institution was conducted. Much of the business, although routine, is vital to the ongoing management of day-to-day Institution affairs. The remainder of the business was concerned with the development of the Licensing Scheme and further extension of the Institution’s activities in support of the training and professional development of IRSE members. Council is always delighted to receive visits from colleagues around the world and distinguished visitors this year included Mr W Scheerer, Chairman of the North American Section, who attended two Council meetings. Mr D Dyson, Chairman of the York Section, was also a regular attendee at Council meetings. The Articles of Association provide for the current chairpersons of local sections, both in the UK and overseas, and also country vice-presidents to attend Council meetings and Council is always pleased to welcome any who are able to be present at a Council meeting in London.

ANNUAL DINNER

The Savoy Hotel, London, was the venue for the 39th Annual Dinner held following the Annual General Meeting on 25th April 2003. Approximately 480 members and their guests were present.

Mr John Armitt OBE, Chief Executive Network Rail Infrastructure Ltd, was the principal guest on this occasion.

Prior to the meal commencing an innovation in the arrangements for this year saw the immediate Past President, Mr Peter Stanley, present the Dell Award to Matt Shelley and the Thorrowood Scholarship award to Matthew Lupton. They received their awards amidst enthusiastic applause.

Another innovation this year, for the speech of the principal guest to be delivered before the meal, was taken. The newly installed President, Mr Colin Porter, introduced his principal guest and Mr Armitt spoke of the current high costs of signalling schemes and the complicated process and expense of introducing new technologies and said that IRSE members have a key role to play in tackling these issues.

Following the speeches an excellent 4-course meal was efficiently served to the large gathering by the staff of the Savoy.

This was another most successful and enjoyable evening with a near maximum attendance at the event.

MEMBERS’ LUNCHEON

The fifth annual Members’ Luncheon was held on 18th June 2003 when 90 members of the Institution, including 12 Past Presidents and 13 members with over 50 years membership, took luncheon at the Victory Services Club in Seymour Street, London. An enjoyable 3-course luncheon with wine was consumed with pleasure.

The 79th person to serve as President since the Institution’s formation in 1912, Mr Colin Porter, addressed the members present with a brief speech and mentioned the forthcoming programme for his presidential year of office.

Mr K W Burrage, IRSE Chief Executive, reported on the current membership of the Institution, which continues to grow steadily. Thirty-five members have over 50 years’ membership, 13 of whom were able to accept the President’s invitation to be present at the luncheon as guests of the Institution. Members having over 60 years membership were represented at the lunch by Mr Ronald Post. Two members have over 70 years membership. The longest serving member is now Mr Wilfred Hardman, residing in New Zealand, and aged over 90, with 74 years of membership. He corresponds regularly with the office and had sent his best wishes to those present at the luncheon. Many other members who were unable to attend in person had also sent letters of apology and good wishes.

Members attending the luncheon with over 50 years membership of the Institution were Messrs G Amoss, R Bugler, S Buttery, H Fensom, I Foster, B Grose, E Harris, H Jones, F Kerr, J Lethbridge, G Moppett, M Page and R Post.

Regrettably 15 members had died since the 2002 lunch including Harry Baldwin, a member for 70 years, Armand Cardani, a member for 61 years, the oldest Past President and a regular attendee at these lunches since their commencement five years ago, and also Ron Hall, a valued member of the Membership Committee. The Institution is grateful for the service that all of these friends and colleagues performed for the Institution during their time with us.

The luncheon concluded in a most pleasant and happy atmosphere of friendship and camaraderie and had been thoroughly enjoyed by all present.

INTERNATIONAL CONVENTION

The International Convention was held in Birmingham UK between 26th-30th May 2003,
returning to the United Kingdom after an absence of 16 years. Two hundred and thirty-three members and guests representing 16 countries from around the world were present at the event. Following the welcome speeches members enjoyed a number of technical presentations and viewed a wide variety of interesting technical installations and visits. Whilst the members were engaged on technical activity a number of interesting and enjoyable tourist visits were arranged for the guests, and members and guests together enjoyed a number of excellent social events.

A full report on the Convention has already been published in IRSE News and will also appear in the Institution’s proceedings. The Council is appreciative of the arrangements made by the UK Convention organising committee and the officials and staff of the railways in the UK, and also for the generous support of the Convention’s sponsors that made the occasion a memorable and enjoyable one. Particular mention should also be made of hard work and dedication of the Convention Organiser, Mr Ray Weedon, to whose organisational skill and expertise Council is again indebted for ensuring another successful International Convention.

ANNUAL DINNER AND DANCE

Due to the dwindling attendances in recent years and to the opportunities afforded by the alternative social events arranged in connection with the Aspect conference this year it was decided not to hold an Institution dinner dance during 2003. This matter will be kept under review and if there is judged to be sufficient demand from the membership for a social event of this type then suitable arrangements will again be made.

LONDON TECHNICAL MEETINGS

The level of attendance at the six technical meetings held in London easily maintained the levels of recent years at over 100 plus at each meeting and those who were present enjoyed good topical papers and interesting lively discussions. The Council is grateful to those who find the time from their increasingly busy schedules to prepare and present papers at these meetings. Thanks are especially due to Mr B Grose, Papers Assistant Editor, for the invaluable service he has provided over many years in the transcription and editing of the tapes of the discussion following the London papers for publication later in the Proceedings. Mr Grose has unfortunately had to retire and Mr Peter Grant has now taken over this role. Thanks are also due to Mr Colin Bailey, the Papers Editor, for proof-reading and preparing the papers for publication. Mr Bailey also retired this year and Mr David Stratton has filled this position.

CONFERENCES AND TECHNICAL VISITS

The Institution programme again contained a variety of opportunities for attendance at technical conferences and technical visits.

This year conferences were held on 27th November in London on Resignalling Metro Lines and on 27th February in London on Interlockings and Support Tools.

Technical visits were held on 28th-29th November to Prague and to Bournemouth on 27th-28th February.

These events received a good level of support and Council is appreciative of the hard work and effort contributed by those concerned with the organisation and administration of the events and especially to Keith Walter for his help with the technical visits.

Another in the Institution’s series of International Aspect Conferences was held in London between 23rd-25th September. A full report on this has already appeared in IRSE News. Council is appreciative of the efforts that Mr A Fisher and his conference organising committee undertook to ensure the success of this event.

PUBLICATIONS AND PUBLICITY

IRSE News

The Institution continues to look for improvements in the service it provides to members. With this in mind a further step change was made to IRSE News. Since May 2003 publication has been programmed to occur on ten occasions during each year, now making the newsletter monthly, except for combined July/August and December/January editions. To coincide with the greater frequency a new look was also launched, together with additional pages, including a full-page cover picture to each edition. This change, part way through the year, resulted in the mailing of nine issues of IRSE News to members during 2003 comprising a total of 228 pages, almost doubling the number over the previous year. To assist the editors with the additional workload external professional help has been procured in the laying-up and production.

Content has covered a wide variety of topics including contributions from around the world, whilst the letters section continues to provide a forum for lively feedback and debate. Since October the London technical papers have been included in the body of the newsletter rather than being mailed separately. Revised printing arrangements and satisfactory advertising income have contributed to containing the cost of production. Feedback from members regarding the new format has been largely complimentary. The editors acknowledge the support of contributors and wish to encourage all members to offer articles, letters or photographs for inclusion.

The Council is grateful to the Honorary Editor, Mr J D Francis, and to the Honorary Assistant Editor, Mr A J R Rowbotham, for the work they undertake in producing this very important means of communication with and between members of the Institution.

Proceedings

The Institution’s Proceedings for 2002/2003 were published as usual in October, within six months of the close of the session and the Council is grateful to Ms Andrea Parker, Honorary Editor, for her work leading to such prompt publication. This year for the first time the Proceedings were also made available in CD-ROM format. All members were given the
opportunity to indicate their preference for receiving the Proceedings in either hard copy or the new CD-ROM version in future years.

Website

The Institution’s website has again seen a number of improvements in the last year and favourable comments are often received from website visitors as to its format and ease of use compared with other sites visited.

The website received its annual review in September 2003, at which time the menus were completely revised in order to allow those web pages that are used more often to be directly accessible from the main menu, instead of via sub-menus. Hence one button click of the mouse directs the user to specific pages of interest.

The timing of the annual update allows for details of technical meetings and events held at the London centre, together with those held at UK provincial centres, to be publicised as early as possible and ensure the site remains without dated information. This allows both members and non-members alike the opportunity to enter details in their diaries, thus ensuring they do not miss important events. Where available, information is also provided for events held by the Younger Members’ Section and overseas sections. In some cases, hyperlinks are provided to registration and application forms for technical visits, conferences, dinners etc.

The website, which is managed by the Institution’s Publicity Officer and Council member David Crabtree, has new features added to it regularly, to make the website easier to use and more informative. David is always keen to point out that constructive feedback is welcome, providing a useful way of gauging visitors’ needs for the website.

The website and IRSE News are the two main methods of interface available to members. The website contains invaluable reference information for members and any additions or changes are highlighted regularly in IRSE News. Non-members are able to use the website to find out more about the Institution and to obtain membership information directly without having to contact the HQ office. The “Restricted Area” of the website, with strict access controlled by encrypted usernames and passwords, allows authorised users the opportunity to view information that would otherwise only be available by being sent copies by post. This has proved invaluable to the IRSE Council and officials in the last year, saving the Institution postage charges and enabling official access to IRSE documents when away from their offices.

Following the decision to remove the direct hyperlinks to email addresses (in respect of IRSE officials) from the website to reduce the volume of spam received in the office, the facility to contact the IRSE HQ office by use of several on-line enquiry forms available on the website was made available.

Council is grateful to David Crabtree for his continued assistance in maintaining the Institution website.

Recruitment Activity

The Recruitment & Publicity Committee has met four times throughout the year and is grateful to the companies who have sponsored these meetings by the provision of the venue and hospitality. Work continues in the active promotion of the Institution’s activities throughout the profession.

The Committee assisted in the development of a recruitment campaign that was targeted at those IRSE licence holders who were not presently members of the IRSE. The Bye-Laws of the Institution allow those who hold a valid IRSE Licence (above “Assistant” level) to become members in the class of “Accredited Technician”. It was identified that there were in excess of 3,500 licence holders that met this criteria. An individual invitation was made to these licence holders for them to apply for the grade of “Accredited Technician”. As a result some 600 responses were received and subsequently processed by Membership Committee for membership of the Institution.

The IRSE publicity stand was deployed at both the InfraRail 2003 Exhibition, held at the GMex Centre Manchester, and at the IRSE Aspect 2003 Conference in London. The Committee expresses its thanks to the volunteers who manned the stand throughout these exhibitions.

Council is appreciative of the efforts of Derek Edney and the members of the Recruitment & Publicity Committee for all the work they do to promote the activities of the Institution and to encourage people to become members.

RELATIONSHIPS WITH OTHER BODIES

Engineering Council

The Institution is a fully nominated body of the Engineering Council, licensed to register Incorporated Engineers and Engineering Technicians. During the year the Institution registered one Incorporated Engineer and one Engineering Technician.

Institution of Incorporated Engineers

The collaborative arrangements with the Institution of Incorporated Engineers that permits joint membership of both Institutions at reduced subscription levels has been continued.

The Council is grateful to the IIE for its ready help and co-operation in providing accommodation and services at Savoy Hill House for IRSE use.

Institution of Railway Operators and the Permanent Way Institution

The Institution continues to liaise with operating colleagues in the development of the Institution of Railway Operators and also with engineering colleagues in the Permanent Way Institution in exchanging ideas and information.

Railway Engineers’ Forum

Together with the Institutions of Civil, Electrical and Mechanical Engineers, the Institution continued as a member of the Railway Engineers’ Forum that arranges technical meetings on railway engineering topics of multi-disciplinary interest. The IRSE took
over the chairmanship of this body for two years with effect from 2003 and Past President Mr C Kessell is now the Railway Engineers’ Forum Chairman. The Permanent Way Institution is a recent addition to membership of the Railway Engineers’ Forum.

INTERNATIONAL TECHNICAL COMMITTEE


COMMITTEES

The following were appointed to serve on the standing committees shown and the Council extends its thanks to them for the valuable work they undertake on behalf of the Institution:

Management Committee: Messrs J D Corrie (Chairman), R E B Barnard, J D Francis, M Govas, J Irwin, C Kessell, J Poré, C H Porter, P W Stanley, F Wilson, D Woodland and K W Burrage (Secretary).

Membership Committee: Messrs C Kessell (Chairman), D S Angill, P Batley, R Blakely, J D Corrie, D A Edney, P Grant, A P Gunner (EC (UK) rep), R Harding, C H Porter, Mrs C Porter, P W Stanley, J Tilly (Secretary), F Wilson and K W Burrage.

Finance Committee: Messrs P W Stanley (Chairman), R E B Barnard, J D Corrie, M H Govas (Treasurer/Secretary), C Kessell, J Poré, C H Porter and K W Burrage.

Training & Development Committee: Messrs R E B Barnard (Chairman), W Alexander, B D Chowdury, M Fitzgerald, Ms K Gould, A Fisher, O King, A Kornas, M Moore, R Moore, R Nelson, G Neacy, M Poole, J Sadler, A P Smith, C R White and R Hobby (Secretary). Advisors: K W Burrage (IRSE Chief Executive), P Wason (IIE Chief Executive).

Examination Committee: Messrs C R White (Chairman), I Brown, K Donnelly, K Harrison, D A Hotchkiss, C Lovelock, D Jones, A Kornas, T Lee, S Rodgers (Secretary), R C Short, N T Smith, C I Weightman, and D N Woodland and R Hobby.

International Technical Committee: J Poré, Chairman (France), W J Coenraad (Netherlands), J Gal (Hungary), E O Goddard (UK), G Hagelin (Sweden), Y Hirao (Japan), S Hiraguri (Japan), C Kessell (UK), F Kollmannsberger (Germany), L Lochmann (Czech Republic), L Matikainen (Finland), F Montes (Spain), J Noffsinger (USA), R Seiffert, (Switzerland), C Sevestre (France), O Stalder, (Switzerland), P W Stanley (UK), K Stolte (Netherlands), J Stutzbach (Germany), K Suwe (Suwe), H Uebel (Germany) and A Zierl (Austria).

Licensing Committee: Messrs J D Corrie (Chairman), J W A Colvin, D Harford, F How, P Mann, M Poole, P Wilshire (Secretary) and D N Weendon. Ex officio: C H Porter, Ms K Gould (Licensing Registrar), M Watson-Walker and R Bell. Advisors: K W Burrage (IRSE), M D Moore, and P F Wason (IIE).


Internal Auditors: C Kessell, Mrs C Porter and F Wilson.

OVERSEAS, UK LOCAL AND YOUNGER MEMBERS’ SECTIONS

The overseas sections of the Institution in Australasia, Hong Kong, North America and Southern Africa, and the Midland & North Western, Plymouth, Scottish, Western and York Sections in the United Kingdom all continue to operate successfully. Each section arranged its own programme of meetings and other events during the year, details of which will appear in the Proceedings. Local meetings of members in Central Europe continued to be held occasionally.

The Younger Members’ Section continues to arrange meetings during the year for the younger members of the Institution. This year’s programme included the usual meeting for the IRSE Examination review as well as a seminar event in association with Aspect 2003.

The Council wishes to record its thanks to the Officers, Committee members and all others in the Sections, both overseas and in the UK, for the excellent work they undertake in organising the meetings and other events. Their dedication, hard work and enthusiasm, when under increasingly heavy day-to-day work pressures, is a major contribution to the success of the Institution.

The Officers of the Sections were:

Overseas

Australasian Section: Chairman, Mr K I Walker; Country Vice-President, Mr P R Symons; Vice-Chairman, Mr C R Page; Hon Secretary & Treasurer, Mr G Willmott.

Hong Kong Section: Chairman & Country Vice-President, Mr P Gaffney; Vice-Chairman, Mr F Fabbian and Mr P K Wai; Hon Secretary, Mr F L Hui.

Southern African Section: Chairman, Mr R C Gould; Country Vice-President, Mr A le Roux; Vice-Chairman, Mr R W Kohler; Hon Secretary, Mr V Bowles; Hon Treasurer, Mr J C van de Pol.

North American Section: Chairman, Mr W Scheerer; Vice-Chairman, Mr D Thurston; Secretary/Treasurer, Mr G Young.

UK

Midland & North Western Section: Chairman, Mr I Mitchell; Vice-Chairman, Mr I Allison; Hon Secretary, Mr W Redfern; Hon Treasurer, Mr C Williams.

Plymouth Section: Chairman, Mr J Stiles; Vice-Chairman, A D Wilson; Hon Secretary & Treasurer, Mr D Came.

Scottish Section: Chairman, Mr P Humphreys; Hon Secretary, Mr A King; Hon Treasurer, Mr A McWhirter.

Western Section: Chairman, Mr P Martell; Hon Secretary, Mr D Gillanders; Hon Treasurer, Mr M Brookes.

York Section: Chairman, Mr D Dyson; Hon
Secretary, Mr J Maw; Hon Treasurer, Mr R Price.

Younger Members’ Section: Chairman, Mr J Haile; Hon Secretary, K Goodhand; Hon Treasurer, C Oyekanmi.

ACKNOWLEDGMENTS

Our Institution thrives because of the combination of the contribution of our full- and part-time staff in our London office, led by Ken Burrage, our Chief Executive, and our volunteers who do so much, not only in the UK but throughout the world to arrange papers, seminars and newsletters for our members. We all owe each of them a debt of gratitude for the commitment they give. Martin Govas has been our Treasurer for ten years now and has overhauled our finance and membership database systems during that time. Mark Watson-Walker, having made a substantial contribution to the Licensing Scheme for over ten years, has taken up the Systems Manager role, with Karen Gould taking over the management of the Licensing Scheme as it faces additional challenges. Linda Collins has been the most patient and hard-working of individuals in her support role to the Licensing Scheme. As for Linda Mogford, words fail me! She not only keeps on top of all the day-to-day routine administration of the Institution in her own particular way, but remains cheerful and makes very welcome cups of tea for the President and any other visitors to the London office. Derek Edney has not only got a good grip on the membership administration but has led the recruitment drive that has been so successful. Richard Hobby, recently recruited to the full-time staff, shows great promise with his organising of our seminars and our T&D activities. The chief conductor though, Ken Burrage, keeps all plates in the air, and with his calm, careful and considered reasoning provides tremendous support to incoming, current and outgoing Presidents, and I am truly grateful for that. It is a fact that Presidents last a year and the IRSE appears to go on forever!

For my own particular year’s events, I want to thank especially, Quentin MacDonald who managed a different stage management of the Annual Dinner, Bill Boddy and Ray Weedon and all the 2003 Birmingham Convention Organising Committee, Alan Fisher and the 2003 Aspect Conference Organising Committee, and Jacques Poré and Bob Barnard who both thought up and organised the two technical seminars. Keith Walter, together with Libor Lochman from Prague, and Keith Jackson from Siemens, organised the two technical visits, with help from many others in their own sectors. The authors of all the London papers during the session produced their papers on time and all were available for the meeting despite some necessary rearrangement thanks to the fast footwork of David Stratton who edits the papers. I want to thank them for their hard work in writing these papers and presenting them so well. All those involved in organising the various Presidential Visits, particularly those overseas, made a tremendous effort to make the visits interesting and memorable and I am truly grateful to Ryan Gould and his wife Charlene and all the rest of the Southern African Section Committee for arranging our visit to South Africa, Phil Gobetz, Mike Donald and Richard Bell and all the Australasian Section Committee for our visits to Perth and Melbourne, and Francis Hui, Franco Fabbian and Michael Hamlyn for organising our Hong Kong visit.

My employers, Lloyd’s Register Rail Limited, have been very supportive to me and the Institution during my year of office and I owe an enormous debt of gratitude to Paul Thomas, my boss and the company’s Managing Director, for his patience in managing events around my rather fixed diary, together with my own staff who from time to time have wondered where I have been for the last year. Michael Hamlyn recruited me three years ago knowing I had these upcoming responsibilities, and I want to thank him for his faith, trust and support during this period. My wife Claire has joined me at most functions throughout the year and has put up with the various crises that naturally occur with patient good humour and warm support.

Finally, I want to thank you all, our members, for giving me such a wonderful opportunity to be your President for a year and for participating so well in the various events that have been organised throughout the world. It has been a marvellous year and one which neither Claire nor I will ever forget.

C H PORTER
President
Savoy Hill House
Savoy Hill
London WC2R 0BS

March 2004
PREVIOUS MINUTES AND AUDITOR’S REPORT

It was proposed by Mr R Blakey (Fellow) and seconded by Mr J Waller (Hon Fellow) and carried that the minutes of the 90th Annual General Meeting held on 25th April 2003 be taken as read and they were signed by the President.

The President then asked the Secretary to read the Report of the Auditor, which he did.

ANNUAL REPORT AND ACCOUNTS 2003

The President commented upon the main features of the Annual Report for 2003, in particular he referred to the 27% increase in membership that had been achieved by the recruiting campaign, the decision by Network Rail and LUL to make the IRSE Licensing Scheme obligatory, and the high number of candidates applying to sit the Institution examination (130 in 2003).

