IRSE Institution of Railway Signal Engineers

NEWSLETTER

HONG KONG SECTION

October 2005
Issue 11

ERTMS-Compatible

Control of Tilting Trains

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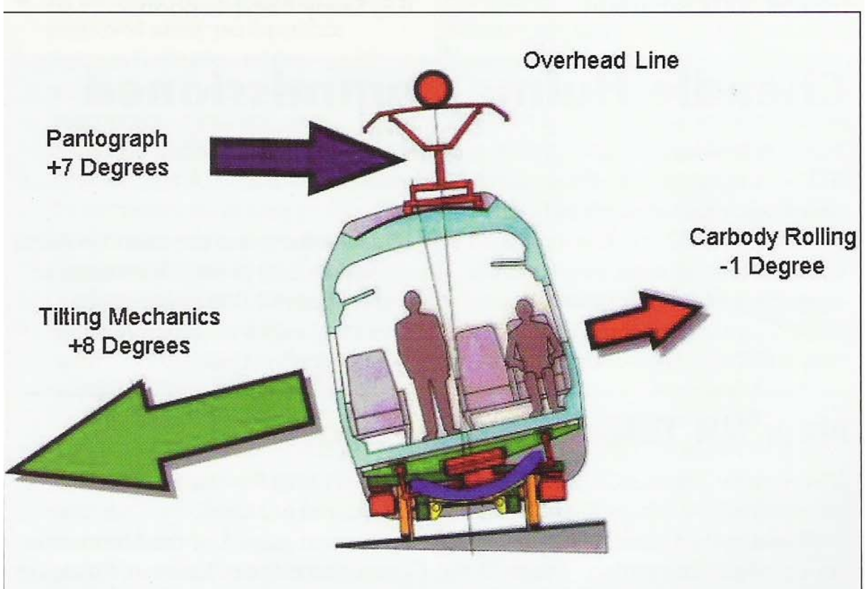
Based on a lecture given to the IRSE Midland and North Western Section at Crewe on 9th January 2003.

A Pendolino at speed on the Midlands Test Centre at Asfordby



The tilting train concept

It is very unusual for requirements I for a new train .control system to emerge totally "out of thin air" in the course of a project. It is also unusual for a Train Operator to be tasked with defining the solution to such requirements, rather than the infrastructure owner.

In late 1998, whilst Europe's train builders were bidding to supply Virgin's new West Coast and Cross Country train fleets, a team at Railway Safety was taking a comprehensive look at the underlying standards needed to support safe operation of high speed and tilting trains. Although most of their work covered essentially "non-signalling;' areas such as track alignment quality and maintenance standards, two areas of increased risk emerged. The first was the risk of a tilting train (in either normal or tilt failure conditions) infringing the structure gauge and colliding with a structure or with a passing train. The second was the increased risk of overturning or derailment arising from a driver overspeeding whilst a train was running at increased speeds round curves. The result was two new Railway Group Standards, which mandate controls for these new risks.

Contracts

When ALSTOM Transport was named preferred bidder for the Virgin West Coast fleet with its "Pendolino" tilting train, it was faced with having to satisfy these new Group Standards requirements, and called on the company's Information Solutions team in Borehamwood. So, work began on the "Tilt Authorisation and Speed Supervision" system - "TASS" for short. Ultimately, ALSTOM found itself with a number of contract responsibilities:

- To develop the TASS system, obtain safety approval for it and supply equipment for 53 Class 390 (Pendolino) tilting electric trains;
- To supply TASS equipment to Bombardier for 44 Class 221 (Super Voyager) tilting DEMUs;
- To design, for Virgin, around 1000 route km of trackside TASS applications and to supply about 650 programmed balises, to implement TASS in accordance with infrastructure data provided by Railtrack (now Network Rail).

Virgin meanwhile arranged for Railtrack to appoint contractors to install the TASS balises, and later to take the balises into their signalling assets, for maintenance purposes.

Tilting Trains

Tilting trains offer fundamental advantages to train operators:

- They provide improved passenger comfort when running at normal line speeds;
- They allow journey times to be reduced by running at enhanced speeds through curves.

The second advantage, especially, has a significant commercial value, as it allows shorter journey times and better utilisation of the train fleet.

The bodies of a tilting train are individually controlled by actuators to tilt inwards on curves, in response to various sensors measuring track curvature and lateral acceleration. The cant deficiency at the train wheels is virtually unaffected by the train tilting, nor is the overturning speed of the train changed appreciably. The tilt applied to the train is designed to partially offset the lateral acceleration felt by passengers, reducing it to a comfortable level.

As tilting trains preserve passenger comfort in curves, they are driven closer to over-turning speed, and the overspeed margin may be reduced from more than 50% for a conventional train, to just over 20% for a tilting train running at high cant deficiency. Tilting trains also regularly make greater speed reductions on the approach to fixed low speed areas, such as at large stations.

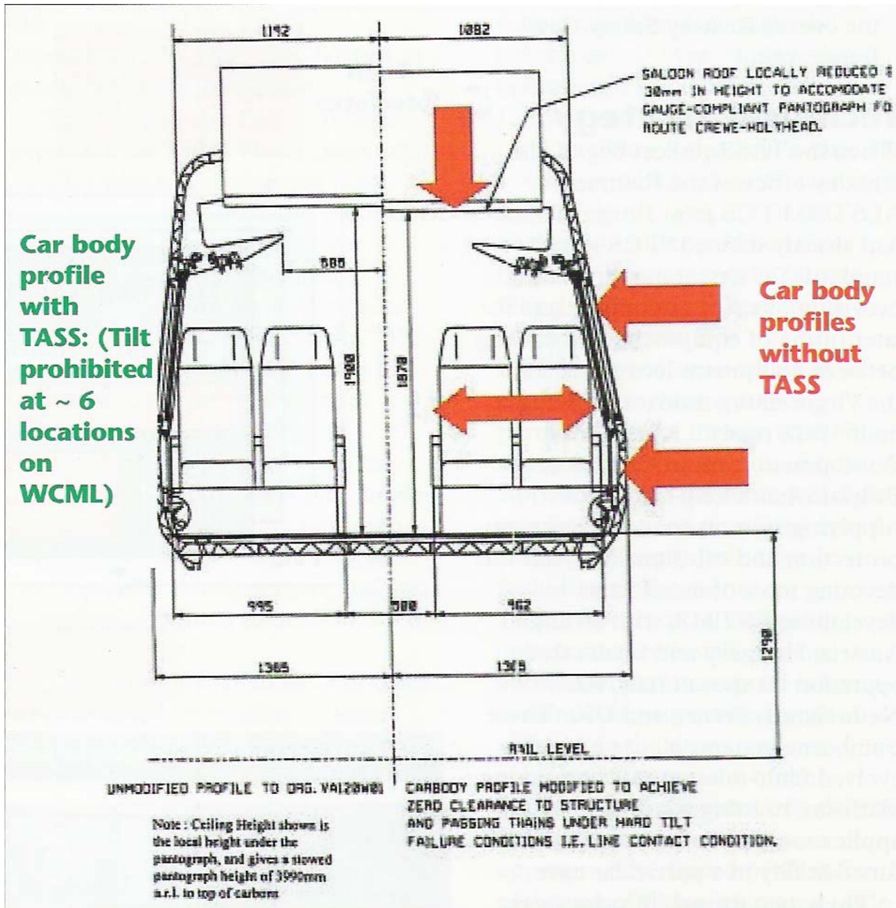
Tilting trains world-wide generally run on high speed lines, and are provided with comprehensive train protection, including continuous supervision of drivers' adherence to speed limits, as a matter of course. Thus, the additional risk of derailment due to overspeed is already mitigated by ATP But in Germany, where tilting trains are used on some secondary lines not fitted with ATP, a separate speed supervision system is provided. In the UK, most high-speed trains still operate without continuous speed supervision, so the overspeeding risk remains.

Designers of tilting trains must choose either:

. A reduced body cross-section that always remains within the permitted kinematic envelope, in all train tilting modes; or

. A more generous body crosssection, together with inhibition of tilt at any locations on the route where clearances between trains on adjacent tracks, or between trains and structures such as tunnels, are restricted.

In continental Europe, structure gauge is generous, and the first approach is normally used. In the UK, however, structure gauge is both restricted and variable, and so the second approach is necessary to avoid very cramped passenger accommodation.



