IRSE INTERNATIONAL TECHNICAL COMMITTEE

IRSE SEMINAR ON COMMUNICATIONS BASED TRAIN CONTROL

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The IRSE Seminar on Communications Based Train Control (CBTC) was held in London on 15 February 2011 and attracted some 110 participants. All of the major CBTC suppliers were represented as well as a good cross section of consultants, operators and infrastructure managers which provided for an excellent exchange of information and experience with this state-of-the-art signalling technology.

In opening the Seminar, Paul Jenkins (IRSE President) welcomed all of the participants and noted that - as a telecommunications engineer - he was curious to learn more of the role of "communications" in CBTC.

Alan Rumsey (Delcan) introduced the Seminar themes and structure and provided the following generally-accepted definition for CBTC, namely: 1) train-borne determination of a train's location, length and integrity; 2) a continuous data communications link between the train-borne CBTC equipment and CBTC wayside equipment; and 3) train-borne and wayside processors capable of supporting automatic train protection (ATP), automatic train operation (ATO) and automatic train supervision (ATS) functions.

Alan argued that CBTC was not just a new signalling product, but rather the foundation for a strategic and integrated approach to signalling, train control and operations management that not only provides for the highest levels of train protection but also enables the maximum return on the investment into rail transit infrastructure through optimised line capacity and reduced operating/maintenance costs.

Peter Gracy (Docklands Light Railway Limited) built on this theme by highlighting business case drivers and operational/maintenance benefits for CBTC which included: improved train protection, support to driverless operations, "moving block" control philosophy providing shorter headways and optimized network capacity, schedule/timetable regulation, coordination of multiple train movements (e.g. junction management), improved passenger service, bi-directional capability, real-time train data, real-time response to hazardous conditions, integration of operating systems, including traction power, tunnel/station ventilation and passenger information & security systems, redundant/fault tolerant designs, lower maintenance costs, less trackside equipment and reduce support costs (energy savings).

It was stressed that the aim of CBTC was to effectively remove the signalling system as a constraint on line capacity, with operating performance only being constrained by the capabilities of the rolling stock and the physical track alignment.

Paul Thomas (Parsons) provided an update on the re-signalling of the Copenhagen S-bane, as an element of the ambitious nationwide re-signalling of Denmark's railway. In

comparing “moving block” CBTC technology with “fixed block”, distance-to-go, audio frequency track circuit technology, Banedanmark had concluded that CBTC offered lower life cycle costs; was easier to install and commission on a working railway; provided improved capacity; was capable of sustaining Banedanmark’s punctuality and performance requirements; and when integrated with automatic train operations enable less costly migration to Unattended Train Operation (UTO).

Although 20% of the S-bane network’s signalling is not life expired, a total replacement of the signalling systems was consider the cheapest alternative as a mix of signalling technologies would be expensive, would require two sets of operating rules, and would create safety concerns. The 180km of the S-bane network will therefore be re-signalled under a single contract. Paul also noted that the re-signalling project will have significant impacts on Banedanmark and its employees. A major reorganisation is envisaged during the next 10 years with impact on all traffic management staff, signalling technicians, train drivers and the train operation companies. Changes will include new operational rules, new workplace systems and new places of work geographically.

With respect to CBTC system design alternatives, Greg Balsdon (Thales) discussed the importance of reliable and secure bi-directional data communications, and the importance of accurate, reliable and safe determination of train position. With respect to data communications, Greg summarized the pros and cons of radio-based communications when compared with loop-based communications. With respect to train position determination, Greg discussed accuracy requirements, the role of tachometers/speed sensors and the need to accommodate wheel slip/slide, and the use of transponders/balises as absolute position references. Finally, Greg discussed the importance of train length determination and train integrity monitoring, which are fundamental requirements of CBTC, as well as system design considerations to support mixed fleet operations with both CBTC-equipped and unequipped rolling stock.