At the request of the President, the Institution’s Treasurer, Mr M H Govas, reviewed the Statements of Account and Balance Sheets for the year. Mr Govas said a satisfactory financial result had been achieved by the Institution in 2003. £1M turnover had been achieved for the first time with a surplus of £42,000 and the Licensing Scheme had also achieved a surplus of £10,000. A provision has been made in the accounts for the Institution to move offices as it is expected that this will be necessary in the near future in connection with the IEE plan to refurbish the Savoy Hill House offices. The President then asked whether anyone present wished to discuss any point in the Annual Report and Accounts. Mr D McKeown (Fellow) asked if the Institution had queried the rates charged by the IEE for accommodation and refreshments at meetings as these rates had risen considerably recently. Mr Porter explained that the President had written to the IEE President concerning this matter and had received a reply that indicated that the IEE were not prepared to make any discount on the IEE standard rates for the Institution, despite the IRSE’s very long association with the Savoy Place premises. This was disappointing, although not unexpected, given the IEE’s current policy on maximising the commercial use of its premises and facilities. The Institution had taken steps to minimise the impact by seeking alternative accommodation for certain of its meetings where this was appropriate.

There being no further questions raised, it was proposed by the President, seconded by Mrs C Porter (Member) and carried that the Annual Report and Accounts for the year 2003 as presented be adopted.

COMPOSITION OF COUNCIL 2004-2005

The President announced that as a result of the ballot that had been held the Institution’s Council for the year 2003-2004 would be composed as under:

President: J D Corrie
Vice-Presidents: J Poré, J D Francis

Members of Council from class of Fellow:
W J Coenraad, A J Fisher, F Heijnen, F How, J M Irwin
P A Jenkins, I Mitchell, A Simmons, D Weedon, J F Wilson

Members of Council from class of Member:
Mrs C Porter, A S Kornas, G Simpson
D N Woodland, N C Wright, K L Walter

Members of Council from class of Associate Member:
J Haile, C Lake

The President proposed a vote of thanks to the following members of Council, who were retiring, for their service to the Institution:
• C Kessell, Fellow, Council member for 16 years and President in 1999/2000;
• S Angill, Member, Council member for eight years.

The meeting showed its appreciation and thanks with applause.

AUDITOR

The President announced that the Institution’s Auditors, I Katte & Co, of 8 Wexfenne Gardens, Pyrford, Woking, Surrey, had indicated their willingness to continue in this capacity for a further year and it was the recommendation of the Council that they should do so. It was proposed by Mr R Harding (Fellow), seconded by Mr D McKeown (Fellow) and carried that I Katte & Co be appointed Auditors to the Institution for the year 2004.

OTHER BUSINESS

AWARDS

Dell Award

The Dell Award is made annually under a bequest of the late Robert Dell OBE (Past President). It is awarded to a member of the Institution employed by
London Underground Ltd (or its successor bodies) for achievement of a high standard of skill in the science and application of railway signalling. The award takes the form of a plaque with a uniquely designed shield being added each year with the recipient’s name engraved on it and a cheque for £300 to spend as the recipient wishes.

The winner of this year’s Dell Award is George Clark, of Tube Lines Ltd, and Mr Porter presented Mr Clark with the Dell Award amidst applause.

**Thorrowgood Scholarship**

The Thorrowgood Scholarship is awarded annually under a bequest of the late W J Thorrowgood (Past President) to assist the development of a young engineer employed in the signalling and telecommunications field of engineering and takes the form of an engraved medallion and a cheque to be used to finance a study tour of railway signalling installations or signalling manufacturing facilities. The award is made, subject to satisfactory interview, to the Institution young member attaining at least a pass with credit in four modules in the Institution’s examination.

The Thorrowgood Scholar for 2003 is Mr James Carney, a signal engineer at Cardiff with Mott MacDonald.

Mr Porter presented Mr Carney with the Thorrowgood Scholarship medallion and a cheque for £1000 amidst applause.

**York Section Golden Jubilee**

The President explained that the York Section of the Institution had been in existence for 50 years this year, having been formed in 1954 following a petition to Council by York members, and to celebrate its Golden Jubilee a specially engraved medallion on a crimson ribbon was presented to the York Section chairman Mr D Dyson amidst congratulatory applause.

**RAILWAY TELECOMMUNICATIONS TEXTBOOK**

The President announced the publication of the Institution’s latest textbook entitled “Railway Telecommunications”, which had been produced in very timely fashion by a project committee under the chairmanship of Mr C Kessell. The President invited Mr Kessell and members of the textbook project group present at the AGM to come forward and receive congratulations from the President and the appreciation of the AGM for an excellent job well done.

**NEWLY ELECTED PRESIDENT TAKES THE CHAIR**

The retiring President, Mr C H Porter, then invited the newly elected President, Mr J D Corrie, to take the chair, which he did amidst applause, and Mr Porter invested him with the Presidential Chain of office.

**VOTE OF THANKS TO MR C H PORTER**

Having taken the chair, Mr Corrie invested Mr Porter with his Past President’s Medallion and proposed a hearty vote of thanks to him for the excellent way in which he had carried out the Presidential duties during the past year. Mr Corrie’s proposal was carried with enthusiastic applause.

**PRESIDENTIAL ADDRESS**

The President, Mr J D Corrie, then delivered his Inaugural Address, a copy of which will appear in IRSE News and in the Proceedings.

A vote of thanks to him for his Address was proposed by Mr A C Howker (Hon Fellow), and carried with applause.

The meeting then terminated.

**POST-MEETING NOTES FOR THE RECORD**

**The Wing Award for Safety**

The “Wing Award for Safety” was introduced in 1994 to commemorate the life and work of the late Peter Wing, a Fellow of the Institution and employee of British Rail, who during his career made a major contribution to the cause of line side safety. The award takes the form of a certificate and an amount of £500 to be devoted to personal development and is made to an individual who it is considered has made an outstanding contribution to railway track safety by, for example, coming forward with a novel idea for improving safety, is a long term champion of improving track safety standards or has made a significant contribution to the awareness of track safety in his business.

The Wing Award for Safety this year had been made to Mr Barry West, Amey Rail, nominated by Network Rail, for his unselfish dedication and total commitment for over 20 years to obtaining trackside safety improvements in Devon and Cornwall. The retiring President Mr C H Porter will present him with the Award at the National Railway Engineering Safety Awards to be held at the International Conference Centre in Birmingham on 29th April.

**Co-option of Past Presidents to the Council**

Council had decided to co-opt the following three Past Presidents in accordance with Article 14.4:

- Messrs C H Porter (President 2003-2004)
- P W Stanley (President 2002-2003)
- R Barnard (President 2001-2002)

**Authority to Sign Cheques**

Council had confirmed that the following are authorised with effect from 20th April 2002, and until further notice, to sign cheques on the Institution’s accounts: Messrs P W Stanley, J D Corrie, M H Govas, C H Porter and K W Burrage, and authorised to transfer monies between the various Institution accounts without prior reference to Council: the Treasurer, M H Govas and the Assistant Treasurer, Mr C H Porter.
40th Annual Dinner

The Savoy Hotel, London, was the venue for the 40th Annual Dinner held following the Annual General Meeting on 23rd April 2004. Nearly 500 members and their guests were present.

The newly installed President, Mr John Corrie, introduced his guests and the principal guest on this occasion was the Institution’s Chief Executive, Mr Ken Burrage, who spoke of the contribution the IRSE and its members can make in providing safe, efficient and cost effective signalling schemes providing that they are working in an organisational environment that supports and values their efforts.

Following the speeches an excellent 4-course meal was efficiently served to the large gathering by the staff of the Savoy.

This was another most successful and enjoyable evening with a maximum attendance at the event.  

K W Burrage

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2003 Convention – Birmingham

The International Convention held between 26th–30th May, returned to the United Kingdom after an absence of 16 years; and was based in the city of Birmingham, situated in the heart of England.

MONDAY 26TH MAY 2003

Following registration at the Hyatt Hotel a welcome reception was held in the adjoining International Convention Centre.

The President, Colin Porter and his wife Claire, welcomed 233 attendees from 16 countries to the 2003 Convention. The members present represented all the UK local sections together with the overseas sections from Australasia, Europe, Hong Kong, North America and Southern Africa. He thanked all the sponsors of the Convention whose generous support ensured that it was possible.

Colin went on to say, recounting his own experiences from his first Convention in 1974, "it was the duty of the members to look after younger members on their first Convention". Then the question "why Birmingham"? Previously the IRSE has been made very welcome overseas and now was the time to repay that hospitality. Also no convention is possible without trains and, in the privatised UK railway industry, there was only one possibility to make that happen, ie Chris Green of Virgin Trains. Together with Network Rail (NR), who wished to show the work being carried out by themselves and S&T engineers in the UK, this resulted in the organisation, by many people, of the various activities and visits throughout the week and we will look back on Friday to see whether plan and reality actually match and being proved very right or very wrong!*

Colin introduced Chris Green, Managing Director of Virgin Trains, and Andrew Simmons, Head of Signalling, Network Rail.

Chris gave a short address on his experiences of the UK rail network from public to private sector and the resulting challenges of introducing a new fleet of rolling stock, Pendolino tilting EMUs and Voyager tilting/non-tilting DMUs, onto an existing infrastructure. He considered "after some seven years of privatisation, industry is now coming back together, working and thinking much more closely. The train operating companies require tried and tested solutions, not necessarily ‘state of the art’, as high reliability and availability are the first priorities."

Andrew welcomed the IRSE Convention on behalf of NR and said that the rail infrastructure is now under the control of NR and their core mission statement is "Engineering Excellence for Britain’s Railway". He commented "we are going to see the Channel Tunnel Rail Link (CTRL), Ashford IECC, West Coast Route Modernisation project (WCRM), heritage equipment in the York National Railway Museum and on the Severn Valley Railway – however, similar heritage equipment is operating 24 hours a day on NR infrastructure and we must determine the most cost-effective way of maintaining and renewing this equipment. To this end, scheme development and the maintenance programme are now being dealt with directly by NR.

Recent completion, to an accelerated programme, of the train protection warning system (TPWS) to all regulated signals on NR is a credit to the S&T profession."

Following the speeches a concert of light orchestral music, given by The Heart of England Chamber Orchestra, was enjoyed by everyone.

TUESDAY 27TH MAY 2003

After an early breakfast, buses conveyed members and guests to New Street station to join a Virgin Pendolino special train (390 022 Virgin Hope) for the journey to Kings Langley. This station is situated adjacent to the infamous M25 London orbital motorway. This motorway is known locally as the "Road to Hell" or the "greatest car park in the south"; as with any incident, it regularly blocks up with traffic which is at a complete stand! On leaving the train the members split into their respective colour groups whose guides were from the IRSE Younger Members’ Section. The members and guests joined separate coaches to travel, via the M25, to visits in the Kent area. The coaches journeyed round the M25 passing over the River Thames at Dartford by the imposing Queen Elizabeth II bridge. Thankfully the worst fears of the Organising Committee were unfounded as, with very tight schedules for the day, the motorway was running well and no delays were encountered.

The members’ coaches travelled to Singlewell near Gravesend, viewing CTRL installations en route. Video presentations were given on board the coaches detailing various aspects of the construction of this the first high speed line in the UK. Refreshments were provided at the Manor Hotel and the members received the following presentations on the CTRL project:

Chris Jago, Managing Director, Union Railways (South), gave an introduction and welcome to the CTRL project. The CTRL has one unusual feature, compared with most other high-speed lines in the world, as it has been designed to cater for freight operation. He went on to outline the history of the project culminating in the start of construction of Section 1 of the line, in October 1998, between the Channel Tunnel and Fawkham Junction in North Kent, where the CTRL connects with the existing Network Rail lines. Section 1 has been constructed mainly adjacent to existing lines or...
motorways with some tunnelled sections and an imposing viaduct has been built to carry the line over the River Medway together with connections to/from Ashford International. Commencement of revenue services on this section are scheduled for September 2003. Section 2 brings the new line from Southfleet Junction, where the Section 1 line diverges towards Fawkham, beneath the River Thames and through east London to St Pancras. Here extensive works are being undertaken to construct the international terminal within the listed building. Section 2, where the majority of the route is in tunnel, is scheduled for completion in 2007. The line is electrified at 25kV 50Hz ac overhead, whilst the signalling system is conventional ‘cab-signalling’ TVM 430 as used in the Channel Tunnel and TGV lines in France. Signalling and power supply control will be integrated into the existing NR Ashford control centre. The key to the success of the project is to use proven technology and to date the project is on time and budget.

John Francis, Westinghouse Rail Systems (WRSL), described the works undertaken by WRSL in modifications to the existing NR infrastructure to enable construction of both Sections 1 and 2 of the CTRL. Ashford IECC was originally built as part of the works required for the opening of the Channel Tunnel and the Eurostar service to Waterloo International. The signalling system is conventional lineside multiple aspect signalling with solid state interlockings (SSI), controlled by an integrated electronic control centre (IECC), equipped with automatic route setting (ARS) and train descriptor (TD). An interface from conventional to cab-signalling already existed at Dollands Moor for the Eurostar trains entering or leaving the Channel Tunnel. Owing to the track modifications and increased capacity at Ashford and other areas, the SSI and IECC data has been reconfigured to allow for these changes in conjunction with the associated lineside alterations. Other key areas of work for CTRL are:

- Dollands Moor – relocation of connections from the existing railway to the Channel Tunnel and provision of a new connection from the freight yard to CTRL.
- Beechbrook Farm (near Ashford) – railhead constructed for the delivery of construction materials for Section 1. The connection to the existing railway was provided with SSI signalling controlled from Maidstone East.
- Fawkham Junction – provision of new double track junction between the CTRL and existing railway. Resignalling work and immunisation using SSI equipment controlled from Victoria signalling centre with interface to TVM 430 cab signalling.
- Ripple Lane (Dagenham) – enabling works and realignment of existing lines to facilitate construction of tunnel portal for Section 2 of the CTRL. SSI and IECC alterations with associated lineside works controlled from Upminster.
- West Thames (Thurrock to Ripple Lane) – enabling works and remodelling of lines, to facilitate construction for Section 2 of CTRL alongside existing railway, including alterations to four level crossings. SSI and IECC alterations with associated lineside works.

- St Pancras – extensive track alterations and provision of new facilities associated with the CTRL Section 2 works in the area. Initial stages involve alterations to the geographical interlocking controlling the station area. When the Midland Main Line platforms are commissioned new SSIs will be provided. Interface to the new signalling for the CTRL platforms will also be provided.

When the North Kent lines were resignalled with SSI the additional control desks for this area were provided in the Ashford IECC. Thus all interfaces with the CTRL, south of the River Thames, will be handled by the one control centre. WRSL has worked closely with the suppliers of the CTRL control system to develop the various interfaces to NR at operational, cab radio, control system protocol and interlocking levels.

Dominic Kelsey, Rail Link Engineering (RLE), outlined the EMC issues surrounding the new CTRL and its electrical systems. This strategy includes the NR existing 750V dc third rail system, the Highways Agency road traffic signalling and communications system and British Telecom etc. All the interfaces were identified, such as trackside cables, both signalling and telecomms, with an emphasis on interfaces particularly with third party utilities. The electro-magnetic interference derived from a high power (7MW) Eurostar train and the 25/0/25kV ac power supply was investigated which required modifications to immunise existing track circuits. Extensive testing has been carried out during possession periods to ensure that operation of the
CTRL will not cause interference with the existing circuits. Isolating transformers are provided at the interfaces to ensure that any stray d.c. current, arising from the existing d.c. traction supplies, does not enter the CTRL networks.

Paul Robins, RLE, gave a technical description of the signalling systems on CTRL. Principal objective is to provide for 3-minute headways at a line speed of 300 km/h for Section 1 and 270/230 km/h on Section 2. The difference from other high-speed lines is the need to provide for different classes of train. The signalling system uses the proven TGV cab signalling system, TVM 430, which utilises coded track circuits to transmit track to train speed information and provides continuous ATP. There are no lineside signals, only marker boards at the end of each block section, nominally 1500m, and an auxiliary two aspect position light shunt signal has been provided at some marker board locations to authorise a movement when the train is not TVM fitted, eg maintenance vehicle. When the route is locked the signal is allowed to display two flashing white lights. The TVM on-board train computer translates the code received from the track and translates this to speed information for display to the driver. Should the driver exceed the displayed speed a full brake application will take place. The interlocking and TVM functionality are combined in a distributed computer-based system called the interlocking and train control system (ITCS). All the ITCS equipment is located in rooms and track circuits are direct fed from these rooms at a maximum distance of 7.5km, thus rooms are situated at a maximum of 15km separation. The CTRL is fitted with the usual voice and data systems as well as both UK cab secure radio (CSR) and GSM-R. The CSR is being used as an interim until all the trains are fitted with GSM-R. (Full technical details of the CTRL signalling and communications were presented in the London paper read on 12th March 2003.)

Mike Essex, RLE, covered maintenance on CTRL with the first example of outsourced maintenance on a high speed line in the world. A contract has been placed with Carillion as the maintenance contractor. They will provide first line rapid response teams for both signalling and communications with full escalation procedures should this be required. The teams are small and are trained in both the UK and French signalling systems together with the radio and telephone communication networks. There are also integrated track inspection teams of client and contractor. Each ITCS processing unit provides a link to the local maintenance equipment (LME). The LME records all data allowing for the replay of ITCS functions should a failure occur, it also allows for the ‘barring’ of routes etc. (ie in the same fashion as provided by an SSI technician’s terminal on conventionally signalled lines). The distributed LMEs are linked to a central data concentrator which, as well as having a logging facility, allows for interrogation of each LME. Staff competency systems are being developed to suit the application on CTRL with the intention to use the IRSE Licensing Scheme in the future.

After these detailed descriptions of CTRL the members departed by coach to Ashford. During the journey various points on the CTRL were viewed, including the Medway Viaduct, North Downs Tunnel portal, Lenham freight loops and Beechbrook Farm depot.

On arrival at the Ashford International Hotel, a buffet lunch was provided and displays by WRSL and Balfour Beatty were viewed. During lunch Mike Sowden, NR, gave a short presentation on NR and the interfaces between NR, Union Railways (South) and CTRL on Section 1.

Colin Porter then thanked all the presenters for their presentations and the members departed by coaches for the afternoon technical visits:

Ashford IECC – in the control room the IECC signalman’s training workstation was viewed together with the workstations for the Ashford and Dartford control areas. In the equipment rooms the SSIs, IECs, telecommunications and associated equipment were inspected.

CTRL – the signalman’s training simulator workstation was explained together with the method of operation. Note: this included provision for power supply supervision, signalling, communications and controlling maintenance possessions, the CTRL having clearly defined and agreed possession limits built into the system.

Connex Drivers’ Simulators – after a short presentation on the computer-based interactive driver theory training programme, the members were given time to try the system for themselves. There are also six full-size driver simulators and the members were shown how different parts of the line are available in order to allow for driver training. The virtual reality displays could be changed to represent differing driving conditions, eg rain, fog, snow, day/night etc, also it was possible to create obstructions on the line to test incident reaction. There was an opportunity to try out these simulators and it was difficult to drag some members away!

Ashford Station – during a visit to the station a short talk on the OHLE power supply and earthing arrangements for the platform lines was given; as the lines are dual electrified with 750V d.c. and 25kV ac overhead. Also, the CTRL line passes adjacent to the platforms at this location and the opportunity was taken to see the
civil engineering works involved.

Eurostar gave a brief introduction to the workings of the international station terminal and the facilities.

The guests’ programme began at Royal Tunbridge Wells for morning refreshments and a short visit to the town. The town lies at the heart of one of the most scenic stretches of countryside in England surrounded by the unspoilt beauty of the Weald of Kent. After a buffet lunch at the Holiday Inn, Maidstone, the guests transferred to Leeds Castle (Kent). Over a thousand years of myths, legends and history create this special castle. Henry VIII, the most famous owner of all, converted much of the Norman fortress into a Royal Palace in the 16th century. Here time was available for a leisurely tour of the Castle and extensive grounds before joining the coaches for travel to Ashford station to join the members.

After the whole party had assembled on the platform they boarded the special Venice-Simplon Orient Express British Pullman car train. During the return journey to Birmingham an excellent champagne dinner was served en route, which was thoroughly enjoyed by all and made a relaxing and fabulous finale to a very hectic day.

WEDNESDAY 28th MAY 2003

Members departed by coach from the hotels for visits to installations in the Midlands as follows:

Stoke – the radio block centre (RBC) operations and equipment rooms were visited and a presentation given of the WCRM telecommunications systems. This included a description of a GSM-R station and the project for the replacement of the current NR analogue radio system with GSM-R. This is planned for 100% coverage of the NR system. Displays were arranged illustrating building a base transmission station, the national roll-out plan for GSM-R, together with radio train-borne equipment and antenna.

Crewe – Catalis training school, here demonstrations were given of equipment including:

- High Performance Switch System: this is the new point operating mechanism being fitted to installations, including the WCRM project. It is primarily designed for the UIC 60 rail section switch and crossings being installed on the NR network.
- TPWS: a typical installation and method of operation was explained and the equipment inspected.
- Interlockings: here an entrance-exit panel is connected to a variety of different relay interlockings; GEC geographical, WRSL Westpac MkIII and free-wired. These are arranged in order that the trainer can create faults on the systems which the trainees then have to find and correct. Also housed in the room is the Aspect Sequence training rig. (Illustrated on the cover of IRSE News 86, July/August 2003.)
A buffet lunch was provided at the Weston Hall Hotel, near Stafford, where the President thanked the sponsors of the day and made a presentation to three Atkins staff for their work on the AZL axle counter safety case for the North Staffs resignalling scheme.