The benefit to UK passengers of active tilt authorisation

Engineering a Solution

Because of the unusual way TASS came into being, no one having preconceived ideas of the form the solution should take, three parallel work streams were started:

. ALSTOM TIS formulated a technical strategy, defining the . hardware and software architecture of TASS, initially with only a sketchy idea of the functionality that would finally be needed;

.The detailed operational principles for tilting trains running on the UK network were developed jointly by all the TASS stakeholders (Virgin, Railtrack West Coast Route Modernisation, Railway Safety, ALSTOM and Bombardier). With Railtrack WCRM as chairman, ALSTOM TIS took the lead in proposing solutions, which were discussed and agreed by the Working Group members. The group met HMRI periodically, to keep them informed. This approach allowed ALSTOM to move on to define the TASS functionality in detail, ready for implementation in the TASS Applications Software;

. New Railway Group Standards do not prescribe the technical solution to control risks. However, the TASS solution was specific to the Infrastructure Owner and one Train Operator (who both legally must take responsibility for it), but by its geographical extent was likely to become a de facto standard for the whole network. Therefore, a "Pre-System Authority" was set up to allow other UK train operators (who might later operate tilting trains) HMRI and other ERTMS suppliers, to challenge TASS concepts and influence the solution. Mterdue debate, this group either accepted TASS design decisions, or agreed that they were project-specific responsibilities. The group did set top-level safety goals for tilting train operation in the overall Railway Safety Case framework.

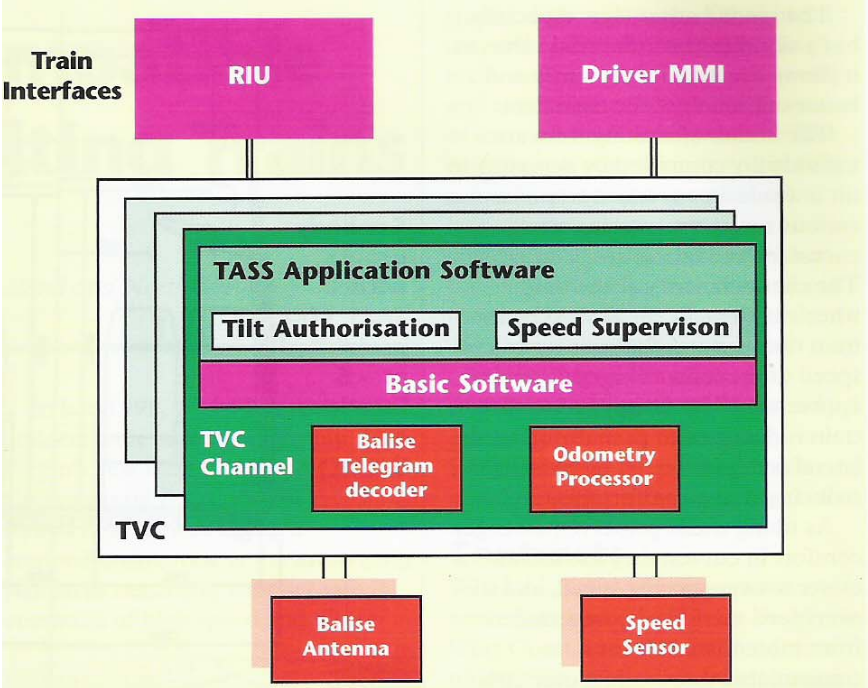
Technical Strategy

When the TASS project began, the Croxley office of the Railtrack/ ALSTOM TCS Joint Project Team had already defined "TCS ready" standards for new trains (including provision of space and mountings for later fitting of equipment, and cabling between equipment locations), and the Virgin tilting trains were being built "TCS ready". ALSTOM's development team in Charleroi, Belgium, has a long history of supplying systems for main line train protection and cab signalling, but was devoting most of its effort to developing ERTMS, with testing in Austria, Hungary and Spain, then operation on sites in Italy, the Netherlands, France and UK. These trainbome systems all use a highly evolved fault-tolerant safe computing platform, running a software application that defines the functionality in a particular case.

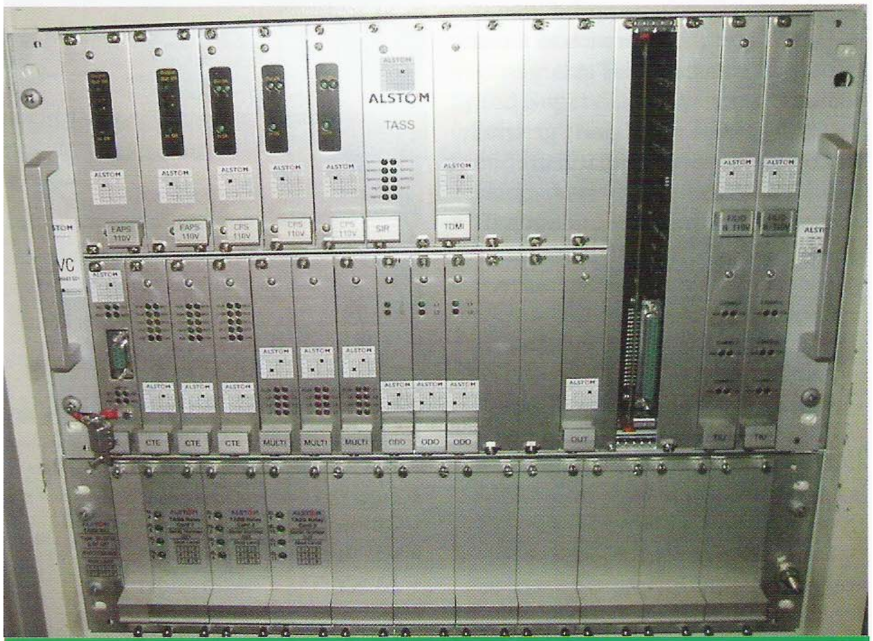
These two threads of prior work made it logical that TASS should be based on ERTMS components, with a software application tailored to Virgin's needs running on a standard safe on-board computer. Such a computer can implement SIL4 functions, so no TASS safety requirements that might emerge later should be unrealisable.

Class 1 ERTMS does not include standard functions to safely enable and disable tilting operation according to gauging constraints. Neither does ERTMS allow a train to swap dynamically between two different speed profiles according to the current state of its on-board tilt system. These functions could usefully be added to ERTMS, but until this is agreed UK tilting trains operating under ERTMS can still achieve full performance operation by using data in ERTMS Packet 44 messages.

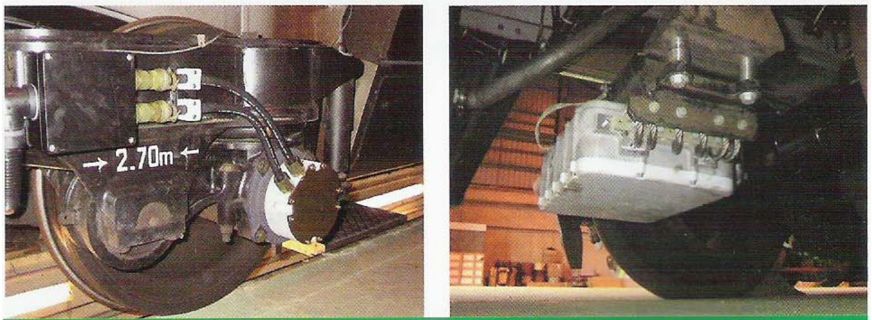
Although Level 2 ERTMS was working on test sites around Europe, and GSM-R infrastructure was being implemented on WCML, there was insufficient operational experience to rely on radio for TASS operation. So Eurobalise transmission was chosen, and passive Eurobalises at intervals



Block Diagram of TASS Trainborne Architecture



The TASS Vital Computer (TVC) and Class 390 Train Interface below it



TASS Speed sensor (left) and bogie-mounted balise antenna (right) on a Pendolino train along tilting routes define the behaviour needed by TASS on tilting trains in the section ahead.

To improve value for money, simplifications of the standard ERTMS equipment architecture were made for TASS, although compatibility with ALSTOM's generic ERTMS solution was maintained, to allow later upgrade of the trains to full ERTMS operation:

. The radar sensors needed to meet ERTMS speed and distance measurement accuracy requirements are not fitted, the odometry subsystem just using two axle-end speed sensors;

. Except on bi-directionally signalled sections, single Eurobalises up to 5km apart are used;

TASS needs only a minimal driver interface, so the ERTMS screenbased display is not used;

. TASS operation is logged by the train's own data recorder, not by a separate ERTMS Juridical Recorder.

In fact, very few items of hardware were designed specifically for TASS use. The interface to the train circuits is a small sub-set of the ERTMS one and is class-specific of course, and the simple driver interface is provided as part of the cab desk design. The simplification of The ERTMS odometry software was developed for the project, and the TASS Application Program was defined to meet Virgin's requirements.

