IRSE NEWS

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ERTMS Level 3 the Game-Changer

Japanese signalling Thorrowgood tour

Control Centres the Austrian approach

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Welcoming everyone

In February the IRSE's governing Council approved a policy on "*Diversity, Equality and Inclusion*". We believe that equal opportunities should govern every aspect of our work, and that all staff, applicants for jobs, volunteers, and members should be treated equitably and fairly. Setting goals and putting in place activities to treat people fairly, and actively include them, is both the right thing to do and will ultimately contribute to the creation of a better society.

For companies and for industry, the principles of embracing diversity, treating people equally, and including them, also have an important business dimension. Companies with more diverse workforces are more profitable, according to a "Women Matter" study by McKinsey. A diverse workforce within a company makes it stronger in all areas, including its resilience and its ability to innovate. A company's customers are usually very diverse, so having a workforce that is drawn from a similarly varied pool means that the company is more likely to understand their customers' needs.

In the field of engineering, the gender disparity is the most obvious aspect of a lack of diversity that needs attention. Other professions, notably medicine and law, are already changing visibly. We need to change too, in order to ensure there are no unintentional barriers to attracting people with the requisite skills and experience, whatever their background.

Many countries have laws that prohibit discrimination and unfair treatment of people on the grounds of age; disability; marriage and civil partnership; pregnancy and maternity; race; religion or belief; sexual orientation.

The IRSE may be a relatively small organisation, but we have members worldwide, and we should not under-estimate our ability to influence others. So let us commit ourselves, both as an organisation and as individuals, to making the Institution and the industry in which we work one where everybody feels welcomed and valued.

Francis How, Chief Executive

Front Cover: One of this issue's major articles looks at signalling in Japan through the eyes of the winner of the Thorrowgood scholarship, Tom Corker. Our front cover shows the supervision of high speed train departures at Shin-Osaka station, Japan. *Photo Francis How.*

IN THIS ISSUE

ERTMS Level 3: the Game-Changer




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This Presidential Programme technical paper was presented on 14 March in London.

Why Level 3?

Our railways are full. Our networks do not currently have enough capacity to meet our customer needs. In Great Britain for example passenger numbers have doubled since 1996 and are set to double again over the next 25 years. It is not possible to meet projected demand with existing technologies.

Conventional lineside signalling systems have been optimised to their limits. In many locations the use of conventional methods to increase capacity such as building extra tracks, flyovers and introducing larger trains has been exhausted. But there is an alternative – use of digital technology. This provides a great opportunity to deliver increased capacity for our networks.

A key digital technology which can provide this is ERTMS. Currently most worldwide implementations of ERTMS are of ERTMS Level 1 and ERTMS Level 2 systems. Of these it is ERTMS Level 2 which can, with careful implementation, provide improvements in capacity. To get significant improvements in capacity from ERTMS Level 2 means increasing the amount of trackside train detection systems. This is clearly technically feasible, but is it affordable?

For significant capacity increases on a line, 50 metre train detection sections may be needed. This means purchase, installation and maintenance of a significant amount of train detection equipment at the trackside. This is not affordable from a financial perspective, and would not easily enable high performance and reliability of ERTMS Level 2 operation.

Moving to ERTMS Level 3 solves this problem. ERTMS Level 3 can deliver better capacity, reduce costs, improve flexibility and increase reliability in comparison with ERTMS Level 2, removing reliance on train detection equipment. But does ERTMS Level 3 actually exist, or is it a theoretical concept not yet fully defined?

In fact ERTMS Level 3 is already defined in the CCS TSI (Command Control and Signalling - Technical Specification for Interoperability) [R1], and there are some applications of ERTMS Level 3 in operational service. Implementations to date, such as the ERTMS Level 3 line between Malung and Borlänge in Sweden and Uzen to Bolashak in Kazakhstan, are typically on railways which are largely single lines with low traffic levels. So whilst ERTMS Level 3 clearly does exist and has been implemented, application experience to date is limited. Further development is required before it can be considered as a solution ready for immediate Europe-wide deployment alongside ERTMS Level 1 and ERTMS Level 2.

This need has already been recognised by the European railway industry and has been included in the European Union Agency for Railways long term perspective plan [R2]. This plan published in 2015 identifies the development of ERTMS Level 3 as one of five business-driven game changers to be taken forward over the next few years.

During European level discussions on the ERTMS long term perspective plans, ProRail and Network Rail identified strong and similar interests in the development of ERTMS Level 3 as part of their commitment to increase capacity on main line railway networks. Both networks have similar challenges, being complex mixed traffic networks with areas of high capacity demand, with the need to deliver high reliability and availability.

Our key drivers were the need to build on our current ERTMS Level 2 programmes and to find a cost effective way of increasing capacity on our networks step by step at minimal risk. ProRail and Network Rail had both previously run some ERTMS Level 3 tests to understand the state of the available ERTMS Level 3 products. In 2013, Level 3 tests were performed by ProRail in Lelystad in the Netherlands. In 2014 in Great Britain, Level 3 tests were run on the test track at the ERTMS National Integration Facility (ENIF). These tests provided a good foundation for the future work.

With this common interest ProRail and Network Rail agreed to take a joint approach on the definition of an effective path to deploy ERTMS Level 3. To facilitate the cooperation (sharing a road map of activities and resources), a Memorandum of Understanding (MoU) was signed by both parties on 2nd February 2016 [R3]. As ProRail and Network Rail are both members of the ERTMS Users Group and the European Rail Infrastructure Managers (EIM), the work is being shared proactively as it is developed. Members of these organisations are also showing a strong interest in ERTMS Level 3. Alongside this work sits Shift2Rail, where Innovation Programme 2 also includes an ERTMS Level 3 work package titled Moving Block [R4]. Network Rail is an active member of this work stream, which provides another opportunity for development.

So a need for ERTMS Level 3 has been established and an agreement to do some work is in place, but to move forward it was first necessary to confirm an agreed understanding of ERTMS Level 3.

As specified by the CCS TSI, Subset-026 [R1] ERTMS Level 3 is a radio based train control system where movement authorities are generated trackside and are transmitted to the train via Euroradio. ERTMS Level 3 provides a continuous speed supervision system, which also protects against overrun of the authority. The Radio Block Centre (RBC) knows each train individually by the ERTMS identity of its leading ERTMS on-board equipment, which regularly reports its speed, position and integrity information to the RBC. ERTMS Level 3 is based on Euroradio for track to train communication, and on balises as spot transmission devices mainly for location referencing. This is all common functionality with ERTMS Level 2.

The main difference between ERTMS Level 2 and ERTMS Level 3 is that in ERTMS Level 3 the train position and train integrity supervision is performed by the RBC, using the position and integrity reported by the train to determine if it is safe to issue the movement authority. This provides more accurate train location and removes the need to use fixed blocks and trackside train location equipment (such as track circuits and axle counters) which are essential features of Level 2. ERTMS Level 3 allows the shift from the use of fixed blocks using trackside equipment (as in Level 2) to more frequent train position information (fixed virtual blocks or moving blocks).

These changes allow ERTMS Level 3 to provide capacity benefits (allowing more trains on a line), to reduce costs (e.g. removal of trackside elements) and to improve reliability (due to less equipment on the trackside).

Challenges of Level 3

Level 3 requires trains to be fitted with additional functionality in the form of Train Integrity Monitoring (TIM). The purpose of the TIM function is to inform the ERTMS trackside that the train is complete with respect to the reported train length, providing confidence in the location of the rear of the train and that the train has not broken or split since the previous reported position. Whereas it appears possible already to provide a TIM system for passenger trains, providing one for variable composition trains such as freight is currently an open issue. There is not yet a reliable and operationally robust TIM system implementation available for use with variable composition trains. This is a critical area to resolve for Level 3, as failing integrity of just one train could affect the operational performance of many trains in a large Level 3 area.

In the absence of trackside train detection, the Level 3 concept relies fully on the condition that the RBC knows at all times the position and integrity status of every train or vehicle that is physically present in the area under its control. The problem is that in practice this condition cannot always be fulfilled when degraded modes of operation are considered.

Take the situation where there is no radio connection. Here the train will not be visible to the RBC. For example, if the ERTMS on-board enters shunting mode, it is switched off intentionally (Cab close, No Power mode). Even if the RBC remembers the last reported position of the train and the area in which the train was authorised to move, there is no guarantee that the train will stay within this area whilst disconnected. For example there could be reasons to move the train under the supervision of operational procedures, or the train could move without any authorisation. Without trackside train detection, there is no way for the trackside to know the location of such a train in a sufficiently reliable way.

Then there is the case to solve where an RBC is switched on or off (e.g. an intentional restart, or due to a crash). In this scenario an RBC would lose all knowledge of the trains in its area. Recovering from this situation would be cumbersome (involving sweeping the whole RBC area) and could take a long time, causing significant operational disruption. The safety of such a process would be based only on operational procedures.

Another issue is the accuracy of the reported train position. The margin in the reported train position and safe train length can result in points being kept locked behind the train on the basis of this information when in fact the area is physically free. This would reduce performance, and could result in a deadlock situations e.g. on an overtaking area on a single track. Also in this situation, where a train loses its valid position the Level 3 system cannot locate the train and so additional operational procedures are required.

Types of Level 3 implementations

In order to overcome these challenges as well as to take account of how to migrate from existing railway systems, a number of types of Level 3 have been proposed.

These types have been developed based on the following items.

- The need to migrate the existing fleet of trains into ERTMS, i.e. the potential need to overlay Level 3 on conventional signalling systems.
- The need to have train integrity monitoring solutions available and fitted on all types of trains.
- The use for trackside train detection if no ERTMS train information is available.
- The existence of two types of technologies for the safe train separation in Level 3:
    - Fixed Virtual Block: This solution relies on the use of virtual fixed sections (based on reported integer train position information).
    - Full Moving Block: The safe separation between two trains is given dynamic handling of reported integer train position information.

Note: an 'integer train' is one which allows the trackside to release infrastructure behind it on the basis of its position reports. This is because it is possible to guarantee its completeness (i.e. no carriages or wagons left behind) thanks to Train Integrity Monitoring Systems. In the case of a fixed-formation unit, this completeness information will be available permanently.

The types of Level 3, which are at different levels of maturity in terms of definition and development, have been named as follows:

- Level 3 Overlay.
- Level 3 Hybrid.
- Level 3 Virtual block.
- Level 3 Moving block.

Of these, Hybrid Level 3 is the most mature and is defined in detail in the following sections. The others are less well developed, and so are covered at conceptual level only, building on the understanding gained in the definition of Hybrid Level 3.

Hybrid Level 3

Hybrid Level 3 has been developed as a type of Level 3 which mitigates the Level 3 challenges described above using existing technology solutions. It does this by dealing with the potential issue of insufficient train information by using a limited amount of trackside train detection. In this way this concept avoids the need for new and complex operational procedures and should secure performance when introduced. It means trains which are not able to report confirmed integrity can still be authorised to run on the line, albeit with longer, but still acceptable, headways. Trains which are disconnected from the RBC are no longer lost. They are still visible by means of the trackside train detection, which facilitates operational movements of disconnected trains, protection against unauthorised disconnected trains, and recovery after RBC crashes. In addition, in certain key locations trackside train detection should enable good performance by providing faster release of critical infrastructure (e.g. points) than on the basis of train position reports (e.g. if the position reports are delayed, or there are margins in the reported train length).

When considering the migration to Hybrid Level 3 on existing railway lines, the concept enables the use of legacy trackside train detection equipment, re-using that already in place. This introduces advantages when commissioning works take place for capacity increases on the line. It means there is a minimum of engineering work required on the trackside when compared to the works required for increasing capacity using other ERTMS levels, thus providing a cost effective way to increase the capacity of the line.

The Hybrid Level 3 concept supports both integer and non-integer trains, that is trains with and without train integrity. This provides a migration path for trains on the line, enabling full operation of all trains when all types of train have not yet been fitted or are unable to be equipped with TIM. The capacity of the line will increase as the level of trains equipped with TIM increases. This enables the creation of a high capacity line if predominantly TIM equipped trains are scheduled (e.g. to create extra capacity in the peak hours). It also enables trains without TIM (e.g. freight trains) to run, although to retain maximum capacity benefit in the peak these would need to be scheduled in off-peak timetable slots.

This solution also aids simpler operation of non-ERTMS equipped trains if they are needed to be able to run procedurally on the line, (e.g. to move engineering trains to work areas). In these circumstances the normal operation recovers automatically after the passing of these trains without operational procedures such as sweeping being required. Identical considerations apply for shunting movements where trains do not report their position to the RBC.

And last but not least: Hybrid Level 3 is fully compliant with the ERTMS specifications as defined in the CCS TSI [R1]. There are no additional requirements which require introduction for the ERTMS onboard.

Moving or Fixed block

The Hybrid Level 3 concept as currently defined uses virtual blocks. This is not a fundamental requirement for the concept but is for pragmatic reasons. In comparison to moving blocks, fixed virtual blocks have less impact on the systems involved such as the RBC and traffic control centres, as well as on operational procedures. These are illustrated in Figures 1 and 2.

In a Level 3 moving block system, train separation is based on the last reported safe rear end position of the leading integer train, providing an optimal Level 3 capacity. The 'moving block' is based on periodic position reporting of the train's rear end position, and so it jumps periodically. For instance for a speed of 160 km/h the moving block jumps with distances of >200m. By reducing the length of the virtual blocks, only known by the RBC, moving block performance is also achieved in Hybrid Level 3 concept.

Main principles for Hybrid Level 3 with virtual blocks

For Hybrid Level 3, trackside train detection sections can be divided into several Virtual Sub-Sections (VSS). This is with the constraint that a trackside train detection section containing movable elements should not be divided into several VSS sections.

The 'occupied' and 'free' status of the VSS is based on both train position information and trackside train detection information. A VSS is reported 'free' if the underlying trackside train detection is reported free. It is reported 'occupied' if a train reports inside this section (based on front end position and reported train length).

As shown in Figure 3, the ERTMS trackside considers that a train occupies only the relevant VSS in which it is located, and the TIMS provides confidence as to the location of the rear of the train. However, a train not fitted with TIMS occupies the sections in rear, because for the RBC the train rear is not safely known. A train not fitted with ERTMS occupies the entire train detection section, because for the RBC the train position is not known. An ERTMS train without a TIMS can follow an integer train on VSS sections, but other trains can follow it only on separate train detection sections. The result of this is that capacity benefits are only achieved for ERTMS trains, and full gain is achieved around ERTMS trains fitted with TIMS.

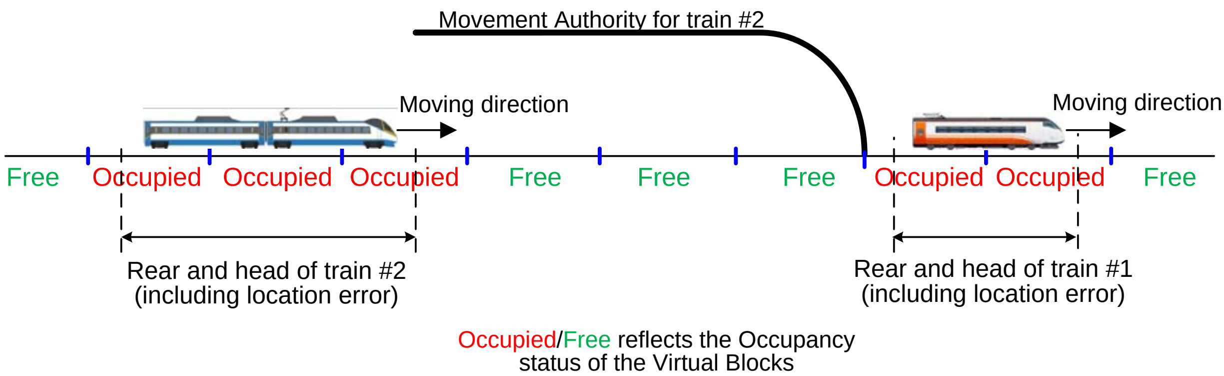


Figure 1 – Virtual Block system.

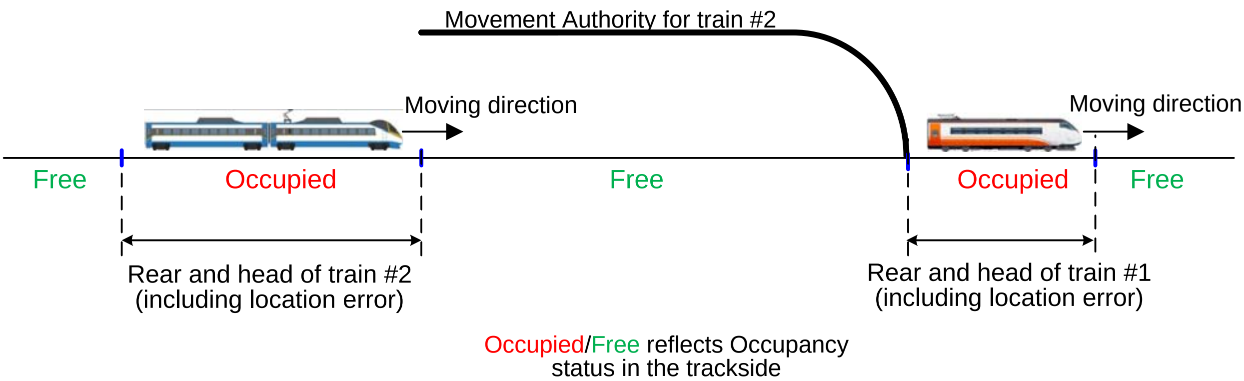


Figure 2 – Full Moving Block system.

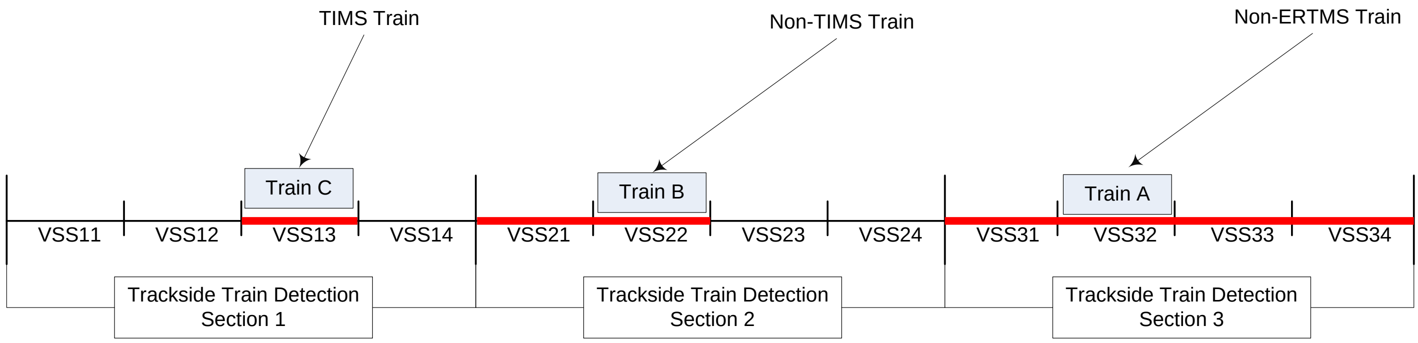


Figure 3 – Different capacity exploitation depending on the presence of the ERTMS on-board and TIMS.

If the capacity benefits of Level 3 are to be realised in situations where there is a mixed fleet of trains operating (i.e. some trains are fitted with ERTMS, TIMS and others are not) consideration will need to be given to optimising the timetable for these different train types.

Because the timing and spatial accuracy of the trackside train detection and ERTMS train position vary considerably, two additional internal VSS states are introduced: 'ambiguous' and 'unknown'. These statuses will be reported to the external systems (e.g. the Traffic Management System) as 'occupied,' and so no new requirements or operational procedures are needed for such systems. The trackside train detection occupancy information is used only as an input for the VSS status.