Saltley – Network Management Centre (NMC). A demonstration was given on the proposed signalling control system for the first Network Rail NMC. The control system allows for the possibility to set multiple through routes (e.g., London–Crewe) if they are available. The system will calculate the best route, through temporary speed restrictions for example, with the ability to reroute to ensure minimum journey time lost due to perturbations. As with the CTRL control system seen on the Tuesday, possession management facilities will be part of the control system. The building also housed the NR Midlands Region operations control. Here controllers use touch-screen VDUs for telephone calls with fall back facilities of mobile phones. The train running systems (TRUST and TOPS) are integrated into the room. The power supply for the centre is situated in the plant room with duplicated uninterruptible power supplies backed up by a diesel generator.

Central Rivers Depot (Barton-Under-Needwood) – Bombardier maintenance depot for the Virgin Voyager and Super-Voyager DMUs. Before being allowed to visit everyone had to wear safety footwear and high visibility clothes. For those without their own footwear, a selection of boots were available but at times it resembled a rugby scrum as they tried to find the correct size! A tour of the facilities was undertaken, including the vehicle lifting jacks capable of lifting a complete 4- or 5-car set and the wheel lathe for reprofiling wheel-sets. The depot track layout is provided with a depot protection scheme comprising European style point indicators and axle counters for locking the points.

Today the guests visited Stratford-upon-Avon where, following morning coffee, a guided tour was arranged highlighting the various places of interest associated with William Shakespeare and his life. Following this a buffet lunch had been arranged at the Royal Shakespeare Theatre and the afternoon concluded with a visit to Upton House, Banbury. This is a National Trust house built in 1695 and re-modelled between 1927–29 by Walter Samuel (Chairman of Shell 1921–46). The house contains many fine old master paintings, porcelain figures and furniture, together with very fine gardens and grounds.

Today another early start beckoned for the visit to York, buses once again transferred members and guests to New Street station to join a special Virgin Voyager train for the trip.

On arrival in York the members split into their now familiar colour groups to view technical installations/facilities in York. The guests, after refreshments, were free to explore the city of York and its many varied attractions including the Minster, Castle Museum and Flags of all colours at York. On arrival at York members are marshalled into their colour groups before departure to various railway venues around the city.
Jorvik Museum. An optional visit had been arranged to the Lord Mayor's residence, the Mansion House, which contains a very fine collection of silverware.

The members visited the following:

Bombardier Transportation – a presentation was given on the Ebilock computer-based interlocking (CBI) together with examples of the system components and design tools. In 1978 Ebilock was the world's first CBI and is currently in operation in more than 14 countries:

- **Ebilock 950**: this is the latest version building on over 20 years experience in the field. It comprises a central interlocking computer and either centralised or distributed object controllers. Objects are typically signals, points etc. The central computer is duplicated with on-line and hot standby computers. Each computer has dual redundant architecture and diverse software for safety and reliability. The same hardware and basic software is used for interlocking and European Rail Traffic Management System (ERTMS) RBC applications. Interlocking upgrades are easily managed as the new configuration hardware and software may be loaded into the standby computer with the on-line computer handling the current train operation.

- **Application design and test tools**: these are a feature of the system and give a significant reduction in design time, through the use of standard logic for each railway administration, the automatic production of material requirements list and installation documentation. Simulators and auto-test tools are used for verification purposes.

Corus Rail Consultancy – gave a demonstration of their 3D CAD simulation system.

- **Leeds 1st remodelling and resignalling**: this project had significant track and signalling changes to the Leeds Station area and its approaches. The system gives a virtual reality display of the infrastructure and was used for initial driver training, some 1,500, on the revised layout. It was also configured for the various stages of the project.

- **Tyne & Wear Metro**: this involved the metro extension to Sunderland and the system was used for both route familiarisation and also as a training aid. This is interactive such that different conditions, eg day, night, fog, snow, obstructions on the line etc, may be modelled.

Jarvis Rail – are one of Europe's largest rail support services and their York control centre operates around the clock every day of the year. The centre manages and monitors possessions, engineering trains, plant, materials and staff working within the Jarvis contract area (eg the East Coast Main Line (ECML) of Network Rail). A number of areas were visited and presentations given including:

- **Possession, fault, renewals planning and management**: all the various worksites are recorded and logged (number) with progress shown on various display medium, including VDU wall map and operators displays. Possessions are shown as "green" if to plan, "yellow" possibility of an over-run – therefore monitor closely, "red" over-run hence major priority requiring management action. In this way the centre can manage, in real time, all work being carried out on the infrastructure by their staff.

- **Vehicle tracking (road/rail)**: all mobile units are fitted with GPS data location devices and two-way voice communications. Their current position may be easily located and despatched to attend incidents as necessary. The rapid-response motorcycles are fitted with web-camera technology in order that central control staff can view the images and agree the best course of action following an incident (eg bridge strike etc).

- **CCTV surveillance and video recording**: demonstration of CCTV cameras provided for level crossing incidents (i.e. road vehicles crossing when red lights are showing or zigzag around half barrier installations) was given. These are also used in areas of vandalism and trespass on the railway. The evidence obtained may be used in a court of law to identify and prosecute the offenders.

- **Condition Monitoring**: use is made of predictive monitoring techniques to identify changes in equipment parameters such that these may be resolved before actual failure and train delays occur. One of the most critical areas being point operating mechanisms.

National Railway Supplies (NRS) – the NRS service centres, founded in 1904, service and repair a wide range of railway products. During a guided tour of the centre a wide variety of equipment was seen including:

- **Relay refurbishment and repair**: of particular note was the 'P' style relay programme for Dutch Railways.

- **Electronic servicing**: this included SSI modules, CCTV monitors and cameras plus hand held and train-borne radio equipment.

- **Manufacture of an entrance/exit (NX) control panel, CCTV monitors and cameras plus hand held and train-borne radio equipment**.

- ** Manufacture and serving of REED FDM remote control equipment.**

- **Electro-mechanical equipment servicing and...**
manufacture, ie point machines, level crossing barrier booms and road traffic signals.

Network Rail (NR) – gave a presentation on the Tyne & Wear metro extension to Sunderland:

- The project consisted of a new grade-separated junction at Pelaw to link the metro system to the NR infrastructure. It included resignalling and electrification, at 1,500V dc overhead, of the line from Pelaw to Sunderland together with the reinstatement of the line from Sunderland to South Hylton. This is the first application of mixed heavy/light rail operation in the UK on NR infrastructure and is based on the example in Karlsruhe in Germany. The signalling system was standard four-aspect signalling controlled by SSI, utilising track circuits for train detection. To ensure separation of the light rail (metro) and heavy rail (passenger and freight) both the INDUSI trainstop system, already fitted throughout the metro area, together with TPWS were fitted to all signals in the dual running area. (For full details of the project see IRSE News 79, July 2002.)

Thales Telecom Services – gave a demonstration of the recent developments to their Customer Information System (CIS):

- CIS are installed at a number of major stations utilising a varied range of display systems; plasma screen, TFT, LED or VDU monitor, the type of display being dependant on location and natural/artificial light levels at the particular site. The CIS operator console consists of a triple screen VDU console with an interface to the train descriptor. The voice levels of the public address loudspeakers are automatically raised/lowered dependant on the ambient noise levels.

Westinghouse Rail Systems (WRSL) – demonstrations were given on the latest control technology from the company:

- WESTLOCK - this is the 4th generation CBI developed by WRSL, it meets the requirements of the ERTMS and is a successor to SSI. One WESTLOCK has the processing power of multiple SSIs and is of a compact size, thus giving significant space saving compared with conventional SSI. It is retro-compatible with existing SSI thus allowing upgrade and life extension capabilities without having to completely replace the entire system. The configuration data utilises existing and enhanced SSI data constructs which have been developed and tested over years of application. Safety is met by the use of dual diverse software and data together with triple modular redundancy in the hardware. A comprehensive technician’s workstation is provided to aid maintenance staff in incident analysis and provides event recording with play back facilities.

- WESTeX – this is a microprocessor-controlled train detection and warning sequence initiation system for automatic level crossings (LX). Traditionally within the UK conventional track circuit methods have been used to determine LX road closure times. These always ensure that a train travelling at the maximum permissible line speed does not reach the crossing in less than the minimum prescribed warning time. Hence a slower train will create increased road closed time and could lead to road users ignoring the traffic signals and raise the level of incidents with possible fatal consequences. Predictor equipment is used widely in the USA to provide consistent warning times to road users regardless of the speed of the approaching trains. The WESTeX Level Crossing Predictor uses the rails to transmit audio frequency track circuits and, with the predictor situated at the crossing, both directions of approach are terminated using termination shunts. The predictor module operates in two modes – motion sensing (ie the audio frequency track circuit is occupied) and prediction, that is the rate of change of the inductance of the track circuit. By analysis of the change in inductance and comparison with a preconfigured warning period, the predictor is able to calculate the optimum warning sequence giving consistent road closure times regardless of the speed of the approaching train.

After the technical visits members rejoined the guests for a buffet lunch, at the Moat House Hotel, where the President gave a short vote of thanks to the sponsors and organisers of the morning’s activities. In the afternoon the IRSE York Section had arranged a number of optional tours for the party, these included visits to the York IECC control centre and guided walking tours of York. Others made their way to the National Railway Museum to view the exhibits prior to the evening reception and dinner that was to be held there.

The National Railway Museum, voted European Museum of the year 2001, comprises three halls which tell the story of the train from the age of Rocket through the first Japanese Shinkansen "Bullet Train" to the present day. The "Station Hall" (Ian Allan building), houses, amongst other exhibits, a fine collection of rolling stock built for the Royal Family. The "Great Hall", centre piece of which is the operational turntable, has many locomotives displayed on tracks radiating from the table in a true roundhouse fashion. The "Works" building has an extensive restoration facility where the Great Western Railway (GWR) locomotive "City of Truro" was undergoing a rebuild, to full working order, prior to 2004, the centenary of its 100 mph plus record run.

Andrew Scott, Curator, gave a very interesting talk on the museum and its activities, after which everyone enjoyed a cocktail reception. The President welcomed the Lord Mayor of York and civic party in the Great Hall with the Lord Mayor responding on behalf of the City of York. At the conclusion of which an excellent traditional English dinner of roast beef and Yorkshire pudding was served in the Station Hall. At the end of the meal the President rose to thank the sponsors and organisers for the day. The party then returned to York station to board the special Virgin Voyager for the return trip to Birmingham.

FRIDAY 30th MAY 2003

No formal activities were arranged for the guests until the evening reception and dinner, so there was time to relax, shop or sightsee in Birmingham.

However, some of the guests decided to join the
members for the technical visits to Kidderminster and Bewdley on the Severn Valley Railway. This is an independent Heritage Railway operated mainly by steam locomotives and controlled by traditional semaphore signalling systems which are predominantly mechanically worked.

On arrival from Birmingham by coach the members were shown around the Kidderminster station area visiting:

- The Museum – this houses a collection of railway artefacts together with a display of signalling and telecommunications equipment.
- Kidderminster station signal-box – the brick building was based on the design of similar GWR boxes and was commissioned in 1987. It houses a 62-lever, 5-bar lever frame together with an extensive electrical relay room.
- Turntable (ex-Fort William in Scotland) – the vacuum motor which powers the turntable is capable of turning a locomotive or coach in two minutes. If vacuum is not available it may be operated by hand-crank.
- New carriage shed – this has been constructed following a grant from the Heritage Lottery Fund towards the total cost and opened in April 2000. There are four tracks within the building capable of housing approximately 56 coaches.
- Point machine and location – the restored SGE HB machine operates the run-round connection at the buffer stop end of Platform 2. This is one of the very few electrically operated points on the railway.

On completion of the visits, members joined a steam-hauled service train to Bewdley. At Bewdley the members split into their various colour groups again for more technical visits:

- Bewdley South signal-box – this was built in 1878 and houses a 37-lever, 3-bar vertical tappet frame of GWR design. A mechanical locking bar for holding facing points was inspected and a demonstration given of the use of three of these bars to provide mechanical route locking to one set of facing points which are a considerable distance from the controlling signals.
- Bewdley North signal-box – the frame is a 37-lever 5" horizontal tappet frame and, of particular interest, were the single and double Spagnoletti Instruments provided for the absolute block working to Bewdley South box.

In the evening the Convention concluded with a reception and dinner at the International Convention Centre. After an excellent dinner, the President made his closing speech. Firstly he thanked everyone on behalf of himself and Claire for making the week such a memorable one. He then asked Peter Cuffe of Irish Rail to say a few words about the 2004 Convention. Peter outlined the proposed visit to Ireland and formally invited next year’s President, John Corrie and his wife Nicola, to Dublin. John accepted the invitation and responded that he looked forward to the 2004 Convention and the technical and social programme that is being prepared and hoped to see everyone there.

Colin then invited Claire to say a few words about the guests’ programme. Claire gave personal thanks to all the guides and organisers who had made the guests’
programme such a success.

Colin continued by reviewing his opening comments from Monday night; “whether plan and reality actually match” – with the answer being a positive YES! Special thanks were given to Bill Boddy, Chairman of the organising committee.

In response, Bill went on to thank all the organising committee, the members’ colour group guides and all those who arranged so many things in order to make the Convention actually happen. Following on from Bill’s remarks, Dougie Young, on behalf of all the colour group guides, from the Younger Members’ Section, gave a big thank you to everyone for the week and commented on how much they had enjoyed themselves.

Colin then concluded the formal part of the evening and yet another highly successful and informative convention was played out with live music and members and guests enjoyed the entertainment into the early hours.

To sum up then: the English weather had been good to us all week. The guides from the IRSE Younger Members’ Section, who after some early trepidation, rose to the challenge of keeping their respective groups to programme and time throughout the week. This they achieved whilst at the same time thoroughly enjoying themselves, meeting new friends, which will contribute to their professional development as S&T engineers. Well done and to all of you “thanks for a great week”. We have visited, seen and sampled many things that in ordinary day to day life are just not possible. But above all you need stamina and commitment to enjoy the convention as it is no holiday!

So another convention over, Dublin to look forward to next year and in 2005, well that’s another story.

Derek Edney

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Presidential Chain of Office and Past President Frank Horler HonFIRSE

This year at the Annual General Meeting, on 25th April, a slight mishap occurred to the Presidential Chain of Office when one of the coloured stones that decorate the chain became separated from its mount and was lost. Fortunately the jeweller that engraves the Institution’s plaques and medals was able to carry out an urgent repair and replaced the missing stone so that the President was able to be properly attired with a fully-restored Chain of Office in time for the Convention in Birmingham.

As I was dealing with this mishap I was reminded that many members would probably be unaware of the origin of the splendid item of regalia that each President wears during his term of office. So I decided to undertake a bit of historical research into both the origin of the Presidential chain and the person who made it.

THE PRESIDENTIAL CHAIN OF OFFICE

The adjoining photographs show the Chain of Office, which was designed and wrought by Mr Frank Horler (Honorary Fellow and Past President) and presented by him to the Institution on 15th February 1956. In his Presidential Address to the Institution on 17th March 1950, Mr Horler remarked that a choice between art and signalling had been open to him after his first few years of experience on the railway and that he had adopted signalling as a profession and art as a pastime.

The design motif on the pendant of the Chain of Office is taken from the badge of the Institution and bears the same Greek motto, which when translated means “I bring a far shining sign”. The medallion is carved in relief and fretted, with a concave backing in blue enamel. It is hung from an oval three-way link bearing the initials IRSE also with a blue enamel background and which in turn is supported by two branching decorative links each mounting three stones of the signalling colours, red, yellow and green and terminating above in buckles to take a blue moiré ribbon. Mr Horler also designed and made a velvet-lined case for the safe-keeping of the greatly admired and highly prized Chain of Office.
The design and fashioning of the Chain of Office followed a series of examples of Mr Horler’s artistic work for the Institution, among which were a beautifully hand-carved beech gavel made and presented by him to the Institution, also illuminated addresses which were presented from time to time to distinguished guests and the design of Institution certificates together with the writing of the names on such certificates and the self-portrait published in the Proceedings for 1950.

FRANK HORLER

Mr Frank Horler was elected President of the Institution on 17th March 1950. He had begun his railway signalling career at Crewe in 1902 when Mr A M Thompson was signal engineer of the London & North-Western Railway. Working at first in the drawing office, he came to the conclusion that practical experience was as essential as theoretical training and he accordingly took a course in workshop practice at the Manchester School of Technology and obtained a transfer to the outdoor railway staff.

He remained for two-and-a-half years on the Liverpool (Edge Hill) district before returning to the drawing office. Early in the First World War, Mr Horler joined a railway construction company of the Royal Engineers and served in France and Belgium for four-and-a-half years, taking part in several phases of railway work, including a comparatively small amount of signalling carried out in conjunction with the French companies. He was commissioned in the Field in 1917 and demobilised two years later with the rank of captain. He spent the next six months in the Ministry of Transport, leaving there to take up the appointment of assistant signal engineer on the North Eastern Railway at York, under Mr E F Fleet.

During the next few years, among the many interesting works with which he was connected was the co-ordinating of what had been two separate departments at York and Newcastle and the introduction of some measure of standardisation of apparatus which until then had been widely variant. When the signal and telegraph departments were amalgamated in 1928 (by which time the North Eastern Railway had become the North Eastern Area of LNER), he was appointed assistant signal and telegraph engineer, resigning two years later to become signal engineer of the Siemens and General Electric Railway Signal Company, which position he still occupied when he became President in 1950. During his service with that company, he was associated with the development of relay interlocking and with their major installation contracts at King’s Cross, Fenchurch Street, Edinburgh Waverley, Bethnal Green and Liverpool Street.

Mr Horler’s interest in the Institution was always assiduous. He became a member in 1920 and was elected to the Council in 1930. He served on nearly all the standing committees and was Chairman of the special committee on standardisation of electrical interlocking tables. He contributed several papers to the Proceedings and in every possible way helped in the Institution’s activities for the spread of technical information. Throughout his career he found the problems of signalling a continuous and unwaning fascination, however they did not provide a monopoly of interest and he had a wide and varied range of hobbies and artistic recreation. As well as the Institution regalia articles referred to above, he produced the self-portrait reproduced here which he drew specially for the Proceedings of his Presidential year in 1950.

Frank Horler was created an Honorary Fellow of the Institution in 1957 in recognition of his service to the work of the Institution and he died aged 90 or so in 1978.

It is interesting to observe from this brief résumé of Frank Horler’s career that reorganisation, modernisation, technical innovation, amalgamation and standardisation issues were just as prevalent then as they remain today. The flexibility, ingenuity and creativity to deal with these matters are, in my opinion, the hallmark of all great signal engineers.

Fatal Train Accidents Caused by Drivers
Wrongly Passing Signals at Danger 1948 to 2002

Stanley Hall, the author of several classic books on the subject of railway accidents, has kindly passed over to the Institution the results of some research he has carried out on the subject of SPADs. He has analysed all the major UK accidents involving SPADs since 1948 and determined whether each could have been prevented by AWS, TPWS or ATP. The results are shown in the accompanying table.

Mr Hall points out that, inevitably, a certain amount of judgement has to be applied in considering the circumstances of an accident, in order to decide what preventive measures were likely to have been effective. In those cases where AWS was ineffective, the approach speeds were below 75 mph and within the capacity of a TPWS speed-trap. It will be noted that there were no cases in column 5.

In those cases where a platform starting signal was passed at danger (marked PSS) it is assumed that the train would have been brought to a stand clear of the fouling point ahead by the application of the TPWS train stop at the signal. In some cases there was only a short distance beyond the signal, but the train was standing very close to the signal.

To save space in the tables the five right-hand-most columns have been merely numbered, the numbers having the following meanings:

Column 1: No protection
Column 2: Could have been prevented by AWS
Column 3: AWS was in operation, but ineffective
Column 4: Could have been prevented by TPWS
Column 5: Could only have been prevented by ATP

The columns which apply to a particular accident are marked with a #. Some entries have, instead of the #, a longer explanation defined by letters as below:

a The colliding train had stopped at the outer home signal, but then ran past the inner home signal at danger.
b The signalman was also implicated because he accepted a train under the then Reg 4 when he had already cleared his signals for a conflicting move and did not have the necessary 440 yards clearance.
c In dense fog a train had been stopped at the home signal but was then allowed to proceed to the starting signal at danger to await acceptance. The driver failed to stop there and proceeded into the section.
d The driver of an incoming train correctly responded to the distant signal at caution, but failed to control the speed of his train and ran past the home signal at danger.
e The driver suffered a coronary thrombosis although he must have cancelled the AWS warnings without applying the brake.
f Absolute block. The train was allowed to proceed to the starting signal to await acceptance, but the driver went past it into the section ahead. The signal was at “half-cock”.
g Special signalling arrangements. The driver passed a stop signal at danger giving access to the single line from a loop. There was a station stop between the distant signal and the stop signal. There was an additional AWS magnet at the stop signal as a safety measure but it was either ignored by the driver, or the AWS was isolated. Due to the wreckage, it was not possible to discover which, but probabilities favour the latter.
h Let it be firmly understood once and for all that AWS alone would almost certainly have prevented this accident. It was switched off. ATP also failed to help – it too was out of use.