The heart of the TASS on-board system is the TASS Vital Computer (TVC) which is configured from standard components, in a 2-out-of-3 architecture. Apart from main processors, each channel has dedicated pre-processors for balise reading and odometry, and the TVC has parallel and serial I/O cards to interface to train circuits, driver indications, data recorder, etc.

The TVC receives information from two balise antennas (one bogie mounted, the other body mounted due to lack of space) operating in a main/standby configuration, and two speed sensors fitted to non-motored axles.

The Driver MMI consists of three or four lamps (according to train type), a reset button and an audible device.

Operational Principles

The TASS Working Group defined a set of fundamental principles covering the operation of tilting trains in the UK. These affect TASS functionality and application rules, as well as other responsibilities on the railway, and can be summarised as follows:

. Sections of routes over which tilting trains are intended to tilt will be fully gauged, to determine the precise extent over which tilting operation is to be permitted;

. Eurobalises, installed on routes used by tilting trains, will define the areas over which trains of each type may safely tilt. Receipt of data in Packet 44 structures from these balises will automatically initiate tilting operation of these trains where appropriate;

. Lineside speed signs will indicate to drivers the highest enhanced permitted speed for any type of tilting train using a route. Sectional Appendices for the route will define precise enhanced permitted speed profiles for every train type, including tilting trains;

. Tilting operation, at normal or enhanced speeds will only be allowed whilst train speed is being continuously supervised, with warning to the driver and subsequent automatic brake application in the event of a driver failing to control speed appropriately. Speed profiles for each type of tilting train on a route will be defined in the same Eurobalises that define tilt authorisation areas;

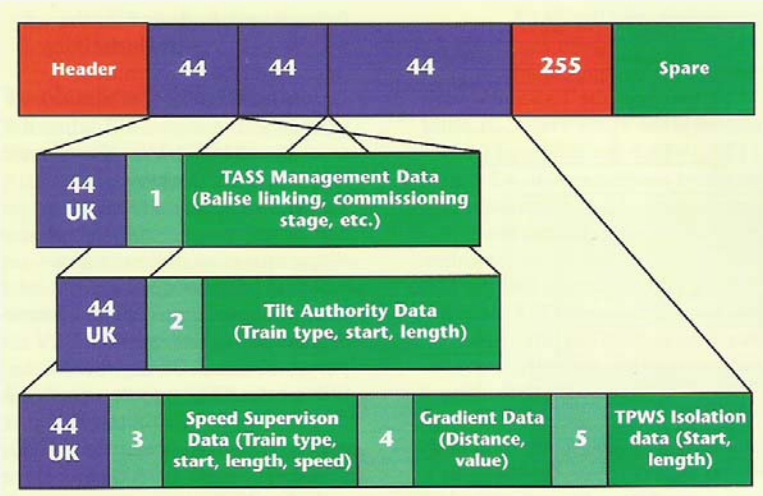
. Whilst train speed is being continuously supervised, TPWS on tilting trains will be automatically isolated in the immediate area of any speed traps supervising speed reduction to inappropriate lower PSRs. Data defining the location of such speed traps will be included in the same Eurobalises;

. Indications to the driver confirm the status of TASS and tilt systems, and inform the driver of warnings and interventions resulting from overspeeding;

. Until the advent of ERTMS on routes operated by tilting trains, responsibility for informing the driver of which route is set ahead, and of the appropriate speed for that route, remains with the lineside signalling and speed sign systems (including TSRs and ESRs), as for conventional trains.

These principles provide significantly more comprehensive speed supervision than is mandated by the Railway Group Standards. It is obviously legitimate for the train operator to choose to do this , and was

TASS Driver Machine Interface in a Pendolino Cab
(Note: The Blue Lamp has since been renamed "Speed Supervised")



TASS Balise Telegram Format - using data contained in three ERTMS Packet 44s

decided after human factors studies on the driving task, and after consultation with Virgin's drivers.

TASS Functions

TASS operation is selected according to the state of the driver's master controller. TASS reads Eurobalise messages, and acts on those containing TASS data packets, which are of three types:

- Management Data, including data for fault reporting, distance checking, etc. This packet takes the place of more complex functions within ERTMS;
- Tilt Authority for the section ahead (which may be different for the two train types);
- Speed ProfIle for each train type for the section ahead, with associated gradient profIles and details of any TPWS isolation actions needed.

Each of these data packets is an ERTMS packet 44. TASS is a registered UK application, and the TASS balise telegram specification is published by Railway Safety.

TASS measures speed and distance travelled since the last TASS balise. Large odometry errors result in safe reversion to non-tilting operation of the train, but these are infrequent due to the use of two speed sensors on separate unmotored axles. Measured balise-to-balise distance is recorded on every train's data recorder, allowing a database to be progressively built up of measurement accuracy in varied main line operation.

Based on the above inputs, the TVC carries out three more or less independent primary functions:

- Enabling and disabling tilt at the relevant locations, including monitoring the correct operation of the interface to the tilt control system;
- Supervising train speed according to location, generating braking curves as appropriate;
- Isolating TPWS at any defined locations, including monitoring of the interface to the TPWS equipment.

TASS Operation

When the driver opens up the cab, TASS tests itself and its interfaces with other on-board systems. The driver checks the cab indications and, on the alert tone, resets the TASS brake application. The "Health" light confirms that TASS is fully operational and the train will be able to tilt during its journey. The driver is then free to drive the train.

When the train enters the main line, it reads the first TASS balises in the track. The on-board equipment checks its odometry operation, and then begins supervising speed. It sounds a short alert tone and lights the blue "Speed Supervised" light, which remains on for most of the journey, assuring the driver that TASS and the train's Tilt System are working, balises are being read, and the train speed is being supervised to the appropriate profile for the type of train and the location.

As the train enters the tilting route, a cab indication informs the driver that tilt is now enabled. Successive balises along the route extend the tilt authorisation and the speed profile. The driver is responsible for controlling his speed, according to his instructions, and the lineside signs.

TASS is installed on all Virgin's Class 221 (Super Voyager) and Class 390 (Pendolino) trains, both seen here in service at Manchester Piccadilly

With the "Speed Supervised" light lit, he may follow the enhanced speed profile, the train providing a comfortable ride by tilting as appropriate on the curves.

If the driver goes too fast anywhere on a TASS route, an audible warning alerts him to the fact that the TASS "Warning/Intervention" light is flashing, telling him to brake until the speed is reduced to an acceptable value again. If the driver ignores the warning, the audible warning stops, the light shows steady, and TASS applies the train brakes. The train slows down, and once it reaches a safe speed, the light flashes to tell the driver he can reset the intervention, and reapply power to follow the correct speed profile.

Approaching locations with restricted clearances, the train automatically stops tilting, but the train speed is still supervised by TASS. When the train has passed the restricted area it starts to tilt again.

If a balise is missing from the track, or if the tilt system signals a fault, TASS warns of the need to slow down, and then supervises the train speed down by 25 mile/h, before leaving the driver free to continue as a non-tilting train. This ensures passenger comfort is maintained.

Migration to ERTMS

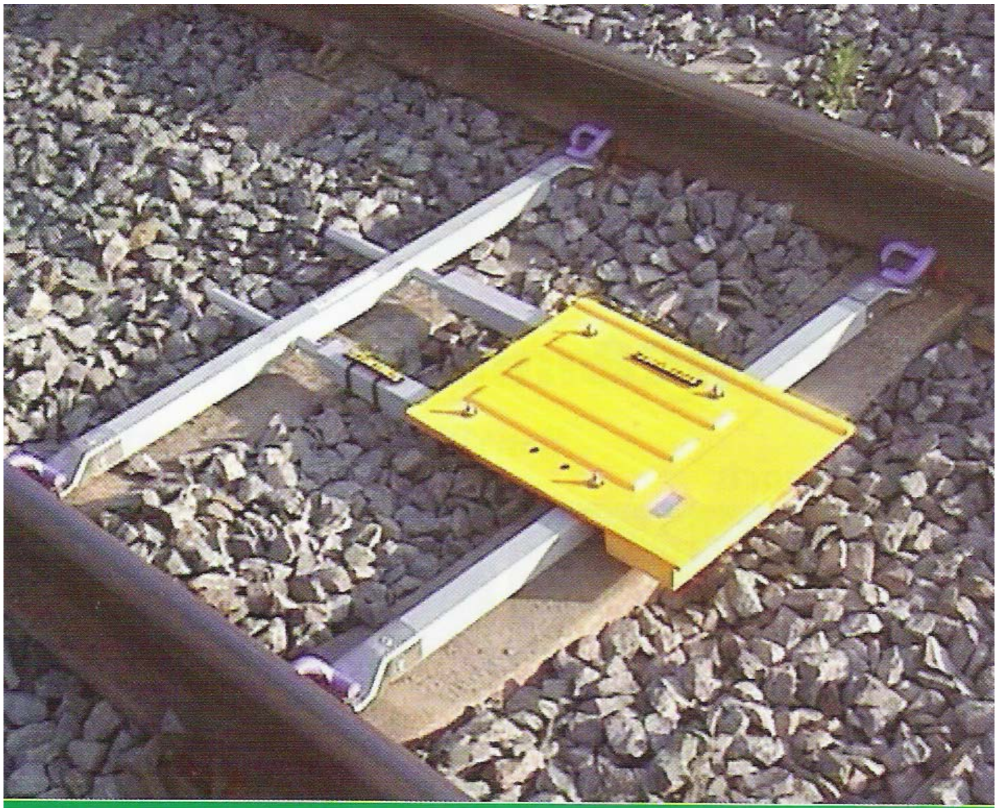
High-speed routes and the trains that use them will be among the first in the UK to be equipped with ERTMS. A migration path from TASS to ERTMS is planned as follows:

. When ERTMS is initially fitted to tilting trains, their ability to continue to operate on TASS-fitted non ERTMS fitted routes must be maintained, so TASS functionality must be "ported" into ERTMS, as a national function;

.When tilting trains operate under ERTMS on a UK route, tilting will still be automatically enabled and disabled according to TASS data packets conveyed to trains along with the ERTMS Movement Authority (either from Eurobalises or by GSMR radio);

. ERTMS will supervise tilting trains to the appropriate safe operating speed;

. Standardised screen icons on the ERTMS screen will replace the initial TASS driver interface.



A TASS Eurobalise installed on the track using the rapid fixing kit

Once all tilting routes are ERTMS fitted, the TASS operating mode can be abandoned and the balises recovered.

Scope of TASS Application

TASS is fitted to all Class 390 and Class 221 trains - a total of 194 sets of equipment.

TASS will be fitted to all West Coast Main Line fast lines and platform loops used regularly by Virgin trains. It will not be fitted to the larger stations where blanket low speed restrictions apply. About six areas on WCML (mostly tunnels) will be "Tilt Prohibited" for Pendolinos. Sections of Cross Country routes will be fitted once they have been gauged and cleared for tilting operation. Infrastructure data is compiled section-by-section, validated, and issued by Network Rail. ALSTOM define acceptable balise locations, and then use an automated tool to generate the telegram contents for each balise. Programmed balises are labelled and supplied with rapid mounting kits, similar in design to those used for TPWS.

Current Fitment Status

Extensive development testing of TASS has been carried out on laboratory simulators in the UK and Belgium. TASS balises are fitted to the high-speed test track at the Midlands Test Centre, Asfordby, where all type testing of TASS has been carried out on a pre-series Class 390 train. Balises are also fitted at Bombardier's Monk Bretton test track, near Doncaster, for Class 221 commissioning tests.

The Carlisle to Carnforth section of the WCML is fully equipped with balises and high speed tilt testing has been carried out there on both train types. The Cross Country route between Banbury and Oxford is also fitted, and is being used for driver training on tilting Class 221 trains running between service trains. The next section to be equipped will be Brinklow to Colwich on the WCML, for tilting Pendolino driver training in the summer of 2003. Then, TASS will be progressively rolled out over the remaining WCML route sections as line speed improvements, gauging and speed signing work are completed, and final infrastructure data is issued by Network Rail.

TASS functionality is also implemented on all Virgin's driver training simulators at Crewe (one Class 390 and two Class 220/221 cabs, the latter with "motion" simulation, including train tilting).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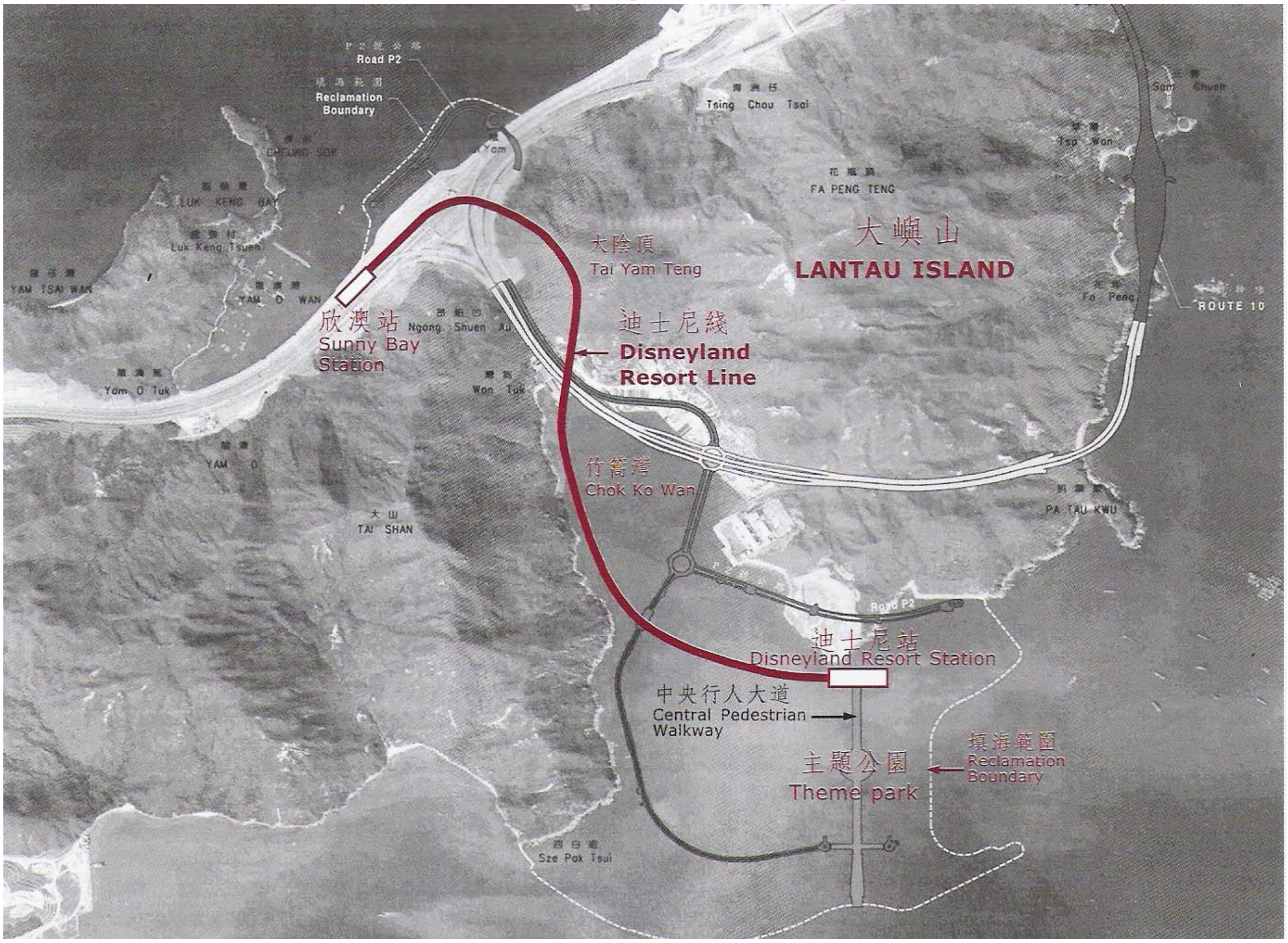
DRL Signalling



Combining Proven Methodology with State-of-the-Art Technology

Lam Bik Shun, Gordon
Senior Construction Engineer – Signalling

Chan Chun Sing
Senior Design Engineer

Disneyland Resort Line (DRL) is a dedicated MTR line to provide an efficient and leisure transit to the soon open Disneyland Theme Park by connecting the new Sunny Bay Station (SUN) on Tung Chung Line (TCL) with Disneyland Resort Station (DIS). The layout is in principle a single line track with a bypass loop provided. Two trains in synchronised mode will shuttle between the 2 stations with a minimum headway of 4 minutes for peak-hour service. Despite its relatively small scheme with only 2 stations and about 3.4 km in length, there incorporated a number of new attempts and advanced concepts in the application of DRL signalling.

This article will highlight its distinguishing features in control principle, open standard, mode of operation, and integration with LAR. The overall system architecture will also be introduced which gives a simplified concept of the embedded subsystems.