This is the enabler for using existing systems with this concept.

The different VSS state transitions, as shown in Figure 4, are defined based on reported train information and trackside information which is explained in more detail in the General Principles Level 3 VSS [R6]. For instance the transition from 'occupied' to 'free' takes place if an integer train reports it has left this VSS. Another example is the transition from 'occupied' to 'ambiguous'. This happens when a train loses its integrity or does not report integrity. VSS sections left by a non-integer train in an ambiguous VSS section will become 'unknown' until the underlying trackside train detection reports unoccupied.

Protection against non-reporting trains

To protect against undetected movement of non-reporting trains, the VSS sections on which the train is located when disconnection is detected by the trackside are set to 'unknown'. To enable the train to still use its Movement Authority (MA) completely, all the VSS in advance of the last train location which are part of the MA sent to that train need also to be set to 'unknown' if the underlying trackside train detection reports 'occupied'.

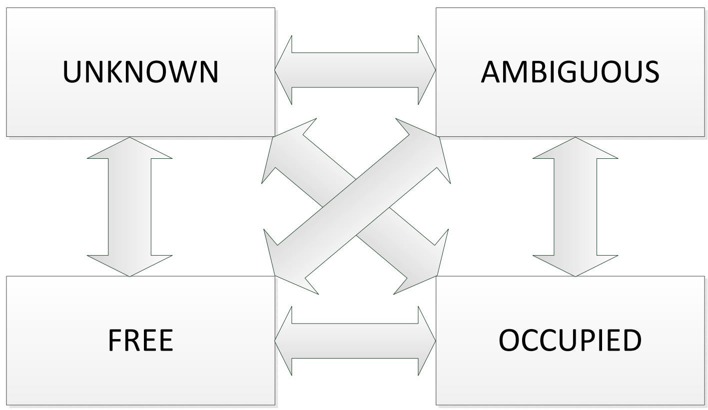
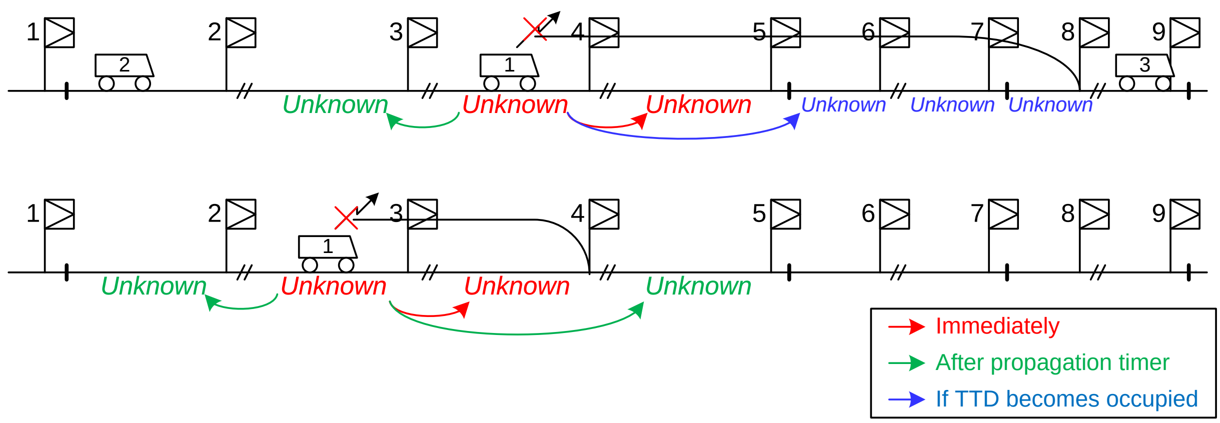


Figure 4 – VSS section state diagram.

As the train may move after the disconnection of the radio link without the trackside being aware of the movement, the status 'unknown' is propagated after a specified time on to adjacent VSS, forward and backward, until either a free trackside train detection section or another train is reached. On reconnection of the same train with an unchanged length, the VSS statuses can be restored to allow continuation of its journey. The propagation time can be configured to be location and direction specific. This means the system can take into account conditions where changing direction and opposing movements are required. This is illustrated in Figure 5.

Figure 5 – Propagation of 'unknown' after disconnection during mission.



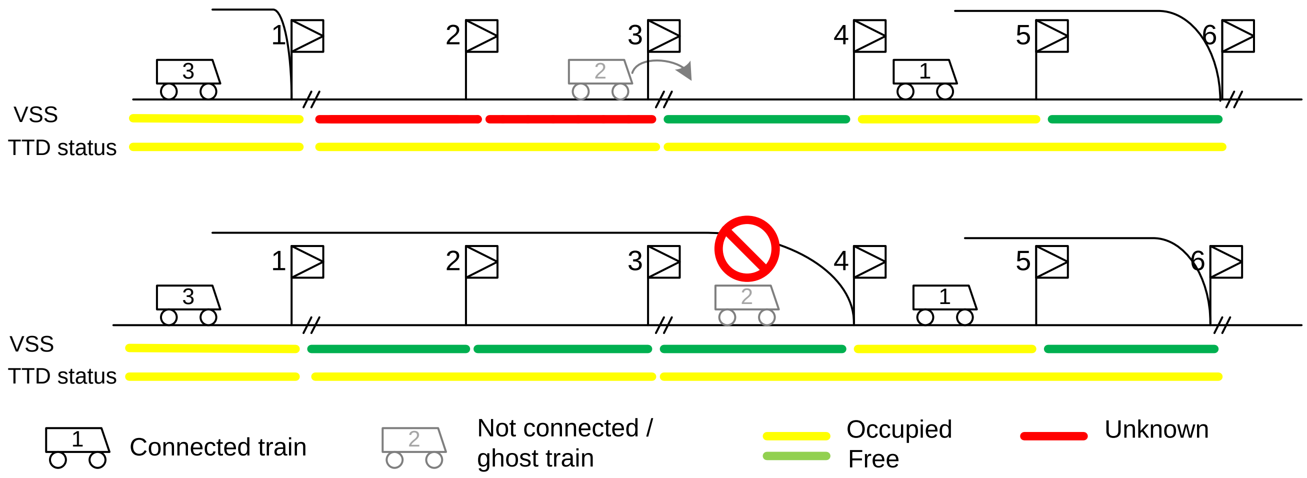


Figure 6 – Shadow train hazard.

Backward propagation can also be configured for the situation where a train reports loss of integrity. This covers the risk that a detached part of a train could roll back undetected into free VSS sections.

This mechanism and the additional information from the trackside train detection allow areas to be configured within the Level 3 system where trains can be parked, split and joined. The presence of trackside train detection means impact on normal operation is avoided, meaning that some benefits of Level 3 are still able to be provided when insufficient train position information is available.

‘Ghost’ and ‘shadow’ train risk

For a Level 3 system a ‘shadow train’ hazard could occur as depicted in Figure 6. In other words because of the undetected movement of train (2) the trackside could authorise another train (3) on to the infrastructure released by the integer train (1).

To add protection against shadow train movements in the Hybrid Level 3 concept, the trackside train detection information is used to check if releasing infrastructure in rear of the train is safe. This includes the detection of possible ‘ghost’ train movements with trackside train detection.

Trackside train detection can be used, in addition to position reports, to release sections of track and clearing points, overcoming potential performance issues and to prevent possible deadlocks. Additional performance is achieved in situations in which the train position reporting is not fast enough (e.g. due to the frequency of the position reports) or not accurate enough (since the train position is defined including margins from the odometer confidence interval). Deadlocks can be avoided, for example, by detecting the movement of trains when communication has been lost or by safely releasing points on overtaking areas that otherwise would remain unnecessarily locked when they are considered occupied due to margins added to the train position.

For situations where the trackside train detection cannot release ‘unknown’ sections, an integer train can ‘sweep’ these VSS sections. The train information can also be used to increase the availability of the infrastructure by supporting ‘sweeping’ trains for recovery from trackside train detection failures. That is, in this case the train position information function increases the availability and reliability of the trackside train detection.

Benefits and Opportunities from using Hybrid Level 3

The possibility of reusing existing trackside train detection in the Hybrid Level 3 concept brings with it a number of advantages.

Hybrid Level 3 allows the management of scenarios where no train information is available, i.e. train disconnection and failure of train integrity. It also manages scenarios at locations where a train is parked, changes direction, shunts, etc. These scenarios have to take into account that a train, or parts of a train could be moved without being connected to the RBC. Hybrid Level 3 deals with these by using trackside train detection systems to mitigate the problem.

The combination of train position and trackside train detection information also provides protection against ghost and shadow trains risks, particularly required at entrance and exit points of a Level 3 area.

In addition the combination of trackside train detection and train position information provides mutual benefits in performance and reliability of these systems.

In Level 3, trains are normally required to correctly monitor their integrity (that is, the completeness of the train). However the challenge is around the safe management of this integrity information: finding solutions for all types of trains, both freight and passenger. Hybrid Level 3 allows the running of a mixed fleet of trains; i.e., those with and without integrity monitoring are supported. So there is no immediate need to upgrade an existing fleet with TIM. However it should be recognised that this solution brings capacity benefits only around those trains equipped with TIM functions. Therefore, provisions should be made on trains to allow the implementation of TIM systems as soon as possible, ideally as part of ERTMS fitment. It is recommended that new trains should as part of initial design come fitted automatically with ERTMS and TIM.

The migration of an ERTMS Level 2 trackside to Hybrid Level 3 will mainly consist of updating the software in the RBC. The existing interlocking and trackside hardware (such a track circuits or axle counters) will be reused.

Finally it is expected that the Hybrid Level 3 should be able to be operated using the operational rules developed for Level 2 deployments with minimal alteration. This is critical in the case of trains not yet fitted with TIM devices, as they will be expecting to run in Level 3 as they do in Level 2. This means it is expected that staff training requirements for such an implementation will be minimal (assuming drivers, signallers and others have already been trained to operate Level 2).

The solution allows easy migration for trains, operational rules and trackside.

Level 3 Overlay (overlay on class B national systems)

Level 3 may be applied alongside conventional signals and class B national protection systems. Trains capable of using ERTMS are able to run using the Hybrid Level 3 variant as described above, or using the alternative Level 3 variants as described below. Trains unable to use ERTMS (due either to lack of on-board ERTMS equipment or to driver competency constraints) can run according to the existing fixed block sections, using conventional signals and trackside train detection (i.e. they can run using the class B system). This means that the trackside will be equipped with signals and trackside train detection to which ERTMS Level 3 will be overlaid. Special attention is required for more complex operational procedures due to the mix of trains and the national signal aspects for the ERTMS trains. Special attention is necessary for the scenario where an ERTMS Level 3 train is allowed to pass at line speed a lineside signal showing a Stop aspect.

The advantage of this solution against using Hybrid Level 3, as described above, is that it enables non-ERTMS trains to run.

Level 3 Virtual block

ERTMS Level 3 virtual block management relies on virtual objects (software- and database-related ones) for managing track occupancy and train separation. The term 'virtual block' is used to designate a headway section defined in the ERTMS RBC.

The occupancy of such virtual objects is defined through the reporting of trains. The RBC assigns trains to these sections on the basis of location messages supplied by the trains, and ensures that no section is subject to more than one train movement at a time.

Even if the virtual blocks have predefined fixed limits (as in conventional fixed block systems), this configuration provides flexibility in the length and number of blocks which can be defined for application on the line. The benefit of this approach is the possibility of adapting the size of the virtual blocks according to operators' needs (for example to reduce headways). Such refinement for adapting the size of blocks is easy to achieve through an update of the corresponding databases. In theory a line can be divided into an almost infinite number of virtual blocks of infinitely small length. In practice, the need to protect points and junctions will constrain the safe distance between consecutive trains and the length of the blocks in some areas.

Figure 1 shows an example of a virtual block system, where the second train's movement authority is defined downstream by the first occupied virtual block.

Trackside train detection systems are removed in this type of ETCS Level 3. This requires that all trains operating within the virtual block area must be fitted with TIMS, and Level 3 operational procedures are required for degraded situations.

Level 3 Moving block

Here the trackside is not divided into sections; safe separation between two trains is no longer given by a static value enforced by fixed blocks, but by an adjustable distance based on a real time calculation of the train speed and the reported train location among other elements.

As shown in Figure 2, each reporting train is therefore associated with one, and only one, virtual block that moves with the train. As the leading train moves forward, the next train follows while maintaining a safe distance separation; movement authorities are calculated up to the rear of the leading train. Since the separation is kept to a bare minimum, there is no wasted space, the train is not left waiting for a block to clear (as it is in fixed block) and, most importantly, the headway is kept as short as possible.

As moving block utilizes the track in the most efficient manner while ensuring safety, the result is that consecutive trains run closer to each other than in a Level 3 virtual block solution, while safety is maintained.

Trackside train detection systems are removed in this solution; this means that all trains operating within the moving block area must be fitted with TIMS, and Level 3 operational procedures are required for degraded situations.

Summary of the types

Table 1 overleaf provides a summary of the different types of Level 3 and their main characteristics.

Having demonstrated above that a lot of conceptual development of ERTMS Level 3 has taken place, we acknowledge that there are some steps required to complete before going into implementation. These are outlined below.

How is Level 3 development being taken forward?

Development of Level 3 is being taken forward in two related and complementary work streams.

The first work stream aims at minimising risk in early implementations of Level 3. It plans to facilitate the management of degraded scenarios and to target a simple migration, of both trains and tracks, from Level 2 to Level 3 to gain capacity advantages through the development of Hybrid Level 3. This work is being developed by a collaborative team from ProRail and Network Rail with support from other rail partners.

The second work stream focuses on developing the other types of Level 3 implementation. This work stream has to confront two key challenges: further requirements on the trains, and the need to manage degraded scenarios without train detection systems in place. This work is being developed in the Shift2Rail Innovation 2 Programme which commenced in September 2016.

Development of Hybrid Level 3

This solution is being developed through collaboration between ProRail and Network Rail. The plan is to have requirements and standards ready to allow an early deployment demonstrator of a Hybrid Level 3 system from 2017 onwards, and to integrate these standards in cooperation with the European Union Agency for Railways into the European ERTMS specifications as needed.

The involvement of the European Union Agency for Railways is intended to minimise the risks of the project, keeping the Hybrid Level 3 solution within the EU ERTMS specifications. This is particularly important as, if parts of the development did require a change in the existing European ERTMS specifications, they would have to be agreed through the European ERTMS change control process.

The development process

The Hybrid Level 3 solution will be developed and then validated to achieve technical demonstrators in several steps.

Type of Level 3	Fleet Fitment	Infrastructure	Benefits and challenges
Overlay (on Class B)	ERTMS recommended but not mandatory, allowing fleet fitment of ERTMS. TIMS not mandatory, allowing phased fleet fitment.	Signals (Class B system) and trackside train detection retained. Use of virtual block technology.	Moderate increase in capacity for trains with ERTMS+TIMS only compared with operation using the Class B system (may also need to update the time table to assist in delivery of benefits). Solution needs to be found to allow ERTMS L3 trains to pass a lineside signal showing a Stop aspect.
Hybrid (virtual blocks)	ERTMS required. TIMS recommended but not mandatory, allowing phased fleet fitment (especially relevant for freight).	No signals. Trackside train detection retained. Use of virtual block technology.	Increase in capacity for trains with TIMS without adding trackside train detection. Increased reliability because of redundancy in train localisation.
Hybrid (moving block)	ERTMS+TIMS recommended but not mandatory, allowing phased fleet fitment (especially relevant for freight).	No signals. Limited trackside train detection. Use of moving block technology.	Increase of capacity by adapting the size of the virtual blocks in software data bases. Impact on traffic management systems and operation impact (two trains in a block) to be considered.
Virtual (without train detection	ETCS+TIMS fitted trains only	No signals. No need for trackside train detection. Use of virtual block technology.	Increase of capacity by adapting the size of the virtual blocks in software databases. Reduction of costs and increase in reliability due to the removal of trackside equipment. Solutions for trains without radio connection and degraded situations have to be found.
Moving block (without train detection)	ERTMS+TIMS fitted trains only	No signals. No need for trackside train detection. Use of moving block technology.	Maximised capacity on the available infrastructure. Reduction of costs and due to the removal of trackside equipment. Solutions for trains without radio connection and degraded situations have to be found.

Table 1 – summary of the different types of Level 3 and their main characteristics.

- A set of common Hybrid Level 3 principles have been developed in cooperation with Alstom, Bombardier and Siemens, in conjunction with an operational concept.
- A laboratory simulation of the Hybrid Level 3 principles was organised by ProRail in 2016 with support from Network Rail, Alstom, Bombardier, Siemens, Ansaldo, Arup, SNCF Réseau and the ERTMS User Group.
- A Network Rail/ ProRail demonstration will take place in 2017 at the British ERTMS National Integration Facility.
- A Hybrid Level 3 pilot line could be delivered by 2018. An option analysis will be performed to determine the most suitable location for a pilot demonstration. Options for undertaking pilots in both Great Britain and the Netherlands are currently under investigation. The pilot demonstration will be used to verify compliance with the specifications and to check the expected performance of the system.

The development of this early ERTMS Level 3 solution will bring return of experience for the other possible implementations of Level 3. In particular it is expected to give an insight into the benefits of having some train detection systems at the trackside (as in Level 2) for Level 3 degraded mode operation, for example in areas of complex switch and crossing work.

The development of Level 3 in Shift2Rail

There are several Level 3 solutions which require the following elements to be further developed for the main line railway: systems to manage operational Level 3 constraints, safe train integrity monitoring solutions for all type of trains, and the Level 3 technologies for the safe separation of trains.

Shift2Rail addresses these issues through the following activities [R4].

- The Level 3 operational scenarios and additional constraints will be analysed (e.g.: a train or part of a train without a RBC connection shall not move).
- For the Level 3 train separation management system, the scope of Shift2Rail covers the definition of an operational concept, engineering rules and system specifications, with a delivery date by the end of 2018. This includes several variants of Moving Block, 'Virtual Fixed Block' and 'Full Moving Block', both with and without train detection, as each may be important in different applications. While 'Full Moving Block' would in theory bring maximum benefits in terms of train capacity, its use could be challenging around junctions. In complex trackside configurations 'Virtual Fixed Block' will be easier to implement and the benefits in capacity could be in practice as good as using 'full Moving Block'

if implemented correctly. The starting point for this work in Shift2Rail will be the moving block principles that were developed and validated as part of the Next Generation Train Control (NGTC) programme [R5].

- On-board train integrity definition and prototyping. The functionality will be developed notably for those market segments (freight and passenger low traffic lines) where such a function is not yet available using reliable existing on board features.

The Shift2Rail work on this area is currently at the start of its development cycle having commenced in September 2016. Network Rail as a Shift2Rail member is directly involved in this work and looks forward to providing continuity and lessons learnt from the Hybrid Level 3 work into this development programme. The ERTMS Users Group, as a linked third party within Shift2Rail, will also support this work.

Conclusions

There is a clear requirement for ERTMS Level 3 on our networks today to improve capacity, and there are a number of ERTMS Level 3 solutions which are able to meet it. They are currently at different levels of development, as is the business case analysis to support application of the different variants.

Of these solutions, ERTMS Hybrid Level 3 is the most advanced and is currently seen as the low risk solution for application on rail networks. This is due to its built-in optimal use of both train position and existing train detection information and its simple and smooth migration path from existing trackside systems and trains.

As the solutions move towards ERTMS Level 3 without trackside train detection there are more issues to solve in terms of application on complex interconnected main line networks. Will there ever be a moving block system without trackside train detection which will add benefits, or will the developments show that the optimum benefit comes from a hybrid system? These are questions that must be answered as these developments continue.

It is applicability and the ability to migrate these solutions from existing trackside systems and trains which will ultimately determine how to implement Level 3 on our networks in future.

