Train Control and Management Systems – A recap of trends and technology

The Train Control and Management Systems conference had specialists from national and international organisations present to more than 70 network and signalling professionals.

There were multiple themes explored across the various presentations, and many of them were connected by comparable challenges and operational requirements.

Consolidation

Increasing capacity demands and technological alignment were major influences for many of the presenting organisations, including Network Rail, Réseau Ferré de France (RFF) and Sydney Trains.

Rail Operations Centres (ROCs) are being developed across their networks in a bid to streamline all existing technologies and consolidate them into a central hub.

Network Rail

Running a national railway network is a gigantic task for any organisation, and Network Rail has its own set of unique challenges.

Every year, passenger and freight traffic increases and it is predicted that by 2020 there will be 400 million more passenger journeys and an increase of 30% in freight. This will result in many of the major rail routes exceeding current capacity.

The challenge of operational costs falls under efficiency. At this point in time, it’s a very expensive undertaking for Network Rail to manage its existing infrastructure and provide paths to run the trains.

Ian Barnes, Programme Manager, Network Operations, has noted that “Over the next 15-20 years we will close down around 800 existing centres across Great Britain and control the network from 12 ROCs.”

Constructed ROC in Great Britain
RFF

France currently has 1500 signal boxes in operation across 14000 km of the main network (representing 90% of the traffic). The mixture of signalling technology reflects the impact of legacy systems that have been maintained over many years:

![Mechanical signal box](image1) ![Electric (push button) signal box](image2) ![Computerised signal box](image3)

Sylvie Lesueur, former Deputy Manager for the Signalling and Rail Operations Centre (ROC) Department, was directly involved in the project early on.

After embarking on the ROC project, investment was raised to 340 million Euros in 2013 (with intentions to reach a target of 400 million). The increased scope of this project meant ensuring that there was enough manpower to support the required amount of work.

“The ROC project in which I was involved was part of a current initiative to consolidate these 1500 operating locations (signal boxes) into 16 rail operations centres, in order to have a more efficient and economical organisation for managing train movements. It started with an issue of ageing signal equipment and led to a train traffic management project,” Sylvie said.

RFF expects 60% of the project to be rolled out by 2032. At this time 14 rail operations centres will be completed with a total of 148 traffic section (out of 256) remote controlled from these ROCs. Development of all 16 rail operations centres will be completed by 2050.

Sydney Trains

A business case is under way to develop a new rail operations centre known as the ROC. This will bring together all the expertise within Sydney Trains from the operations, maintenance, security and customer service divisions.

Tony Eid, Director of Operations at Sydney Trains, said: “The centre will be built at a greenfield site. The business case is expected to be completed by Christmas 2013, but we’re still in the initial planning and development stages.”

More recently, Maintenance operations at Sydney Trains consolidated six former control centres around the state into one Infrastructure Control Centre (named ICON), located in the heart of Sydney Central Station.
The Maintenance Directorate previously had six control centres provide the 24/7 support for network incidents and maintenance operations, which were effectively a product of various disciplines working independently.

Although these centres were able to manage incidents quite well, there were multiple challenges to coordination in complicated circumstances that required various groups to work together.

The lack of a single point of contact also contributed to frustrations amongst staff, especially from an operator’s perspective.

The control centre comprises five specialised departments:

1. Electrical Operations
2. Corridor Safety System
3. Central Control Systems
4. Infrastructure Operations
5. Rail Technology Operations

**European train control systems (ETCS)**

ETCS was also discussed at the conference, being a unique signalling, control and train protection system designed to replace incompatible safety systems used by European railways.

Sylvie Lesueur noted that one of the core challenges facing the RFF network related to the rollout of ETCS. Small parts of the network had ETCS Level 2 installed in 2009, and the wayside equipment is currently being put in revenue service.

A train with on-board equipment is slated to run this year. Large sections of the network, however, still maintain original systems.

From a signalling perspective, the main issue is interoperability on high-speed railway and fret corridor lines. The network already has track-to-train transmission implemented into its high speed railway lines.

There are two track-to-train transmission (Transmission Voie-Machine – TVM) versions in use:

1. The TVM-300, which was developed in the 1970s as part of the *Train à Grande Vitesse* (TGV – high speed train). TGV trains operate on dedicated railway lines labelled *Lignes à Grande Vitesse* (LGV) and exceed 220 kmph. Whilst travelling at such speeds, drivers cannot accurately identify colour-light based railway signals
positioned track-side. Signalling information is directly transmitted to the train and displayed within the train controls.