In his presentation, Stephen Shirlaw (Alstom) summarized state-of-the-art practices in non-disruptive migration to CBTC. Steven defined two possible migration strategies, namely: “switched operation” or “mixed operation”. In “switched operation” all the trains would operate on the line with the same signal system, either the new CBTC system or the old legacy system. The old system could be retained as a fallback at the trackside and train level. With this strategy, all the trains must be equipped before switching to CBTC and at the trackside there is no requirement to interface the new CBTC system to the legacy system.

In “mixed operation” each train can operate on the line with either the new CBTC system or the old legacy system. At trackside, both systems operate simultaneously. On the train, either the CBTC system or the legacy system is active. The legacy system is used for a non CBTC-equipped train or as fallback for a CBTC-equipped train when the train is dual-equipped. At trackside the CBTC system must be interfaced with the legacy system. “Mixed operation” can be an intermediate step before switching fully to CBTC.

Steven noted that the choice of the best migration strategy for a given application depends on several parameters such as: duration of fleet modification, the required timescale to deliver the performance benefit, the availability of the track during the night, the specifics of the existing interlockings, the specifics of the existing central office/ATS equipment, and the ability of the trains to be dual-equipped

Finally Steven stressed the importance of close cooperation between the customer/operator and CBTC supplier on all aspects of the project. Building on this comment, George Clark (London Underground) provided lessons learned in implementing

CBTC systems on the Underground. From a stakeholder management perspective, George highlighted the challenges of building confidence in the new signalling system with front-line staff and the importance of team-working to avoid the temptation to make CBTC look and work like other London Underground signalling systems. In addition, George stressed that from a design perspective, there was significant value in establishing, prior to award of contract, the detailed Operating Requirements for the new signalling system and defining performance requirements that were easy to measure. George went on to describe the challenges of interfacing and integrating CBTC with legacy signalling systems, the scale and complexity of rolling stock fitment and integration, and experiences with CBTC installation, test and commissioning that required careful management of track access utilisation.

Rod Muttram (Bombardier) then provided details of Madrid Metro's experience in re-signalling with CBTC while maintaining revenue service operations. As with London Underground, to respond to increasing ridership, Madrid Metro requires a capacity increase of 20% on each line. The solution for lines 1 and 6 was a new signalling system and CBTC was chosen as the best match for Madrid's requirements. It was recognized that a structured approach towards the introduction of the new system was key to achieving zero interruption to revenue service and a high level of collaboration between the operator and supplier was again stressed as critical. Having first replaced all of the interlockings, a "mixed operation" migration strategy was adopted in Madrid with all trains dual fitted with both the legacy and new CBTC on-board equipment and with a new 'dual system' cab display. Trains were then returned to service based on proof of safety for non-interference with the old legacy system.

Finally, Marc Genain (RATP) described experience in operating/maintaining CBTC systems at RATP in Paris which has shown that CBTC solutions do indeed allow improved operational margins between trains by providing improved headway flexibility, do offer minimal impact on wayside and track, and can improve operating costs significantly when combined with organizational changes and upgrading of job functions. Marc also noted that CBTC now represents the core portfolio of most of the major signalling suppliers who can therefore be expected to focus on such technology for the coming decades. Marc explained how CBTC represented a fundamental element of RATP's strategy in operating and maintenance cost optimisation.

The final session in the seminar was a lively panel session providing an opportunity for members of the audience to quiz the presenters and provide their own insights and experience with CBTC. All of the seminar presentations can be found on the IRSE web site at: www.irse.org/Seminars.html

In closing the seminar, Paul Jenkins (IRSE President) thanked all of the speakers for their presentations, and the audience for their questions and contributions. Paul noted that it was good to hear that the aim of CBTC is to remove signalling as a constraint on capacity, and it was encouraging to hear operators describe CBTC as "flexible and progressive" - words that the signalling profession would do well to become associated with.

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