References

R1 Commission regulation (EU) 2016/919, of 27 May 2016, on the Technical Specification for Interoperability relating to the 'Control-Command and Signalling' subsystems of the rail system in the European Union

R2 ERTMS long term perspective version 1.5, 18/12/15

R3 Memorandum of Understanding between Network Rail and ProRail signed on 2/2/2016

R4 Shift2Rail Multi-annual Action Plan, Rev 3, November 2015.

R5 NGTC-WP5-D-DIM-064-01_-_D5.1_Moving_Block_Principles_Draft_15

R6 General Principles ERTMS Level 3 with Virtual SubSectioning, ProRail, 27-08-2015

INDUSTRY NEWS

In order to bring IRSE NEWS readers the latest global signalling, telecomms and train control information, we have teamed up with the **Railway Gazette International** *(**www.railwaygazette.com**) to supply brief summaries of major news in our industry. We will of course also publish items of news from other sources when we receive them.*

Siemens opens new depot in Glasgow

UK: Siemens' new rail depot was officially opened on 24 February 2017 by the Scottish Government Minister for Transport and the Islands, Humza Yousaf, MSP.

With passenger numbers in Scotland growing every year and a comprehensive programme of rail infrastructure works planned across the country over the next decade, Siemens took the decision to relocate its site teams to this purpose-built facility in Cambuslang, on the outskirts of Glasgow.

Siemens Rail Automation Operations Director, East, Richard Cooper, said: *"We are delighted to welcome Humza Yousaf to the new Cambuslang depot and honoured that he performed the official opening ceremony. I am particularly pleased that he took such an interest in our apprentices; we are proud of the young people we have recruited from the surrounding area and look forward to the positive contributions they will make to our business in the future."*

Transport Minister Humza Yousaf said: *"I'm delighted to open this new facility and get the chance to meet some of the people who work here."*

Industry backs faster ERTMS deployment

[RGI] EUROPE: The Chief Executives of the eight signalling companies that are members of the UNISIG association renewed their commitment to the development and roll-out of the European Rail Traffic Management System at a meeting in Brussels on 7 February attended by DG Move Director-General Henrik Hololei, ERTMS Co-ordinator Karel Vinck and EU Agency for Railways Executive Director Josef Doppelbauer.

Alstom, Ansaldo STS, AZD Praha, Bombardier, CAF, MerMec, Siemens and Thales all signed individual Letters of Intent supporting the updated ERTMS European Deployment Plan which was formally adopted by the European Commission on 5 January.

The commitment by the suppliers follows on from the signing by various rail sector associations including UNISIG and UNIFE of a fourth Memorandum of Understanding with ERA and the European Commission in September 2016. This is intended to secure long-term stability for the ERTMS specifications following the adoption of Baseline 3 Release 2 and promote a *"swift and co-ordinated"* deployment across Europe.

The suppliers hope that their commitment to the future development of ERTMS will encourage individual railway operators and infrastructure managers to sign similar letters of intent in the near future, following on from the signing of the memorandum by both CER and EIM.

Five operating control centres for the rail network operated by ÖBB Infrastructure

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The following article was originally published in Signal+Draht in early 2016 and is reproduced here with permission, and minor modifications.

The lines comprising the Austrian railway network have a total length of around 5500 kilometres. The network manager, ÖBB Infrastructure, is in the process of implementing a concept to establish five operating control centres (called 'BFZ' or 'Betriebsführungszentralen' in German). The area covered is being expanded in stages and currently is around 1200+ kilometres of lines in various parts of the country. The final state envisaged by the plan is to have 3300 km of lines managed from the five operating control centres (see Figure 1). The first of these new operating control centres entered service in Innsbruck in October 2008, having taken only three years to construct, with an initial ten dispatching locations controlled remotely from it. All five operating control centres are now in service, located in Innsbruck, Salzburg, Vienna, Villach and Linz. This represents a big step towards the goal of having a single operating and dispatching system throughout Austria – an idea that was actually first launched back in the 1980s.

ÖBB Infrastructure regards the five operating control centres as a crucial component in ensuring that it is able to implement the agreed nationwide 'target network 2025+' ('Zielnetz 2025+'), the aim of which is to be able to provide 30 % more trains a day (up from 6400 to 9000), to carry more passengers (up from 235 million a year to 300 million) and to run more train-kilometres (up from 143 million a year to 198 million). It is intended to complete the control centre strategy in its entirety by 2028.

How it all began

It was halfway through the 1980s that the concept was first presented of centralising the technical and organisational processes necessary for operating the railway in Austria. At the time it was the biggest challenge within the field of command, control and safety systems because the technical aspects of rail safety in Austria were then primarily implemented using relay technology. Physical connections in the form of copper cabling were a prerequisite for the dependable transmission of interlocking commands. The initial concept envisaged a total of 77 operating control centres that would remotely control the network. It was not until 1989 that the first prototype electronic interlocking units entered service in Austria. While Siemens and Alcatel (now Thales) were preparing these for regular use from 1993 onwards, the Austrian Federal Railways (ÖBB) themselves were working in parallel on the development of their own unique supplier independent interface for the dependable exchange of interlocking controls and indications (the 'X25').

Technological development favouring centralisation

For the first time ever, the X25 interface offered the possibility of very considerably extending the distances over which commands could be transmitted between stations and master signal boxes. This development led to a review of what would be required to cover the whole of Austria using this technology, and the target number of operating control centres was reduced to 44. The

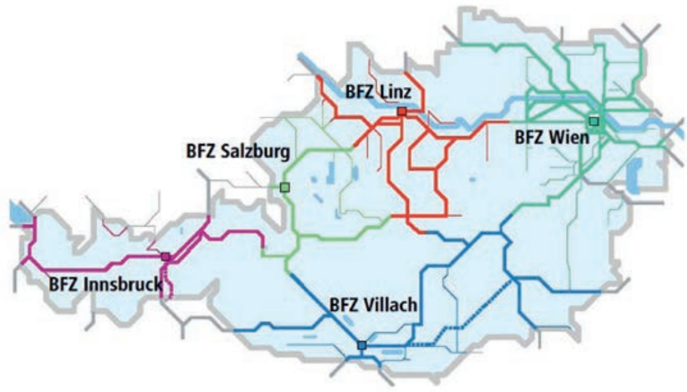


Figure 1 – Locations of the five control centres.

basic requirement for such a configuration was for stations and signal boxes to be remotely controlled no matter what distance was involved or what interlocking and control centre equipment was installed.

As the technology of electronic interlocking systems continued to develop, and with rapid improvements in transmission channels and technology, a further review of the remote control concept in 2003 led to the conclusion that just five 'operating control centres' would now suffice to cover the entire national territory. Considerable effort had already been given to issues such as the locations of the buildings, system architecture and redundancy.

Operational integration

There was, however, yet another barrier to be overcome before centralised traffic management could be established. Up until that point in time, responsibility for controlling train movements (i. e. setting routes) had been largely independent of dispatch management (i. e. planning traffic movements and providing information to passengers). In order to be able to manage traffic efficiently, it would be necessary to combine the operational and dispatching elements. The development of the 'ARAMIS' rail management system was a key requirement for the implementation of such an operational concept. Today, this system is capable of supporting multiple clients, is integrated into all the workstations, and is a key tool in the optimisation of operational processes.

There are other capabilities closely linked to the concept of centralised operational control which are also required, particularly when dealing with urban areas for which real-time traffic management is an important component. One is the provision of structured, computer-aided customer information. Customer surveys show that the significance of providing high quality dependable information to customers must not be under-estimated.

Controlling operations centrally also means having plans for deciding what to do in abnormal situations. This requirement is met through a Railway Emergency Management system that is installed on workstations especially adapted for it.

Other technological features of particular importance in delivering centralised control have been the construction of a data network, including the installation of GSM-R for voice and data communications, covering the core of the network – now completed.

With centralised operating control, ÖBB Infrastructure is working towards the strategic, long-term goal of managing an infrastructure business that is an attractive form of public transport – and, moreover, is doing so economically.

Practical aspects of the programme

When the first operating control centre entered service in Austria in 2008, milestones were set for the further stages of implementation. It was recognised that it would make sense to collect information about the early experiences that could be applied in the subsequent expansion. The factors to emerge fall under two headings: technical and organisational, some of which are discussed below.

At present the ÖBB network has around 700 signal boxes and interlockings. Of these, a little under 300 are electronic interlockings that satisfy all the technical pre-conditions for being controlled remotely. They are thus suitable for integration into an operating control centre. A further ~250 relay-based interlockings can also be made suitable for remote control by installing interface computers. When dealing with relay systems, however, the extent of modifications required for interfacing, including adaptations at the control centre, may make it preferable to replace the older relay interlockings with electronic ones.

On the organisational side of such a large programme of work, particular attention needs to be paid to the human resources. The programme must be planned in detail to ensure that the implementation matches the available resources, taking into account the client's own personnel and those of the supply industry.

As far as possible, integration of lines into the operating control centre should always be done in phases. The transfer of control to the new centres may necessitate moving operating staff from regional locations, as well as reducing the numbers of people required to operate the control centres. Some employees will volunteer to move into the operating control centres, whilst others leave work through natural wastage (retirement etc). The management of this human aspect makes frequent adjustment of the implementation plans essential.

Another key decision was to fully equip each control centre with all the operating consoles that it would eventually require, even though individual consoles may not enter service until some years later. This approach has proven to be very worthwhile in minimising disruption to the working environment.

System architecture and safety

In terms of safety engineering, each operational unit (local interlocking or signal box) is a high integrity remote-controlled device, receiving instructions from the operating control centre, which also has an element of technical responsibility for safety (SIL2). Each interlocking unit locks routes and prohibits conflicting movements.

Each operating control centre has a 'cellular' architecture, which is either implemented in hardware or programmed through software blocks, making it possible for several remote interlockings or signal boxes to be integrated and operated in each cell through the X25 interfaces, whatever the interlocking type. There are technical differences between the cellular concepts practised by the two suppliers of operating control centres, Siemens (Innsbruck, Villach and Vienna) and Thales (Salzburg and Linz). However, there is strict uniformity in the presentation of information to operators, using the second-generation of the uniform operator interface, 'EBO2', thus ensuring that operators always see the same images and have the same operating actions to perform.

Integration with train protection systems

Austria has strict rules regarding Technical Specifications for Interoperability (TSI) conformity of any systems introduced on both existing railway lines and new ones. That means that only the most modern, interoperable systems for train protection can be used. In the case of Austria, it is ETCS Level 2 that has emerged as the preferred technology, with radio block centres (RBC) integrated with the operating control centres.

Roles in the operating control centres

As a consequence of implementing the control centre strategy in Austria, the classical job description of a traffic controller is having new functions added to it on account of the multiplicity of tasks to be performed. The types of roles required in these centres are now defined as:

- Operations coordinator.
- Production planner for timetabling and operations.
- Train router.
- Area operations controller.
- Operations controller for customer information.
- Emergency coordinator.

Job rotation enables personnel to gain and maintain experience in various roles. Simulation systems are used to ensure that personnel have the necessary route knowledge and to familiarise them with the areas under their supervision. These same systems are also used for integration testing and for further training each time the system is expanded.

A view of a typical control centre can be seen in Figure 2. Automation helps to reduce employees' workload and to ensure they act correctly

Because every member of a team working in the operating control centres has numerous functions to perform, spread over several geographical areas, it is essential to reduce the mental burden on them by automating repetitive processes.

The use of ARAMIS for automatic timetable execution of the annual and daily timetables is a primary tool in reducing the operator workload. If kept up to date by the production planners, this system makes it possible to process the timetable with an extensive degree of automation. Manual dispatching by the train routers then only becomes necessary, for instance, in the event of late running with connection conflicts or unscheduled crossing of train paths.

The semi-automation of shunting movement authorities uses a system called 'EVA' for handling requests from local staff for shunting movements. It includes an operating mode known as 'acknowledgment operation', which passes all shunting requests from the local shunting manager to the competent area traffic manager. If no conflict with timetabled movements exists, this request can be acknowledged with a single command. There is second operating mode known as 'authorisation operation'; in this, GSM is used to automatically request shunting routes from the interlocking system and, if the route is available, it is set automatically.

It is desirable to be able to automatically implement protection for worksites where the work does not require a safety criterion of 'no train movements', such as work on a closed track in a tunnel while the second track remains open to traffic or inspection

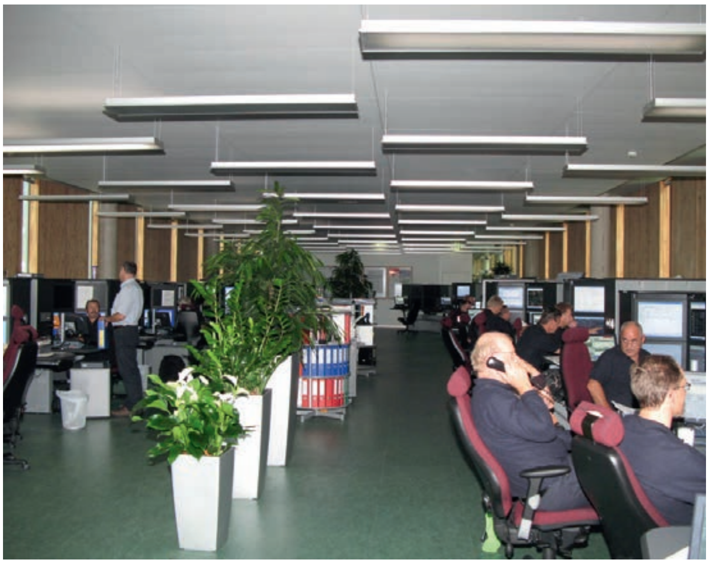


Figure 2 – Internal view of an operating control room.

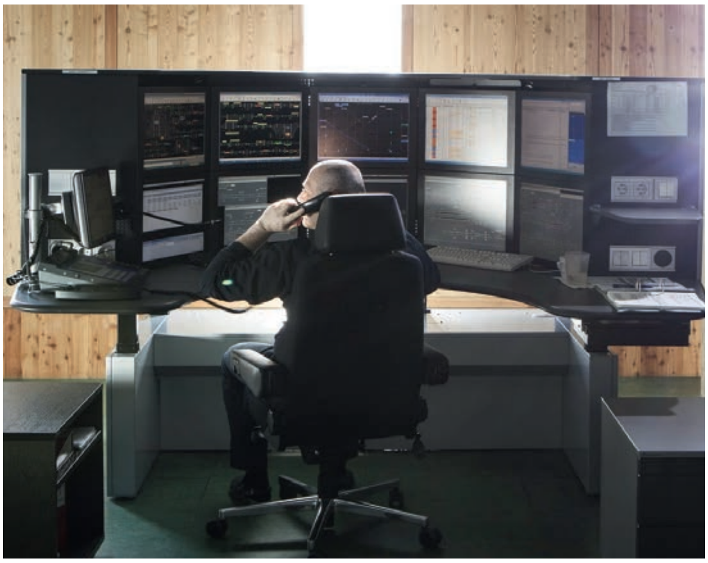


Figure 3 – Operations are processed from an adjustable-height console with ten monitors.

activities, during which the affected track can be cleared at any time. To achieve this, the ÖBB use the SCWS system (Signal Controlled Warning System) supplied by Zöllner. This warning system uses data from the train protection, interlocking and train detection systems, and it keeps trains moving whilst providing guaranteed warning times for the trackside personnel.

Customer information

It is the role of the 'operations controller responsible for customer information' to communicate up-to-date customer information and announcements. They already make use of systems that are substantially automated. The latest timetable information shown on central master displays and on platform displays uses data processed and visualised through the ARAMIS system of automated passenger information. The timing of the audio announcements is optimised as a function of the train numbers and sequences of operations. In larger locations with uncertain arrival times a system of sensors is used to detect when the train actually comes to a standstill, and precisely that point in time is used to trigger the announcement.

The latest generation of installations uses Text To Speech (TTS) voice synthesis to generate announcements, facilitating the use of a fully digitised corporate voice. Up-to-the minute announcements to be used on just one occasion can thus be entered via a keyboard and played back in groups at various operating locations. If such announcements deal with situations that are likely to recur, they can be post-edited and then remain permanently available in the server's dictionary. In the process of digitisation no more than 8000 names and specialised railway terms needed to be loaded directly into the dictionary. With this degree of automation, it is possible for just one employee to handle the customer information for whole sections of the network, including coping with delays.

Operator workstations satisfying the highest demands

At the time the first operating control centre was set up, the operator consoles where designed to satisfy occupational health and safety risks/requirements relating to working with computer screens. Personnel may be working with up to ten monitors (see Figure 3).

Since the Innsbruck operating control centre entered service, 140 operating consoles of this type have been installed in such centres throughout Austria, and a further 80 or so have been commissioned in stations, signal boxes and other train-routing locations. The consoles permit electrical adjustment of the working height and the ergonomic, glare-free use of the monitors, including integrated desktop lighting. This eliminates glare for the user and any form of annoyance for colleagues at neighbouring workstations.

Console desktops are uncluttered, apart from input devices (mouse and keyboard) and the internal telephone equipment. The consoles have honeycomb panels on their sides, which have proven extremely efficient in suppressing noise from other workstations (bearing in mind that there may be up to 24 workplaces in one room). Each workstation has its own independent power supply and backup.

Achieving high availability

To cope with the most important possible abnormal and exceptional situations, an organisational and technical redundancy concept has been applied, and work is in progress to make it possible to transfer whole areas of control from one operating control centre to another. All the operating control centres include spare workstations ready to assume any necessary roles at short notice.

To cope with the complexity of the technical systems, a technical support service has been introduced in all of the operating control centres to manage and clear disruptions as they occur. Working a 24/7/365 shift system, the first-level support undertakes remote diagnoses of local and remote systems, enabling decisions to be taken quickly. It is not until this decision is about to be taken that the deeper diagnosis is launched with a view to optimising the rectification activity by managing response and travel times.

Summary

In 2008, the entry into service of the first operating control centre in Innsbruck marked the beginning of a new era of controlling train movements on the Austrian Federal Railways. The plan has been to provide centralised dispatching and train control from a maximum of five operating control centres ('BFZ') spread throughout Austria. A phased approach to implementation has been adopted, and each centre started with a limited area under its control and was later expanded a step at a time. Eventually there will be ~3300 km of main line tracks (out of a total of 5500 km) controlled from these centres. Automation of processes, careful planning of the migration to the new centres, and integration of systems have been central to the programme of work.

Signalling in Japan

Tom Corker

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 signalling and telecomms. The award is made to the younger member who achieves the best performance in the IRSE exam.

In the 2015 exam the award was given to Tom Corker from the UK, who undertook his study tour in 2016. In this article Tom tells us about his trip to Japan.

"My choice of Japan as the destination for my Thorrowgood Scholarship study tour was a relatively easy one. The Japanese railway network has long had a reputation for being one of the most advanced, efficient and well used in the world, but it also faces similar challenges to many other networks, including the UK. The opportunity to go behind the scenes and see the signalling technology that keeps this impressive network running was one not to be missed."

An introduction to railways and signalling in Japan

My flight landed in Tokyo early on a Saturday morning. With the rest of the day to fill I headed to Tokyo's main station for my first taste of Japan's railway system, and then to the excellent Railway Museum at Saitama, 30 km north of the City Centre. The museum is affiliated to JR East, and I was surprised to find a plaque in the foyer linking the museum to the UK's National Railway Museum in York. The museum is certainly comparable to the NRM in terms of scale, but the amount of technical content was also notable. A whole exhibition was dedicated to signalling technology, covering signal aspects, block principles, various automatic train protection systems, relays and even a working point machine.

I spent the following two days with Prof Yuji Hirao at Nagaoka University of Technology. Yuji, a Fellow and Council member of the IRSE, had very kindly arranged my study tour and gave me an introduction to railway signalling in Japan. This grounding proved to be invaluable over the coming days, allowing me to make much more sense of what I saw than I would otherwise have managed.