In fact, fatal SPADs occur once every two years on average. The clear period of almost eleven years between 1958 and 1969, most of it without the benefit of AWS, is remarkable. Most of the accidents in the 1950s occurred in different circumstances, with no AWS, semaphore signalling and absolute block. They are not really representative.

The research also revealed other principal causes of fatal accidents by drivers to be:

- travelling too fast through a section after having been cautioned;
- misunderstandings during shunting;
- travelling too fast round curves;
- travelling too fast through speed restricted junctions;
- hitting the buffers.

The last three scenarios have since been equipped with AWS and in some cases with TPWS.

To finish in a provocative manner (and to hopefully promote some discussion in the letter pages of the NEWS), Mr Hall points out that Bellgrove, Newton, Cowden, Watford and Ladbroke Grove all involved recent changes to the track layout and/or signalling, which might be considered of a questionable nature in some quarters. This fact prompts the question of whether we are forgetting about the end user – the driver. Has the railway profession (in other disciplines as well as signal engineering) learned any lessons from these accidents?
### Thorrowgood Scholar Tour

Following in the footsteps of a previous Thorrowgood Scholar, I decided to study a new system that was intended to see the end of conventional lineside signalling. N J Terry's tour in 1995 in North America looked at several trial systems. Eight years on, there is a pilot line in commercial operation in Europe and this was the focus of my study tour.

Landing at Stockholm Arlanda Airport I took the Arlanda Express to the centre of Stockholm. The Arlanda Express is an impressive train: I don’t know of any other train service that gives you a free ticket if you are more than two minutes late regardless of the reason for the delay! The line was constructed as Build, Transfer, Operate (BTO) project by the Arlanda Link Consortium (ALC), transferred to the state when completed and then leased back for more than 40 years. Both my journeys were on time so I was unable to test the free ticket promise.

Bombardier Transportation, Rail Control Solutions were the hosts for my visits to their offices in Stockholm and the ETCS pilot line in Olten, Switzerland.

Rail Control Solutions (formerly Ericsson Signal and Adtranz Signal) have achieved a number of firsts in the development of railway signalling, including the first centralised traffic control in Europe (1938) and the first computerised interlocking in the world (1978). Furthermore, the Eurobalise used in ERTMS is based on the technology developed for the EBI-
CAB ATP system introduced in 1978 in Sweden. The purpose of my study tour was to look at another first – the first application of ETCS on an operational railway.

Firstly, I should explain the terms ERTMS and ETCS. ERTMS is the European Rail Traffic Management System and is the total railway control system (including infrastructure, power, rolling stock etc.). ETCS is the European Train Control System and is a subset of ERTMS that includes the control, command and signalling system elements, ie ATP functions, radio block centre (RBC). The railway enhanced version of the Global System for Mobile Communications (GSM-R) will provide the data bearer for ETCS (levels 2 and 3) as part of ERTMS.

The drivers for ERTMS are the wide variety of signalling systems and principles across Europe that are an obvious barrier to cross border operation. Cross border may be the border between different signalling systems and although this will normally correspond to a country border this may not always be the case. Even where trains currently operate cross-border this can only be achieved by fitting the trains with multiple train protection systems, eg the Eurostar with six systems and the Thalys units with eight systems. These systems all require space on board the train and they need maintenance. This increases the cost of running the services. Driver training and human factors are also important where there are differences in the meaning of the same (or similar) indications to drivers. For example, in Sweden a single green means the train can travel at linespeed and a double green means a 40 km/h maximum, whereas in Norway the same signals have the opposite meaning!

There are different “levels” of ETCS. The main levels are:

- Level 1 provides ATP and speed supervision from Eurobalises overlaid on conventional optical signalling;
- Level 2 provides fixed block signalling through radio communication (GSM-R) and does not require conventional optical signals but still uses conventional train detection;
- Level 3 provides train position reporting from on board equipment together with train on board integrity monitoring, so conventional train detection is not required. This means that moving block signalling is possible.

There are a number of different variants within each level, for example Level 2 can be provided with or without optical lineside signals.

A full simulation system for the ETCS pilot line has been constructed by Bombardier in the Stockholm offices. This allows all aspects of the system operation, from the signaller’s display to the driver’s interface to be simulated, tested and developed in an office environment.

One problem of installing ETCS on existing rolling stock is the space needed for the additional equipment. The Bombardier system uses relatively small discrete modules rather than a rack mounted approach: this makes retrofitting to existing rolling stock easier as components can be fitted where space is available (ie without removing revenue earning seats). Much of the ETCS equipment produced by Bombardier is based on already proven technology. For example, the driver’s display in the cab is developed from the EBICAB system and the RBC uses Ebilock 950 hardware.

A product that is currently unique to Bombardier is a handheld terminal for taking possessions. This
allows a possession to be requested from the trackside and when authorised by the signaller, the possession site is protected by the signalling interlocking. This should speed the process of taking and giving up possessions allowing more work to be done in a possession period.

Just before I left Stockholm I visited the traffic control centre in Stockholm. The centre controls more than 1,000 km of route with over 2,500 signals (excluding automatic signals) setting approximately 35,000 routes per day of which around 32,000 are set automatically and the remainder manually. The hub of the rail system is Stockholm Central Station with 10 through platforms, and seven terminal platforms, including two dedicated ones for the Arlanda airport trains. There are nine traffic controllers who each control a given area, and two traffic supervisors who manage the operation of the control centre including deciding priorities on train operation, the most important rule being a late train may not delay an on-time train. Five information staff inform passenger information systems and local radio stations in the event of significant disruption. In addition to individual computer screens there are 50 projection panels, filling the entire wall, and showing the complete area covered with all trains and routes shown. During low traffic hours the staffing requirement is lower and theoretically one traffic controller can take responsibility for the entire area.

The pilot line in Switzerland runs for 35 km from Zofingen to Sembach. The line is a 140 km/h double track and although there are no complex junctions, it is an operational railway: nine stations, 4,000 trains/month carrying three million passengers/year and 240,000 tonnes of freight.

It was ressignalled with ETCS level 2, without optical lineside signals, in 2002 as a pilot to prove that ETCS could work prior to the introduction of ETCS on the Mattstetten to Rothrist route. The installation includes systems from three manufacturers – Siemens (GSM-R and Signaller VDU system), Alcatel (interlocking and trackside equipment) and Bombardier (ETCS-ATP onboard and lineside, balises and RBC).

The project fitted ETCS equipment to 63 vehicles of five types, including locomotives, multiple units and engineering vehicles to operate along the line. Each vehicle type presented different problems when attempting to find space to locate the equipment. The actual fitment was undertaken by Bombardier staff at a depot in Olten. Although Olten is not on the pilot line, GSM-R equipment is provided at the depot for testing.

Swiss Federal Railways (SBB) arranged cab rides for me along part of the pilot line to see the system in operation. The drivers seemed to like the system, and one was on his first solo trip with ETCS. During the introduction of ETCS a significant effort was spent ensuring that drivers were adequately trained on the system. This included a self-study CD-ROM to allow them to learn from home. Despite this, some problems were still encountered when faults occurred with systems. One of the more unusual was a blank screen part way through the system start-up sequence; some drivers took this to mean the system wasn’t working and rebooted the system, only to encounter the same blank screen again. This was one of the easier problems to fix!

The location of part of the signalling system on board the trains raises questions about maintenance, testing etc, and will require training of maintenance staff on these systems. In the UK this will require rolling stock owners to install the on-board equipment, the rolling stock maintainer to train the staff and recruit new staff, the train operating companies to train drivers, the infrastructure owners to install trackside equipment/control centres, the infrastructure operators to train signalling staff, and the maintenance organisation to train staff.

The control centre for the pilot line is based in the existing Olten signal-box alongside a more conventional panel arrangement controlling conventional signalling in the Olten area. The signal-box equipment consists of a number of VDU’s showing the position of trains and allowing the signaller (or dispatcher as they are known) to set routes. The interlocking and radio equipment are located within the signal-box too.

There are interesting questions associated with the introduction of ETCS on operational railways. What should you do if the RBC or GSM-R system fails? All trains would lose their communication with the RBC. Should they all initiate a full emergency brake application, initiate a service brake application, or continue to the end of their current movement authority? Stopping all trains obviously causes significant disruption and could potentially cause further problems, for example with power consumption, when the system is restored and trains start moving again.

The system used on the pilot line initiated an emergency brake application for all trains if any part of the system failed, however briefly. A number of problems associated with the communication systems led to significant disruption during the early stages of operation. This disruption was predictably widely reported in the press in Switzerland and elsewhere.

The fact is that ETCS works, it is available today and is operational on a real railway. It is performing reliably and improving all the time. The delays due to signalling failures on the pilot line are reducing all the time and reduced even further following a system upgrade shortly after my visit. For a typical week in September delays from signalling failures were only
three minutes with over 95% of trains arriving on time (considering all causes of delay) – on time in Switzerland means less than one minute late.

The pilot line is now undergoing the fitment of conventional signalling as the system requirement specification that the equipment was installed to has been updated. The system is therefore not compatible with the equipment being installed on the Mattstetten to Rothrist route.

As a result of lessons learnt on the pilot line, the Mattstetten to Rothrist route is having conventional signalling installed, controlled from the same interlocking in order to provide a fallback mode of operation: this does however limit speeds to 160 km/h rather than the planned 200 km/h linespeed. The intention is that the conventional signalling will be removed at the end of 2005 allowing the higher linespeed to be introduced.

The project has achieved the objective of proving ETCS on an operational railway and has allowed valuable lessons to be learnt for the next projects fitting ETCS as well as providing useful data on reliability, availability, maintainability and safety. It is also interesting to note that when comparing to N J Terry’s findings from his study in America that the approach of building on proven components has again been successful.

I would like to thank Bombardier and SBB for their hospitality and the IRSE for providing the opportunity to undertake the study tour.

Matthew Lupton

### 2003 Examination Results

The overall results of the 2003 examination were down on recent years which is a disappointment to officers of the Institution. Having seen a pass rate between 55% and 58% in the last three years, 2003 saw a pass rate of only 45%, largely due to a severe decline in achievement in Module 3 (Signalling Principles). Of the 236 modules sat, 107 were passed and 129 failed. The good news is that of the Passes, 29 achieved Credit grade and three achieved Distinction. It is also encouraging to record that a number of candidates undertook Telecommunications modules.

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P = Pass, C = Credit, D = Distinction

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**Exam Reminder**

Applications to sit the Institution Examination this year in October should be lodged with the IRSE office before 30th June. You must be a member to apply and your subscription must be fully paid up at the time.

Karen Gould, IRSE Training & Development Manager
3rd Floor, Savoy Hill House
Savoy Hill, London WC2R 0BS, UK
Tel: +44 (0)20 7240 4935
Fax: +44 (0)20 7240 3281 Railnet: 00 38424
Email: training@irse.org

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M1 = Safety of railway signalling and communication
M2 = Signalling the layout
M3 = Signalling principles
M4 = Communication principles
M5 = Signalling applications
M6 = Communication applications
M7 = System management and engineering
A number of study groups are set up each year to assist members in mutual study towards undertaking the IRSE Examination. The next examination will be held in October 2004.

UK: LONDON: Victoria
Mariana Mercado and Jeremy Ricketts
Located: c/o London Underground, 3rd Floor, 84 Eccleston Square, Victoria, London SW1V 1PX
Contact Address: CTRL House, 2 Ossulston Street, London NW1 1HT
Open to all IRSE members by prior arrangement. Concentrating on Modules 1 and 7 until October.
Email: MXMERCAD@ctrl.co.uk or JXRICKET@ctrl.co.uk

THAILAND: BANGKOK
Eddie Murphy
Bombardier Transportation (Signalling) Ltd, 3354/16-19 6th Floor Manorom Building, Rama 4 Road, Klongton, Klongtoey, Bangkok 10110
Tel: +66 2 672 8290 Ext 373 Fax: +66 2 671 7597
Email: eddie.murphy@th.transport.bombardier.com
Open to all IRSE members

HONG KONG
Steven Cho
MTRC, MTR Tower, Telford Plaza, Kowloon Bay, Hong Kong
Tel: 852 2993 2111
Email: stcho@mtr.com.hk
Open to all IRSE members

UK: BIRMINGHAM
Buddhadev Dutta Chowdhury
Siemens Transportation System, 4 Highlands Court, Cranemore Avenue, Shirley, Solihull B90 4LE
bdutta@siemens.com
Open to all IRSE members

UK: NORTHANTS: Northampton
Frances Maria Peacock
Independent Member
Tel: +44 1604 882443
Email: francesmariapeacock@lineone.net
New group to be established – enquiries welcome.
Open to all IRSE members.

UK: NORTH-WEST: Manchester
Matthew Lupton
Network Rail, Room 103, Rail House, Store Street, Manchester M60 7RT
Tel: +44 161 228 8410 (05 8410)
Email: matthew.lupton@networkrail.co.uk
Open to all IRSE members

UK: SCOTLAND
Tom Gallacher
First Engineering, Bridge Office, Forth Terrace, Dalmeny Station, South Queensferry, Edinburgh EH30 9JS
Tel: +44 131 550 4383 (04 64383)
Email: TGallacher@firstengineering.co.uk
Open to all IRSE members

UK: SURREY: Godalming
Peter Harding
Parsons Brinckerhoff, Westbrook Mills, Godalming, Surrey GU7 2AZ
Tel: +44 20 7830 5852 Fax: +44 20 7830 5971
Email: HardingP@pbworld.com
Open to Parsons Brinckerhoff employees only

UK: WESTERN: Bristol
Stella Norris or Dextor Stewart
Amey Rail, One Redcliff Street, Bristol BS1 6QZ
Tel: +44 117 9348063 (07 42063) Fax: +44 117 9348770 (07 48770)
The IRSE Study Group is to meet each Tuesday evening from 4 pm to 6 pm in the Amey Rail Offices at One Redcliff St, Bristol. This year the group will concentrate on Modules 3 and 5. Open to all IRSE members; if you want to be kept informed by email contact stella.norris@amey.co.uk or dextor.stewart@amey.co.uk

UK: YORK
Andrew Smith
Westinghouse Rail Systems Ltd, A006, Hudson House, Toft Green, York YO1 6HP
Tel: +44 1904 733433 Fax: +44 1904 733368
Email: andrew.p.smith@invensys.com

If you are interested in setting up a new Study Group, contact Richard Hobby at IRSE, 3rd Floor, Savoy Hill House, Savoy Hill, London, WC2R 0BS. Tel: +44 (0) 20 7240 4935, Fax: +44 (0) 20 7240 3281.
Technical Visit to the Czech Republic

It was on a cool Friday, 28th November 2003, that 36 IRSE members and partners arrived by train and plane in Prague, the capital of the Czech Republic, for what was thought to be the first visit of the Institution to that country.

The visit had been organised to see the different approach taken in a former “Eastern Bloc” country to the development of new signalling systems compared with that taken within the EU countries.

The Czech State Railway (CD) is still government-owned and operated as a vertically integrated operation, but a number of former departments have been privatised over the last decade.

One such was its signalling design, manufacturing and projects arm, now called AZD Praha sro. The visit was organised by AZD in conjunction with Mr Libor Lochmann from the CD Railway Research Institute, VUZ.

A technical seminar took place on the Friday afternoon at the HQ offices of AZD. The history of CD and the evolution of AZD from an integral part of the railway into a standalone private-sector company were described.

The company now employs approximately 1,800 people, and has manufacturing plants in three cities including Prague. It designs, manufactures and installs a wide range of signalling equipment, including relay and electronic interlockings, control systems, level crossing and automatic block systems, track circuits, axle counters, ATO and ATP systems, various types of point machine, signals and power supply systems. The company turnover in 2002 was 104m Euros, and about ten interlocking/resignalling projects are completed a year.

The Czech Republic sits between Germany in the west, Austria in the south, Poland in the north and Slovakia in the east, and thus there are major rail corridors through the country linking these up for both passenger and freight services. Two of these corridors are TEN routes.

Work has been carried out to progressively modernise the signalling on these major transit routes, usually in 25 km sections, with a major civil engineering company being the main contractor and other suppliers, such as AZD, providing the signalling systems. AZD had also carried out the complete resignalling of the Prague Metro system following the flooding experienced in the city during the winter of 2001/02.

Senior engineers presented a comprehensive description of the various types of equipment coupled with details of their application in excellent English, as is usually the case, from AZD.

The Saturday morning saw the members join a reserved coach on the service train from Prague to Decín, where a technical visit to the recently completed resignalling project at Decín took place. The main features observed were the ESA11 electronic interlocking installation and its associated control system, with the rest of the expected features of a resignalling project. The resignalling was part of a comprehensive modernisation of the track layout and station. The whole project completed for what at least, in UK terms, appeared to be a bargain price of 51m Euros.

Members also had the opportunity to visit the old signal-box at Decín, which is in the process of being renovated to form part of the country’s transport...
York Section Golden Jubilee

It may not seem long in the lifetime of the Institution, but the York Section is 50 years old this year. It all started in January 1954 when the S&T Engineer of the North Eastern Region of British Railways, Mr A F Wigram, wrote to all the IRSE members (54 of them in all) in the north-east asking if they would support the formation of a Provincial Centre at York.

A meeting was called, each member wishing to travel to it being granted an additional free pass and leave of absence (subject to the necessary relief being available). In total, 26 attended with Mr Wigram in the chair. It is recorded that he had to leave almost as soon as the meeting had started “as a mishap on the main line called for his presence” so Mr Halliwell took the chair.

It was unanimously agreed that a “Provincial Centre be formed at York”. It was stressed, however, that any arrangements made would only be provisional pending agreement of Council. A provisional committee was subsequently formed and a programme of meetings was formulated. There were also several suggestions for visits that should be arranged for the benefit of the members. After the formal part of the meeting, a question and answer session was held dealing with such topical questions as:

- Has the adoption of flat bottom rail section increased the operation, maintenance and renewal problems of rodding and ancillary apparatus?
- What are your opinions regarding the use of PBJ (paper backed jute) as an insulant for the transmission of control functions and power feeders?
- Is the present steel apparatus case considered suitable?
- Connections to level crossing gates are one of the signal engineers’ problems. Have you any suggestions regarding the design which would simplify the layout and reduce the maintenance and renewal costs?
- How can the comparatively short life of signal fittings as supplied at the present time be lengthened?

Obviously signal engineers were concerned with the introduction of new technology, design and maintenance problems along with renewal costs and issues with manufacturers’ equipment. Very much the same issues as still faced today.

The formation of “Provincial Centres” was discussed at the Council meeting of 17th February 1954. After much discussion it was deferred until March.

Meanwhile, the York Section continued to grow and technical meetings and visits were arranged. The formation of the York Section was finally agreed at the Council meeting held on 17th March 1954 under Minute 6236 and the rules governing Local Sections forwarded. A set of bye-laws were drawn up, including one which defined the area from which the membership of the York Section should be drawn, covering those residing or working in an area bounded by Goole, Retford, Sheffield, Huddersfield, Carlisle and Berwick. There was a section (since removed) that any member could introduce a visitor to any meeting but must advise the Hon Secretary in advance. The visitor could only attend one meeting per session.

The bye-laws were submitted to the Annual General Meeting and approved for submission to the Council of the Institution. Also at the AGM in 1954 the formation of the committee was agreed. The York Section was formed with an initial membership of 54 and it has now grown to around 360. Initially the Chairman of the Section was not re-elected every year. Mr Wigram continued until the end of 1956 when the committee decided every member of the Section should have the opportunity of taking the chair, through membership of the committee. However, it was not until 1958 that it was agreed that the other committee members should elect the chairman and vice-chairman each session.

To date, Denis Dyson has been chairman on four occasions. It is interesting to note that he is our most stalwart committee member having been first co-opted on to the committee on 2nd December 1971. He retired in 1996 but because of his depth of knowledge of the running of the York Section was co-opted again for the following two years before being re-elected in 1998. One other present
committee member, Denis Bowiby, has had a longer association with the York Section committee having first been co-opted in December 1970.

Technical meetings have always been a big part of the York Section's activities and each year the committee formulates a programme of papers to be presented. The aim is to educate, inform, advise and entertain.

The first recorded technical meeting was held on 24th February 1954 when the Institution President Mr T Austin was present. After being invited to take the chair he congratulated the York Centre on a splendid turnout (43 members and 59 visitors) and pointed out that this was the first local centre established since World War 2. He then introduced Mr J F H Tyler, Assistant S&T Engineer, BR Western Region, inviting him to read his paper “Signalling Developments on the Western Region 1947-53”. Two present York Section members, Mr N E Pick and Mr M W Dodds attended this meeting (although only as visitors) and still attend whenever possible.

The second paper to be read on 24th March was “Automatic Train Control” by Mr J H Currey, of the ATC Development Section of the BTC. He traced the progress of ATC from its inception on the North Eastern Railway (Raven's Apparatus) to the development of the present BR system. It was once again a splendid turnout with 33 members and 21 visitors.

At this meeting Mr Wigram announced that the petition for a local centre at York had been approved. The first Annual General Meeting was held on 21st April when the result of the election for the committee was announced. Following the formal agenda, a “Brains Trust” was held where members of the audience were invited to ask a panel of S&T engineers topical questions.