2. The TVM-430, established in the 1980s. This system transmits more information than conventional signalling enables, such as gradient profiles and the conditions of nearby signalling blocks.

Not only does interoperability play a crucial role to determining the effectiveness and opportunity for ETCS network rollouts, but also the fact that these systems actually work very efficiently for the railway.

James Clendon, Engineer at AEP Signalling Design and Development Manager at KiwiRail, presented on the implementation of ETCS Level 1 and future proofing the New Zealand rail network for Level 2.

ETCS Level 1 was deployed on the Auckland Metro – the passenger suburban part of the national network – in November 2013. Programming of the trackside transponders has already taken place, and testing took place shortly after.

There were some issues singled out following testing, including:

- Odometry correction balises needed to reduce premature intervention;
- Several ETCS overlap timers required adjustment and;
- There were inconsistencies in speed profiles, relating to curve signs, track design speed, ETCS enforcement speed, and local operating instructions.

Regarding ETCS Level 2, there’s very little benefit offered to signalled territories like Auckland. However, there’s a growing need to reduce trackside infrastructure and maintenance costs.

Level 2 can potentially enable interoperability with the national rail network, and improve consistency for train drivers. However, with 45-50 km/hr release speeds, there is not a big capacity improvement unless signalling sections are reduced.

James also discussed the “Holy Grail” of ETCS Level 3, which moves well beyond the train protection functionality and goes into implementation of full radio-based train spacing.

This Level effectively removes the need for fixed track-releasing signalling devices (GFM). He indicated that the benefits from realising deployment of ETCS Level 3 are:

- To improve safety;
- Improve network capacity;
- Reduce trackside infrastructure – especially in remote locations;
- Reduce operating and maintenance costs;
- Reduce capital cost and;
- Improve reliability.
Both Sylvie and James noted that ETCS (especially Level 2) must be considered as a whole network solution or interoperability will become an issue.

**Traffic management**

Traffic management was extensively covered at the conference as a critical tool towards meeting capacity and efficiency demands.

Ian Barnes from Network Rail, discussed how many of the routes are set manually across the network, and that Traffic Management would enable automatic routing, thereby eliminating any need for manual interventions.

The focus is shifting to managing the plan for the train services proactively, as the result of last minute changes or incidents. Manual route setting will become the exception, reserved for unplanned moves in and out of depots, for example.

Two pre-qualification exercises were conceived to filter the expressions of interest:

1. Suppliers needed to have had a successful/operational traffic management system deployed somewhere in the world. If so, Network Rail would require introduction to their clients. More than half of the initial interested suppliers were eliminated due to this criterion alone.
2. Rail system applicability to Great Britain’s design, including country population densities, city characteristics and suburban traffic mixed with high speeding routes. At this stage there were 12 remaining suppliers in consideration.

Six months’ prolonged dialogue with suppliers saw Network Rail conduct site visits to supplier customers, case study reviews and in-depth studies of the system architecture. There are currently three suppliers still under consideration: Hitachi, Thales and Signalling Solutions (SSL).

Emilien Dang, Head of Rail Signalling Engineering at Thales Australia, presented on the system from which Network Rail is currently considering – Advanced Railway Automation, Management and Information System (ARAMIS).

The operational efficiency brought by ARAMIS is realised through several specific products:

- **ARAMIS D**: Improving train controller productivity;
- **ARAMIS MPT**: Optimising track work maintenance;
- **ARAMIS ODM**: Optimising network operation by introducing energy savings, automatic conflict resolution, incident recovery management and;
- **ARAMIS B**: Integration with external systems, especially with business processes.
Sylvie Lesueur also touched on the Traffic Management system used in the French network.

France is using 

**Mistral (Modules Informatiques de Signalisation, de Transmission et d’Alarmes)**, which was developed by SNCF (the actual train operator) at the end of the 1990s with AtoS as the supplier. It was first put in revenue service in Marseille (south of France) in 2001.

It can only be interfaced with computerised signal boxes, and enables equipment control via these signal boxes. It also visualises the state of equipment in the field.

At Sydney Trains, the predominant control system was developed in-house, known as ATRICS. It controls 70% of the Sydney Trains network and incorporates automatic route setting. One of its objective is to maximise throughput, which is line with consolidating the infrastructure through ICON.

**Conclusion**

The focus on consolidation, ETCS and Traffic Management represent a fundamental shift from traditional operating models. Capacity demand has triggered the need for change, and an evolving technology market has enabled rail networks to develop more strategic models.