The following sections give an overview of signalling in Japan, largely based on my discussions with Yuji, however any errors are entirely my own!

Railways in Japan

The national railway network is operated by six vertically integrated regional companies, who own and operate the infrastructure and passenger trains. Freight trains are operated nationally by a separate operator, JR Freight, on the infrastructure owned by the other six companies. These companies were formed from the privatisation of Japan National Railways in 1987, and now make up the JR Group. The national network is supplemented by substantial networks of private lines, mainly commuter operations in urban areas.

The national network is comprised of two distinct systems. Conventional lines are narrow gauge (1067 mm) and make up the majority of the network in terms of route miles, with top speeds of 130-160 km/h. The high-speed passenger only Shinkansen system is standard gauge (1435 mm) and therefore isolated from conventional lines.

Signalling on conventional lines

Conventional lines use what could be described as a hybrid system of route and speed signalling, reflecting the mixture of historical British and North American influences. Main signal aspects carry speed information, but the driver is also provided with specific routing information via multiple signal heads or route indicators.

Braking distances are relatively short, due to the maximum speed of 120-130 km/h on most lines, the almost complete prevalence of multiple units for passenger services, and short freight trains. All trains must have an emergency braking distance of no more than 600 m. This allows close signal spacing, especially in urban areas where short headways are required.

The restrictions associated with each aspect and possible sequences are shown in Figure 2. Three aspect (red, yellow and green) colour light signalling is the standard arrangement.

Figure 1 – The Railway Museum, Saitama.

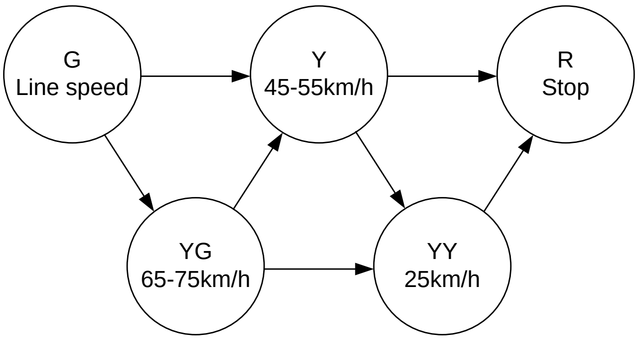


Figure 2 – Typical speed restrictions associated with aspects and possible sequences.

Yellow-green (YG) and yellow-yellow (YY) aspects are also used in certain situations, primarily in urban areas where there is a need to optimise the layout for maximum capacity. YY appears to be used where a short block would otherwise give insufficient braking distance, or to provide protection where an overrun at the following signal could conflict with other movements (overlaps are not otherwise provided). A YG aspect is often used on the approach to YY, where the Y speed limit would be overly restricted, or on the approach to Y if a prior speed reduction is required.

A large proportion of the network is electrified, especially in urban areas. The predominant system for conventional lines is 1500 V DC overhead, although others are also used. As a consequence, AC track circuits are the most common method of train detection, either at grid-derived or audio frequencies. Axle counters have not been widely adopted.

In three aspect automatic block areas, phase reversal of the AC track circuit is used to transmit occupancy state of the block ahead. This means that only a lineside power cable is required. I was told this method was devised in the post-war recovery period when copper was in short supply.

The NS-type point machine, introduced in the 1960s, is most commonly used. The internal mechanism is similar to a UK HW-Style machine, the main difference being that there are only drive and lock rods. The correct position of the switch rails is proved solely by the successful engagement of the lock.

ATS-S is the most basic form of train protection used on conventional lines. A warning is given on the approach to a signal at danger, which the driver must acknowledge within five seconds to prevent an emergency brake application. The track-mounted component simply consists of a tuned inductor-capacitor circuit with two possible resonant frequencies, depending on whether or not a warning is to be given.

ATS-P is a more sophisticated train protection system. Digital transponders are used to send speed and distance-to-go information to an onboard computer, which then provides continuous speed supervision on the approach to a speed restriction or signal at danger. Multiple transponders are provided on the approach to each signal to transmit updated information soon after the signal aspect steps up. ATS-P is widely fitted on high density urban lines.

Digital Automatic Train Control (D-ATC) is installed on a handful of high density conventional lines. This system provides full in-cab signalling, allowing lineside signals to be removed. Operation is similar to the Shinkansen digital ATC systems described below.

Signalling on Shinkansen lines

ATC (automatic train control) systems have been in use on Shinkansen lines ever since their inception. The original system installed on the Tokaido Shinkansen in 1964 used modulated audio frequency track circuits to transmit speed codes to trains, which were capable of automatic braking from one speed code level to the next. However, this tends to result in a stepped braking profile, which limits capacity and reduces ride comfort.

These speed code based ATC systems have now largely been replaced with digital ATC systems. Digital messages containing stopping point information are transmitted via track circuits. The onboard computer stores the route information, including speed limits, gradients and track circuit identities, which are used in conjunction with a tachometer to determine the train's position. Automatic braking is along a smooth profile, overcoming the problems associated with the older analogue system.

JR East

Having bid farewell to Yuji, I headed back to Tokyo from Nagaoka on the Joetsu Shinkansen. The next two days of my trip were with JR East, the main operator in Greater Tokyo and the Tohoku region.

I had been apprehensive that I may have difficulty in finding the agreed meeting point at Tabata station, but I was warmly greeted by my hosts as soon as I passed through the ticket barrier – clearly I was easy to spot. My visit started with an introduction to ATOS (Autonomous Decentralised Transport Operation Control System), the traffic management system used on JR East's high density urban lines around Tokyo, followed by a tour of the vast Tokyo control centre to see the system in use.

ATOS functionality includes train schedule adjustment and prediction, automatic route setting and management of maintenance work. The system is the 'single source of truth', providing data to passenger information systems and depots. Notifications of schedule changes can be sent directly to train cabs, and track workers are able to take and give up line blockages via handheld terminals. ATOS was first commissioned on the Chūo line in 1996 and has progressively expanded to cover almost every urban JR line in the Tokyo area. Although there are some common system-wide functions, the core central system is provided on a line-by-line basis, allowing each line to benefit from the most recent software at the time of commissioning. ATOS is supplied by Hitachi, who have been awarded the contract to deliver the traffic management system for Thameslink in the UK, so it will be interesting to see how the two systems compare.

The scale and importance of the control centre is difficult to describe. It controls all JR East urban lines in the Tokyo area, a system which in 2014/15 racked up 81 billion passenger-km. For comparison, the entire UK national rail network annual passenger-km figure is around 60 billion, and another 11 billion for London Underground. The centre is divided into control areas for each line, plus sections for functions such as passenger information, train crew management, maintenance operations and traction power control. There is even a small television studio for travel updates on breakfast television.

Each line has several controllers who work as a team, rather than each being responsible for a specific section. I was surprised that the controllers still make hand annotations to paper train graphs, despite using a state-of-the-art traffic management system. Apparently it's required by the rule book, providing a fall-back reference in case of complete failure of the control system. The decentralised automatic route setting equipment is co-located with the corresponding interlocking at each station and stores several days of schedule data. In the event of a failure of the

Figure 3 – Tabata Shinkansen sidings, from the JR East Tokyo branch office.

Figure 4 – A positive pressure seal keeps moisture out of the point machine casing.

Figure 5 – Networked position light signal.

central control system the station equipment is in principle capable of keeping trains moving autonomously.

After an excellent lunch in the on-site restaurant (with views of the adjacent Shinkansen depot, figure 3), the tour continued with a visit to the Shinkansen signalling equipment rooms deep in the heart of Tokyo station. My hosts took great care to explain the equipment in detail, much of which is associated with the digital ATC system described above. Of particular note was combined interlocking and ATC equipment (known as SAINT), which performs both traditional interlocking functions and generates the digital ATC messages containing movement authority information, which are then sent to the audio frequency track circuit equipment via a local network. Similarly occupancy states return to the interlocking via the network – no vital interface relays here! Extensive lightning protection is provided for all lineside circuits.

The following day we visited the training centre for conventional lines. The outdoor area featured a section of plain line, various types of switches and crossings, a level crossing even a mocked-up station platform, all with the associated signalling equipment. Now that I was able to get up close to the trackside equipment, the quality of the engineering and emphasis on reliability was readily apparent. The NS point machines are simple in operation but appear to be built like tanks, with heavy duty casings. A newer electronic variant featured a positive pressure seal to keep moisture out, and has to be 'inflated' with a bicycle pump after the lid is has been replaced (Figure 4). Heavy gauge multi-stranded wire is used for rail joint bonding, welded to the rail web. All trackside cables are armoured – my hosts were very surprised when I told them that it is rare for signalling cables to be armoured in the UK!

The final part of my visit was to Daido Signal, a signalling equipment supplier. They have been working with JR East to develop a network-based signalling system. The aim of the system is to reduce trackside cabling to just power and data over a fibre optic network. An object controller is built into or attached to each field element. This allows, for example, the optical fibre to be routed directly into a signal enclosure with no need for a lineside equipment cabinet. A passive optical network using unpowered splitters allows the network topology to suit the physical layout of signalling assets. The advantages of such a system are clear: the reduction in cabling simplifies installation and testing, reduces maintenance and improves reliability.

My two days with JR East were extremely enjoyable and informative, and my hosts had gone to a lot of trouble to ensure my visit was a success. Having bid farewell at Shinagawa station, I boarded the world-famous Tokaido Shinkansen to Osaka where I would be visiting JR West the following day.

JR West

JR West's 5,000 km network covers western Honshu including the Osaka-Kobe-Kyoto metropolitan area, and includes the Sanyo Shinkansen linking Osaka with Fukuoka.

Figure 6 – Osaka station signalling equipment room.

Figure 7 – JR West's outdoor training facility.

I met my hosts at the JR West headquarters building in the Kita-ku district of Osaka, where I was given an overview of the company's research and development projects and the signalling systems in use on conventional lines. JR East, JR West and the other JR Group companies share a common past prior to privatisation, so signalling principles are very similar. There has, however, been some divergence in the field of automatic train protection systems. This became apparent when I was introduced to ATS-SW, JR West's enhanced version of the national ATS-S system. ATS-SW adds basic speed supervision on the approach to signals at danger and speed restrictions, and works in a very similar way to TPWS in the UK.

The architecture of major stations in Japan tends to be modest, with functional platform canopies and underground passageways, despite being among the busiest stations in the world. Osaka station, by contrast, features a large curved glass roof, giving the station a light and airy feel. After a brief tour of the station, we continued to the signalling equipment room. Although the interlocking is solid state, there were still a number of interface relays. The relay names, printed in roman characters, appeared to follow a very similar convention to Britain: TPRs associated with track circuits and KNPR/KRPR for points (equivalent to NKR/RKR). Some follow-up internet research suggested that the commonality might be the influence of power signalling technology brought in from the United States in the first half of the 20th century.

The day concluded with a tour of Osaka General Control Centre (Figure 6), which controls the conventional lines in the Osaka-Kobe-Kyoto metropolitan area. A traffic management system is in operation for the high density lines, with simpler programmed route control (PRC) systems for quiet lines. The traffic management is similar in functionality to JR East's ATOS. The centre also monitors environmental and natural disaster sensors and early warning systems. The Japan Meteorological Agency provides emergency earthquake alerts, which are supplemented by trackside and coastal seismometers. Because of the potential consequences of a high-speed derailment, an earthquake alert automatically disconnects traction power to Shinkansen trains, triggering an emergency brake application. For conventional lines, an alert is raised in the control centre, prompting controllers to send emergency stop messages to trains.

My second day with JR West began with a visit to their extensive training centre, part of which can be seen in Figure 7. The indoor area included a relay interlocking and entrance-exit (NX) style panel, still common in many areas outside urban centres. This was a good opportunity to see the basic signalling principles put into practice. All relay interlockings are free-wired, and, as far as I have been able to establish, geographical systems (such as Westpac and GEC-GS geographical in Britain) have never been used. I'm vaguely familiar with British Route Relay Interlocking (RRI), and found that some of the circuits contained enough similarities to be just about comprehensible, largely helped by the common naming scheme. The emphasis is on simplicity and therefore reliability, for example no overlaps (and certainly no swinging overlaps) and no signal lamp proving.

The outdoor area is most impressive, being large enough to feel like an operational railway rather than a training school. The area is used by all engineering disciplines and for initial driver training and coupling practice using small powered trolleys. At the time of my visit a team were practicing overhead line repairs – apparently there are competitions run between teams to see which can restore the line most quickly.

Finally, my hosts suggested a visit to JR West's newly opened Kyoto Railway Museum, home to the largest collection of preserved steam locomotives in Japan. In my spare time I'm a volunteer fireman at the Ffestiniog Railway in North Wales, so I didn't need to be asked twice!

Once again, my time with JR West was both instructive and thoroughly enjoyable. My hosts extended a great deal of hospitality, even making sure I had a seat reservation for the Friday evening Shinkansen journey back to Tokyo where I was meeting my partner for a few days sightseeing prior to the final technical visit.

Railway Technical Research Institute

The Railway Technical Research Institute (RTRI) is the research and development organisation associated with the JR Group. It was founded just before privatisation to take over the research and development activities of Japan National Railways, and is now primarily funded by contributions from the other JR companies. I visited RTRI's main campus in Kunitachi on the outskirts of Tokyo.

After an introduction to RTRI and the work of the Signalling and Transport Information Technology Division, discussion turned to level crossings in Japan. An article on the subject by Takashi Kawano of JR East was published in IRSE NEWS 225 and provides a much better view of the general situation that I am able to give here. RTRI's areas of research in this field relate to using image processing techniques for obstacle detection, which could in the future provide a low-cost alternative to current laser and radar methods.

After lunch I was given a tour of RTRI's impressive facilities, which include a large-scale vibration table for simulating the effect of earthquakes on vehicle bogies and a static rolling stock test plant capable of reproducing running conditions of up to 500 km/h. The facility for testing ATS equipment at speed consists of a large arm capable of spinning at very high speeds. A large dent in the solid steel door bears testament to the importance of securing equipment.

Much of my day-to-day work is in the field of points condition monitoring, so I was very pleased to get the opportunity to meet RTRI's resident points expert. The NS point machine, widely used on conventional lines, contains an optical sensor to detect the position of the lock rod, allowing an early warning to be raised if the lock is close to the point of failing to engage. This system was first introduced in the early 1970s – well before Network Rail's Intelligent Infrastructure initiative!

Final thoughts

After the conclusion of my study tour, I took the opportunity to explore more of Japan, mainly by rail, including a trip on the newly-opened Hokkaido Shinkansen. The network deserves its reputation for speed, comfort and punctuality; in three weeks of travelling, I only suffered one delayed train.

The privatised system of vertical integration, with the trains and infrastructure operated by the same entity, seems to work well, avoiding many of the frustrations associated with the fragmented structure of the UK railway system. However, ticket prices are expensive, with railways receiving very little state subsidy.

Japan led the world into the age of high speed rail with the opening of the Tokaido Shinkansen in 1964, and has maintained its position as a world leader in railway technology. But it also faces many of the challenges common to railway networks and signal engineers all over the world: maintaining safety on an aging infrastructure, an increasing demand for capacity and reliability, how to deal with internationalisation of standards, and how to integrate the latest signalling technology with legacy systems.

Figure 8 – An enjoyable end to the visit: Kyoto Railway Museum.

I feel very privileged to have been given the opportunity to gain a small insight into the engineering that keeps one of the busiest railway networks in the world running. I have been genuinely humbled by the effort and kindness of everyone involved with my visit. A particular highlight at each organisation was the opportunity to join my hosts for an evening meal.

I'd like to thank Yuji Hirao for arranging the study tour and taking so much time out of his busy schedule; everyone at JR East, JR West and RTRI for all their effort and hospitality; Francis How for his help with the initial stages of planning the visit; my then-employer (Balfour Beatty) and the IRSE for making the visit possible.

INDUSTRY NEWS

ERTMS with satellite positioning trial completed

[RGI] ITALY: A final test train ran from Cagliari to Decimomannu in Sardinia on 24 February as part of the ERSAT EAV project to integrate ERTMS with Galileo satellite positioning and public telecoms networks to provide a low-cost train control option for regional and low-traffic rail routes.

Technology partner Ansaldo STS suggests that ERTMS life-cycle costs could be significantly reduced using ERSAT EAV, with saving of up to 60% in the telecoms component. RFI hopes to have the first commercial deployment in place by 2020, and envisages that the technology could be developed for use on busier routes and high speed lines.

The ERSAT EAV testing has been undertaken in Sardinia since February 2015 as part of the European Horizon 2020 research programme. The project was managed by the 3InSat consortium which brought together RFI and Ansaldo STS with the European Global Navigation Satellite Systems Agency and the Italian and European Space agencies.

ERSAT EAV follows ERTMS standards, but instead of fixed balises uses a GNSS-based location determination system developed by Ansaldo STS. This combines satellite positioning with an onboard track database to determine the train's position in relation to 'virtual balises' every 50 m, which would replace physic balises located every 1.3 km. Testing was undertaken using a Trenitalia ALn668 diesel railcar, which communicated with radio units positioned every 7 km along the route. The trial used a combination of 3G/4G, Tetra and satellite communications as an alternative to GSM-R.

"*The successful outcome of the demonstration campaign confirms the viability of GNSS technology for rail*", according to Salvatore Sabina, Head of Satellite Projects at Ansaldo STS. "*We are now ready to implement the virtual balise concept.*" The company has already supplied a SIL-4 compliant satellite-based train control system for the Roy Hill iron ore line in Western Australia, which is based on the same technology.

GB records ten years without train accident fatalities on national rail network

[RGI] UK: February 23 marked 10 years since the last passenger or staff fatality in a train accident on Great Britain's national rail network.

While there have been fatalities from other causes including trespass and suicide and at level crossings, the last occasion when a passenger died in a derailment or collision was at Grayrigg on February 23 2007.

"*By remaining vigilant and avoiding complacency, the railways have maintained a methodical and targeted approach to managing risk and improving safety*", said Rail Safety and Standards Board Director of System Safety, George Bearfield. "*Stronger trains, better signalling and protection, and day-to-day dedication of rail staff have all played their part too.*"

Saving seconds

J D Francis

Past President IRSE

Research is ongoing into methods by which trains might travel closer together whether this be by virtual or dynamic coupling, platooning or some other method. In reality closer running of trains by such methods will bring little, if any, benefit, particularly in the main line situation and may indeed not actually be possible without compromising safety. The potential also exists to actually create a less efficient railway because the behaviour of the lead train will dictate the performance of those following. At some point the lead train will make a station call and a closely following train will then be halted or slowed prematurely. Similarly the lead train may be required to reduce speed to take a divergence at a junction and a closely following train will then be slowed too regardless of the route it is to take.

Rather than invest in blue sky ideas, the practical way to actually improving capacity and to reducing delay is to address the every day situations which detain or slow trains. These are imposed by the track layout and the position of stations, junctions and other physical characteristics and the way the railway is then signalled. There are solutions already implemented on metro railways which are transferable to the main line but which are rarely considered by operators and signal engineers when main line layouts are modernised. Today layouts tend to be spread out for the convenience and economics of use of standard track components, placing pointwork on straight track wherever possible and the using ladder configurations. This results, when an overlap is added, in protecting signals being placed a considerable distance from station platforms.

There is no doubt that colour light signalling has proved itself as an effective means of train control, superior to its predecessor in many respects, but as we move towards in-cab signalling in the form of ETCS or similar, there are some characteristics of semaphore signalling that would benefit the operation of the railway. Incorporating such characteristics into the application of communication based solutions would allow trains to safely approach closer to occupied platforms and conflict situations and to depart stations sooner.