DRL Signalling System – its Distinguishing Features

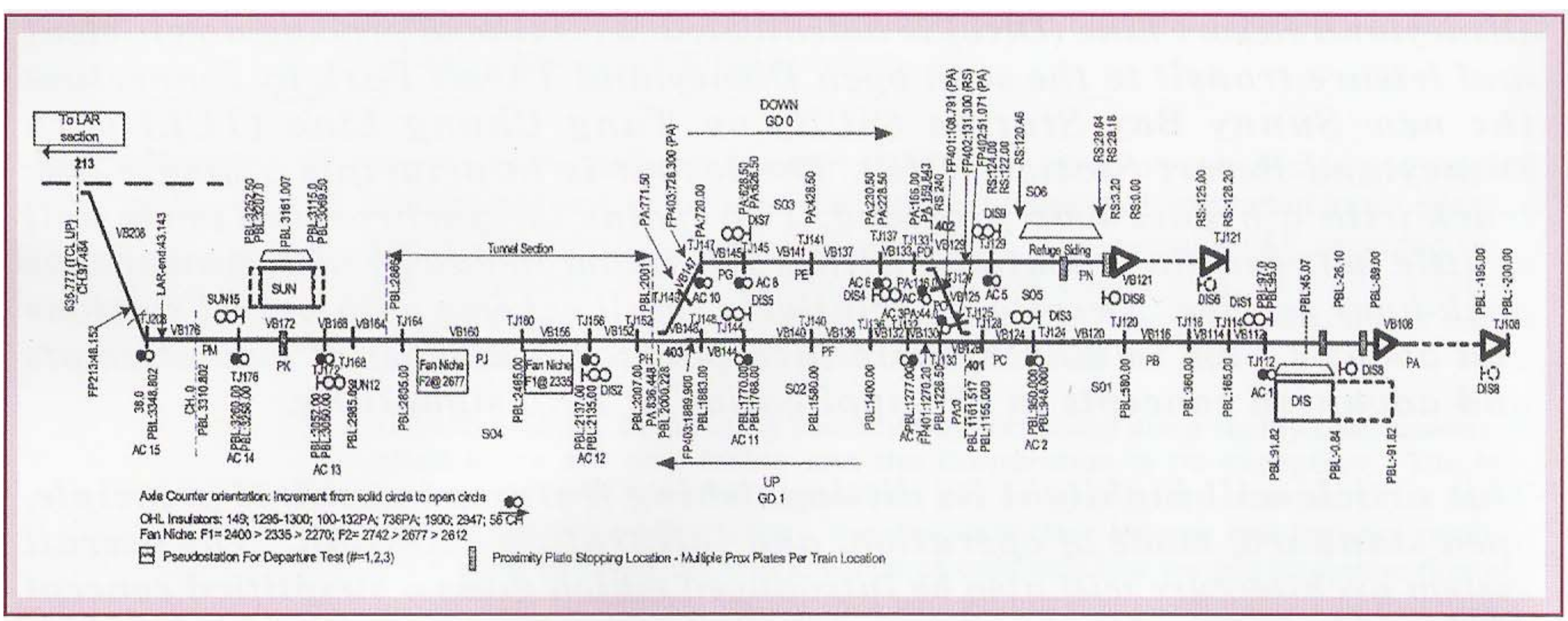
In brief, the DRL signalling system embraces 4 new and advanced features.

DRL signalling system is the first *Communication Based Train Control System (CBTC)* in MTR. CBTC by its nature no longer relies on conventional train detection device like the track circuit for train presence detection. Individual train position information is mainly derived from trainborne computer having real-time checking of its own location and sending the information back to trackside computer via train-to-trackside communication. On the other hand, position of other trains in the network is sent from trackside computer to all trains in the network via track-to-train communication.

Another main feature of DRL signalling system is that track-to-train and train-to-track communication is based on radio communication. The *open standard IEEE 802.11* based technology is adopted. It is the same as the popular standard known as WiFi which is most frequently used in personal notebook computers or palms for internet access. Its first application for such control is the Las Vegas Monorail opened in mid 2004. DRL would be the second system adopting the same application in the world.

Fully Automatic Operation (FAO) is a new operation mode in MTR provided by DRL signalling. Compared to automatic operation currently used by most other lines in MTR, door operation is also fully automatic when trains approaching and departing stations. Besides, a series of remote control functions like train door control, pantograph control, trainborne equipment switch-over, etc are also provided.

After successful interoperability achieved a few years ago in TKE and QBR projects between 2 SACEM-based ATC systems provided by different suppliers, the operability of new DRL trains on LAR tracks between SHD and SUN section is achieved by a different concept *systems overlaying*. Non-passenger DRL train movement under ATP Controlled Mode (CM) between SHD and DRL can therefore be introduced without significant impact to existing TCL and AEL operation in LAR. Thanks to the radio-based nature of the selected CBTC - risk to the LAR normal operation can also be minimised throughout the implementation and testing phase of DRL signalling.

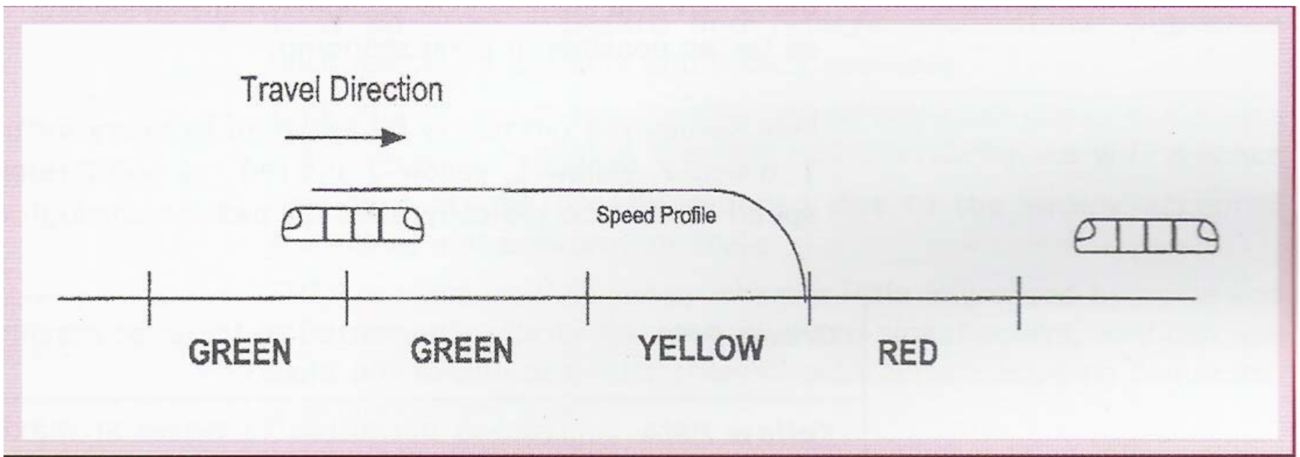


DRL Signalling layout

CIITC for DRL: SelTrac FB/R 4h Modified Fixed Block Signalling for AgiIpIication in LAR

DRL signalling employs fixed and virtual block CBTC, namely, SelTrac FB/R provided by Alcatel. That implies there is no physical trackside device to serve as block demarcation on its baseline system. All blocks are defined in software and hence virtual, giving the advantage of minimal trackside equipment design and this will facilitate future modification.

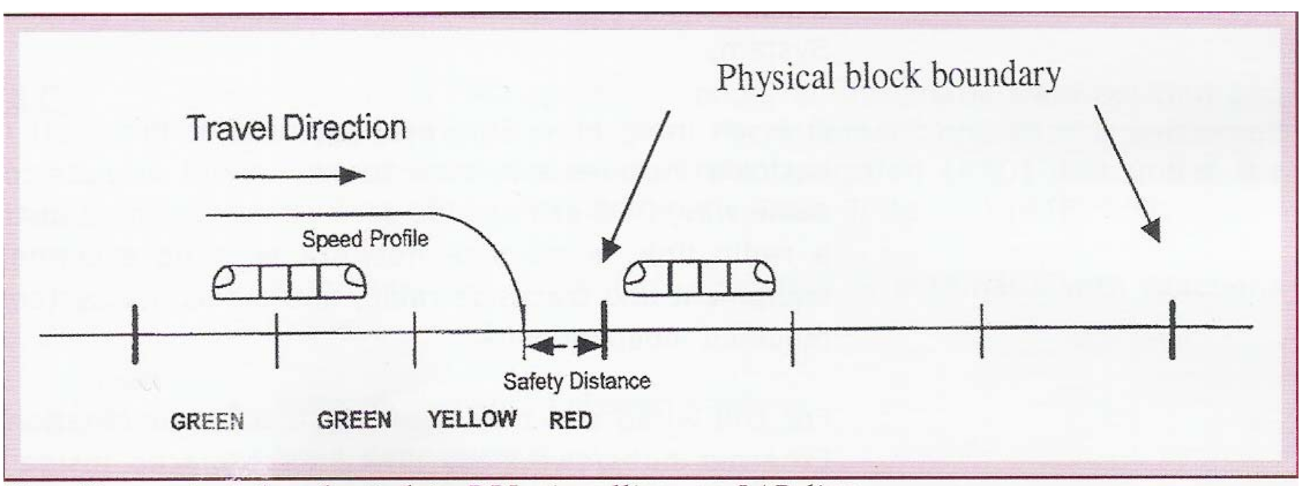
The basic principle in virtual block signalling is to maintain at least one block with "red" Permissive Movement Authority (PMA) between trains. In addition to virtual blocks, axle counter has been designed into the system to provide minimum physical occupancy information for non-CBTC equipped train movement and also facilitate recovery in case of trackside computer failure.