The dinner dance began life as a “Smoking Concert”, the first one being held in the Windmill Hotel on 25th February 1955. The cost to members was 3/- (15p), including refreshments, and each member could invite one male guest. Members were also asked to contribute to the entertainment (what form it took was not recorded). In total, 53 attended the event and the grand profit to the York Section was 4/- (20p).

Smoking concerts were again held in 1956, 1957 and 1958 and at the Annual General Meeting of that year it was proposed that an “Annual Social Function” would be held. This was a dinner followed by entertainment which would replace the annual smoking concert and allow female partners to attend. The October 1958 committee meeting agreed that the members would be asked if they would support such a function. The committee suggested that the entertainment would be a dance band.

In total, 55 members expressed interest in attending an event so it was agreed to hold a dinner dance in Betty's Ballroom on Friday 27th February 1959. Tickets were priced at 14/6 (72 1/2p) and 91 were sold. The President of the Institution, Mr J F H Tyler, was invited as the guest of the section. In 1960 it was again held in Betty's Ballroom but in 1961 transferred to The Merchant Taylor's Hall, a very grand setting in the heart of York. It remained there until 1983, returning after four years elsewhere until 1996.

However, with increasing numbers wishing to attend this very popular event and with severe restrictions on noise levels, the committee looked for a new venue. One local hotel was the next venue (1997), but it was moved the following year to the Viking Hotel (now the Moat House Hotel) on the banks of the River Ouse where it has attracted increasing numbers of guests and the average attendance is now around 200.

Initially it was the practice for the committee to provide some entertainment: in 1970 a sketch show was devised, and in 1971 a quiz with various items of railway equipment provided the entertainment. In 1965, a raffle was organised with the first prize being a half-bottle of whisky, second prize a tin of biscuits. Raffles continued until 1977 when they were replaced by a tombola, which is still popular today.

Since the first dinner dance the President of the Institution has been invited to be the guest of honour and the date of the dinner dance meant it was often the first function after his election. When the date of the dinner dance came before the parent body AGM in 1980 it was decided not to invite the President again but the Senior Vice-President (Mr A R Brown) and his lady, a practice that has continued ever since.
Section Reports

Australasian Section

Fifty-Sixth Annual Report – Year Ending 31st December 2003

During the year, meetings of the Australasian Section were held as follows.

1 ANNUAL GENERAL MEETING – ADELAIDE, SA
14th-16th MARCH 2003

The meeting was called to order at 09.20 hours by Mr Les Brearley who welcomed members, two overseas visitors and then introduced the keynote speaker.

South Australian Minister of Transport, Mr Michael Wright: “The concept of an integrated transport vision of the future for SA”

The last published Transport Plan was in 1968, a plan for the future must service long term needs and be able to change with the times.

Government Transport covers rail, road, sea and air, a plan is required to have sound financial management, be sustainable, fit the purpose and not be gold plated.

The plan must be innovative with a goal of improved safety performance.

At the completion of the address the Minister declared the meeting opened.

Mr Brearley spoke of the past year with the AGM and two technical meetings well attended, reflecting good organisation; however, he stressed that these must be supplemented with local meetings which have much easier access for members.

Commended NSW for their programme with a direction that other States must follow.

IRSE exam modules were taken by nine candidates, with Mr R Love gaining three passes and one credit.

The past two years have seen four nominations for the Byles & Calcutt Award, this year going to Mr Alex Borodin; Mr Paul Huth was asked to accept the plaque on behalf of Alex.

Election of Officers and Committee 2003

Vice-President Mr P R Symons (F) NSW
Chairman Mr K I Walker (F) Qld
Vice-Chairman Mr C R Page (F) Vic
Committee:

NSW Messrs R.A. Stepniewski (F), A F Vaz (F)
W K C Wells (F), T G Moore (F)
Victoria D J Ness (M), H B Luber (M)
M R Donald (M), S W Bosher (M)
Qld P A Huth (AM), G T Josh (M)
H J Revell (M)
WA P L Gobetz (F), I G Costa (F)
SA L D Tran (M)
NZ A E Neilson (F)
Secretary/Treasurer Mr G Willmott (A)
Publicity Officer Mr R A Bell (F)
Auditor Mr A G Cumming (A)

Committee remaining in office from 2002:


The SA Committee will appoint a replacement for Mr I G Roulstone who is overseas.

The Committee was deemed to be elected vide Rule 23(3).

Mr Les Brearley handed over the Badge of Office to the incoming chairman Mr Keith Walker.

Keith told us a little of his experiences, coming from York with British Rail in 1960, to 15 years in Africa, back to the UK where it was too cold, then joining TMG to be based in Queensland.

The average age of the Australasian members is 50 years, the mission is to encourage the membership of the younger people in the industry, not just the Committee but all members. This is a serious Institution, we need to pass on and share our information, but this is not to deny that we enjoy our meetings.

Keith closed with congratulations to Les Brearley on his two-year leadership of the IRSE, then introducing Mr Andrew Kitto to present the first technical paper.

Technical papers were presented by:

Mr Andrew Kitto, Australian Rail Track Corporation, gave a Power Point presentation: “Communications Based Safeworking System”

The system is designed to replace an aging signalling system, will provide comprehensive information to the driver in the locomotive and will be able to enforce compliance with movement authorities.

CBSS will control trains with much reduced headways, providing significant capacity increases with improved safety. It will deliver operational cost savings through reduced idle time, fuel consumption and equipment maintenance.

Tenders for the CBSS are being analysed at this stage and due to confidentiality, the system can only be described in functional and conceptual terms.

Mr Robert Tapsall MIRSE, General Manager Information Solutions, ALSTOM Australia – Transport: “The Application of Next Generation Communication Based Safeworking Technologies in Australia”

This paper explores the important information we need to know about communication-based safe-working systems, primarily to determine if it applies to Australian railways, if so, how and when it should be implemented.
Three models for CBST implementation were considered, followed by the rollout paths by various railways with different priorities and needs.

The capacity benefits of the system are achieved at a much lower cost than track infrastructure, with less equipment, a dramatically improved reliability, better availability of the signalling and the railway.

The nature of Australian railways was discussed, with the opinion that here was a chance for the industry to unify its planning for the future, choose a common path and share in the application of the next generation communications based technologies for mutual benefit.

Mr Tony Simes, TransAdelaide, Mr. Alistair Morrison, ALSTOM Australia: “The Replacement of TransAdelaide’s Operational CTC and PI Systems”

The CTC and PI systems are now close to 15 years old and are based on technology that is obsolete. The original equipment manufacturer, Hewlett Packard, has indicated that they can no longer support the computer hardware and replacement components are extremely difficult to source, recognising the risk of complete failure, planning the replacement commenced in 1998.

An independent consultant confirmed Trans-Adelaide’s concern regarding the sustainability of the systems and presented three options, a second consulting group audited the report for conclusions and costing.

Complete replacement was approved by the State Government.

The final project costs, including contract, project management and any miscellaneous costs were established with State Government endorsement obtained in August 2002. ALSTOM Australia was the successful tenderer.

The proposed system was outlined with a description of the architecture, the support services and implementation strategy with an expected completion and commissioning by mid 2005.

Mr Wayne McDonald FIRSE. Westinghouse Signals Australia: “Signalling the Alice Springs to Darwin Railway”

The paper describes the signalling of a 1,420 kilometre long, new railway, in a harsh and remote environment with most locations too remote from mains power to even contemplate its use.

A new railway gave the opportunity for standardised signalling, that saves design time, cost and is ideal for prefabricating common components for locating on site with a minimum of installation.

Westinghouse Signals Australia is providing simple appropriate and safe signalling, for active level crossing protection, automation of passing tracks and train order control.

The system can be upgraded for greater control centre automation, train position reporting, maintenance management and driver supervision as the network utilisation demands.

Mr Jack Turner, Passenger Transport Board of South Australia: “Information to Passengers, an Ingredient of the Marketing Mix”

The PTB manages the operation of public transport in Adelaide, which includes the contracts of the service providers, marketing, ticketing and passenger information. Over the past three years in partnership with the service providers a consistent patronage decline has been turned into a 3% increase per annum. Although there are contributing factors to the increase, the change can be explained in large part through better marketing.

There has been an investment in the provision of printed timetables at 1/3 of boarding bus stops, real time passenger information is the next phase in better marketing, which is hoped will show a 5% increase of patronage based on comparable results elsewhere in the world.

Buses will be tracked and the running performance will be evaluated against the schedule, variations of the arrival time will then be displayed on the passenger signs downstream.

A trial of the system will be along two major routes, with the initial configuration, updates of 34 signs will be 15 seconds.

Mr John Aitken, Aitken & Partners” “Australia-wide Communications System for Railway Operators”

The equipment and performance requirements for locomotives operating on the Defined Interstate Rail Network have been defined in the Australian Code of Practice, the radio communications are poorly defined, the Code does not give sufficient information for a purchaser to specify a locomotive radio system.

The disparate radio systems used in various areas demand the use of a number of radio transceivers and other devices. The user interface is different for every operator, creating a dangerous source of errors for drivers working on a variety of locomotives.

Although moving towards a common frequency band over the last 20 years, propriety quirks implemented into the radio system can ensure that no single radio can cover all systems, locos are equipped with up to seven radios to operate through the DIRN.

Recent changes in the cellular telephone market have made the use of GSM-R feasible in Australia, it could replace the incompatible train radio systems in higher traffic areas, with internationally standard equipment. GSM-R is not economical for low traffic areas but can be integrated with existing mobile radio and satellite telephone networks.

Panel Session: Chaired by Mr George Erdos.

Panel: Messrs David Marchant, ARTC; Roy Arnold, TransAdelaide; Charles Page, Invensys; David Ness, Connell Wagner; the members discussed the “New Generation” from the engineering to the management expectations, with a summary by Mr Erdos.

Mr Peter McGregor spoke in appreciation for all presenters and moved a vote of thanks, which was passed by acclamation.
A written poll of members’ assessment of the quality of the meeting was taken, with all answers put in a box with a lucky draw, Mr MacDonald of NSW being the winner.

SATURDAY 15th MARCH

The normal field inspection was varied from the norm, it was held in house, with two presentations:

Mr Alex Kennedy, Pacific National, Train Management System, including a demonstration on the Operational System.

Mr Mike Eichinger, Sydac Pty Ltd, Sydac Train Driver Simulator and Virtual Reality.

After lunch a further inspection was made, this time to the TransAdelaide Operations & Control Centre.

SUNDAY 16th MARCH

The meeting was concluded with a social day, beginning with a visit to the National Wine Centre of Australia which included blind tastings, then to a luncheon and the National Motor Museum at Birdwood in the Adelaide hills.

2 TECHNICAL MEETING – PERTH, WA
28th JULY 2003

Mr Keith Walker declared the meeting open at 09.20 hours, welcoming 71 members and 22 visitors, he then introduced the keynote speaker Mr Reece Waldock, Commissioner of Railways WA, who had been appointed the Acting Chief Executive Officer of the Public Transport Authority which was formed 25 days ago.

West Australia is leading the nation in developing an effective reliable passenger network.

With a $1.5 billion New MetroRail budget, extensions to the rail network are being built including tunnelling under the Perth CBD, new railcars will be introduced, concern for public safety will see guards on trains and secure car parks for commuters.

The PTA is also the controller of the city buses, country road coaches and ferries.

In closing he wished the conference well.

Mr Walker then presented him with an IRSE plaque in appreciation for his introduction to our meeting.

Mr Lido Da Costa FIRSE, US&S, and Mr John Ursich, Westnet Rail, gave a joint presentation: “Westnet Rail Processor based Interlocking Project – Western Australia”.

The processor-based interlocking (PBI) project commenced in October 1999 and included the control of 40 stations extending from Coolup 40 km south of Perth through to Koolyanobbing East, which is 400 km east of Perth in the rail network. The project has successfully delivered a new train control system, PBIs and a variety of interface designs to new and existing equipment.

This paper discusses some of the engineering challenge, achievements, safety benefits and future opportunities such a project brings to the railway operation.

Mr. Anthony Godber MIRSE, Pilbara Rail Company: “Pilbara Rail – A New Challenge”

The Pilbara iron ore railways have for some years been ranked amongst the most efficient in the world. In 2001, the integration of the Hammersley Iron and the Robe River railways was announced. These two railways became the Pilbara Railway Company in April 2002. The primary purpose of this integration was to achieve capital and operating efficiencies for both companies.

In particular, the connection of Robe’s new mine at West Angelas with its port at Cape Lambert was achieved by maximum use of the existing Hammersley and Robe infrastructure, minimising the initial capital outlay to bring the mine on-line. This paper describes some of the challenges presented by the formation of the Pilbara Rail Company, particularly with reference to operations, signalling and communications. It also notes some of the achievements of the first year of operations.

Mr Robert Lowe, Consultant to New MetroRail WA: “Technical Issues for City Rail Project”

The South West Metropolitan railway has been in the planning for 10 years and has changed in route and configuration during that time. It is an extension to the narrow gauge suburban train network from Perth city to the regional, centre of Mandurah 78 km to the south. The current plan is defined in a Master Plan document issued in August 2002 and can be found on the project website. The project is being procured in eight packages of work, all of which are currently being worked on, either in design or being tendered for construction. Package F of the project comprises connecting the new line with the existing Northern Suburbs line to Clarkson, taking the line in tunnel beneath the Perth CBD and connecting with the section of line over the Swan River at the Narrows Bridge. This paper presents an overview of the scope of work and technical issues associated with Package F.

Mr Malcolm Lauder MIRSE, Connell Wagner: “Train Control System – Time for a Paradigm Shift!”

The time for a wholistic approach to delivery of train control systems is nigh!

This paper establishes Connell Wagner’s credentials to engage in a discussion on train control systems. In so doing, it provides a potted history of technology developments and drivers for change over the past quarter century.

The discussion then leaves the past behind and investigates the environment. A broad overview of the train control system market is provided. This is complemented by an analysis of the business drivers that may promote or restrain the change.

The current attitude of stakeholders is discussed. Areas are identified where an adjustment of attitude, and adoption of a new mindset, will result in the improved efficiencies for train control system delivery that all stake holders crave.

Now, in the prevailing spirit of change of the deregulated industry, is the time to take a leap of faith – to check our vested interests and internal bias at the door, and apply a wholistic approach to train control system delivery. Astute and progressive
stakeholders will benefit from the efficiencies that will accrue, as surely as night follows day.

Mr Damian Crompton AMIRSE, US&S Pty Ltd, and Mr Brian Ingleton, Fluor Australia: “West Angelas Rail Project”

This technical paper discusses the modifications to the signalling system to facilitate the amalgamation of the Hamersley Iron Railway and the Robe River Iron Associates Railway and the new rail connection to Robe’s new mine at West Angelas.

Robe operates a heavy haul railway system between its port facility at Cape Lambert and its iron ore mine at Pannawonica and Hamersley Iron between its port at Dampier and mines at Tom Price, Brockman, Yandi, Marandoo and Paraburdoon.

West Angelas is a mine which is located approximately 100 kilometres north-west of the town of Newman in the Pilbara region of Western Australia. A spur from the existing Hamersley Iron Railway at junction called Juna Downs to West Angelas was constructed, along with a connection between Robe and Hamersley at a junction referred to as the Northern Link. This project is referred to as the West Angelas Rail Project (WARP).

Mr Richard Stepniewski AMIRSE, Alstom Australia: “Enhancing Train Visibility”

Enhancing the train visibility in Dark Territories in the NSW metropolitan rail network has occurred through a series of control system projects commissioned by the Rail Infrastructure Corporation NSW, State Rail Authority IT&T and Alstom Australia.

This paper describes the development, installation and commissioning of the various SigView control systems used used to enhance visibility in the Blue Mountains. The paper provides details on each stage of the process, beginning with the initial objective of providing signalling indications in the Dark Territories through to the provision of Train Descriptor systems some of which are currently in use.

Mr Hessel De Jong MIRSE, WestNet Rail: “Communications Backbone Project (Some Lessons and Successes)”

The communications backbone project was a direct consequence of the communications requirements between centralised train control centres and the trackside infrastructure.

Whilst the signalling infrastructure upgrade is the subject of another paper this paper briefly describes the circumstances, criteria and process involved in determining the stages and requirements for the communications backbone.

Panel Session: Chaired by Mr. Keith Walker.

Panel: Messrs Wayne McDonald, Steve Cotton, Tony Godber, Terry McDougal, Graham Russell, John Ursich, who formed three a side for a lively debate with an impressive title of “National Competency Standards for Signalling Engineers. Do we need them in Australia? Is the IRESE Licensing Accreditation Scheme the solution?”

Keith made a summary at the conclusion of the time allotted for the arguments for and against, including questions from the floor, then calling for a show of hands that showed that the majority agreed that we need a National Standard.

Mr Les Brearley presented all speakers with a plaque of appreciation, moving a vote of thanks, which was passed by acclamation.

The technical session closed at 16.20 hours, with the Committee members adjourning for the Section meeting business at 17.00 hours and then joining members and visitors for pre-dinner socialising at 18.30 hours.

TUESDAY 29th JULY, PERTH FIELD TRIP

Two buses transported 69 members and visitors on a tour of the rail extension construction in the Clarkson area, a powered claw lock switch layout with moveable frog was a point of great interest, the tour continuing to Alstom workshop where overhaul of signal relays, searchlight signal mechanisms and temperature testing of signal gear was conducted for rail customers.

Travelling saw the groups view the communications Backbone Projects at the Forrestfield Yard and then on to Westnet Rail Train Control Centre.

This completed the Perth field trip.

WEDNESDAY 30th JULY, KARRATHA FIELD TRIP

A party of 32 departed Perth for Karratha at 06.30 hours on arrival travelling to the 7-mile training centre for visitor induction and welcome.

During the day site visits were made to the dumper, port area and new yard at Cape Lambert, continuing after lunch to an end of siding location at Harding North.

3 TECHNICAL MEETING – SYDNEY, NSW
28th-29th NOVEMBER 2003

Chairman Mr Keith Walker opened the meeting at 09.20 hours welcoming the 114 delegates to the presentation where today’s theme was “Technology for Railways”.

Mr Michael Gallacher MLC, Leader of the Opposition, Shadow Transport Minister, NSW, expressed the pleasure of the first opportunity to address a significant rail independent group, giving them an insight of public transport, he considers input from professionals is important to a government’s effectiveness.

Two legislations have been pushed through parliament:

1 “Rail Safety Regulations” – the opposition is concerned with lack of independence, this should still be a Joint Standing Committee Legislation.

2 “Establishment of RailCorp and the Rail Safety and Reliability Regulator” – this has an escape clause where proposed expenditure can be referred to the Treasurer if it is too expensive, this should not be allowed to happen.

The formation of RailCorp has only moved the problems SRA and Rail Infrastructure Corp. to a new organisation and not solved the issues that led to the Waterfall incident.
After taking several questions from the floor Mr Peter Symons thanked Mr Gallacher for his presentation, commenting that it was unusual for the Institution to have insight to legislation and it was much appreciated.

Ms Jeanette Aitken, Aitken & Partners, Consulting Engineers: “Train Position Detection”

This paper describes a method of improving the determination of train positions that is particularly applicable in areas where track circuits are not available. The method uses multiple GPS antennas for position and heading determination.

One of the key problems with standard GPS solutions is the difficulty in resolving the track that the train has taken at a junction. Parallel tracks may lie within the resolution ambiguity of standard GPS and DGPS position measurements. We propose that attitude determination be used to determine the path that the train has taken at a track junction. The document then explains the equipment and methods that were considered best for solving these problems.

Mr Nick Coleman, Human Engineering (Australia) Pty Ltd: “Driver Recognition of Railway Signals”

The role of human factors in understanding and modelling driver performance is now widely recognised as an essential step in the design and positioning of track side signals and objects in order to support safe driving behaviours and prevent SPADS. This paper provides a brief overview of four extensive projects that are investigating the capabilities and limitations of driver performance and generating data that are being applied to the reduction of SPADS in the UK. Each project is being conducted by Human Engineering in conjunction with Network Rail and/or RSSB (the Rail Safety and Standards Board).

Mr Alistair Morrison AMIRSE, National Sales & Business Development Manager Information Solutions, Alstom Australia: “Maintenance and Asset Management”

The scope of this paper is to promote discussion and review of the maintenance processes and tools used to manager rail network assets. This paper looks at the processes used for signalling systems, but they can be applied to other industries and processes.

With the introduction of the computer-based systems utilising serial communications and multi-layered databases for “real-time” and “static” information, tools can be created to track the data in both forms, to provide positive feedback to maintenance and asset management staff.

Mr Mark Lyons AMIRSE, Rail Infrastructure Corporation: “Resignalling the NSW Country Network”

The NSW country network is a patchwork of signalling systems built between 1900 and 2000. This mix of signalling systems and the age of the signalling has led to a system that does not and cannot meet the operational needs of the Rail Infrastructure Corporation.

The RIC has commenced a project to increase rail business throughout the NSW country network. This paper describes the broad objectives of the resignalling programme and describes in detail the Bathurst Resignalling Project, one of the first of 37 projects to be completed progressively over the coming years.