The saving of seconds is vital in achieving the throughput and the punctuality required today on busy main and suburban routes. Many delays to trains amount to just a minute or two but these sub-threshold numbers occur many times a day and each has the potential to cause reactionary delay to other trains that can then aggregate into a significant amount of time. Elimination of every delay minute and the consequent reduction in total minutes will result in performance improvement way beyond those individual minutes, saving energy, providing a more punctual service and in some cases greater capacity.

With demand to squeeze more capacity out of the railway without adding additional tracks it is the signalling which can be a limiting factor, particularly the spacing between signals that is there to accommodate braking distance. Thus, for example, the placing of a signal at the departure end of a station platform will result in the signal in rear of this being placed at braking distance or more, if in three aspect territory or at a percentage of braking distance if in four aspect territory. The higher the line speed the greater this distance will be (Figure 1). As is well known, particularly in mass transit circles, the critical issue in determining headway is how close a following train is able to approach the previous train as it occupies and then departs a station platform or negotiates a junction that requires a reduction in speed. In the main line railway scenario not only do signals separated by braking distance affect platform reoccupation time but also the headway achievable for non-stopping and freight trains that are following a previous train.

In terms of platform reoccupation time a following train will be slowed towards or brought to a stand at the signal protecting the platform. In three aspect territory this signal will be at least braking distance minus the length of the platform from the station and it will not show proceed until the overlap of the platform signal is clear. The situation is slightly improved in four aspect territory as the signals will be spaced closer together.

Spacing signals to satisfy line-speed braking distances brings with it the inability to draw trains closer together at those places which are critical to enable maximum throughput. The addition of close-up signals is a solution but these interfere with the normal aspect sequence in three and four aspect territory and can become SPAD (signal passed at danger) traps. They are more easily accommodated in two aspect territory such as can be found on some metro lines where multiple close-up signals are provided on the approach to stations, backed up with train stops to enforce compliance. That's not to say they are not used on main lines but they are rare and generally only applied where speeds are low and traffic throughput extremely high.

With semaphore signalling there was generally no braking distance constraint placed upon the positioning of stop signals. It was only the distant signal which had to be placed at braking distance from the first stop (home) signal. Any number of stop signals might then be provided through the node of a station, junction or yard layout to protect each track element and to assist in facilitating the moves that might take place at that location. The distant signal applied to all of these stop signals and a train could be kept moving forward slowly from one stop signal to the next if the section ahead was not clear by each signal being lowered in turn as the train approached (see Figure 2). In essence the line through each node on the railway was divided into small portions, a feature which is largely lost in multiple aspect signalling but one which is possible to reintroduce with ETCS.

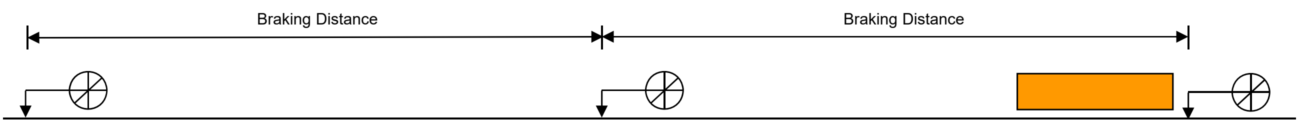


Figure 1– Signal positioning for classic three-aspect signalling.

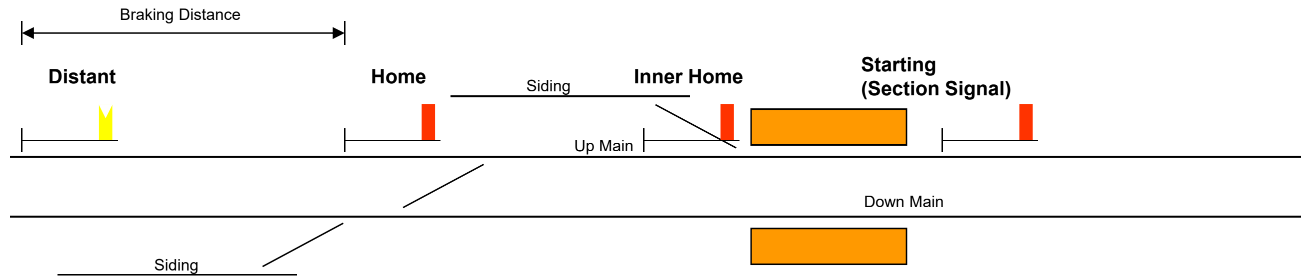


Figure 2 – Multiple stop signals typical of semaphore signalling.

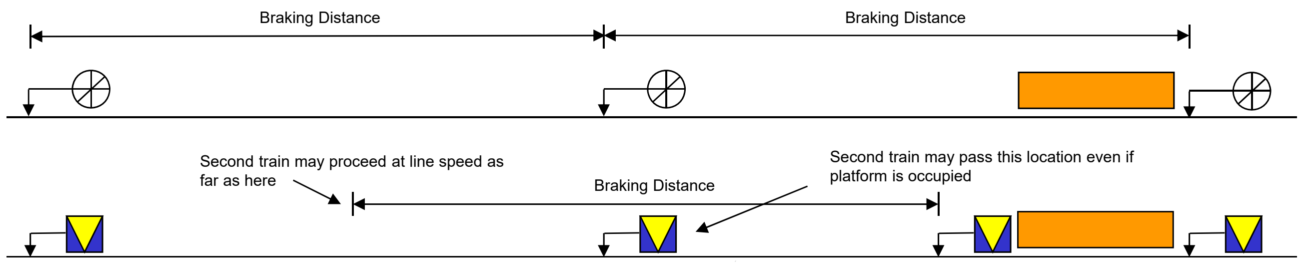


Figure 3 – An option to close up using ETCS.

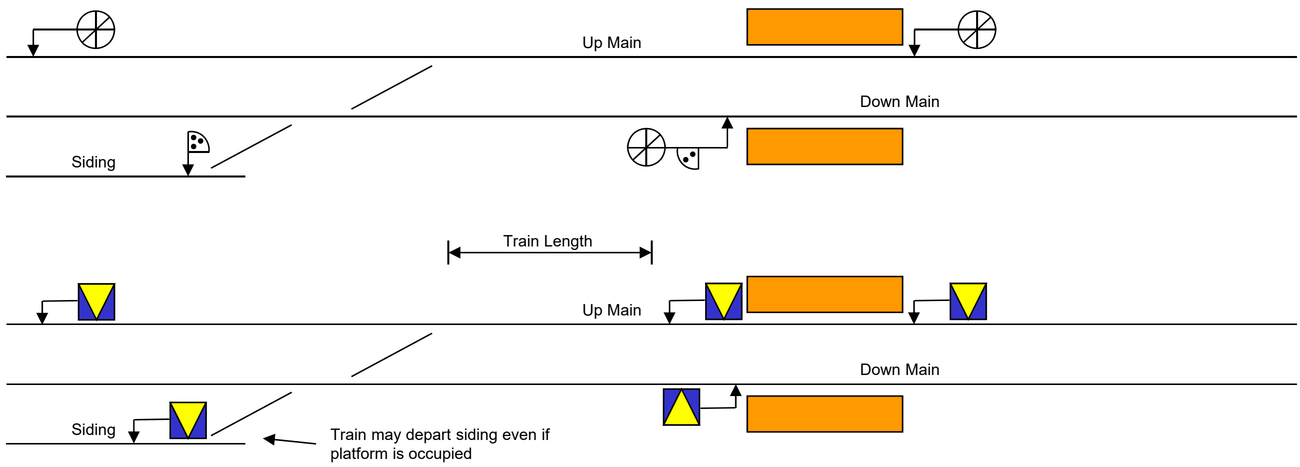


Figure 4 – Closing up in a turn back situation.

The position of a block marker is the point beyond which a train must not proceed without authority but need no longer be related to the braking distance to the next marker. Assuming blocks and their associated markers are located in the same position as where multi-aspect signals would otherwise have been then no change in headway or platform reoccupation time can be achieved by changing from multi-aspect to cab signalling. However, if an additional block is introduced to subdivide that which encompasses the platform then a subsequent train can be allowed to approach the station and occupy the platform within a shorter time of the previous train departing. This is no different to providing a close-up signal but is more easily achieved with ETCS by the provision of data and a marker board. Moreover the continuous ATP provision within ETCS removes the need for any approach controls to be applied and the complications associated with aspect sequences are avoided (Figure 3).

The practice of introducing additional blocks can bring benefit to a whole range of real-life situations. Expanding this simple example to a station where some trains turn back from a siding, as in figure 4, would bring not only the platform reoccupation time advantage for through trains but also for those starting back. This would be particularly useful if the previous train is running late as it would enable the crossing move from the siding to be undertaken whilst the platform is still occupied. Making the move at this time could be advantageous to avoid any conflict that might arise with an opposing train before the platform becomes clear, which would result in either the crossing move having to be delayed despite the platform being clear or the opposing train being stopped or delayed.

Nowadays if a signal is provided at the end of a platform the closing of the train doors before departure does not normally take place until a proceed aspect is displayed. Thus, when it is not possible to set a forward route for whatever reason before departure time the actual movement of the train, once a proceed aspect or movement authority is given, is delayed by the door closure process. In some places the inability to set the route will be awaiting on a conflict situation to be resolved, this conflict occurring some significant distance into the route. Subdividing

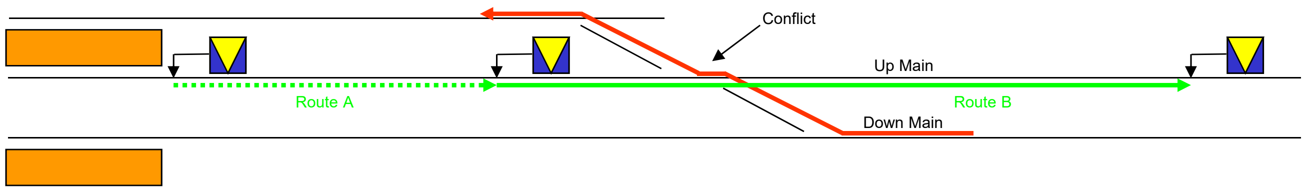


Figure 5 – Introducing an extra section to promote prompt departure.

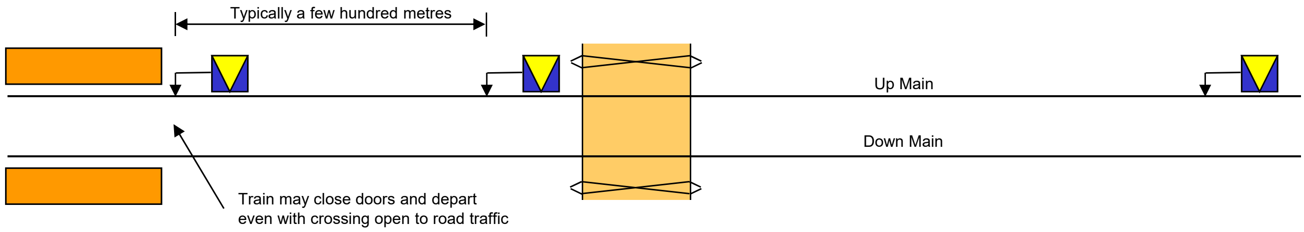


Figure 6 – Protecting level crossing without delaying departure and minimising road closure time.

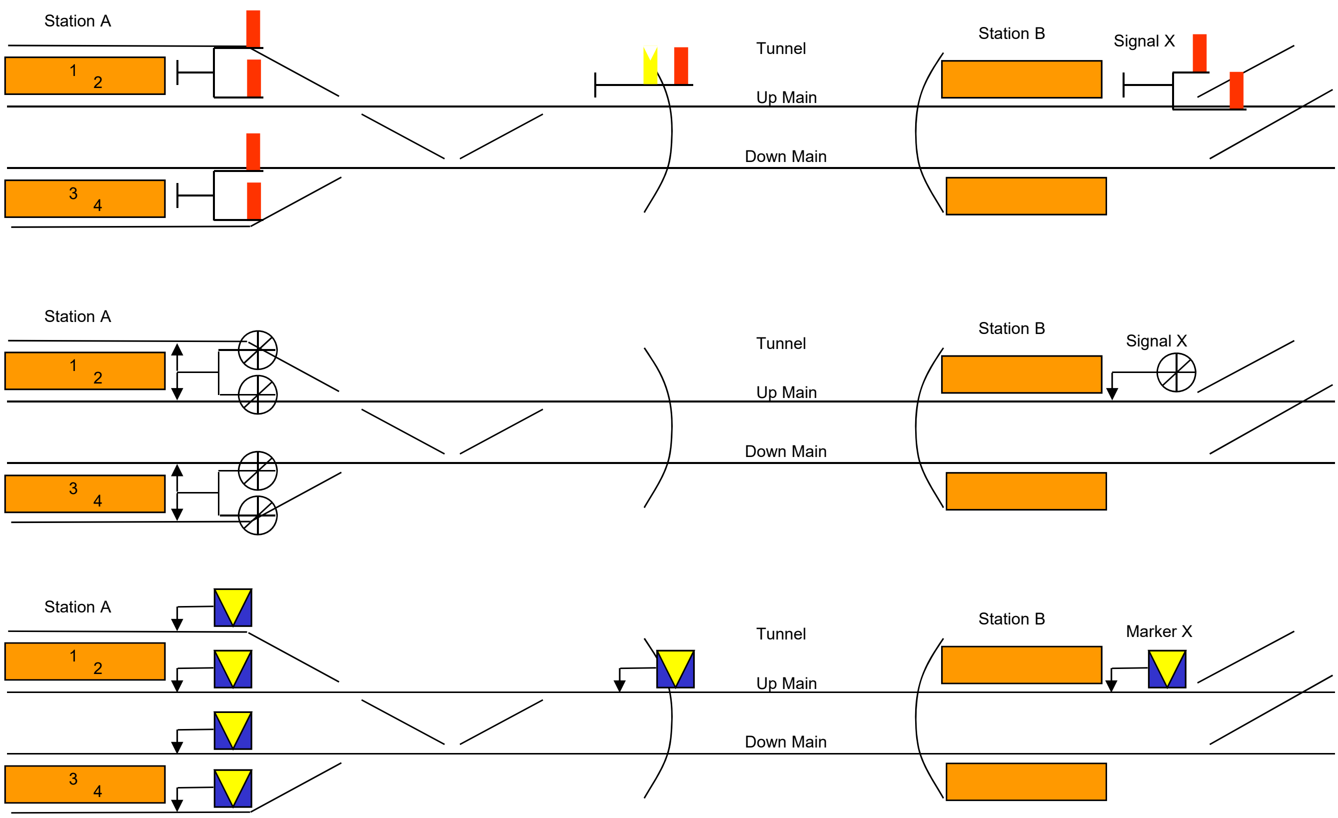


Figure 7 – Improving headway in special situations.

such a route in the manner shown in figure 5 would reduce and in some cases eliminate the impact of the conflict on the departure of the train. The door closure procedure could be initiated as soon as a movement authority is received for route A. Even if the conflict continues to exist the train can still depart into route A but in many cases the conflict will resolve with route B becoming available at the end of or shortly after completion of the door closure procedure before the train actually leaves the platform or shortly afterwards, an extended movement authority (route B) then becoming available.

This concept can be applied to situations where a level crossing exists within the route beyond a station but which is some distance into the route. It would be particularly valuable where trains originate at the station or have long dwell times. Before a movement authority can be given the level crossing must be closed to road traffic in order for the route to be set. The crossing is therefore closed, not only for the time it takes for the train to traverse the distance from the station to clear of the crossing but also for the door closure time, increasing the build up of road traffic. There will also be occasions when, for whatever reason, and unknown to the signaller the train does not depart immediately thereby extending the road closure time further.

A minimum road closure time can be achieved by dividing the route into two separate routes, the first extending to a point short of the crossing (Figure 6). A movement authority for this first, short route, could be given prior to departure time to allow the train doors to be closed promptly, the crossing only having to be closed to coincide with the need to extend the route at time of departure. Similarly a non-stopping train can be given a movement authority beyond the station towards the crossing with closure of the crossing being able to be delayed until the train is approaching the braking point.

Delay to train departure is not just down to door closure time, other physical features often come into play. Take figure 7 for example. Here two stations are shown which are close together but which have a tunnel between them. Before a second train can depart station A the first train must have passed clear of the overlap of signal X at station B. This in itself imposes a poor headway which is exacerbated by the door closure time of the second train before it leaves station A. Add to this the fact that successive trains take alternate routes at the junction beyond station B then the service for one route has an inordinate impact on the following service for the other route.

Braking distance to signal X begins within the tunnel but it is not sensible to place a stop signal within the tunnel. It would, however be possible to place a signal at the entrance to the tunnel which, in semaphore days would have been done. The provision therefore of a cab signalling block up to the tunnel mouth would enable train doors to be closed and the train to depart station A then, before it reaches the tunnel station B will likely be clear and thus the forward authority would become available. The initial authority could even be subject to detecting that the first train has begun to depart station B.

The whole situation is further complicated by the conflict that arises between trains departing platforms 3 and 4 and those arriving in the opposite direction. The ability to allow a train to depart platform 3 or 4 earlier would in some instances remove the conflict against the opposing train.

Readers will be aware of many locations that match the examples given and of other variations that would benefit from suitable application of multiple blocks. The intricacies of main line railway networks provide many legacy situations that impede the flow of traffic. ETCS provides an opportunity through judicious application to reduce the impact of these physical impediments. To achieve this the signal engineer must work with operating colleagues to fully understand the issues that arise at each location so that the solution maximises the ability to optimise the layout. In so doing capacity can be increased and delays reduced.

What do **you** think about the points John has raised in this article. Do you think that there is a future for techniques such as 'motorway driving', platooning and virtual coupling? Do we need to completely change our view of railway operation, or do the laws of physics and the experience of nearly 200 years of railway operation limit what can be achieved? Our mantra of *"inform, discuss, develop"* depends upon members sharing views and ideas. Why not write to the editor (***irsenews@irse.org***)? We always welcome letters for our 'Feedback' column.

INDUSTRY NEWS

Siemens forms UK Mobility Digitalisation Unit

[RGI] UK: Siemens Rail Automation announced a restructuring of its signalling and train control activities on February 20, with the formation of a Mobility Digitalisation unit. This aims to bring together products from across Siemens' businesses, other industries and modes to support the creation of a 'fully integrated, information-led' transport network.

Director of Operations Rob Morris said Siemens was aiming to ensure that its regional delivery teams had the resources to undertaken conventional main line and metro signalling renewal and enhancement schemes, while establishing a new team to focus on "*development and effective integration of digital train control and passenger information technologies*".

"These are certainly exciting times for the industry, with initiatives like the Digital Railway programme providing a great opportunity to deliver some real step-changes in technology", said Morris. "*Our Mobility Digitalisation unit will be right at the heart of this, focusing, shaping and leading our work in this key area."*

'IRSE NEWS' NEWS

The missing link

We frequently provide links to websites in IRSE NEWS. To avoid providing very long and complex addresses, we have previously used the bit.ly shortener service, which creates links like ***http://bit.ly/2cKEn4A***.

We are trying a different approach for some of our links from this issue of IRSE NEWS, with our own '***irse.info***' links.

This will let us use tailored links like ***http://irse.info/dallas***, or to create simpler five-character links like ***http://irse.info/bd9mf***.

Most modern web browsers don't even need the 'http://' at the start of the link, allowing you to type something simple like ***irse.info/dallas***.

Other advantages that we can't realise with the services like bit.ly are that we can now amend links if they change or we've got them wrong, and that we can see how many people used each of the links.

If you press the wrong button, or if we've made a mistake in the link, you'll find yourself back at the IRSE website.

If you have any trouble with the new system, do let us know by emailing the Production Manager, ***mark.glover@irse.org***.

News from the IRSE

Francis How

Annual General Meeting

The IRSE's Annual General Meeting will take place on Friday 21 April 2017 at the IET, Savoy Place, London, following which our incoming President will deliver his Presidential Address. Refreshments will be available from 17.30, and the AGM commences at 18.00. All are welcome.