Virtual block signalling principle

For cross-line movement in LAR tracks, consideration has been given to the current LAR signalling block principle which allows 2 trains in adjacent physical (i.e. track circuit) blocks. Modified fixed block signalling is hence developed in DRL signalling to meet this need, and that:

- 2 trains will never be allowed in the same, but at most adjacent physical blocks in LAR
- 2 trains will be separated by at least one red virtual block in LAR & DRL



Signalling principle adopted in DRL signalling on LAR line

Contrary to conventional train detection device, virtual block occupancy in DRL signalling is hence based on information received from 2 sources simultaneously:

- continuous report on train positions
- physical block occupancy report - either track circuit occupancy input in LAR area, or axle counter occupancy input in DRL

Using all these virtual block and physical block occupancies, PMA is calculated using PMA equations. These equations take into account of point status, routing constraints governed by the necessary interlocking rules, etc to prevent opposing routes and ensure safe separation between trains. These PMA equations shall also consider other specific design criteria such as ECS equipment airflow outlets not to be blocked as far as possible in train stopping.

PMA values will ultimately be assigned to every virtual block: green1, green-2, yellow-1, yellow-2 and red. (1 and 2 refer to the different speed restriction typically used for passing through a point)

Green PMA	Train is permitted to travel at maximum speed to the end of the block
Yellow PMA	Train is permitted to travel at maximum speed, but must stop at the end of the last yellow block
Red PMA	Train is not permitted to travel in the block

The number of red blocks calculated beside an obstruction would ensure that there is sufficient length to guarantee that under all failure modes, a train is prevented from colliding with the obstruction. Normally PMA for 4 consecutive blocks would be sent from trackside computer to trainborne computer.

Data Communication System (DCS)

One pioneering feature of the system is the open standard RF communications technology 802.11 Frequency Hopping Spread Spectrum (FHSS) adopted for the communication between train and track. The network in totality is called the Data Communication System.

It is an integrated Ethernet-IP (Internet Protocol) network which basically includes a wireline backbone and wireless components. In some way, DCS can also be seen as comprising 3 distinct elements a radio link, a wayside network with fibre connecting wayside equipment and trackside radio, and a security system which can be modified independently.

For the wired wayside network, it is a combination of connected Ethernet hubs/switches. They were placed inside the signalling equipment room and connected to radio Access Points (AP) along trackside via media converters. The network serves as a high-speed Ethernet backbone.

For the wireless part, it refers to the communication between 2 elements - APs and Station Adaptors (SAs). APs are placed at fixed locations along the trackside and SAs are the mobile components on trains. APs are typically at about 120m apart subject to the coverage needs which need to be optimised with respect to geographical constraints, and SAs are installed as part of the train's DCS subsystem. Located at both ends of the train, each radio is connected to 2 antennas to ensure diversity. With such diversity, 2 independent wireless signals can be received and compared by the SA. As a result, the better of the 2 is selected.

The main advantages for choosing IEEE 802.11 with FHSS modulation are:

- "' It is an open standard and related professional published documentation is freely and widely available
- " IEEE 802.11 radios *are* commercial-off-the-shelf components with many vendors available ensuring interoperability via WiFi Alliance
- "' The cost can be greatly reduced due to the widely accepted standards and economy of scale
- "' FHSS is a robust technology which is little influenced by noise and reflections due to its less sensitivity to signal delays, and can use up to 79 available 1-MHz channel with certain hopping sequence and customised dwell

In addition, there are typical benefits from radio application which include:

- complete link redundancy
- less overall equipment
- high data throughput
- easily upgradable and expandable

Security Device (SD) is, on the other hand, inserted into DCS to authenticate all communication between subsystems. This feature isolates the ATC device from unauthorised telegrams and communications. It ensured routing of ATC communication traffic along secure paths using authentication keys that are periodically distributed by a master key server.

FAO

Under normal FAO operating mode, all automatic train position and operation functions are active. The automatic operation is performed by the non-vital Automatic Train Operation (ATO) unit under the supervision of the vital Automatic Train Protection (ATP) unit.

In summary, the entire FAO operation is automatic with functions including:

- train movements between stations
- train door operation
- cab display
- pantograph control
- triggering of all digital voice broadcast messages

If an FAO mode train in DRL loses positions (analogy to delocalisation in SACEM) due to failure of its both Vehicle On-Board Controllers (VOBCs), it may be possible for the train controller to recover one of the VOBCs and re-establish the train position by using Remote Speed Restrictive Mode (RSRM) to regain FAO mode without train attendants intervention.

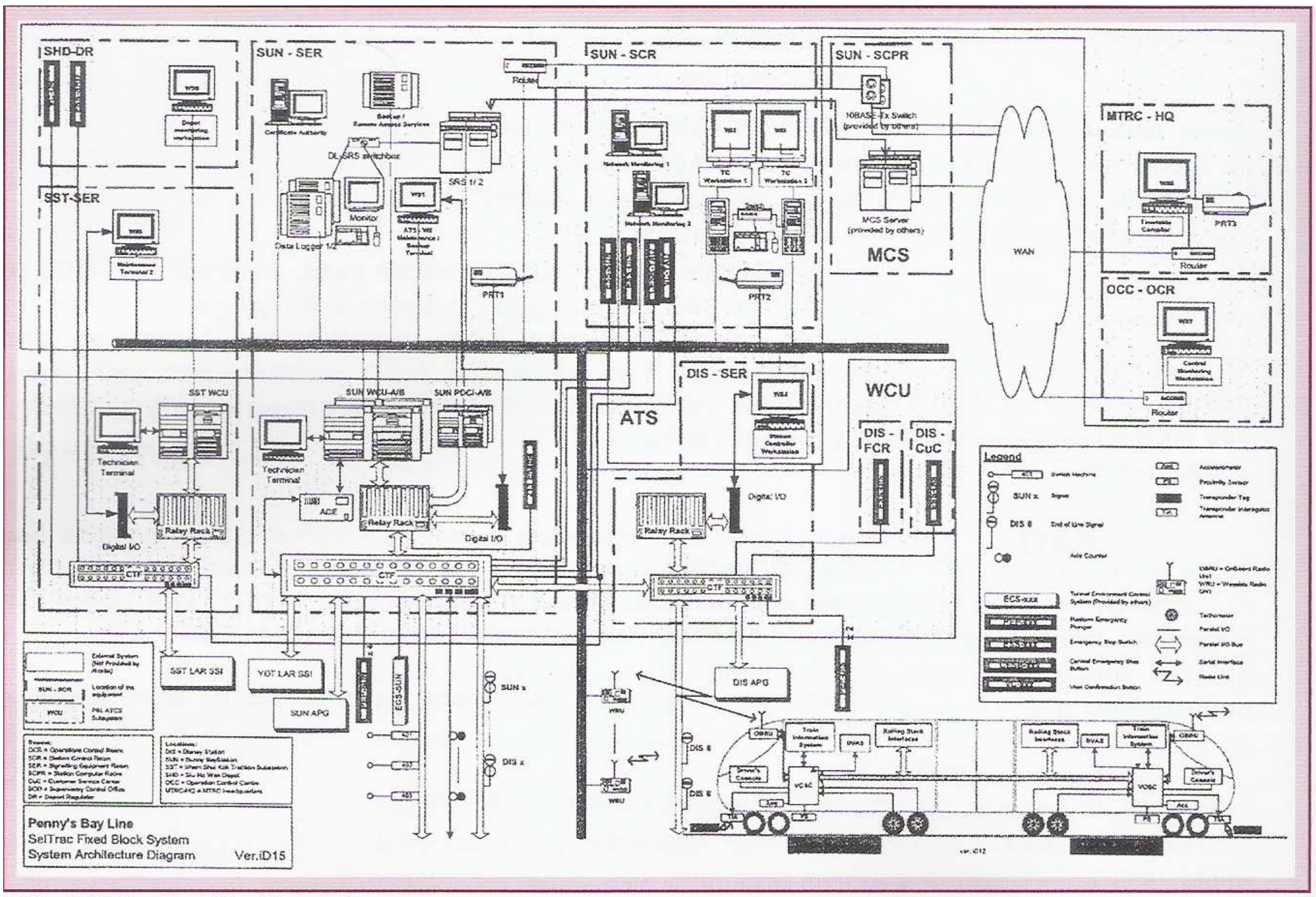
Two trains will be running in DRL at the minimum headway of 4 minutes during peak hours. The trains will travel as synchronized shuttles between SUN and DIS.