The scope of works and functionality for the remote control of the Bathurst, Kelso and Newbridge signal interlockings will be covered, including the new technologies introduced on this project and the interfacing between these technologies.

This paper will describe the method of operation introduced for the single line block section between Bathurst and Newbridge, including the use of the US&S Phoenix train control system.

The aim of this paper is to also provide a greater insight into US&S Micro Lock II Coded Track Circuits and factors to be considered when adopting this technology.

Mr Paul Furniss, Omnicom Engineering Pty Ltd: “Virtual Track Surveying”

Following the privatisation of the UK rail industry in 1994, resource migration to the devolved business units caused knowledge of the railway infrastructure to be lost from the core. Acquiring quality track based asset information has historically been a slow and dangerous process that involved track possessions or working between operational traffic. With track speed and train frequency increases new methods of gathering this information was required and prompted development effort to provide a solution.

The OmniSurveyor3D system, developed by Omnicom Engineering, has taken the lead by providing a world-class solution that is safe, due to users collecting information from their desktop PC and cost-effective because the raw data is collected from a rail vehicle that can operate at track speeds.

This paper describes the methods used to collect the raw data, how it is processed and made available to the end user. The paper goes on to examine the requirements for such a system and its increasing number of varied uses within the rail industry.

Mr Les Brearley FIRSE, Manager, Systems Safety & Quality, Union Switch & Signal Pty Ltd: “Supporting Technology – The CRC Course in Signal Engineering”

The technology supplied by the railway industry requires the support of appropriate education and training to deliver safe and efficient systems for railway operations. In the past there has not been a common, formally structured course available for the signalling engineering profession in Australia. The need for such a course has increased with the ongoing changes in the rail industry structure over the past decade and the aging profile of signalling engineers in Australia.

To fulfil this need, the Co-operative Research Centre for Engineering & Technologies (Rail CRC) has sponsored the development of a project based, distance learning course for railway signalling in
Australia using innovative teaching approaches to meet the needs of individual States. The objectives of the signalling course is to develop in the students the skills and knowledge required by competent signal engineering practitioners.

The course is being developed with wide input from industry and will require further support during the delivery phase. The successful establishment of this course is a vital element in ensuring that there is sufficient competent signal engineering staff for the future. This in turn is a fundamental requirement in ensuring the effective implementation of signalling technologies for railways.

This paper builds on a paper presented to the Institution August 2002 and sets out the stakeholders in the course and the innovative education approach that is being adopted to meet the industry’s needs.

The Panel Session format was changed from a discussion to a few minutes’ presentation each by Chris Miller, Peter Symons, Trevor Moore and Keith Walker of first-hand knowledge of their attendance at Aspect 2003 in the UK.

This completed the day’s presentation and Mr David Ness, called on by the Chairman, commented on each paper and congratulated all speakers for the overall quality, then moved a vote of appreciation followed by the usual acclamation from the floor.

SATURDAY 29th NOVEMBER

A short walk from the hotel saw members use the train to visit Sydenham control centre to inspect the technical area and the operation floor.

After again “training” to the city for lunch, members visited the security conscious rail management centre at Central Station to view the overall management of City Rail, the meeting was concluded by an unusual visit to an underground station that was built for the future expansion but has never been connected to the system, there were all the normal structures, but only a few metres of tunnel bore at each end of the platform!

Thank you is extended to the following for their assistance in providing sponsorship for events, trade displays and advertisements at the technical meetings through the year:

- Alstom Australia Ltd – Rail Transport
- Asia Pacific Rail
- Australian Rail Corporation
- Bombardier Transportation
- ComGroup Australia Pty Ltd
- Connell Wagner Pty Ltd
- Gobetz Engineering Services
- GHD Transportation Systems
- O’Donnell Griffen
- Pilbara Rail Transport
- Public Transportation Authority WA
- Rail Personnel
- Siemens Ltd Transportation Systems
- Teknis Electronics
- TMG International (Australia) Pty Ltd
- TransAdelaide
- Union Switch & Signal Pty Ltd
- Westinghouse Signals Australia
- WestNet Rail

Local meetings were held as follows:

Victoria
1 9th April, Signalling – Alice Springs to Darwin – W McDonald. Working in the UK – R Baird.
2 11th May, ERTMS update – R Baird.
3 10th September, TPWS update – C Page.
   Inbearer points Drive – P Baker.

NSW
1 26th June, Signalling – Alice Springs to Darwin – Philip Baker (WSA).
2 28th August, joint meeting with PWI & RTSA, TMG track cleaning car for Hong Kong MRTC – Dion Phan; UK Channel Tunnel Rail Link and the IRSE International Convention – R Stepniewski (Alstom).
3 16th September, Train Visibility System – Lionel Portela (Alstom).

Queensland
1 9th September, MicroTrax track circuit – Palanivel Chidambaram.
2 9th December, Columbia Shuttle Disaster – guest speaker from QR, Mr Dave Haley.

Note: Reports of these two papers have been forwarded by Queensland and are included as an addendum.

MEMBERSHIP

The Australasian Section membership as of 31st December 2003 was 399, with nine applications pending financial or Council approval.

A list of changes for the year are appended.

SUBSCRIPTION PAYMENTS FOR 2003/2004 PERIOD

There has been a good response to payment this year but there are still 35 outstanding accounts with 11 of those also in arrears for 2002/2003.

FINANCE

MYOB balance sheet for the year ending 31st December 2003 is appended.

The Committee wishes to thank members for their support to the Australasian Section during the year, and looks forward to the continuing attendance at meetings and functions in the future.  

G Willmott
Central European Section

On 5th September 2003, the IRSE Central European Section was invited to a technical visit of the first German ERTMS installed on the line between the cities of Berlin and Halle/Leipzig. Test operation on this line started in July 2003 in the presence of the Chairman of DB and high ranking politicians.

The technical visit took place in Bitterfeld, a town at the southern part of the line where it splits between the two destinations Halle and Leipzig. About 35 IRSE members were welcomed by representatives of the DB and the system suppliers Alcatel and Siemens. After a short lunch the electronic interlocking system and the ETCS radio block centre (RBC) at Bitterfeld were visited. At Bitterfeld, one of three RBCs of the Berlin-Halle/Leipzig line is located. The Bitterfeld interlocking is remotely controlled from Leipzig and hence normally unmanned.

After the visit of the RBC, the party was taken for a demonstration run on a special DMU to the town of Wittenberg where the next RBC is located and then returned to Bitterfeld. The DMU was supplied by Siemens solely for the purpose of carrying out intensive ETCS test (Level 1 & 2) and demonstration runs, thus avoiding dependency on the availability of DB rolling stock for this purpose.

During the demonstration run the ETCS on-board equipment (VOBC) could be inspected. A televised life view from the driver's cabin during the entire journey permitted all visitors to have a useful direct comparison between the actual line-side signalling and the ETCS cab display. The technical visit was concluded by examining the equipment mounted beneath the DMU.

A more detailed report can be found in IRSE News of November 2003.

Hong Kong Section

The Committee of the Hong Kong Section

President
Mr Phil Gaffney, Mass Transit Railway Corporation Ltd

Vice-Chairmen
Mr Franco Fabbian, Mass Transit Railway Corporation Ltd; Mr Pang Kwok Wai, Kowloon Canton Railway Corporation.

Secretary
Hui Fook Lun, Francis, Control & Communications Consultants Co Ltd.

Committee Members
Mr Sung Yuen Fat, Kowloon Canton Railway Corporation; Mr Cheung Nin Sang, Henry, Kowloon Canton Railway Corporation; Mr Lam Lai Yan, Mass Transit Railway Corporation Ltd; Mr Kong Yam, Mass Transit Railway Corporation Ltd; Mr Luk Kam Ming, KML Engineering Co Ltd.

Membership Sub-Committee
Mr Sung Yuen Fat, Kowloon Canton Railway Corporation; Mr Li Kin Man, Mass Transit Railway Corporation Ltd.

Licence Sub-Committee
Mr Simon Lee, Mass Transit Railway Corporation Ltd; Mr Tsang Kwok Leung, Kowloon Canton Railway Corporation; Mr Hui Fook Lun, Francis, Control & Communications Consultants Co Ltd.

Learning & Development Sub-Committee
Mr Alfred Lui, Wharton Business Management Ltd; Mr Philip Lee, Mass Transit Railway Corporation Ltd; Mr Chan Wing Tin Terry, Mass Transit Railway Corporation Ltd; Mr Wong Wai Ming, Philip Kowloon Canton Railway Corporation.

China Affairs
Mr Sung Yuen Fat, Kowloon Canton Railway Corporation.

Overseas Affairs
Mr Franco Fabbian, Mass Transit Railway Corporation Ltd.

Membership
The Hong Kong Section has completed the task of updating membership data following receipt of completed new-style forms from members. The Section now accepts three years’ subscription prepaid, which reduces administrative activity each year.

The Section started promoting membership across societies and in the colleges, the response from the young graduates was very positive to joining as student members.

The Section intended to extend the membership services into China by visiting signalling contractors, the signalling and communications sections in Guangzhou, Shenzhen Metros and Railway. The visiting plan has been fixed for 2004.

The membership up to date is 190

IRSE Continuing Professional Development
Twenty members were successfully accepted by Beijing Jiaotong University to join the second intake of the Railway Automation Degree Programme which was started in early January.

The IRSE Examination Study Group is under-way with the help from the Training Centre of MTRCL. Another study group was established in KCRC this year, which was open to all IRSE members.
SECTION ACTIVITIES

Twenty-seven members completed their Transportation Management Bachelor Degree programme in January and the graduation ceremony was held in Beijing Jiaotong University.

Sixty members completed their MBA programme and the graduation ceremony was held on 29th March in Shenzhen.

A technical forum was jointly organised with Mass Transit Railway Corporation, Train Services Engineering Group in 2003.

10th-17th August: Management Seminar of Innovation Management by Tsing Hua University at Shenzhen Hi-Tech Parks Campus.

6th September: Technical visit of West Rail, train ride as available, train maintenance depots, WR Central Control and Signalling Control Rooms.

16th October: IRSE (Hong Kong Section) Annual Dinner (Venue: Maxim’s Chinese Restaurant, Shatin New Town Plaza).

15th November: Boat Trip on MTR “Sea Breeze” for new joined members.

5th December: Technical visit of Mass Transit Railway, maintenance depots, signalling trackside and station equipment, signalling and communications control rooms, operation central room at Tsing Yi.

IRSE (HK) WEBSITE

The website has been successfully updated with bilingual English and Chinese pages. An open forum page was made available for discussion between members.

IRSE (HK) NEWSLETTER

A new editorial group has been formed so the newsletter can now be regularly published.

F L Hui

Midland & North-Western Section

The Midland & North-Western Section had a most successful year, with no fewer than nine technical meetings, in five different locations. We believe this may be a world record for any section of the IRSE! Despite blockades on the West Coast Main Line, we visited all our usual venues in Birmingham, Crewe, Derby and Manchester, final meeting at a new location – Banbury. The meetings covered a wide range of topics:

- Heritage Railways Signalling – Graham Bannister (Great Central Railway)
- IRSE Support for Training & Development – Karen Gould and Buddhadev Dutta Chowdhury
- Graceful Degradation of Signalling – Nigel Murphy (Atkins) and Steve Roberts (RSSB)
- Enhancing Train Protection before ERTMS – Charles Weightman (Network Rail)
- RT60 Switches for the Signal Engineer – Andy Foan (Balfour Beatty)
- Air Traffic Control – Steve Kinnersly (AEA Technology)
- TPWS on RETB routes – Bill Redfern (Park Signalling)
- Railway Controls – Past, Present & Future – Tom Birch (Network Rail)
- Cherwell Valley Resignalling – Graham Wire (Network Rail)

As always we are most grateful to all these people in our own and related professions for giving up their valuable time to share experience and ideas. We are also very fortunate for support from organisations that have provided accommodation or sponsorship for all our meetings.

One of our innovations this year has been to produce short reports of our meetings for publication in IRSE News. Hopefully this is giving a flavour of our meetings to a wider audience. Several of the speakers covered new ground that has not previously been presented to the Institution. For example, at the “Graceful Degradation” and “Train Protection” talks, we heard the authors of newly published standards telling us about the background to their work.

All of the committee have given me great support throughout my year as Chairman, but I must specifically mention our Secretary, Bill Redfern, who remains the indispensable focal point for the Section’s operations, and Visits Secretary, Ian Allison, who has put together an excellent programme of visits and social events for the coming Summer. Congratulations also to our Training & Development representative Buddadev Dutta Chowdhury, who has initiated a Birmingham-based study group for IRSE Examination.

One of the happy customs of the Section is the annual Chairman’s Award. This year I am very pleased to present this to Graham Bannister of the Great Central Railway, for his efforts to preserve both the equipment and the skills of previous generations of signalling technology. Graham gave us an excellent lecture this year, on top of the hospitality we were treated to when we visited the S&T installations on the Great Central in 2002, and we are looking forward to another visit to see the latest developments this autumn.

Ian Mitchell
PROCEED ON SIGHT ASPECT, 6th NOVEMBER

Nigel Murphy of Atkins Rail presented a paper by himself and Steve Roberts of rail safety entitled “Graceful Degradation of Signalling”.

Existing UK main line railway signalling has traditionally been based on the fail-safe philosophy, with reversion to manual method of control during failures. Such an approach is not risk-based, nor does it permit train movements to continue without drastic curtailment of service levels.

Despite publication by the IRSE of the report “Operational Availability of Railway Control Systems” in the early 1990s, the concept of using residual functionality to continue movements without manual methods has seen scant application.

The paper described, from an operator’s viewpoint, how the concept of degraded mode signalling functionality has been developed, and how it will bring benefits to the UK railways. This work has come to be known by the acronym of the new signal aspect which is proposed – PoSA, for Proceed on Sight Aspect.

Equivalent facilities already exist in many other European countries, albeit in the context of different overall signalling philosophies. A study has been made of practice in various countries, including the types of aspect used in particular, and this has contributed to the proposals for the UK.

In the UK context, the balance of risks with the alternative manual and verbal methods of control has required careful consideration. The authors described the use of a scenario-based approach to the analysis of the use of PoSA signals. This has enabled the operational requirements to be refined as well as identifying the safety and cost benefits.

A systematic approach to consideration of operational rules requirements and human sub-systems as part of the “whole system” is taken by RSSB to all new Standards. Equipment cannot be considered in isolation without understanding the context in which it is used, and in particular the needs of the humans using it.

The introduction of the new standards (Group Standards GE/RT8071 and GE/GN8571) removes a significant barrier to progress in the UK, and the authors hope that the business will take up the challenge to introduce them, as offering significant performance and safety benefits, enabling the UK to catch up at last with the Europeans and with the IRSE vision of ten years ago.

AIR TRAFFIC CONTROL: NEW DIMENSIONS, 4th FEBRUARY

The speaker, Steve Kinnersly of AEA Technology, has 25 years’ experience in safety, initially in the nuclear industry and most recently in air traffic control. He has worked on major air traffic control systems in the UK and USA and is involved in research projects for future systems. He is a member of the IEE/BCS ISA Working Group.

He entitled his talk, “Air Traffic Control – A trip to the higher dimensions”, explaining that whereas trains can be said to be constrained to move in one-and-a-bit dimensions, aircraft can be said to move in almost three dimensions. This leads to both similarities and differences in control strategies.

The talk gave a short overview of the air traffic control (ATC) system: what it is, how it works and how it is changing.

ATC is based on separation. During the en-route phase of a flight, this is normally five nautical miles laterally, and 1,000 ft in altitude. There are defined air lanes and cruising altitudes. Paths into airports are often the limiting factor. An aircraft is not allowed to take off until it is known that there will be a place for it to land at its destination.

In practice ATC is dominated by the “CNS trinity”: Communications, Navigation, Surveillance.

The ability to communicate with an aircraft in the air is paramount, and loss of ground/air communication is an emergency.

Navigation is the plane finding its own way – “Where am I?” Fixed beacons give directional information, and can also report range.

Surveillance is the ground tracking the aircraft – “Where is it?”

It is regarded as essential to have both navigation and surveillance (in contrast to railway practice, where the equivalents are regarded as alternatives).

The air traffic controller and the pilot take final responsibility. There are various tools to back them up – for example, to predict mid-air collisions. The tool can give a warning to the human, but the human takes the final decision. Again there is an interesting comparison with railway practice.

Air traffic in Europe is growing, and yet European airspace is already very congested. The UK is among the most congested in Europe, with air traffic set to double in the next ten years. Efficient and effective air traffic control is necessary for growth and for safety. This must be achieved consistently across a changing continent.

So ATC issues are of great importance, and improvements are constantly being sought.

David Stratton
North American Section

COMPOSITION OF THE COMMITTEE
Chairman William Scheerer
Vice-Chairman David Thurston
Secretary Gary Young
Members Kendrick Bisset
Joseph Noffsinger
Robert Heggestad
William Petit

The North American Section was formed on 24th May 2002 by 28 IRSE members. We began the 2003-2004 Session on 10th July 2003 by holding our first NAS Annual General Meeting at the Navy Pier in Chicago, Illinois. The 17 NAS members in attendance were very pleased to welcome IRSE President Colin Porter to our meeting. All in attendance appreciated his comments regarding the activities of the Institution and his patience in answering our many questions. Membership of the Section stood at 34.

On 11th July we held our first formal technical activity. This consisted of a technical visit to the Northern Indiana Commuter Transportation District (NICTD). We travelled by NICTD train to Michigan City, Indiana, where we were treated to presentations by Vic Babin, Chief Electrical Engineer NICTD, and David Thurston, Vice-President SYSTRA, on NICTD’s history, the present operation of its signal system, and NICTD’s plans for the future. We also toured the Mid-Life rolling stock overhaul facility, the Eastport power substation, the signal and catenary maintenance facility and historic line car 1100.

During our return to Chicago, a tour of the Hammond station and interlocking was arranged. The Section extends its thanks to Vic Babin for hosting us and to Dave Thurston for his efforts in arranging an informative and interesting day.

The second NAS Annual General Meeting was held on 20th May 2004 in Nashville, Tennessee. The Section was again very fortunate to have IRSE President John Corrie in attendance at our AGM. His remarks were of great interest and included excellent advice for moving the Section forward in ways that will be beneficial to the members and the Institution as a whole. We are very grateful to President Corrie for taking the time to attend our meeting, especially on the eve of the International Convention in Dublin.

The local Committee for 2004-2005 was elected as follows:
Chairman David Thurston
Vice-Chairman Kendrick Bisset
Secretary Gary Young
Members Vic Babin
Joseph Noffsinger
William Petit
William Scheerer

The meeting was followed by a members’ dinner where we were able to socialise and get to know President Corrie on a more personal basis. Membership in the North American Section presently stands at 40.

In summary, the North American Section is growing, working to support the goals of the Institution in North America and to provide value to its members. The Committee extends its thanks to the Railway Signal Suppliers Inc for providing the venue of our meetings and its support of the Section and its goals.

W J Scheerer

Plymouth Section

In October 2003, the Plymouth Section lost one of its stalwart members in H S (Stan) Buttery, who passed away following a long illness. Several members joined a full congregation at the church of St Werburgh on the cliff-tops at Wembury overlooking Plymouth Sound for a service of celebration of Stan’s life. Stan had moved to the area many years earlier and as well as continuing to be well known within the signalling industry through his work, he became a very active member of the Plymouth Section, culminating in becoming Secretary/Treasurer and continuing in that post until well into his retirement years. He will be sadly missed.

The Plymouth Section of the IRSE commenced the 2003-2004 programme on 30th October 2003 with a paper entitled “Wrong Side Failure Testing” presented by Stuart Isbister of Network Rail. Stuart is obviously well qualified in this field and was able to provide a very detailed insight into the many aspects of failure testing in general, using that approach to make the point as to what is a wrong side failure and what is not so. The qualifications and experience necessary to perform the duties were addressed as well as the process followed and application and interpretations of the rulebook, there being more than one way to apply the rules in a sensible manner. On a more general note and very interesting were facts about the involvement and approach of the British Transport Police in some cases and policies concerning non destructive as against destructive testing.

The second presentation was by Peter Cross of TRE Co Ltd, and was entitled “System Modelling for the Signal Engineer”, given on 26th November 2003. By quoting many examples, Peter explained the basic principle that many different applications can be computer-modelled in advance of implementation thus allowing measurements of performance, viability of a design, human interface efficiency and operability, power distribution and many other important considerations. In addition, extended opportunities include timetable verification, training,
assessments, scenario testing and possession planning. Peter illustrated the opportunities by identifying many applications so far undertaken, together with additional opportunities still in the pipeline. In summary terms, schemes or ideas can be tried out theoretically using computer modelling in order to achieve any of justification, viability and operability.

Peter is well known to be a true railway buff and he added to the entertainment by interspersing his paper with many old photographs of well known stations and junctions, challenging his audience to identify the locations.

On 27th January 2004 the President, Colin Porter, made the traditional visit to the Section to attend a paper, and accepted the invitations to both say a few words and to chair the meeting. The President outlined his itinerary of world visits, made reference to his previous visit to Plymouth eight years earlier and finished by advising attendees that the Institution was in good shape.

Dave Smith and Dave Came, of Bombardier Transportation, then presented a joint paper entitled “Automatic Control of the East London Line”. The latter opened proceedings by describing the scope and history of the project and why it had taken longer than anticipated, with particular reference to the importance of concise specifications and comprehensive requirements capture and the part they had played within the project.