The Annual Dinner will take place in The Savoy, London (adjacent to the IET), at 19.00, immediately after the AGM. Our Guest of Honour is David Waboso, Managing Director of the UK's Digital Railway Programme. WSP | Parsons Brinckerhoff is sponsoring the Dinner.

IRSE 2017 Convention: 25 – 29 September

The 2017 Convention will take place in the Dallas/Fort Worth area of the USA from 25 - 29 September. Details of the Convention (including the programme), the Booking Form, and the Hotel Booking Form are all now available via the links below. We are offering Early Bird rates for people booking by 30 June.

We have produced a 'template business case' which you might wish to make use of if you need to persuade your employer to support you attending the Convention, also available via the link below.

For the first time we are also opening the Convention to non-members (at a higher rate). If you know of work colleagues who might be interested in attending, please show them the information about the event.

We are also offering bursaries for younger members – you can find the Application Form via the link below. Applications for bursaries must be received no later than 30 April 2017.

Find out more by visiting:

- the Convention page of the IRSE website at ***http://irse.info/irsecon17***.
- the special Convention website at ***http://irse.info/dallas***.

Stephenson Conference 25-27 April

There is still time to book for the 2nd Stephenson Conference, taking place in London on 25 – 27 April 2017. This is a conference for rail researchers and rail industry people, with ~70 papers being presented across a wide range of research, supported by real-life case studies of the application of that research.

The event also has several keynote speakers, including Mark Carne (CEO, Network Rail), Carlo Borghini (Executive Director, Shift2Rail Programme), and Professor John Miles Arup/ Royal Academy of Engineering Research Professor in Transitional Energy Strategies, University of Cambridge (UK).

More information and booking details are available from at ***http://irse.info/vy5or*** .

Subscription renewal: e-membership

The next subscription year begins on 1 July 2017 and renewal invoices will be prepared during May ready for issue at the beginning of June. If you wish to change your membership type to or from 'e-membership' for the new subscription year, you must register the change by 30 April 2017. E-membership means that you receive all communications from the IRSE (including IRSE NEWS) electronically, not by post, at a lower annual membership subscription rate.

To switch, go to the IRSE website, log in and go to the Home page, then navigate to **Manage your record** (direct link is ***http://irse.info/2rib7)***. Select "*Yes*" or "*No*" for the "*EMember from 1st July 2017?*" option near the top of the page, and then click the **Save** button near the bottom of the page.

IRSE Exam 2017

If you are thinking of taking the IRSE Exam this year, new 2017 Exam Application Guidance (v1) is available on the IRSE website, which you must read in order to understand the process for applying. Visit ***http://irse.info/bd9mf*** to see the IRSE Examination webpage. Downloadable documents, including the Guidance, are available on the right of the page.

Note that if you are taking the Exam, we need to receive your Sponsorship Declaration Form (SDF), signed by your Sponsor, by 30 April.

EXAM STUDY GROUPS: We know about a number of Exam Study Groups that operate in preparation for the Exam, but not all. If you led or attended a Study Group in 2016, please let our Professional Development Manager (Judith Ward, email ***judith.ward@irse.org***) know, including details of where it met, approximately how often, and who the leader/coordinator was.

Reviewing Signalling Principles in Great Britain

The Institution of Railway Signal Engineers has been commissioned by Network Rail in Great Britain to undertake a review of a number of signalling principles. Some of these relate to changes that are relevant to the introduction of ETCS; others are proposed for conventional signalling in order to improve reliability and/or reduce the complexity of the design.

The need to reduce complexity was prompted, in part, by concerns expressed in the IRSE's review of the safety of signalling, produced in 2015 as a collaborative work with Network Rail and a number of UK-based signalling suppliers. The IRSE is pleased to be working with Network Rail on this present review of signalling principles, providing an independent review of the proposals by a number of experts. The work is under way and we expect to complete it by the end of May 2017.

The initial work is aimed at allowing existing processes to be more focused from a safety perspective. However the GB Digital Railway programme is considering building upon this current work to facilitate higher levels of safety and whole-life efficiencies through the application of automated design and assurance processes.

The IRSE professional examination 2016

Antony Kornas, Chairman Examination Committee

The IRSE examination took place on Saturday 1 October 2016 at a number of locations worldwide. The table below shows the performance of candidates in each of the modules. Only five people attempted four modules on the day. Most candidates took one or two modules.

A total of 286 papers were submitted in connection with the seven examination modules. This was much reduced from last year where we had a record 471 papers submitted. The reduction is attributed to the introduction of candidate Sponsors in 2016. This arrangement will continue in 2017.

The examiners are pleased to see that candidates still place great importance on passing the examination and recognise the value of it across the wider industry.

The Examination Committee spends considerable time reviewing the content and challenge presented to candidates, who give up so much of their own time and effort taking the examinations. As a committee we wish to pass as many candidates as possible, whilst still maintaining the high standard and credibility of the examination.

In 2015 we saw the pass rate fall to only 37%, which was extremely disappointing. The positive news in 2016 is that the pass rate is now back up to the ten-year average of 48% which is encouraging and reflects an improvement in the quality of the candidates sitting the exam.

On behalf of the Examination Committee, I would like to congratulate all candidates who passed a module in the examination in 2016. Well done to you all!

For those of you who were not so lucky, or those of you who are thinking about doing the examination for the first time, why not get involved with a local study group now to prepare yourself for the 2017 examination?

	M1	M2	M3	M4	M5	M6	M7	Totals
Distinction	1	3	0	0	0	0	1	**5**
Credit	6	7	5	0	2	1	3	**24**
Pass	19	29	26	1	14	3	16	**108**
Near miss	8	2	11	1	7	0	0	**29**
Fail	22	27	41	2	19	2	7	**120**
Total Candidates	**56**	**68**	**83**	**4**	**42**	**6**	**27**	**286**
2016 Pass Rate	**46%**	**57%**	**37%**	**25%**	**38%**	**67%**	**74%**	**48%**

The exam modules are as follows:

M1, Safety of railway signalling and communications.

M2, Signalling the layout.

M3, Signalling principles.

M4, Communication principles.

M5, Signalling applications.

M6, Communication applications.

M7, System management and engineering.

The Signet Exam Workshop – one way to prepare for the exam

Peter Woodbridge

The long wait for the October 2016 exam results is now over, so gradually thoughts are turning to the 2017 exam. The Signet Exam Workshop weekend has now become an established regular event. It is good to see the progression of those who come along one year to get their first idea about what it is all about, then attend for one or more years as a student preparing to sit particular modules. It is particularly gratifying that a sizeable minority continue to attend having completed the exam to share their experience and knowledge with those coming after them; many find it rewarding and of course it is good for their own CPD record.

So whether you are a true novice, someone working in the industry but wishing to expand your understanding of traditional UK main line signalling, a person thinking of the exam in future years or a candidate for the 2017 exam (don't forget that end of April deadline for your sponsor's support!) then you are encouraged to register for a place at the weekend.

Choosing a question to discuss at a previous Signet Exam Workshop.

Under exam conditions.

The class of 2016.

Conversely if you are more experienced then why not volunteer your services to help run the Exam Workshop event?

Perhaps you are one of the MIRSE/FIRSE who may have been asked to sponsor one or more candidates in 2016 or 2017 as a result of the new rules; have you yet asked if this event features in your candidate's preparation plan? Some may be in the somewhat awkward position of being asked to act as sponsor never having sat the exam themselves (or it was a long ago……); in which case why don't you arrange to attend to find out more of what it entails nowadays?

The event will be held on the weekend of 1 - 2 of July 2017 at Signet in Derby. Details can be found on website, flyers will be included in next months IRSE NEWS, alternatively send an email to ***younger.members@irse.org*** to request an application form. Places in the various categories are necessarily limited, so you are recommended to register your interest promptly.

Introducing Judith Ward: our new Professional Development Manager

As the IRSE's latest recruit, I have been asked to introduce myself and my role as Professional Development Manager at headquarters in central London.

I am what could be described a "*career signalling engineer*", having worked for large contractors, delivering and supporting re-signalling projects for mainly main line railways for the last 25 years, working within signalling design, project engineering, safety management, operations management and latterly technical development of people. My new role will advance my interest and knowledge of development of people and talent further, taking it across the signalling, telecoms, train control and traffic management industry with a much more global focus as over 50% of IRSE membership is outside UK.

I have been a member of IRSE for most of my career and am a corporate member and also a Chartered Engineer. Over the last few years, I have been secretary of the Recruitment, Marketing and Publicity Committee as well as one of the Professional Registration interviewers for those applying to become Incorporated and Chartered Engineers through the IRSE. Through all these activities, I have got to know some of the staff at IRSE who are now my colleagues.

The Professional Development Manager role was previously filled by Elaine Clarke, who was a regular contributor to IRSE NEWS with articles about Continuous Professional Development (CPD), Apprenticeships and other Professional Development information. I intend to do similarly, with information to help our members and other interested people who read IRSE NEWS develop their careers and professional knowledge further.

As Professional Development Manager, I have a number of main responsibilities, some of which are my sole responsibility to deliver, and others I work with others in HQ and some of the IRSE's many fantastic volunteers to achieve.

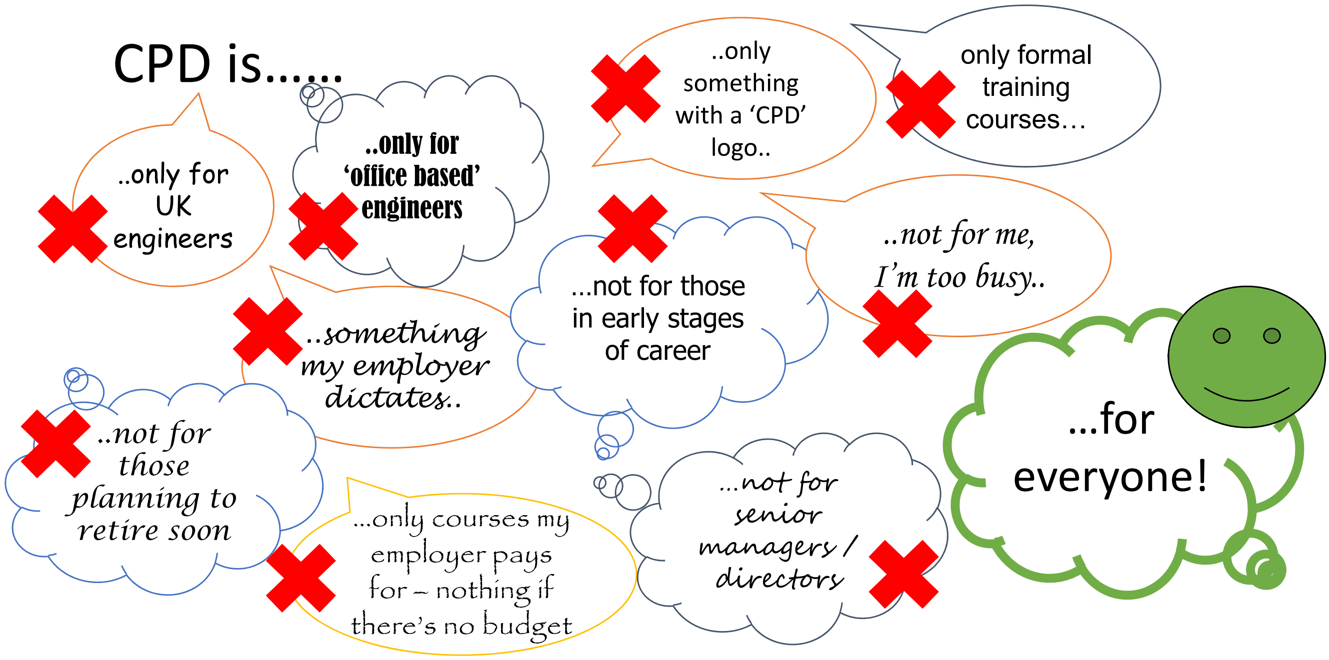
For example, I am responsible for encouraging members to undertake Continuous Professional Development (CPD) and support IRSE in its role as a licensed body of UK's Engineering Council, specifically to implement the UK's Engineering Council's policy of monitoring of CPD. To achieve this, I and volunteers from the Membership and Registration Committee are reviewing randomly chosen registered engineers' CPD records, giving feedback to all. I will also to inform our members about what CPD is, and its benefits to them as professional engineers.

Other areas I am currently working on are assisting in the collation of Study Guides and other information for the IRSE Examination and overseeing the management of IRSE's mentoring scheme. Mike Moore and I are working through the paperwork so that IRSE can become end point assessors for appropriate UK apprenticeships through an extra stage in the assessment of their assistant-level licences. Although the apprenticeship work is clearly UK focussed, I am working hard to ensure that as many of my tasks look across our global membership base.

I look forward to working with you all.

What is Continuous Professional Development (CPD)?

Judith Ward, Professional Development Manager IRSE



There are many common misconceptions which have led to Continuous Professional Development (CPD) not being done, including those shown above.

To start thinking about your CPD, you should consider your career plan, whether rough or detailed, of where you want to be in a few years' time. It can be ambitious or not, it is your plan for your career. You then identify what you need to do to reach that goal and when you need to do it – this is your **Development Action Plan**, and that determines whether subject matter is **relevant** for your CPD.

Development Action Plans are personal to you: You may be planning to stay in the same job until retirement; so will need to keep up to date with technology, standards and processes as well as potentially learn new skills / technology. Others plan to move into a new role; so may need to learn skills, or become an expert, or be professionally recognised through, say, Incorporated or Professional Engineer status or a higher IRSE licence category. If you plan to be a consultant in 'retirement' you will need to be a current expert in your field, able to communicate with your clients and able to ensure that you are paid for your work.

Your plan may change through your career with experience, interest and life changes, and your aspirations may change and evolve – hence your plan should be reviewed regularly. You may have two plans – one which you can share with your employer, showing potential career steps within their organisation; and the other showing potential career steps within the wider railway industry or beyond.

Continuous Professional Development is about maintaining or developing your knowledge and experience to enable you to do your current job and/or a future role to a professional standard in accordance with your Development Action Plan. It consists of:

- **Formal training** in a relevant subject: Examples could be a manufacturer teaching you how to maintain a piece of equipment, or undertaking an online course to learn more about Excel, or passing a training course in signalling.
- **Voluntary Work**: Examples include those many volunteers enabling ASPECT2017 to be run smoothly, those ensuring IRSE NEWS is published to such high standards and those in our many local sections who run events. Others promote engineering in schools or have responsible posts in local voluntary organisations. These volunteers are gaining and using technical knowledge, organisational, management and interpersonal skills, some of which they may not have the opportunity to learn or use in their current day jobs.
- **Work Experience**: Examples include shadowing a senior manager, doing a job swap with someone in your project team, taking on additional responsibility of managing staff or chairing meetings or being seconded to a different discipline or office.
- **Self Study**: This can include reading text books, case studies, articles in technical journals such as IRSE NEWS and watching TED lectures. It can also include successfully sitting one or more module of the IRSE examination.
- **Events and Seminars**: Examples include attending or presenting technical papers at seminars run locally and globally by IRSE and other professional bodies like Institution of Engineers Singapore or 'lunch and learn' sessions run internally by some companies. All these give opportunities to share knowledge and experience, often resulting in cross working across different parts of industry.
- **Academic Study**: This is not appropriate for all engineers, but some are able to gain an academic qualification in a relevant subject through attending lectures, distance or e-learning.

Unlike many other professional bodies, IRSE does not stipulate how much CPD you should do, but leaves it to you as a professional engineer to consider how much and what is appropriate, given your professional development plan, your current role and the stage you are in your career. IRSE measures CPD in hours, other professional bodies in points, this equates to 1 point = 1 hour.

When you are planning, doing and reviewing your CPD, you should be recording it. The IRSE's preferred method of recording is electronically via Mycareerpath (available via the IRSE website), however licence logbooks, company records, apps or other appropriate methods could be used. If you are a registered engineer, your records could be monitored by IRSE and any other bodies that you belong to.

There is further information about CPD on IRSE website (in the professional development area) and the CPD team are happy to offer advice and be contacted on **pd@irse.org**.

INDIAN SECTION

New Council Members of IRSE India Section

Report by Anshul Gupta, Secretary, IRSE India and DRM, Adra, Indian Railways

Elections for IRSE India Council members were held in October 2016. On previous occasions, it was noted that elected council members used to come predominantly from one geographic region of India. In order to ensure wider representation from different regions of India this time, elections for the new council were conducted for the first time using electronic means. Special efforts were made to get participation from different regions of a vast country like India.

First the nominations for Council Members were requested through email notifications and publication on the election website, from those members who were interested in joining the council and were enthusiastic to contribute to the IRSE's activities in India. The nominations were open to any active IRSE member (Indian section). After three months of the nomination period, electronic voting was conducted by IRSE India members and subsequently the Returning Officer of the election committee declared the results on the website. Below is the list of elected members of IRSE India Council:

Chairman:	Mr A K Misra
Vice Chairman:	Mr Nikhil Swami
Vice President:	Mr A K Saxena
Secretary:	Mr Anshul Gupta
Executive Members:	Mr Ashutosh Kulkarni, Mr P K Varma, Mr Shailendra Kumar Shahi, Mr Raghav Kumar Konduri, Mr Sanjai Kumar, Mr D R Pal, Mr Jaswant Singh.

This new IRSE India council, which is an unprecedented representation of S&T professionals from East, West, North and South parts of India, plans to bring fresh ideas and renewed energy to the IRSE Indian Section. Several activities are currently being planned for the benefit of S&T Professionals and IRSE members in India. The IRSE India council will be working as per the byelaws and the guidelines established by IRSE for its Local Sections. The broad focus of the council will be on the following:

1. To organize events for the benefit of IRSE Members and S&T Professionals, for the dissemination of information on S&T systems.
2. Encouraging paper presentations and technical discourse in the S&T field in different regions of India.
3. To encourage participation and collaboration between IRSE and Industry professionals, academic Institutions and companies.
3. To take the IRSE to a wider range of S&T professionals in different regions of India.
4. To encourage younger members and engineering students to participate actively in the IRSE and in the S&T field in general.

The newly elected council acknowledges that in India there is an imminent need for providing professional up-skilling opportunities for S&T professionals. The IRSE India Section is in active discussions with various universities to initiate certificated and diploma courses in Railway Signalling and Telecommunication systems for the benefit of S&T professionals.

There are many expectations of our council members, and the IRSE members in India are convinced that they will be able to exceed these by fulfilling their commitments towards the Institution.

For more information on IRSE India Section and its activities, please visit the website: ***www.irse.org.in/***.

MIDLAND & NORTH WESTERN SECTION

January Technical Paper: Future Signalling Systems by Atkins – Safety, Reliability, Availability and Performance

Report by Ian R Bridges

For the first meeting of 2017 in January, John Martin from Atkins gave a presentation to a packed audience at Atkins' office in Crewe. John has been involved in the railway industry for around 14 years, the later part of which has been working with new technologies and their application in the railway industry. He is currently involved in the delivery of the company's Future Signalling Systems initiative.

Introducing Future Signalling Systems brings new processes and products to the industry, which collectively reduce the need to depend so much on the human element, thereby eliminating risk at the highest level. With complex interlocking software comes an increased possibility of wrong side failures as the current data structure limits the ability to design and test it effectively. The tools provided to get deep into the data to find any hidden traps lag behind what is needed with high levels of intricacy. Automated production and testing can help to eliminate some of these traps.