Crossline train movement- between SHD and DRL

It refers to moving trains between the depot and DRL area. The route setting shall be performed manually. When requirement of this movement has been coordinated between the train controllers for LAR and DRL, the cross-line route can be initiated. The controller requesting the route should initiate the route request from respective ATS system. Subsequent route acknowledgement made by the other train controller in associated ATS should complete the route setting mechanism when safety conditions have been checked and fulfilled in both systems.

DRL Signalling System Architecture

The DRL CBTC system is implemented in a structured architecture, comprising 3 levels of control:



DRL ATC System Configuration

1. *Automatic Train Supervision (ATS)*

This subsystem provides overall system management functions. It is implemented by a number of computers interconnected through DCS. Each of them is configured to meet specific needs and performs one or more of the following functions in the scope of ATS control:

- schedule regulation
- line overview
- schedule compiler
- data logger
- graphical user interface
- maintenance terminal

2. *Wayside Control Unit (WCU)*

It is the core and vital subsystem at control and supervision layer. With the trainborne layer, the interlocking and Automatic Train Protection functions are implemented, including:

- train tracking
- safe train separation
- PMA generation
- route and point interlocking
- vital point control and monitoring
- emergency stop systems
- axle counter interface
- interface with LAR SSI interlocking

There are 3 WCUs for DRL signalling system. Two shall be running as redundant configuration in SUN, and for control of DRL area and part of cross-line operation. The third unit, SST WCU, shall control the remaining cross-line operation and the test track in SHD.

WCU also controls, monitors, or corresponds with the following trackside equipment:

- point machines
- 2-aspect signals and buffer light
- axle counters
- transponder tags
- platform emergency plungers
- emergency stop switches

3. *Vehicle On-Board Controller (VOBC)*

VOBC is responsible for trainborne control at on-board control layer. It implements ATP with WCU layer, and also the Automatic Train Operation (ATO) functions. There are 2 VOBCs installed on each train, one at each end. They are configured as hot-standby. Either VOBC can control the train in FAO, in both directions.

Each VOBC consists of ATP unit and ATO unit and interfaces with rolling stock equipment, Digital Voice Announcement System (DVAS) and Train Information System (TIS).

Typical functions provided by ATP include:

- train position and speed determination and supervision
- rollback protection
- position reports to WCU
- train direction supervision
- PMA reception and supervision
- door control enable and supervision
- emergency brake control
- propulsion and brake control interlocks
- vital pantograph commands
- vital auxiliary power commands
- vital traction power commands
- motion obstruction supervision
- train integrity supervision
- on-board VOBC switchover

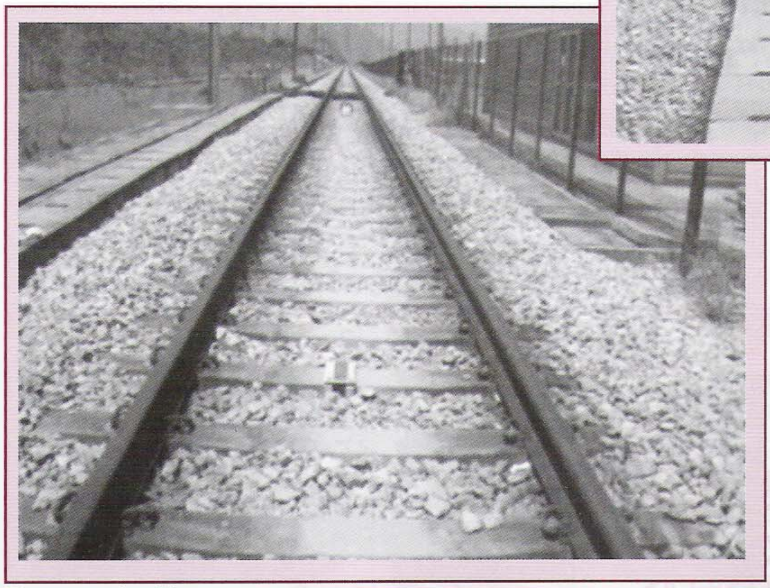
Typical functions provided by ATO include:

- automatic movement control
- train propulsion and brake control
- station stopping and dwell
- door control commands
- interface with DVAS
- interface with TIS
- operational pantograph control
- cab display control
- reports to ATS

There are 3 trains equipped with VOBCs. Besides, there is also other equipment on-board per VOBC:

- tachometers for speed measurement
- accelerometers f1or slip/slide detection and compensation
- transponder interrogator (T1) and antenna for positioning
- proximity sensor for station stopping

Antenna



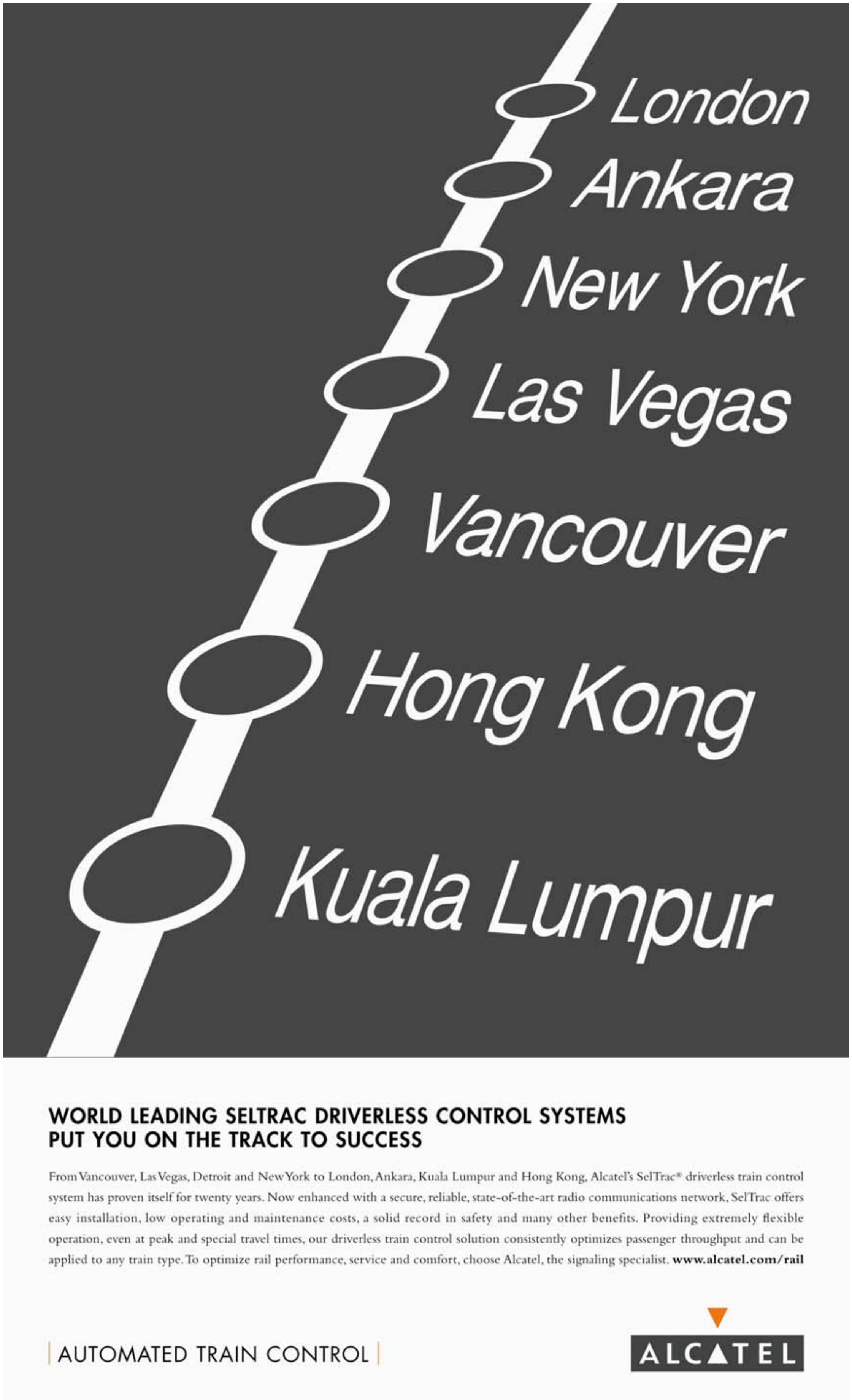
Transponder Tag

Conclusion

The 3.4km DRL will be able to shuttle about 10,000 passengers an hour to the Disneyland Theme Park during peak service. Its signalling system embeds various new attempts in the application of CBTC, IP derived from IEEE 802.11, FAO and LAR interface implementation. These were challenging but rewarding endeavours, bringing new exposure to the project signalling team. .