Dave Smith, who was the supplier’s software manager for the project, then made the major contribution to the presentation. The commissioned system is fully automatic in that the daily timetable is downloaded at a set time and signal routes are called in accordance with the timetable. The only need for manual intervention is in the case of disruption such that the timetable cannot be maintained, in which case the system allows operators to edit running trains and the timetable in a variety of ways. The editing features are very comprehensive and the speaker explained the facilities available in detail together with the implications of their use. The system is synchronised to a GPS clock to ensure accurate timings for train movements and interchanges. A passenger information system with displays at all stations formed part of the scope, and one of the key issues was to maintain accurate train information to passengers irrespective of the depth of editing undertaken.

The final paper of the session, on 3rd March 2004, was entitled “Fibre Optic Signal Developments” presented by Mike Mackie, of Bombardier Transportation. There had been a presentation on the fibre optic signal during the 2001-2002 session, and the objective of the new paper was to update the audience on the progress of the continued development of the signal and its potential applications. There are pros and cons to be evaluated when considering the use of the signal, and it would appear that there will be applications where it is more suitable and those where it will be less suitable than either conventional or LED signal technology. Early considerations had assumed there would be a “winner” out of the choice of technologies, but it would seem each has its own merits and pitfalls depending on the application. In the case of the fibre optic signal, with a single lens being capable of displaying multiple aspects, and consequently where a four-aspect is reduced to two lamp positions, lamp changing carried out at ground level, plus the aid of unique mounting designs inclusive of a hinged pole for ease of maintenance, which despite the hinge will maintain its sighting, a number of potential installations are being considered. As is always found with something so dear to the heart of signal engineers, questions were many, challenging and varied, but all well fielded by the speaker.

The Annual General Meeting of the Section was held in April 2004. Under local rules, three members of the standing committee had to retire, having served for three sessions. The Committee for the coming session was confirmed as follows:

Existing Committee members: Alastair Wilson
                          Dave Biss
                          Geoff Ledger
New Committee members:  Chris Carter
                          Jim Easterbrook
                          John Lovick

Dave Came was confirmed as Secretary/Treasurer with Alan Peters as Auditor.

In view of the successful numbers attending technical meetings, taking into account the limited potential, it was agreed to continue with the same policy in terms of number, time of start and venue of meetings.

Scottish Section

Scottish Section Committee 2002/2003:

Chairman:  Paul Humphreys
Secretary:  Alan King
Treasurer: Alistair McWhirter
Members:  Peter Allan
          Peter Rowell
          Ian Hill
          Tommy Gallacher
          Simon Lowe

Our 2002-3 session started in October with the first of two joint lectures with the Permanent Way Institution. Charles Weightman and Bruce MacDougall respectively described design principles and the technology adopted on the Manchester South Resignalling Scheme. Charles described how the train protection (TPWS) was applied to the track layout in the Stockport area to minimise the consequences of a signal overrun in this complex area. Bruce explained how the Italian
Ansaldo ACC technology was applied from the control centre layout though to the various trackside components. Both talks were superbly illustrated with diagrams and photographs which gave us all a good flavour of how this unique project was implemented. (Attendance: members 21, guests 10)

In November we were pleased to welcome members of the Institution and guests from all parts of the British Isles (and beyond) to the Annual Dinner. Yet again we managed to break a previous record of dinner guests. Our speaker was Colin Porter and his subject “Improving the Value of S&T Engineering”. Colin engaged the audience in a brainstorm of the multitude of issues that have pushed up the cost of S&T engineering over the years since privatisation of the UK rail industry. Having created a list stretching to several sheets of flipchart paper, Colin outlined some hints on how S&T engineers could approach their tasks to curb unnecessary expenditure. He cited some examples of railway projects where “blind compliance” with standards created engineering solutions which went well beyond the scope of being “reasonably practicable”. Colin also expressed the opinion that there is opportunity to challenge aspects of the approvals process that applies to new signalling equipment such that such products could be more easily accepted for use in the UK market and so stimulate competition.

(Attendance: members 46, guests 28)

The dinner that followed this lecture provided ample opportunity to continue related discussions informally, while catching up with colleagues from across the industry in a most relaxed atmosphere. The Marriott Hotel again proved its capability to look after us well.

In January the Section welcomed Paul Sellar from Lloyd’s Register Rail. Paul is the Head of Verification and Validation within that organisation, which is an accredited rail industry Notified Body. Paul was able to explain what this meant and the wider impact of the European Interoperability Regulations which are now coming into force. Paul also expressed the opinion that there is opportunity to make provision for future projects that applies to new signalling equipment such that such products could be more easily accepted for use in the UK market and so stimulate competition.

(Attendance: members 27, guests 10)

Siemens kindly sponsored this lecture.

(Attendance: members 24, guests 35)

Our second joint lecture with the Permanent Way Institution was held in March, the subject being “Mossend SSI Resignalling”. Peter Allan, who was Engineering Manager of the Mossend MIPMT, gave us a superbly illustrated insight into the scope of this project. He emphasised that, although there was limited innovation on this project in signal engineering aspects, there was a great deal of integration with most other railway engineering disciplines. Peter explained how this integration was arranged through regular interdisciplinary meetings where changes in the detail developed were shared with other disciplines to ensure compatibility. There were extensive works in all of signalling, telecomms, overhead line, E&P and permanent way. Examples of opportunities to make provision for future projects were also described. These included power supply busbars and computer floor area in Motherwell signalling centre. Presently this provision is now benefiting the Larkhall project I the form of a suitable location and power supply point for another SSI interlocking.

(Attendance: members 23, guests 36)

Following a great success last year, it was been decided to repeat the joint AGM and Quiz Night format held locally in licensed premises. Following the AGM business, our Section committee quizmaster, Peter Allan probed our general and (a little) railway engineering knowledge through some searching questions, in a most relaxed atmosphere. A King

Southern African Section

MEMBERSHIP

The membership of the Southern African Section stood at 51 at the end of the 2003 session. This was made up as follows:

- Companions: 1
- Fellows: 9
- Members: 27
- Associate Members: 5
- Accredited Technicians: 9

The membership per country within the Southern African Section is:

- South Africa: 47
- Zimbabwe: 3
- Zambia: 1

Despite some changes in detail of the membership, there was no significant change in the level of membership during this session.

OFFICERS FOR THE 2003 SESSION

- Chairman: Ryan Gould
- Vice-Chairman & Visits: Derrick Marais
- Secretary: Vic Bowles
- Treasurer: Johan van de Pol
The feeder transport to the railheads. The feeder incorporated the upgrade/provision of road-based transport and the rapid rail would operate as an integrated system, ideally using through ticketing concepts. The rapid rail would have its own dedicate rolling stock. The trains are expected to run at speeds of up to 160 km/h. Advanced forms of train control (level 2 ERTMS) are envisaged for the rapid rail system. The tendering process was already under way.

This was countered by a short presentation by Johan van de Pol focusing on the project cons of a very long payback period, large upfront investment in a period of unstable currency and over optimistic passenger forecasts.

The discussion concluded that the viability hinged on the following:

- the degree of success in establishing the integrated feeder/rail system thereby offering effectively a door to door service;
- the ability to sustain the political will to support the project and provide the seeding funding;
- the will of the people to use the system;
- affordable fare structures;
- the possible need to impose disincentives for private road based trips.

On 22nd May 2003, Jonathan Hanford presented a paper titled “The Use of Linux in Traffic Management Systems”. The paper started with a review of what is Linux and why should one consider using it for traffic management systems. The paper then explored in more detail the pros and cons of using Linux for traffic management systems and discussed the inevitability of this move in time. The case was made for this being in line with the worldwide trend against proprietary software and growth of open source software, and moving towards internationally accepted standards. The life-cycle cost of acquisition and maintenance in the railway environment was also addressed. The discussion that followed indicated an acceptance that open source software, such as Linux, would play a more prominent role in traffic management systems over time.

Due to various factors, the joint technical meeting that normally takes place in June could not be...
arranged and a suitable alternative time slot could not be found in the rest of the 2003 session. Accordingly, this event was cancelled, with the intent that the next joint meeting would take place in 2004.

On 26th August 2003, the Southern African Section of IRSE had the rare pleasure of a joint address by the current international President, Colin Porter, and the immediate past President, Peter Stanley. The paper focused on the state of the IRSE and developments going forward, followed by a section on the state of the signalling industry in the UK and developments going forward. This information was of great interest and benefit to the members of the Southern African Section as well as honoured guests from Spoornet and the South African signalling industry.

On 18th September 2003, a paper titled “Signalling Projects: Converting Requirements into Reality” was presented by Berend Ostendorf. The paper set out to show that the changing corporate and technological landscapes of the signalling users and industry have required a different approach to planning and implementing signalling installation and replacement projects. The paper reviewed these changes, explored how signalling projects are currently handled and took a glimpse into the future. Spoornet has been required to operate on the basis of commercial principles in recent years. Accordingly, there has been significant pressure to improve efficiencies in both the operational and investment arenas. Furthermore, the extent of signalling knowledge and expertise in South Africa has declined significantly within the user, supplier and contract management environments over recent years. The paper postulated that this has necessitated that the preparation of signalling project specifications and contract documentation needed to be done much more closely to the user environment and that the user has had to become more directly involved in the contract management and administration functions.

On 23rd October 2003 Johan (JFW) Pretorius presented a paper titled “The Use of Pattern Recognition Algorithms in an Automatic Vehicle Identification System”. The paper informed that, apart from reading wagon numbers passed at a given point, the automatic vehicle identification system (AVI) is required to build a record of the train consist and requires identification of the vehicle types such as wagons and locomotives. This must be accurate even if tags are missing on some of the vehicles or when the train speed changes while being measured. A further requirement is that the train consist should not be corrupted when two trains pass the same reader site simultaneously. To address this, different pattern recognition algorithms had been implemented on the system to ensure reliable performance in accordance to these requirements. The paper detailed the algorithms employed, some of the operational problems experienced and the unique developments undertaken to solve these problems.

TECHNICAL VISIT

As is customary, the annual technical visit coincided with the visit of the IRSE President and the immediate Past President. This event entailed visiting both the Impala Platinum Mine and the Amplats Platinum Mine in the vicinity of Rustenburg. The customised surface rail train positioning and train movement control systems at each of these mines were enthusiastically explained and demonstrated to the IRSE entourage. Both of these systems were communications based and used GPS equipment, of which the positioning data was relayed over the radio network, to determine the train positions and movement. Each of these two installations had a differing custom designed PC based control computer that kept track of the positions of the trains on the network, processed dispatcher requests to check for and prevent conflicting movements, and generated the authorities for the train movements. Being ring fenced private railway systems for mainly the conveyance of platinum ore around these mines, these basic train positioning and train control systems had proven very successful and cost-effective.

The day’s proceedings were ended off by a late lunch and social at the Wigwam Hotel.

PRESIDENTIAL VISIT

The Southern African Section officially hosted the presidential party, comprising the current IRSE President, Colin Porter and his wife Claire and the Immediate Past President, Peter Stanley and his wife Carol, for 10 days in the latter part of August 2003. The presidential party participated in the annual technical visit. They were also treated to visits to view various train condition monitoring installations on the coal line and the various installations of self-normalising crossings and track warrant control on the Pietersburg line. The President and immediate Past President visited various South African Rail Commuter Corporation (SARCC) signalling installations in Johannesburg and Pretoria. On the same day, the ladies were treated to a visit to a cultural centre in Broederstroom and the De Wildt Cheetah Farm, where a highly successful cheetah-breading programme has been established. Outside of the technical events, the presidential party were exposed as widely as possible to the unique cultures, environments and lifestyles of the people of South Africa. They thoroughly enjoyed their visit as manifested by their letters of thanks and appreciation.

COMMITTEE AND IRSE MEMBERS

The successes achieved during this session are attributable to specifically the commitment of and contributions made by each of the Committee members and more generally to the participation of the Institution’s members, interested potential members and their families. The individual efforts of the Committee members are acknowledged and they can be proud of their work. Equally, without the interest and participation of the members, the IRSE would not exist. Without the participation of spouses, partners and family members, the IRSE
This session was again well attended which suggests the Committee have got the balance of, and the interest in, the papers about correct. The section has had joint meetings with the Somerset and West Wiltshire branch of the IEE and the South Wales PWI as is now customary.

The Committee members wish to extend their thanks to Amey Rail, Hyder Consulting and Westinghouse Rail Systems both for the use of their premises to host the meetings and for the provision of light refreshments at the meetings, which have become an enjoyable feature of the Western Section meetings.

**COMPOSITION OF THE COMMITTEE**

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
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<tr>
<td>Chairman</td>
<td>Peter Martell</td>
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<td>Vice-Chairman</td>
<td>Chris Napper</td>
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<td>Hon Secretary</td>
<td>Doug Gillanders</td>
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<td>Hon Treasurer</td>
<td>Mark Brookes</td>
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<td>Members</td>
<td>Chris Napper, Ed Gerrard</td>
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<td>Andy Scarisbrick</td>
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**TECHNICAL MEETINGS**

The first meeting of the year was on 14th October and was preceded by the AGM as there were no visits during the summer of 2003 to attach it to! This was expertly chaired and concluded by both Mark Brookes, who was standing in for the outgoing chairman Mark Glover, and Peter Martell, the incoming chairman. The main meeting held in Bristol was entitled “E10k or Western Region Route Relay Interlocking” and was given by Mr Michael Page – a well-known figure in the ex-Western Region. This speaker started by stating that the paper would look at the general scene around E10k rather the circuit diagrams. The very first solid state interlocking was illustrated – it being very contentious at the time – at Newport in 1928. It only had route levers equivalent to the later OCS type system. Mike expressed his thanks to John Francis and Tony Howker for their help in finding this early information.

At the end of the war, the railways were clapped out and there was a general shortage of staff when the government introduced the modernisation plan. Western Region, which had a good track record in terms of safety and performance, were extending their AWS system to reduce the risk. The staff who were employed, stayed in their employment, so the conclusion was that to modernise the region needed to adopt an economical signal design. The Great Western has a standardised system right across the region and had a reputation of being independent. The IRSE proceedings of 1928 – 1931 detail “robust” discussions on points. The region also had a tradition of doing work in-house.

A new factory was opened in Reading, which had ample capacity and was hailed in the local press as the most advanced in the UK at the time. It was fully staffed as well. However, WR had no recent experience of major contracts and generally contract resources were committed elsewhere. There were financial constraints, which would remain in place for another ten years. In the early years of the 50s, research was carried out by WR into the technical options open to it and they developed technical standards, equipment standards and the organisation to look after it. Cardiff Valleys had around 135 signal boxes in the early 50s, but 20 years later there were only eight signal-boxes. This was nothing to do with the signal engineers – just a change in the mining industry. Lots of training to establish a competent and motivated work force was going on. At West Ealing there were the early trials of combined lever frame and panel in one signal-box.

The main features of the new route relay interlocking were:

- A standard control panel made by Integra of Switzerland which upset the home market. The first introduction was at Snow Hill at a cost of £6.5k which was 10% of the project cost.
- Safety and non-safety circuits were separated. Switches and lamps on the panel were non safety and the wiring was “cheap and cheerful”.
- Use of a double coil lock relay.
- A locked indication on the points which helped in the hand signalling situations.
- Use of remote control systems – the first was around 1960. The decision was made that no push button circuits were to be sent over the remote control system.
- The aspect sequence circuits were novel – not to be underestimated.
- Double cutting was not done on external circuits
- Negative feeds – this is because the negative points always were the ones to corrode and hence instead of having a number of corroding points you had one.
- The train describer which was a disaster, but was the only display available in the 1960s.
- Quick release track circuits – common DC track circuit was too slow to release greater than one second.
Old Oak panel was the only panel to have clock in it, whereas Swindon panel covered the most route miles of any panel box at the time - 80 miles.

Mike then looked at some typical E10k circuits. British Rail interlocking principles were not seen on WR before 1969.

Mike concluded with some lessons for today:
- self sufficiency creates a knowledge base;
- strong leadership inspires the team;
- control over standards brings benefits in costs training and staff knowledge;
- good planning iron's out peaks and troughs;
- a flawed design brings maintenance problems.

Chris Napper proposed a vote of thanks
(Attendance: 27 members, 3 visitors)

The second meeting held in Chippenham on 18th November was entitled “RBC and the Euradio” and the paper was delivered by Mr Stuart Bamforth and Mr John Harmer, both of WSRL. Mr Bamforth opened the evening with the RBC part of the paper.

RBC stands for radio block centre and is a SIL 4 Level product using a 2-out-of-3 configuration. It manages the radio communications with the train and is a Level 2 ETCS. It uses the radio to the train for movement authority and the balise for train position. It is specified in UNISIG specifications for the components on the train. However, there are no specifications for the other parts of the system. ETCS replaces drivers route knowledge as the driver can go anywhere with the RBC in control. The RBC contains the movement authority - the distance to go from the last balise, the service brake information, the danger point, the overlap position and the emergency brake application if needed. It also contains driver related functions such as train class, speed profile, axle load, gradient information and any TSR information. The RBC also has international “Go/No Go” information in it such as axle load restrictions, traction voltage or loading gauge. There is national information which the UK is currently considering such as door side enable, advisory speeds, automatic pantograph lowering. Other countries have other ideas, hence this is a threat to the interoperability of the system. To start the system up the driver needs to input 15 different messages.

As the train can contact any RBC to determine its location, each balise has to have a unique world identity. Train reports are relative from the last balise, the service brake information, the danger point, the overlap position and the emergency brake application if needed. It also contains driver related functions such as train class, speed profile, axle load, gradient information and any TSR information. The RBC also has international “Go/No Go” information in it such as axle load restrictions, traction voltage or loading gauge. There is national information which the UK is currently considering such as door side enable, advisory speeds, automatic pantograph lowering. Other countries have other ideas, hence this is a threat to the interoperability of the system. To start the system up the driver needs to input 15 different messages.

Mr Bamforth then took a series of questions from the floor.

Mr Harmer then spoke on Euradio which he explained was the interface between the application and the radio, with its key role being to add the safety to the radio transmission. He likened the system to modular stacking of layer with each layer having a different function. The first of these layers is the application layer which initiates the train connection to the RBC and connects to the nearest RBC. The next layer is the safety layer which provides message authentication and prevents the message from being changed. The transport layer chops big messages into small messages and then re-assembles them at the other end. The network layer co-ordinates the transport layer and allows only one network connection. This is then followed by the data link layer which did not get a mention and the final layer is the physical layer which is the GSM(R).

Applications have addresses called the ETCS ID. The GSM(R) has a network ID. Encryption takes 8 bytes at a time, thus for a message of more than 8 bytes, the encryption takes place more than once. The message is authenticated (by a mac) by a code using triple encryption of the last 8 bytes. The set up time is about 8.2 seconds.

What does the future hold? The likely way is by packet radio (GPRS) which has the link set up “permanently” and the messages use a packet system whereby the message get's sent along with others in a discreet packet rather than a dedicated link. There are two consortia working on GPRS RBC interface – Ansaldo/Alstom and Alcatel/Bombardier/Invensys/Siemens.

Following a series of questions to both Mr Harmer and Mr Bamforth, Mark Brookes proposed a vote of thanks. (Attendance: 22 members, 12 visitors)

The meeting on 16th December was again in Bristol, where another well-known figure of the ex-Western Region, Mike Hanscomb, made a return appearance to give a splendidly nostalgic evening of “Railway Archive Films”. Mr Hanscomb started by stating that he intended to show a mixture of archive film clips with some modern video clips to compare the “then and now” locations. His first clip was from “The Lady Killers” which showed a house as the principal location over the top of Copenhagen tunnel and had Jack Warner as the local superintendent. This house does not appear to have existed at any time over the top of the tunnel. There was a view out of the doorway of the house which showed St Pancras station – but the house was not in Argyll Street either!

He then showed a clip of “Train of Events” which again starred Jack Warner, who insisted before the filming took place on being taught how to drive a steam locomotive so that it looked more realistic in the film. He is believed to have injured himself in the back and thigh on the metal work in the cab whilst pulling a lever to bring the train to a stand and falling backwards – something that was to dog him thereafter.

Mike then returned to the final scenes of “The Lady Killers” with the scene where the ladder with one of the killers on it, is prised from the portal face of Copenhagen tunnel so that he falls into a passing freight train. The remaining villain is then hit on the
head by the signal returning to danger and he too ends up in passing freight train.

Mike then changed to then and now with a modern view of Copenhagen tunnel portal where he had gained access by the present landlord who uses the land on top of the tunnel to graze animals!

There followed a couple of short video clips of steam locomotives in action at Bierley on the Stratford to Birmingham line and another on the Warminster to Salisbury line.

A departure from railways followed when the old movie “The Circle of Magnetism” produced as a training film by ICI was shown. The late Professor Laithewaite of Imperial College, who showed how water and fluid flows could be analogous to magnetism, introduced this. This really caught the imagination of the assembled members as it brought to life a normally rather dull subject.

This was followed by an introduction to level crossing gates and their operation. Much to the chagrin of the Western Section, it did not show the method of operation of the gate stops as used on the Western Region, which were on an independent lever. Those shown were part of the controlled movement of the gates themselves.