Research

Atkins undertook a significant amount of research to find the best way forward for the system it wanted to introduce and ElectroLogIXS™, a successor to VHLC, was chosen. This was an established GE (now Alstom) product with a significant pedigree of around 7000 units across the world. The system is IP based, using a central interlocking to communicate with field object controllers (also ElectroLogIXS units) by TCP/IP addressing over fibre cables. The system uses a two-out-of-two SIL4 architecture and provides around 100 years Mean Time Between Failures (MTBF). It is believed that by using ElectroLogIXS there is a capital expenditure saving of around 10%, but an operational expenditure saving of around 50%, across its expected life of 35 years, mainly due to the reduced equipment count. Maximum tail cable lengths for trackside equipment can be up to 1600 m for low current components, allowing better grouping of input/output modules and around 50% reduction in volume of location cases required. This in turn has a consequential benefit in occupational safety as locations can be placed near access points and there is less requirement for staff to access the lineside. The unit is scalable and comes in crates with space for one, four or nine cards, which can be mixed and matched as required.

Level crossings

Moving onto level crossings, John explained how level crossing reliability could be improved. Barrier machines, particularly ones with 9.1 m booms, can prove to be unreliable and more modern technology can help to improve the situation. Future Signalling Systems uses new drive up/drive down barrier machines that have been developed by Newgate and integrated into the Atkins level crossing solution. All the new equipment is driven using 110v AC supplies, allowing smaller cables and reduced civil engineering costs. At the heart of the crossing is the new ElectroLogIXS controller. The Programmable Logic Controller (PLC) solution enables relays to be removed from the design and the equipment footprint to be reduced to a minimum. In the simplest solution, only two location cases are required to control a level crossing. As the whole system is PLC controlled, a significant level of diagnostic information is available to the maintainer, predicting those rare failures before they happen.

Interlockings

Vital communication protocols used by the UK signalling industry since the mid-1980s, are now considered slow and not so appropriate to modern flexible architectures. More modern computer based interlockings have significantly increased the areas that can be controlled, but the production techniques and overall system architecture are not widely different from those first implemented in 1985 when the first SSI was introduced at Leamington Spa.

Additionally, all new interlocking equipment is required to communicate bi-directionally with Radio Block Centres (RBC) for future ERTMS implementation. ElectroLogIXS has been integrated with Alstom's RBC and has been successfully tested at the ERTMS National Integration Facility at Hertford in the UK, ensuring its pedigree for the next generation of signalling control. Other tests undertaken during the development include rigorous proving of immunisation against Electromagnetic Interference in AC and DC traction areas, which were passed with flying colours.

John explained how the use of Commercial Off The Shelf equipment will reduce the price of providing interlocking equipment in the future and that it is the Future Signalling Systems process that provides the intelligence behind the system, not the hardware. There is also a need to drive for a much-improved Mean Time To Repair (MTTR), increasing the availability of the railway when failures do occur.

EN50128

Network Rail's requirement for the future is that all new interlocking products using safety critical software must comply with EN50128, using the 'V-cycle' as the basis for developing and testing the system software.

Within the Atkins Future Signalling Systems process, the first stage of producing the software is to collect the requirements associated with the project using natural language, which must be precise and meaningful. Requirements come from different sources including standards, operational and safety requirements. A large percentage of requirements are common across all projects so only have to be collected once, then iteratively expanded as new projects identify new ones. Requirements are next turned into mathematical equations on which modelling is used to test the Boolean equations using modern techniques. Each component only ever needs testing once and can then be stored in the library. These tested components are then assembled into larger groups before being turned into ladder logic automatically by the production system.

John concluded his talk by informing the audience that Atkins are currently working on delivering projects at Chilworth CCTV level crossing, Shepperton Branch re-signalling and Old Oak Common Crossrail depot. The new Future Signalling Systems process certainly promises to take signalling interlocking safety to a new level within the UK, along with reduced design and testing times. A lively Q&A session followed, demonstrating the level of interest in the subject.

The M&NW Section wish to express their thanks to John for his talk and to Atkins for sponsoring the meeting.

MINOR RAILWAYS SECTION

Nominations for the S&T Technician of the Year 2017

One of the main aims of the Minor Railways Section is to encourage the transfer of knowledge to those working in the S&T for the various Minor Railways, but who might not be professional signal and telecommunications engineers. The section provides for a transfer of knowledge in the format of guidance notes and a range of training workshops and support through an award scheme.

The guidance notes are available to all on our web pages and this year we are planning their review and update later this year.

Our range of training workshops is being expanded from the original signalling workshop which covered basic signalling maintenance and installation, to a basic signalling cabling workshop covering installation and faulting of signalling cables and now our latest effort which is a basic level crossing workshop. In the longer term a telecommunications workshop is being developed and one on signalling principles too.

On the theme of knowledge transfer, the section are organising a one day seminar on technology and its application to Minor Railways at Kidderminster in November 2017, and anyone can come along and contribute.

The award for the Technician of the Year on a Minor Railway recognises the role of the S&T engineer from candidates nominated by their peers to receive the trophy for the year. This year's award will be a cheque for £250, a place on a training workshop with a subsistence allowance, membership of the IRSE for one year, and a trophy and certificate to hang on the wall.

But to identify our candidate we need nominations, it is simple to do, it can be an individual or a team, it can be the boss or the new recruit and anyone can do a nomination, not just S & T people. There is a form with all the points described you can fill in or it is acceptable to just send in two pages of text. Anyone in S&T on a minor railway can be nominated and this year as a trial we are accepting nominations for staff members. All the necessary information will be on our web pages at ***www.irse.org***

The award will be presented at the Section's seminar in November 2017 and nominations will close at the end of September 2017. For more details on the training workshops contact Mike Tyrrell at ***mrsvisits@irse.org*** , regarding the award please contact Colin Porter at ***colin.porter@irse.org*** and for further details of the November seminar contact Ian Hughes at ***ian@4greendragon.com***.

January Technical Paper: HS2 – High Speed to Failure

Report by Tony Pinkstone

Chairman Doug Gillanders welcomed members and guests to the January 2017 meeting of the York Section on 12 January. He then introduced Quentin Macdonald and Colin Elliff who would present a paper on *"HS2 – High Speed to Failure"*.

The Speakers had done a considerable amount of work on an alternative to HS2 namely *"HSUK"* which had been covered in a previous paper, and HSUK was well known to most of the audience. Quentin would show how HS2 would not achieve what it was intended to achieve, namely to deliver hugely enhanced capacity and connectivity between the UK's major conurbations. It must achieve far more for an expenditure of £70 billion of public money, it must exploit the once in two centuries opportunity to transform the existing railway into a better connected and higher capacity network to meet the needs of the 21st century. The new network must be accessible to the greatest proportion of the UK population, and offer the greatest improvement in connectivity and capacity, with the greatest reduction in journey time for the least cost and environmental damage. It must radically improve links to the UK's principal airports, not only Heathrow. It must maximise the opportunity for more freight to be carried on the existing network and enable the development of 'Powerhouse' economies in all UK regions. It must give a Benefit to Cost ratio of at least 4.0 in accordance with Treasury guidelines and conform with Government policy in respect of reduction of CO_2 emissions etc.

HS2 has only been designed as a High-Speed line connecting 8 regional stations, often remote from key population centres, and is largely disconnected from the existing network. This failure to integrate will have disastrous consequences not just for the high-speed rail project but for the entire UK system.

In an assessment of HS2's connectivity between 20 major UK cities, HSUK has full connectivity in all 20 centres and improves frequency or journey time on 208 out of 210 journeys between centres. By contrast HS2 only improves 43 journeys, makes 48 worse and leaves 20 bypassed completely. This was demonstrated by maps and diagrams. HS2's 2-track route fails the capacity test and leaves many centres with a worse service and no links to the high-speed service. In comparison HSUK's four-track spine from London to South Yorkshire provides this capacity and is routed adjacent to existing transport corridors, accessing more major population centres.

HS2 stations are either termini or remote parkways whereas HSUK uses central stations in all principal cities. HS2 is to be built and operated largely segregated from the existing network. This means it is almost impossible to produce a meaningful timetable to show how the journey times will be improved or worsened between major centres. HSUK's design of over 1000 km of new and upgraded railway and 50 connections has enabled an outline timetable to be developed. Considering 33 key centres, 475 out of 528 possible journeys are improved and none are made worse. Trans Pennine and Cross Country journeys are greatly improved with HSUK.

HS2's planned spur to Heathrow airport has now been abandoned and so high speed connections to regional centres, which would have reduced the pressure on Heathrow, no longer applies. The possibility of an HSUK extension to Gatwick would provide a link between the two major airports with a journey time of approximately 15 minutes, with airside transits for luggage and transit passengers. Lack of capacity on HS2, i.e. only 18 trains per hour, means there is no room for additional direct regional services to Heathrow.

HS2 has no link to Europe via HS1 due to its western approach to Euston from Old Oak Common and the very high cost of a Euston – St. Pancras International link. HSUK follows the Midland Main line to West Hampstead where the domestic services leave to Euston via a tunnel and the International services carry on to St Pancras International platforms where they will reverse or continue to HS1. Due to its four-track spine, HSUK has the capacity to provide direct services to Europe from regional centres if required. HS2 costs for the HS2-HS1 link are £700 million, HSUK-HS1 link costs would be £2 million.

Little consideration has been given to a National freight strategy by HS2. Lack of capacity means slow speed local/regional traffic will be retained on the existing infrastructure leaving little capacity for additional freight. Under HSUK, selected existing routes will be upgraded to continental gauge e.g. the Midland Main Line to Leicester and Newcastle-Edinburgh which are paralleled by HSUK high speed lines. A Trans Pennine lorry shuttle using the reinstated Woodhead route is being evaluated by HSUK.

HSUK's Spine route follows the M1 motorway alignment to avoid the Chilterns area of outstanding natural beauty, avoids massive tunnelling (12 km as opposed to 50 km in the Chilterns) and is £7 billion cheaper.

Works at Euston can be reduced by HSUK providing 2 km of surface railway from Harlesden on the WCML to Old Oak Common to link in to Crossrail. This enables Crossrail services which terminate at Old Oak Common (10 per hour) to be extended on to the WCML, to reduce the suburban commuter pressure on Euston by one third. This simplifies the works at Euston and reduces the timescale for the work and saves £2 billion.

The 'Midlands Engine' concept is not helped by the poor connectivity of HS2 in the Birmingham area, which basically only serves central Birmingham, at Curzon Street. All other major centres are bypassed by HS2. HSUK will bring High Speed intercity services to all major West Midlands centres by upgrades to existing lines and connections to HSUK. The latter would include four-tracking Rugby-Birmingham, through Burton and the HSUK line in the Leicester area.

The HS3 Trans-Pennine line is crucial to the Government's 'Northern Powerhouse' plan with Leeds, Sheffield, and Manchester at its heart. HS3 arose because HS2 did not provide the necessary links. HS2 would provide terminal stations in Leeds and Manchester which would not allow through running say, from Hull to Liverpool. HSUK would have a Trans Pennine route through Woodhead to provide the required reductions in journey times. HSUK would cost around £7 billion less than the disjointed HS2 and HS3 schemes.

Regarding Scotland, HS2 plans to follow the WCML to Carstairs, splitting there to Edinburgh and Glasgow. This will only link Scotland to London, Birmingham and Manchester and passes through the Lake District and Yorkshire Dales sensitive National Park areas which will require extreme lengths of tunnelling. HSUK adopts a route east of the Pennines which links all principal UK cities to Scotland and since the East Coast route is through more favourable terrain would cost £11 billion less to construct. This option also provides a high-speed route between Edinburgh and Glasgow.

Costings at this stage indicate that HSUK requires 227km less new railway, 74 km less tunnel, 6 fewer new stations and is £21 billion cheaper than the HS2/HS3 combination. HS2 predicts it will be Carbon Neutral whilst HSUK is forecast to reduce CO_2 emissions by 600 Mt over 40 Years.

HS2 is designed for a maximum speed of 400 km/h. There appears to be no recognition of the drawbacks of excessive speed, energy use and emissions. At 400 km/h four times the energy of running at 200 km/h is needed. Maintenance and technical risk rise at an exponential rate. Increased engineering cost of earthworks, longer tunnels and viaducts are required at the higher speed to cater for the near-straight alignment in an undulating landscape. Design for 360 km/h allows HSUK's new lines to follow existing transport corridors especially the M1 motorway and the West Coast Main Line.

HS2 has not examined alternative routes to the Chilterns in any detail, with numerous false or spurious justifications for rejecting the M1 route. HS2 has no consideration of how a high-speed Network can be developed from the initial London-Birmingham route.

Quentin and Colin provided a wealth of diagrams and tables to support HSUK, one of which was a night-time satellite photo of the UK with the HSUK route superimposed on it, showing how the major centres of population would be linked in a far superior manner than with HS2.

A question and discussion session followed, among those taking part were R A Pinkstone, R Parker, P Hepworth and A Pope. A vote of thanks on behalf of those present was given by Grace Nodes who congratulated the speakers on an interesting and thought-provoking paper and on the amount of work that had gone into the project, wishing them every success.

As with all articles published in IRSE NEWS, readers are reminded that views expressed in this article are those of the authors of the paper, and not necessarily those of the IRSE as a whole. If you have a view on the content of any article in IRSE NEWS, why not write to the editor at ***irsenews@irse.org***, so that we can consider your letter for the Feedback section?

February Technical Paper: Reading Remodelling

Report by Tony Pinkstone

Chairman Doug Gillanders welcomed members and guests to the February meeting of the York Section. Doug welcomed the IRSE President, Charles Page who was visiting the Section. The President gave a short address in which he detailed his travels in his year of office so far, and of the formation of new sections such as China and Thailand. He wished to see more contact between sections and the sharing of papers between sections on topics of mutual interest.

The Chairman then introduced Tony Pope of Siemens Rail Automation UK, who would present a paper on the Reading Remodelling. (Reading is a major station on the Great Western Main Line from London Paddington to Wales and the West of England).

Tony gave a short detail of his career in signalling, starting as a Student Technician Engineer up to the present, where his last six years had been devoted to the Reading Remodelling!

Close liaison was maintained with Reading Borough Council and other local organisations throughout the project. The project had its own newspaper, and a strong PR presence. Reading Station deals with 50,000 passengers per day or 25 million per annum. The project consisted of two main elements, Enabling and Remodelling. Enabling was to clear the area to the North of the station for the additional platforms and tracks. This area contained the existing signal box which contained a wide variety of equipment such as the original Western E10k interlockings and the interface equipment to 17 outlying interlockings. New Time Division Multiplex (TDM) systems and temporary SSI interlockings would facilitate the changeover and stage works. The remodelling included additional platforms, platforms extended to 12-car length, a new viaduct to carry the fast through lines over the West junction, and a new train maintenance depot. Where possible, provision for the pending 25kV electrification was included in the work packages.

The works commenced in 2010 with the re-locking of the station area, with the E10K interlocking being replaced by SSI, and all track circuits converted to axle counters. This work was carried out in March and April 2011.This would facilitate the 16 main remodelling stages. Critical first stages were the replacement of Caversham Road Bridge, and the construction of the main footbridge, (the Transfer Deck). At Christmas 2011 the southern platforms at the east end were remodelled and extended with the appropriate track works, becoming platforms 4/5/6. A tunnel under the main lines on the Eastern approaches was refurbished and brought back in to use to enable trains to and from the former Southern Region lines to access the Northern platforms.

Easter 2013 saw the Transfer Deck and the New North and South entrances brought into use, and the Fast Lines slewed into the Relief lines position. This Stage alone required 43 new point ends. In parallel with the remodelling, a new train maintenance depot was being constructed adjacent to Reading West Junction on the Northern side of the tracks. This was commissioned in September 2013 and this completed Key Output Stage 2.

In November 2013, Platform 7 was brought into use. Christmas 2013 saw the commissioning of the 'Berks and Hants' lines. The next stage major was the construction of the viaduct which carried the Fast Lines over the Reading West Junction. This eliminated the conflict whereby the freight flows from West to South had to cross over the Fast Lines on the level, with the associated problems of regulation and consequent delays. The work lasted from January 2014 until the commissioning at Christmas 2014. This completed Output Stage 3. Severe flooding of the main line in the Maidenhead area in 2015 resulted in the requirement for provision of temporary axle counter block sections, designed and installed at very short notice, to keep traffic moving whilst repairs/replacements were carried out to the damaged and flooded signal equipment.

By combining stages and rearranging works it had been possible to save a whole year on the original programme, which saw the complete commissioning of the project with the signalling now worked from the Thames Valley Signalling Centre at Didcot, extra capacity, and increases in line speeds throughout the area. Final costs were £895M.

The vote of thanks was given by Ian Moore, who thanked the speaker on behalf of those present for his account of a very challenging Project completed to budget and one year early. Among those taking part in the questions and discussion which followed were Quentin Macdonald, Paul Hepworth and Ian Moore.

New Editorial Team member: Alexander Patton

The latest recruit to the IRSE NEWS team is Alexander Patton. Alex explains the role he's taken on below.

Last month, I took Helen Kellaway's place as an assistant editor for IRSE NEWS, supporting social media and focusing on the needs of younger readers. Helen is a great contributor to the IRSE, and I am grateful to have received her invitation to join the team. Though I have only worked 'on the railway' for one and a half years, the IRSE is already an important part of my early career. Participating in an IRSE exam study group and regularly attending talks and seminars has accelerated my understanding of rail industry challenges, and has helped me develop personally and professionally.

My own route into rail came unexpectedly. From 2011 to 2015, I studied aerospace engineering at the University of Surrey. I was always passionate about transport, and although it was commercial aviation that first captured my imagination, my passion for rail developed after spending a couple of years during my studies living (and commuting) in London, Munich and Helsinki. The rail and metro systems in these cities were inspiring. Innovations in the transport industry have a huge impact on quality of life. The aviation industry has put international travel within reach for billions of people, while S&T engineers have created the capacity necessary to support thriving megacities.

During my time at Siemens, the company has placed a growing importance on diversity and inclusion. Breaking down barriers helps us all work more effectively to deliver better railways. This is of tremendous importance as the Digital Railway progressively transforms our industry. The IRSE Younger Members Section wants to break down barriers between experienced signalling veterans and those in the early stages of their rail career. For those who are even newer to rail than me, IRSE NEWS is a valuable regular source of major signalling and train control developments happening around the world. Equally, young engineers – apprentices and graduates included – are highly encouraged to submit their own articles to IRSE NEWS.

Writing an article in your early career may seem daunting, but there are few better ways to cement your understanding of a topic than explaining it to an audience. The rail industry has a great variety of work, and sharing your knowledge offers wider insight to other young engineers. Submitting an article to IRSE NEWS increases your visibility within the industry and is an excellent professional development opportunity. Relevant topics are not limited to technical matters. For example, many young engineers are involved in STEM activities, and an article showing the benefits or discussing unique approaches to rail industry STEM engagement would be very topical.

Alex is committed to STEM activities; here he enthrals potential younger engineers at the Wiltshire Festival of Engineering and Manufacturing.

Younger members can sometimes feel intimidated by attending rail-related talks and seminars where there are older engineers who seem to know everything. But S&T engineers are in reality very friendly people, and are often eager to share their knowledge. So don't be shy, and please, senior members - next time you see a young person at an IRSE event, be sure to talk with them.

Readers that are interested in promoting the IRSE through social media or by writing an article for IRSE NEWS can contact me, ***alexander.patton@siemens.com***, or another member of the editorial team.

For more information on IRSE activities visit our website

The best place to visit for information on institution membership, activities, publications and up-to-date news is our website at ***www.irse.org***.

Also look out for our tweets at ***@IRSEHQ***.

Do we have your most up to date details?

Please take the time to check your details on our new database system. Visit ***www.irse.org***, click on the **Login to IRSE** link, enter your email address and password, and click on **My Record** on the left hand side of the screen.

Thanks for checking!

Re: Systems Engineering

In the October issue of IRSE NEWS, the article *"Seven Myths of Railway System Engineering"* provides good insights into the realms of System Engineering and its applicability to the Railways/metros. It is appreciable to note how System Engineering can learn from the complexities and uniqueness of railway projects specifically in how interfaces are managed between different subsystems by railways, as has been pointed out by the writers.