Reference

1. *"Open standards for CBTC and CCTV Radio-Based Communication" - by Ed Kunn, Alcatel Canada*
2. *C592 Design Document – "System Design Overview"*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Metro Development in Shenzhen

Shenzhen Metro Route Map 2000 – 2010

Shenzhen Metro Phase 1 commenced operation in 28 December 2004. The Phase 1 project included east section of Line 1 with 15 stations along 17.39 km mainline and south section of Line 4 with 4 stations of 4.48 km. Line 1 and Line is crossed at Huizhanzhongxin Station lower two levels. The depot is located at Zhuzilin with Operation Control Center and maintenance workshop. Huanggang Station is at Line 4 south end and under construction. It will open for service in line with Hong Kong LMC spur line in 2006.

Shenzhen Metro Phase 2 consists of four lines. Line 1 will extend from the Window of the World (Shijiezhichuang) to the western part of the city, reaching the airport at its western extremity. Line 2 will connect the Phase I Line 1 at the Window of the World and end at the Shekou Passenger Port. Line 3 will start from the center of Luohu District through the eastern part of Shenzhen to Longgang District. Line 4 will cross the city center, extending the metro to the center of Longhua Township. On the completion of Phase 2 the total length of Shenzhen Metro will be 108 km, cost of more than 35 billion yuan.

Line 1 Extension will extend 23.2 km to Shenzhen Airport in the western district. It consists of 18 km of underground main line track work, 0.4 km at ground level and 4.8 at grade with total 15 stations of 13 underground and 2 overhead. It is expected to complete in 2008 at cost of more than 10 billion yuan.
Line 2 will link Shijiezhichuang and shekou with length of 14 km mainline. There will be 11 stations including 10 underground and 1 ground level. The Shijiezhichuang Station is the interchange with Line 1 and Line 2. It is expected to complete in 2010 at cost of 5 billion yuan.

Shenzhen Metro Line 3 plans to commence construction works by 2005. The length of main line is 32.9 km. There are 21 stations including 6 underground and 15 overhead. The route links between Huanglingzhong Station Lu in Luohu District to Hinglongjie Station in Longgang District. There are 6.9 km underground mian line and 25.7 km viaduct. The shortest distance between two stations is 0.96 km and the longest distance is about 3.8 km. The depot is located at Henggang. The interchange station between Line 1 and Line 3 is Laojie Station. It costs more than 10 billion yuan and will complete in 2009.

Line 4 will extend from Shaoniangong Station to Longhua Xincheng Zhongxin Station with length of 16 km, 4.5 km underground, 1 k at ground level and 10 km viaduct. There are 9 new stations, 2 underground, 1 at ground level and 6 overhead. A new depot will locate at Longhua District. It is expected to complete in 2009 at cost of 6 billion yuan.

By 2010, the rail network in Shenzhen, consisting of the metro, light rail and railway, will have a total length of 250 kilometers at a total cost of 69 billion yuan.

By K M Li

Interesting Signals No.65

Signal CR81 at Chester

By David Stratton

The signal in question (picture by David Stratton)

This signal was installed when Chester was commissioned, circa 1984.

It is a mid-platform signal on Platform 3A for tbe Down direction (that is, towards Holyhead). This line is bi-directional and has another mid-platform signal (CR94) for the other direction just past its overlap. There is also a crossover between these two signals, and there are parallel signals on the adjacent line (the Up & Down Main) .

This platform has a low canopy running along its entire length. In order to obtain adequate sighting, CR81 signal is mounted on one of the canopy supports. As a result it is at a slight angle to the horizontal, as can be seen in the photograph.

It was first installed the other way round that is with the Green nearest to the running line. It was noticed that this was contrary to the signal sighting form, and the Red and Green were swapped round in early 2003.

[Additional information supplied by Colin Saunders and John JonesJ.

Jokes of the Month

"Plus 24, minus 42…Yes, exactly as I thought! I had absolutely no women this year..."

"And then they all lived happily ever after... wait, that's not a way to finish my tax report..."

Guys, No Need To Crawl Over Me. My Heart Belongs To My Lover


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Frieda McKenzie, theater fan in New York City
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2005 Activities of IRSE (HK Section)

10 Oct, 2005	IRSE Study Tour & Delivery of a Reliable Signalling System	IRSE	Welcome all IRSE Members
22 Oct, 2005	Tsing Yi Station Operation Control Centre	IRSE	Welcome all IRSE Members
24-26 Oct, 2005	Australasian / Singaporean IRSE Technical Convention 2005 "Embracing the Technologies – Singapore"	MTRC IRSE	Welcome all IRSE / MTRC members
27 Oct, 2005	10th Anniversary Annual Dinner Happy Valley Suite, 3/F Happy Valley Stand, Happy Valley Racecourse	MTRC IRSE	Welcome all IRSE / MTRC members
Nov, 2005 To be confirmed	Hong Kong Police Control Room	IRSE	Welcome all IRSE members
Dec, 2005 To be confirmed	Hong Kong Chek Lap Kok Airport	IRSE	Welcome all IRSE members
6 - 8 Dec,2005	AsiaRail2005 International Congress Intercontinental Bangkok Hotel Thailand	IRSE	Welcome all IRSE members

Happy Birthday!

Our best wishes to the following IRSE (HK Section) members.

WONG WIN KAN	黃永根	1-Oct
CHAN YAT MAN	陳逸珉	1-Oct
LAU WING ON	劉榮安	2-Oct
YU SZE NING, SANDY	余仕寧	2-Oct
CHAU HOK MAN	周學文	4-Oct
TAM SING KIN	譚勝健	5-Oct
CHIANG NELSON	蔣立信	6-Oct
CHUI TOA SHING	崔道城	9-Oct
TSANG HON MAN	曾漢民	10-Oct
HO KWOK NUEN	佝國暖	11-Oct
YIP WAI CHUEN	葉偉泉	12-Oct
NG CHIU HUNG	吳超雄	15-Oct
LAI YUET FU, PHILIP	賴乙夫	16-Oct
KUNG CHI WAI	龔志偉	19-Oct

HO SIU WAH	何少華	21-Oct
CHEUNG CHI MING, AARON	張智明	21-Oct
LAW BOSCO	羅保田	22-Oct
WONG CHEONG WAH	黃昌華	23-Oct
WU PUI YAN	胡珮欣	23-Oct
KO CHUN PAN, ENOCH	高峻斌	23-Oct
MOK HOI KUEN	莫海權	24-Oct
LEE CHE HUNG	李志雄	25-Oct
TSO KA KAM	曹家淦	28-Oct
LEE CHI SHUM	李智琛	28-Oct
HO WAI MING	何偉明	28-Oct
CHU YEE MING	諸義明	28-Oct
LEUNG HONG SHUN	梁康信	29-Oct
LEE KIN LUN	李鍵麟	29-Oct
YIP YAM LAM	葉欣林	30-Oct

IRSE News Letter is published monthly by Institution of Railway Signal Engineers (Hong Kong Section).

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Presently we are looking at how we can improve IRSE (HK Section) Newsletter. To refresh the look, we are hoping to increase our local editions published every month.

We will be looking for additional articles from members to support the increased number of pages that will be available. We also believe, there are many varied and interesting ideas going on in our profession worldwide.

IRSE (HK Section) Newsletter gives the chance for you to share these with Institution members.

So send your contribution now and help us make our publication livelier and interesting.

Myla Pilarta-Li
Editor


進一步連繫 多一分親近
One Link Further One Step Closer