A four-minute journey on the Blue Pullman from London Paddington to Birmingham Snow Hill followed. The most noticeable item was the loss of infrastructure since the filming of this in 1962.

Finally, some “now and then” clips were shown centring around the “Titfield Thunderbolt” at Midford on the Camerton branch near Limpley Stoke.

Following a series of discussions and reminiscences, the vote of thanks was given by Andy Scarisbrick.  

The first meeting of 2004 on 13th January saw the Section again in Bristol, where we were honoured with the presence of the IRSE President, Mr Colin Porter. The speaker was Derek Smitheman, of Amey Rail, who gave a paper entitled “Supplementary Mechanical Drives for Points”. Mr Smitheman started by stating that supplementary mechanical drives for points were better known as backdrives! There are around 21,636 ends of points on the network of which over 10,000 are worked by point machines. The back drive is an integral part of the overall track system which consists of the rails, the switches, the crossings, the rail fastening system, the bearers, stretchers rods, point machine itself, and the detection system. An open switch is a straight rail but a closed switch is forced into a curve. Movement at the actual wheel face has indicated that the ride through an RT60 switch is a lot “smoother” than that over 113A flat bottom rail. The Pway engineers have identified 183 different switch types.

The top three failure modes are dry slide chairs, points obstructed and the drive rod out of adjustment. With the drive rod the failure is usually a combination of factors in the set up and in the state of the components. The stretcher bars connect the two switches together and ensure that the throughway clearance is maintained. Failure of one of the stretchers leads to the reduction (generally) of that through way and can lead to a derailment. The opening of the switch is dependant on the length of the switch and the measurement of the opening at each of the stretcher bars is important. If the opening is incorrect, the switch becomes twisted and bowed along its longitudinal length. The backdrives hold the switch up against the stock rail and ensure the throughway is maintained. They also assist the point motor in closing the switch toes.

Mr Smitheman then showed examples of incorrectly installed backdrives. He also showed a diagram which indicated that when correctly set up, the backdrive had the necessary force to drive the switch over. One of the facing point tests – using a 1.5mm gauge to break detection – is there to prove that the backdrive is not driving up too hard. The escapement of 5-10mm is there so that the motor does not take up the load immediately.

By using a model set of switches and with the use of a video, Derek give a demonstration of the importance of correctly setting up the backdrive. An incorrectly set up backdrive can force the toes of the switches to remain open. A set standard of movement for technicians to use is currently being produced. Derek then demonstrated that expansion or contraction due to temperature variations is unlikely to affect performance.

Train operated points were then briefly addressed. These are operated by a backdrive which if incorrectly set up, will have the toe of the points forced over by the wheels of the train leading to rapid and premature wear of the switches.

Following a series of questions, a vote of thanks was given by Peter Martell. Colin Porter, the IRSE President, then said a few words and thanked Derek again for a very informative presentation.

For the February meeting, on the 17th, the Section returned to Chippenham where Mr Paul Treanor, of Amey Rail, give a paper entitled “CTRL Signalling System”. This was a joint meeting with the Bath & North Somerset branch of the IEE. Mr Treanor introduced his paper with a few CTRL facts:

- **Distance** – 74 km (46 miles) (Fawkham Junction to Cheriton)
- **Maximum Line Speed** – 300 kph (186 mph)
- **Traction System** – 2 x 25kV OCS
- **Signalling System** – TVM 430 Continuous Cab Signalling
- **Tunnels** – North Downs (3.2 km) and Ashford Cut & Cover (1.7 km)
- **Viaducts** – Medway (1.2 km) and Ashford (1.4 km)
- **Maximum Gradient** – 2.5% (1:40)
- **Control Centre (Signalling and EMMIS)** – Ashford AFC
- **Interfaces with Network Rail (NRSR)** – Five
- **Interface with Eurotunnel (ET)** – One
- **Provision for Interface with CTRL Section 2 at**
Southfleet Junction: Number of Point Ends – 53 (Including 37 Swing Nose Crossings)

Contract 550 which provided the signalling was a consortium of CSEE (part of Ansaldo), Amey Rail and Corning Cables and the chosen signalling system is TVM 430 SEI. Originally the high speed lines in France used TVM 300 which is an analogue system. This was then upgraded to TVM 430 – a digital system when installed on the Calais to Paris/Brussels routes (including Eurotunnel) and the Lyons to Valence route, which allowed a lot more information to be transmitted from track to train. TVM 430 SEI has inbuilt ATP and brings the interlocking into the TVM and was first installed on the Valence to Montpellier/Marseilles routes and then on the CTRL route. It is a duplicated system and has the standby in hot standby mode resulting in immediate changeover if required. It is a fixed block system with no signals but each section has a section number.

The information is passed to the driver in figures displayed in front of him. The display is duplicated. Black figures on a green background is the equivalent of a green signal with the figures indicating the maximum permissible speed. A warning indication is given by black characters on a white diamond background and is an order to reduce speed to the figure indicated. A black figure on a red background 000 indicates the requirement to stop at or before the next marker. A flashing indication gives advance warning of a more restrictive regime at the next block section. A black background with white figures indicates a local maximum speed. The system is a speed signalling system and is continuous.

The control systems (ITCS) are distributed along the lineside and are connected to the RCC at Ashford, other signalling rooms, track circuits and points. Usually there is only one interlocking at each ITCS but at Singlewell and Lenham there are two. Each TCS has three sub-cubicles the BAP (Baie d’APplication), BIP (Baie Interface Poste) and BIV (Baie Interface Voie). The BAP cubicle is responsible for all processing activities and also handles communications from and to other ITCS equipment and remote control centres. The BIP cubicle handles all discreet on/off inputs and outputs from signalling room internal and external equipment. It is the I/O for external equipment such as Local Releases, EZP and ERS switches. Points control and detection circuits. Signal aspect control are carried out via a relay interface. The BIV cubicle handles all the track to train transmission. It provides continuous transmission for on board cab display via track circuit equipment. It provides intermittent transmission for "spot" information via ITL loops. These circuits are fed to and from the track directly from this cubicle. It is possible to run 40 track circuits from one BIV. A series of photographs were shown to illustrate the different cubicles. The ITCS uses a 2-out-of-3 concept.

Jointless track circuits are used with a TAD – a tuned area – at each end. All track circuits have to be able to be reoriented because both lines are bi-directional and the train always has to head to the transmitter. Orientation is carried out by a relay and the track circuit can be up to 7 km long. If it is less that that attenuation is added to keep it constant. There are four channels – 1700Hz, 2000Hz, 2200Hz and 2600Hz. Capacitors are connected across the track to compensate for track inductance and are distributed along the line. Broken rails are detected by the track circuits. There are 27 modulations on the track circuit to convey information to the train and the 28th modulation is what the track circuit's receiver is looking for.

As the questions were asked as the paper progressed, there followed only a vote of thanks given by Ed Gerrard.

The final paper for the session was a joint paper with the South Wales PWI and was held in Newport on 4th March. The paper was delivered by Mr John Devine, who is the Permanent Way Engineer for Union Railways, and was entitled “Update on CTRL section 2". Mr Devine introduced his paper by saying that he had a large number of years experience in the railways and did not expect to be on such a steep learning curve when he joined Union Railways as their Permanent Way Engineer. This paper was to be a pictorial journey through section 2 and so minutes of the paper will be limited in scope.

CTRL is part of the European high speed network which encompasses railways from Amsterdam (currently being built) and Brussels through France into Germany and beyond. Stage 2 has now been underway for about two years and all the civil contracts have now been placed. 99% of the tunnelling is complete and St Pancras interim station is well advanced for the opening at Easter 2004.

Mr Devine then showed a series of slides of the progress of the major civil engineering items starting at the junction with Section 1 and working into St Pancras. There were two major bridge slides during last Whitsundite 2003, one at Swanscombe and one at Northfleet. The bridge at Swanscombe required a chalk spine to be left in place until the actual slide took place to allow the North Kent Line to continue to be operational. The bridge weighed 10,000 tonnes and was successfully slid into place with the required chalk spine being removed over the same week end and by coincidence was estimated to be also 10,000 tonnes.

Thurrock Viaduct had to be weaved under the road to the Queen Elizabeth bridge and over the road leading from the Dartford tunnel. It was pushed into place over a live railway – a first in the UK – without incident. No one was allowed on the bridge whilst it was being pushed to ensure nothing was knocked off on to the live railway. The viaduct is over 1 km in length.

Avery Marshes, which sit on a tidal Thames floodplain, is to have a viaduct across it to ensure the stability of the high speed line, which cannot be achieved by the current line across it. In order to achieve this, the viaduct is to sit on 1.5m by 18m piles. Unusually, for a contract of this type, all the pile driving was monitored continuously by Union
York Section

MEMBERSHIP

The York Section membership stands at 360. This represents 9.2% of the total IRSE membership. This compares with 7.8% last year, which is a healthy increase mainly due to the IRSE main body policy of encouraging Technician grades who have an IRSE licence to join the Institution.

COMPOSITION OF THE COMMITTEE

The Committee consists of:

- Chairman: D Dyson
- Vice-Chairman: R H Price
- Treasurer: R H Price
- Visits Secretary: K Yews
- Recruitment Secretary: R H Price
- Membership Secretary: A P Smith
- Secretary: J Maw
- Committee: A S Kornas
- D R Bowlby, R A Pinkstone

2004 DINNER DANCE

The 2004 Dinner Dance was again held in the Viking Moat House Hotel in York. 190 members, their partners and guests attended the event. The numbers this year were limited due to space in the Regatta Suite and the decision to have a live band for the Golden Jubilee. City Lights entertained the members and guests with a varied selection of music and dancing went on until 00.30. Our thanks go to Rod Price for successfully organising the event.

CHAIRMAN’S ANNUAL REPORT

Although this is the fourth time I have been elected as the Chairman of the York Section, this year was a particular honour as my period in office covered the Section’s 50th. Anniversary.

As always, the Committee had arranged a programme of technical meetings covering a range of topics, which have been well attended. The average attendance at the six meetings was 35, unchanged from the previous year, with a peak figure of 46 at Ian Mitchell’s paper entitled “Signalling Control Centres – Today and Tomorrow”. The final paper, “Signal Sighting” by Ian Maxwell, had to be cancelled at very short notice when Network Rail withdrew their permission for David Jones to give it, following the announcement that is a cut-and-cover construction. These civil engineering works were completed 4-5 weeks ago and now a new contract is to be awarded to build the railway and the station in the box.

The structure gauge is GC so that trains from European administrations can run on it. However, as Mr Devine pointed out, these administrations have not yet met Kent Fire Brigade. Kent Fire Brigade is responsible for issuing fire certificates for the trains running through the Channel Tunnel and to date the only train with the necessary fire certificate is the Eurostar!

Mr Devine finished his paper by giving a few high speed line facts – for 300 kph running the minimum curve radius is 4000m, the steepest gradient is limited to 1 in 40 (2.5%), the high speed turnout is a 1 in 46 with a 1 in 46 swing nose crossing worked with a mechanical backdrive! There then followed a series of questions, followed only a vote of thanks given by Peter Martell.

The AGM is to be deferred again to the first meeting of the 2004/2005 session. D Gillanders
maintenance work would be brought in-house. Fortunately, Charles Weightman stepped in to fill the void with an interesting account of his programme of signal-box inspections. I am very grateful to Charles for saving the day.

We were pleased to welcome the President, Colin Porter, to the meeting on 20th January, which was the anniversary of the founding of the Section. Colin presented me with a commemorative medallion to mark the event, to be worn by the Section Chairman as a badge of office. This was a surprise to me, as I was not aware that the occasion was any other than the annual Presidential visit to the Section.

Our Visits Secretary had arranged three visits, but unfortunately the one to the premises of Henry Williams at Darlington had to be cancelled due to lack of interest. I was able to attend the other two, to Heathrow Express and to the Jarvis Control Centre, and found both extremely interesting.

The Institution Convention in the summer of 2003 was based in Birmingham, and included a special train to York on one day, when the Committee arranged a morning programme of visits to various Companies and premises around the York complex, followed by a largely free afternoon. In the evening, there was a Civic Reception and Dinner at the National Railway Museum. The day concluded with a record breaking run back to Birmingham in the Virgin Voyager. Most of the work of arranging the programme for the day was done by Andrew Smith and Rod Price, and I would like to thank them for their efforts.

The IRSE Council meets regularly in London, and it is an established procedure that the chairmen of the local sections are welcome to attend. I have been able to attend five Council meetings to date, and I feel it gives a useful link between the parent body, its officers and our Section.

I would like to thank the Committee for their support and assistance throughout the year and in particular, John Maw and Rod Price. John has continued his excellent work as our Secretary, which involves far more than just writing the minutes of our meetings. Rod, among his many roles for the IRSE, traditionally they serviced relays, point machines and barrier machines. National Railway Supplies has a 24-hour, 365-day customer response. They produce a large range of products from LED signals, TPWS, AWS and APC equipment, level crossing equipment, Telecode TDM control systems, as well as a badge of office. This was a surprise to me, as I was not aware that the occasion was any other than the annual Presidential visit to the Section.

Our Visits Secretary had arranged three visits, but unfortunately the one to the premises of Henry Williams at Darlington had to be cancelled due to

The IRSE Council meets regularly in London, and it is an established procedure that the chairmen of the local sections are welcome to attend. I have been able to attend five Council meetings to date, and I feel it gives a useful link between the parent body, its officers and our Section.

Finally, I would like to wish the incoming Chairman, Rod Price, a successful year in office. I am not able to hand over the Chairman's medallion to him, because it has been sent for engraving, but it will be presented to us again at the London AGM shortly.

**Denis Dyson, Chairman**

### TECHNICAL MEETINGS

The October meeting, sponsored by Westinghouse Rail Systems, was by Godfrey Dance and Phil Waddingham entitled “The WARM Project”. They took the members through the resignalling project of the West Anglia Route Modernisation. The project was an alliance of five specialised railway companies with Westinghouse as the principal contractor. The project involved the resignalling of 200 route miles of track between Bethnal Green North and Stansted Airport. The scheme in total replaced 359 signals, 143 point ends, 757 track circuits, 16 ground frames, 496 location cases, 13 SSIs and 11 CCTV level crossings. The whole of the resignalled area has been transferred to Liverpool St signalling control centre with an additional workstation to IECC ‘A’, two new workstations on IECC ‘D’, 13 new 2MHz SSIs, a new 8-bay CCTV workstation and a team leader’s desk with overview IECC screens. All stages have been commissioned on time, on budget and to specification mainly due to the excellent team spirit and working relationships within the WARM Alliance.

35 members and 3 visitors attended

The November meeting was to have been a talk by David Jones on the “New Maintenance Programme” but had to be cancelled at the last minute due to Network Rail withdrawing permission. Charles Weightman stepped into the breach and gave an excellent talk on the visits he has made to 424 of Network Rail’s signal-boxes. Charles took the audience on a tour of the country starting at Croft signal-box, which has no track circuits. He finished in the Nottingham area with some old photographs of installations that have long been redeveloped. The Mott MacDonald sponsored this meeting.

25 members and 1 visitor attended

The December meeting was a paper by John Armitstead on his journey across Australia and was entitled “The Indian Pacific”. John began by explaining that the Indian Pacific was a train consisting of 22 coaches with a NR diesel loco at the front that ran from Perth (on the Indian Ocean) to Sydney (on the Pacific Ocean). The journey was 2,700 miles and took three days. A stop was made at Kalgoorlie to visit a gold mine where it takes 80 million tonnes of rock to produce 20 tonnes of gold. On the journey the train travelled over the Nullabor desert where the longest, straightest piece of railway track was 297 miles long. The train did not actually reach the Pacific Ocean so to complete the journey John took the ferry to Manly Beach. On this occasion Jarvis Rail were our sponsors.

27 members and 1 visitor attended

Colin Porter, who presented the Chairman, Denys Dyson, with a medal to commemorate the Golden Jubilee of the York Section, chaired the January meeting. The paper was by Peter Webster of National Railway Supplies entitled “The Current Role of the S&T Service Centres”. Peter concentrated his talk on the S&T workshops at York and Crewe where traditionally they serviced relays, point machines and barrier machines. National Railway Supplies was formed within BRB in 1995 and privatised in 1997 with a management buyout backed by Unipart with an option to purchase outright in 2000. It has 23,000 products in its catalogue and 11,000 parts in stock. It has 150 customer outlets countrywide and has a 24-hour, 365-day customer response. They produce a large range of products from LED signals, TPWS, AWS and APC equipment, level crossing equipment, Telecode TDM control systems, as well
as servicing a wide range of relays, point machines, electronic equipment and barrier equipment. They also continue to build location cases and relocatable equipment rooms. They have recently acquired other companies’ products like Telecode TDM in 2001, Alstom Reed in 2002 and Dorman Traffic products in 2002. National Railway Supplies sponsored this meeting. 28 members attended

The February paper was on the subject of “Signalling Control Centres – Today and Tomorrow” and was given by Ian Mitchell of AEA Technology. Ian began with a brief history of the development of the IECC. The first IECC was at Liverpool Street followed by York. Between 1990 and 1994, seven new IECCs were commissioned but since then there have been no new ones. The basic of the IECC is 16 years old which has corresponded with several generations of computer technology, which inevitably means many of the original components, are obsolete, the original processors were Motorola 68000 series, which are no longer available (the latest version is the 68060). The IECC was designed around the use of the SSI as the interlocking. However, as part of major resignalling projects there has been a desire to retain relay-based interlockings within the IECC controlled area. To do this a remote interlocking interface (RII) sub-system has been developed which allows a relay interlocking to be interfaced with the IECC via a conventional TDM remote control system. Finally, Ian discussed the future developments for the IECC. One theme is to integrate traffic control staff into the IECC with access to a modern information system CCF (Control Centre of the Future). Jacobs were our sponsors for this meeting. 29 members and 17 visitors attended

The final paper in March was by Ian Maxwell who presented a paper on “Developments in Signal Sighting”. He began by saying that the current interest in signal sighting has been as a result of Ladbroke Grove. He had looked at the history of the various references to the sighting of signals and the only numerate example was to mitigate inadequate braking distance from the distant signal to the home signal. In 1989 BRB introduced seven seconds sighting with four seconds uninterrupted, which continues today. He compared other foreign railways regarding sighting times and found they varied enormously, with only one able to provide justification of the reading time required. He also looked at the developments in technology (ie LED signals) as well as improvements in the signal sighting process. TICS/Lionverge sponsored this meeting. 38 members and 7 visitors attended

This gave an average attendance per meeting of 35, which is a very creditable number.

Once again we are indebted to our sponsors who willingly support our meetings both financially and physically. Without them we would be unable to use the excellent facilities that the National Railway Museum offers.

Treasurer’s Report

The 2003 balance sheet shows that we spent a total of £13,766.83 whereas our total income was only £13,408.93, which is clearly a deficit of £57.90. This overspend was mainly due to the dinner dance and the cost of room hire at the NRM. The actual cost of the dinner dance to the Section was £221.95, which of course came out of our reserve, and was due to your Committee trying to maintain the cost of attending as low as possible to encourage members to attend. The cost of room hire plus the cost of stationery and postage also rose significantly.

Our reserves in the bank are still quite healthy.

The change of bank to the HSBC has, in my opinion, been a great success with the advantages being a lot more branches are available and we receive a statement every month.

I propose to completely close the Yorkshire Bank account during 2004.

Finally I wish to thank all our sponsors for their support and Ernie Thomson for his loyal help and support in auditing our accounts. Rod Price

Younger Members’ Section

The Younger Members Section of the IRSE is still providing a solid service to the younger generation of Signalling Engineers even with a reduced format of events compared to previous years.

The Past

We provided the annual exam review to all those who have either sat the exam last year or who are interested in sitting it this year. This had the usual round of examples of questions and answers which enabled everyone to understand what is expected. This annual event is an excellent asset to the YM Section and continues to deliver what the YMs need.

Prior to the main ASPECT event this year a whole day was devoted to the YMs of the IRSE. This purpose of this event was to enable engineers who are new to the industry to get up to speed with the main presentations to follow. This was an excellent event and well received by all those who attended. The presenters had made a special effort which was appreciated by everyone. ASPECT can be daunting to the uninitiated, however this extra day gave the YMs a great introduction to the whole event.

The Future

The YM Section is still there to assist all the young and up and coming engineers in the industry who need to want to learn and contribute. However, active assistance is required from these very people. One of the best ways to learn is to do, therefore for those wishing to get the most out of the Younger Members’ Section should get in contact with us and
see where their time and energy can help themselves as well as others.

Other events are planned. However, extra help from other YMs will enable these events to happen sooner which can only be better for everyone.

COMMITTEE

The composition of the Younger Members’ Section Committee at the end of the 2003/2004 session was as follows:

- Chairman: John Haile
- Secretary: Kevin Goodhand
- Treasurer: Chris Oyekanmi
- Members: Matthew Holder, Amber Khaleel, Daniel Woodland, Andrew Love
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The Editor would like to thank Linda Mogford, Peter Grant, Ken Burrage, all the UK and Overseas Section secretaries and the staff of Fericon Press, Reading, for their assistance and co-operation in the production of the Proceedings. The Institution is also most grateful to our colleagues within the signalling industry who have kindly supported the Proceedings by placing an advertisement.
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