While the seven myths about System Engineering have been put to rest satisfactorily, it would be really helpful if the vastly experienced team of writers from University of Birmingham along with Bruce Elliot were to elucidate with some specific examples of those good practices of System Engineering that have been proven in other sectors like defence or aviation, which may be applied to address issues which are challenging for railway projects/metros.

Hopefully, this may encourage the team to write further article(s) on the science of System Engineering for the inquisitive readers of IRSE NEWS across the world.

Nikhil Swami, Executive Engineer (S&T)
Kolkata Metro Rail Corporation Ltd
Chairman-YM Chapter, IRSE India Section

Re: Transport Select Committee Report: déja vu?

David Fenner's contribution on the Digital Railway in the January IRSE NEWS makes interesting reading. It seems that the support of the Parliamentary Committee is slightly muted – perhaps they recall the demise of Railtrack and how this came about (a contractual promise which was broken, based as it was on assertions rather than evidence.)

The objective of removing lineside signalling and its associated equipment seems attractive but if there is such a thing as ETCS Level 3, it would be quite wrong to assert, 'it is just around the corner', or a straightforward extension of ETCS Level 2. The fact is, ETCS Level 3 simply does not exist. On past experience, production of a standard specification for such a system could be a lengthy and expensive process, followed by a long period of development. The sometimes-claimed availability of 'off the shelf' solutions from various suppliers needs testing against inter-operability, anyway. It is possible that the supply industry has lost its taste for long-term participation in such a development without the prospect of early sales.

There is mention of a problem of dealing with a divided train. This is only one of a series of possible problems to be addressed but the technical issues are probably not insurmountable.

As always, the management of ETCS Level 3 needs attention. Importantly, the movement of freight and works trains must be considered at an early stage, even with ETCS Level 2. Every locomotive required to travel over a signal-less route must be suitably equipped and its driver trained and regularly tested. Even if such locomotives are not actually hauling wagons, their use may be necessary to rescue a stranded passenger train. Again, it will be necessary to provide suitably trained personnel at strategic points, available to attend a failed train. The use of a road/rail vehicle or a platelayer's trolley for the local movement of material might have to be discontinued.

The view might be taken that an assertion without supporting evidence has as much credibility as a politician's kiss!

Michael Page

Re: Transport Select Committee Report

The January issue of IRSE NEWS had a summary of the report on the Digital Rail Project which was significant to me. Although now retired I had been working as part of the Alstom Transport team (Signalling Solutions) and was involved in the development of the ROC concept with Network Rail.

There are three topics to address:

- TMS with plan & re-plan.
- ERTMS/ETCS and in particular Level 2.
- Evolution of trains (passengers and freight).

With a main line rail network no line is truly independent due to both trains sharing portions of routes and trains scheduled to make connections with other trains. The network is a system and needs to be treated as such. Thus it is essential to be able to quickly assess the situation in case of an incident and to test for possible solutions. Such solutions must also help the restoration of service with the minimum disturbance to the journeys of the passengers, and freight affected. This delivers the best possible quality of service to the customer.

The railway also works to a relatively 'rigid' timetable but unplanned events occur, either from small delays or the need to move an additional train or move a train to a different location. Tools exist to help the rescheduling in real time in order to minimise the overall disruption to the timetable. TMS is a significant challenge but the principal gain will be in terms of the quality of the service offered to rail users.

I agree with the report that it not possible to rely on ETCS Level 3 without a reliable train integrity solution. Nevertheless, it is possible to get most of its advantages in terms of capacity using ETCS Level 2. At the design speed and using trains which brake according to the braking profiles used in the block design there is very limited benefit from using Level 3 (see simulations done by Aachen University). However at reduced speed, typically approaching a station, existing fixed blocks become a drawback. There is the possibility of defining virtual sub-blocks. Some RBCs have this possibility. With this approach 90% of the theoretical benefits of Level 3 can be achieved, whilst also providing a migration path for unfitted trains.

When it comes to train evolution, the variable formation train is rapidly being replaced by the fixed formation unit. For those trains the train integrity is guaranteed. The issue is for freight trains. But even here much of the traffic is carried in containers on fixed formation flat wagon trains (as for the Betuwe route out of Rotterdam harbour). Freight sorting is now done at the harbour side or in inland terminals. Again train integrity solutions are relatively simple. All that remains are the trains carrying materials (minerals, coal, petrol...). For this type of traffic, the issue is to carry the maximum payload in one train which would have a maximum length of about 750m. Consideration could be given to treating such trains as another form of fixed formation based on a maximum length.

I am surprised that the Transport Select Committee was not guided in such development about the future use of the railway and the opportunities this creates.

Patrice Noury MIRSE

Re: Low cost signalling

I found the article on Low Cost Signalling in the February IRSE NEWS very interesting, but one thing seemed to be missing. And that is the whole life cost of access and maintainability of items of equipment, even allowing for schemes such as ROSE [Network Rail's Reliability Centred Maintenance for Signalling Equipment project].

I can think of multiple items on my patch, Relocatable Equipment Buildings (REBs), signals, location cabinets and so on, that can only be accessed by going on or about the line and these often require the lines to be blocked to traffic. Blocking the lines is as I'm sure we all know an expensive business due to the time consumed in planning such access, the need to do most of this type of work on nights or weekends and the lost revenue from trains due to the increased time required for such access.

So, what's the solution? It's quite simple really, put stuff where it can be accessed if possible/practicable and or provide a continuous or semi continuous access path along the railway from the nearest road. This path would where space is not available immediately next to the line be next to the boundary fence with steps up or down to items of equipment or at least every 200 m. In addition to removing the need to block or work on or about the line it would remove a vast number of slips, trips and falls and we all know how much cost these impart.

So, to this end here are a few examples.

- Axle Counter REB at Weedon placed on down side when vehicle access is available on the UP side 200m further south. Other examples are at Heyford, Hanslope, Collingtree to name but three. Everything could have been placed in locations not requiring RIMINI [Network Rail's Risk Minimisation Standard relating to accessing assets] and response times would be much faster.
- Signal gantry at Brinklow with the ladder on down side, but controlling locations on up side. Due to poor sighting, you have to access the gantry ladder from the south using the down cess, walk back and then drive round to another access to get to the locations via the up cess.
- There are two signal gantries and locations between Castlethorpe and Hanslope that have a footpath running just the other side of the boundary and just need a gate in the fence.

The above probably only accounts for 5% of the items I could list. In an ideal world, the only thing we would need to go onto track for would be Automatic Warning System (AWS) magnets, Train Protection and Warning System (TPWS) components, track circuits, axle counter heads and balises.

So, I would ask that all designers and scheme managers talk to the 'Boots on the ballast' guys and ask *"Is this a sensible place to put this?"* A few more pounds spent up front would save a fortune later on in my humble opinion.

Andy Entwistle

Re: Low cost signalling

The article by Andy Stringer and Graeme Christmas quite rightly focuses on where the money comes from at a time when the country's financial future is far from certain and passenger satisfaction could be much better. At the same time it is difficult to see where we can justify bringing the heritage signalling on secondary lines up to the same level as the core network which by and large already has modern signalling which in most cases is doing a great job and is capable of being enhanced to deal with the capacity demands which continue to rise year by year.

I write this, not as a member of the signal engineering fraternity but as a retired member of the operating department. As an operator I was delighted to see that the authors have highlighted the benefits of providing bi-directional signalling as part of any new re-signalling project. Its ability to increase capacity however is limited by the existence on many lines of regular interval timetabling as, in order to use both lines in the same direction simultaneously as suggested, a gap must be found in the timetable of opposite direction trains. Many secondary lines have at least a half hour frequency timetable as a minimum which means that a gap of slightly less than 15 minutes must be found to make the use of bi-di practicable. This translates into having crossovers situated sufficiently close to each other to make this happen, whilst on many secondary lines crossovers are often quite far apart, facing crossovers in particular being practically non- existent. The cost of providing additional crossovers, particularly if the line is electrified, will make your eyes water!

Where bi-di comes into its own is when an operational perturbation takes place e.g. train failure, emergency incident etc. The operator immediately has available a tool which can keep trains moving and keep delays to a minimum, more importantly keeping the customers happy. In most areas, budgetary considerations have reduced ground staff to a minimum, often located some distance to where an incident may take place and until they come on site everything stands waiting. Bi-directional signalling can take the heat out of many of these situations.

In dealing with the financial burdens of following current practices I was surprised that the paper did not place more emphasis on the general removal of signal post telephones. We now have a very good and reliable train radio system in the shape of GSM-R. It provides a number of additional features which Signal Post Telephones (SPTs) cannot and it promotes greater safety for train crews in that they can remain in their cabs to communicate. Removal of SPTs would permit a considerable reduction in trackside cabling and associated hardware and also obviate the need for drivers' walkways. In the 1980s, faced with a project to renew telecoms cabling on the approaches to a large Scottish terminal station at which approx. 70% of the trains were equipped with Cab Secure Radio (CSR) I agreed to the removal of a large number of SPTs on the basis that they were seldom used and never by the drivers of CSR equipped trains. I am unaware of any difficulties arising from this decision which saved a great deal of money and kept the project costs down.

However, I keep the best till last. I am somewhat surprised in that the paper, having alluded to the difficulties of actually getting on the track to do work and the resultant high costs, did not consider how we can improve the protection of engineering possessions. Current practices over the years have been retained, are extremely labour intensive if properly carried out and are heavily bureaucratic. I read recently that a possession takes an average of 82 minutes from possession request initiation to the start of meaningful work. This is obviously a subject for efficiency improvement and has many potential gains, not only in cost reduction but in overall efficiency. Combined with bi-directional working, the two together could be a very powerful tool.

Until now signal engineering, aided and abetted by the operators and others, has shied away from modernising possession protection. Even in areas where lock-outs are provided (usually in station areas) their use excludes being used to protect possessions. Contrast with the situation in a number of continental countries where the ability to protect engineering work is provided as part of the signalling system. In particular, the situation in France where the concept of Zone Elementaire de Protection (ZEP) ,where possessions must conform to train detection areas (one or more track circuits) which are contained in track diagram books issued to engineering groups and their possession planners, indicated on the ground by identification plates fixed in the four foot at ZEP extremities and protected by lock outs at the trackside, allow for a safe yet very efficient means of handing sections of the line to engineering staff. On the high speed lines (LGVs) the process is semi-automatic, involving the traffic management system whereby the passage of the last train before the scheduled possession time automatically closes down the routes into the line to be blocked and leads to an automated authority being issued to the PICOP (Person in charge of Possession) on a trackside plug-in device. Radio Electronic Token Block (RETB), a Scottish Region development of the 1980's, also contained (and still very much in use today) a facility which handles engineering possessions in a similar manner to the SNCF system and issues protected possession authorities to trackside PICOPS who carry a portable RETB 'train box'. On the Far North lines north and west of Inverness which are certainly in the 'secondary line' class, I was told by the Area Engineer at the end of 1986 that he had achieved his annual 12 months maintenance plan in 7 months, largely due to the new possession procedures and saved a considerable amount of money into the bargain!.

After all, what is an engineering possession in signal engineering terms? It's a train which doesn't move!

Alan Mackie
Tutor, TMCS Module, Institution of Railway Operators

Re: An Inspector Calls

I refer to Peter Halliwell's Report from the M&NW Section's meeting in February's IRSE NEWS relating to the functions of the ORR. For the railway industry, these are (as stated) safety and economic oversight respectively. In the penultimate paragraph of the Report it is suggested that, with respect to Network Rail's funding arrangements, they are "*complicated*" and that "*Network Rail ... is itself in effect another agent of the state*", which in lay terms means that it receives state funding.

This is where the problem lies. Unlike other economically regulated service industries e.g. water, telephone, electricity etc. whose regulators (OFFWAT, OFFGEN, OFFCOM etc.) can levy fines and penalties which have a direct impact on profits, share values and directors' bonuses, ORR's penalties levied on Network Rail simply come from the taxpayer's subsidy.

Nicolas Philipps

Re: SATLOC

This letter was received from the authors of February's article on the SATLOC system in response to Dr M Verma's letter in the March IRSE NEWS.

Dr Verma asked in his letter the following questions to the authors: What is the justification for the OBU to be designed at a safety level, less than that of the ETCS, i.e. SIL4 (refer to the statement at page 21 – "*To reduce investment costs, the OBU is designed for SIL2*").

One of the main goals of the SATLOC system is saving costs for low traffic density lines. Hence the design of the OBU of SATLOC at a safety level SIL2 is mainly encouraged by the cost saving argument as described in the paper. But this economic goal must fit to the required safety standard. In answer to the questions in the letter we would like to state:

(1) Based on a proper risk analysis many low traffic density lines will not require a higher safety level than SIL2. On these lines the proposed SATLOC system,would be more than sufficient.

(2) If SIL2 is not sufficient, SATLOC has the mechanism, named as ' closed loop control' with the TCC , to achieve a lower remaining risk as described in the paper. Hence the OBU must be able to execute the application of the emergency stop with SIL4. To achieve this special requirement a special device (redundant to the OBU) is planned to be introduced, which does nothing other than supervising the emergency message and its application. This small device is comparatively cheap because of its simplicity. The communication channel itself is safe enough. We do not see any further actions of the OBU which must be executed at a higher safety level than SIL2.

Burkhard Stadlmann
Teodor Gradinariu

Oops

In IRSE NEWS, issue 230 (February 2017), page 29, New York City Transit's "*QBL*" is the Queens Boulevard Line, not the Queen Elizabeth Line.

Stuart Landau

Re: The great carbon debate

I enjoyed reading the article on "Carbon" in the March issue of IRSE NEWS and believe it is an important topic for us to consider even if railways are already one of the most carbon efficient forms of transport. There were two items in the article that particularly caught my eye:

1. The inability of our systems to capture the energy reduction benefits of moving to LED signals. In fact you could argue its worse than that because all the lamp proving circuit is now actually achieving is to prove that a suitable ballast resistor is in circuit. You may as well loop the ECR [lamp proving] circuit out.
2. One has to question the veracity of some of the numbers for embedded carbon shown in the final figure. Two complaints about this figure are: firstly that every item starts from a different base making genuine comparison a challenge, and secondly that it would be nice to know how the numbers have been generated (i.e. the main elements creating the numbers).

I have done the obvious and calculated the per kg carbon emission for each product. This raises a few eyebrows. Yes the steel for both the rail and Overhead Line Equipment (OLE) support comes out approximately equal but the embedded carbon in the two signalling products are the worst on the list. Finally and more amusingly I will clearly need to change my diet as crisps are significantly better than bread and a can of cola is also better than a fruit smoothie. We may need to keep that information away from certain parts of the media or risk reprimand by the 'Health Police'.

David Fenner

Keeping the discussion going ...

Many thanks to all of our contributors to 'Feedback' this month. Our ethos of "*inform, discuss, develop*" considers discussion about all aspects of our profession to be critically important to the development of our branch of engineering.

If you have a view about something you've read in IRSE NEWS, or any aspect railway signalling, telecommunications, control or related disciplines why not write to the editor at ***irsenews@irse.org?***

MEMBERSHIP MATTERS

ADMISSIONS

We have great pleasure in welcoming the following members newly elected to the Institution:

FELLOW

Hall	S	Network Rail	UK
Kurniadi	D	Bandung Institute of Tech	Indonesia

MEMBER

Cheng	X	CASCO Signal	China
Garzon Nunez	J	AECOM	Spain
Hauvespre	S	RATP	France
Hu	C	CASCO Signal	China
Liu	J	China Academy of Railway Sciences	China
Liu	ZM	China Academy of Railway Sciences	China
Schneider	SO	BÄR Bahnsicherung	Switzerland
Wang	T	China Academy of Railway Sciences	China
Weijuan	L	CASCO Signal	China
Xing	K	China Academy of Railway Sciences	China
Xu	Q	Yang/Haidong	China
Yuan	Z	Signal & Communication Research Institute	China

ASSOCIATE MEMBER

Cox	BM	HBA Signalling	UK
Lu	D	Beijing Jiaotong University	China
Bramantoro	PS	Empingham Ltd	Indonesia
Christiawan	B	PT Kereta Api Indonesia	Indonesia
Coy	CA	Siemens	UK
Down	J	Kilborn Consulting	UK
Johnson	AP	Siemens	UK
Louden	A	London Underground	UK
Lulek	CM	Network Rail	UK
Martin	A	AECOM	Spain
Pascal	K	Network Rail	UK
Rock	C	Network Rail	UK
Sari	RW	PT Len Railway Systems	Indonesia
Shord	J	Network Rail	UK
Sinha	K	Cognizant	UK
Smith	MGR	Mott MacDonald	UK
Umaryadi	D	PT MRT Jakarta	Indonesia
Yulianto	Y	PT MRT Jakarta	Indonesia
Zhu	S	Transport for London	UK

ACCREDITED TECHNICIAN

Alborough	DR	London Underground	UK
Lewis	D	Keolis Amey Docklands	UK
Patman	C	London Underground	UK
Wheeler	T	Telent	UK

AFFILIATE

Alonso Fernandez	T	Siemens	UK
Aviomoh	VA	Arup	UK
Barker	MJ	Thales	UK
Church	L	Thales	UK
Chu	A	Siemens	UK
Cooper	J	Siemens	UK
Crowther	S	Alstom	UK
Evans	J	Siemens	UK
Hannant	C	SNC Lavalin	UK
Ismailjee	K	Network Rail	UK
Jain	S	Siemens	UK

AFFILIATE (CONTD)

Jin	C	China Academy of Railway Sciences	China
Kamble	A	Keolis Hyderabad MRT	India
Larkin	G	Siemens	UK
Lea	S	Thales	UK
Lew	PR	Siemens	UK
MacNeil	AD	Siemens	UK
Maingi	KM	Siemens	UK
Nair	AV	Kiwirail	New Zealand
Nguyen	J	Signalling Solutions	UK
O'Flaherty	C	Siemens	UK
Patel	K	Transport for London	UK
Patey	G	London Underground	UK
Rahmat	A	PT MRT Jakarta	Indonesia
SA Karthikeyan		Alstom	India
Salami	S	SNC Lavalin	UK
Scaricabarozzi	A	Alstom	UK
Scholl Sternberg	A	Siemens	UK
Stanev	S	London Underground	UK
Stanowski	T	London Underground	UK
Ward	SB	Siemens	UK
Williams	HHM	London Underground	UK
Yang	H	University of Birmingham	UK
Yoganathan	J	Transport for London	UK

TRANSFERS

MEMBER TO FELLOW

Haldar	TK	Network Rail	UK

ASSOCIATE MEMBER TO MEMBER

Adhikary	SK	Atkins	India
Challenor	PF	Siemens	UK
Ettle	IC	Network Rail	UK
Kulshrestha	G	SMRC	India
Oakes	DS	Transport for NSW	Australia
Shahi	SK	Atkins	India
Tavener	P	PT Signalling	UK

AFFILIATE TO MEMBER

Nicholson	WA	Network Rail	UK

AFFILIATE TO ASSOCIATE MEMBER

Lai	KKT	GHD	Australia
Roy Chowdhury	R	Atkins	India

AFFILIATE TO ACCREDITED TECHNICIAN

Bonnett	E	Volker Rail	UK
Evans	J	Siemens	UK
Weight	MJ	Costain	UK

ENGINEERING COUNCIL REGISTRATIONS

Congratulations to members Chen L, McVea C and Pramanick S who have achieved their final stage CEng registration. Also to Albu A and Silva B who have achieved final stage IEng registration.

RESIGNATIONS

Goumri M, Towler J and Vink LB.

DEATHS

It is with great regret that we have to report the death of members Duquesnoy J-N and Rowbotham AJR.

Current Membership: 5435