PARK SIGNALLING
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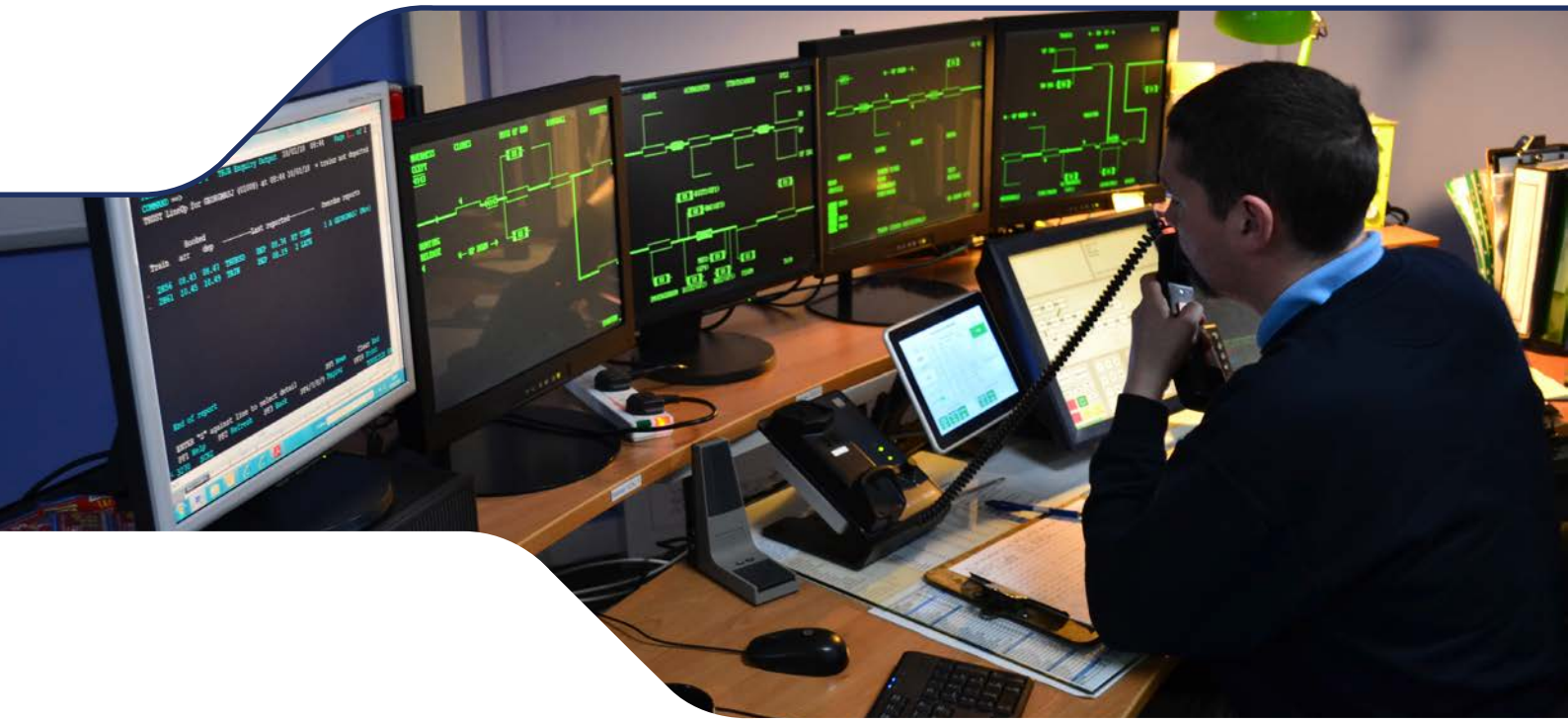
Radio Electronic Token Block (RETB)



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Design • Develop • Integrate • Investigate

Radio Electronic Token Block (RETB) is an economic radio based solution to the problem of signalling trains on lightly used lines where the cost of installing, operating and maintaining full scale conventional signalling systems cannot be justified.

The system, which was originally conceived by British Rail Research, is designed to economically improve operations on lines having little or no signalling whilst securing significant savings when lines with existing signals, need modernisation.

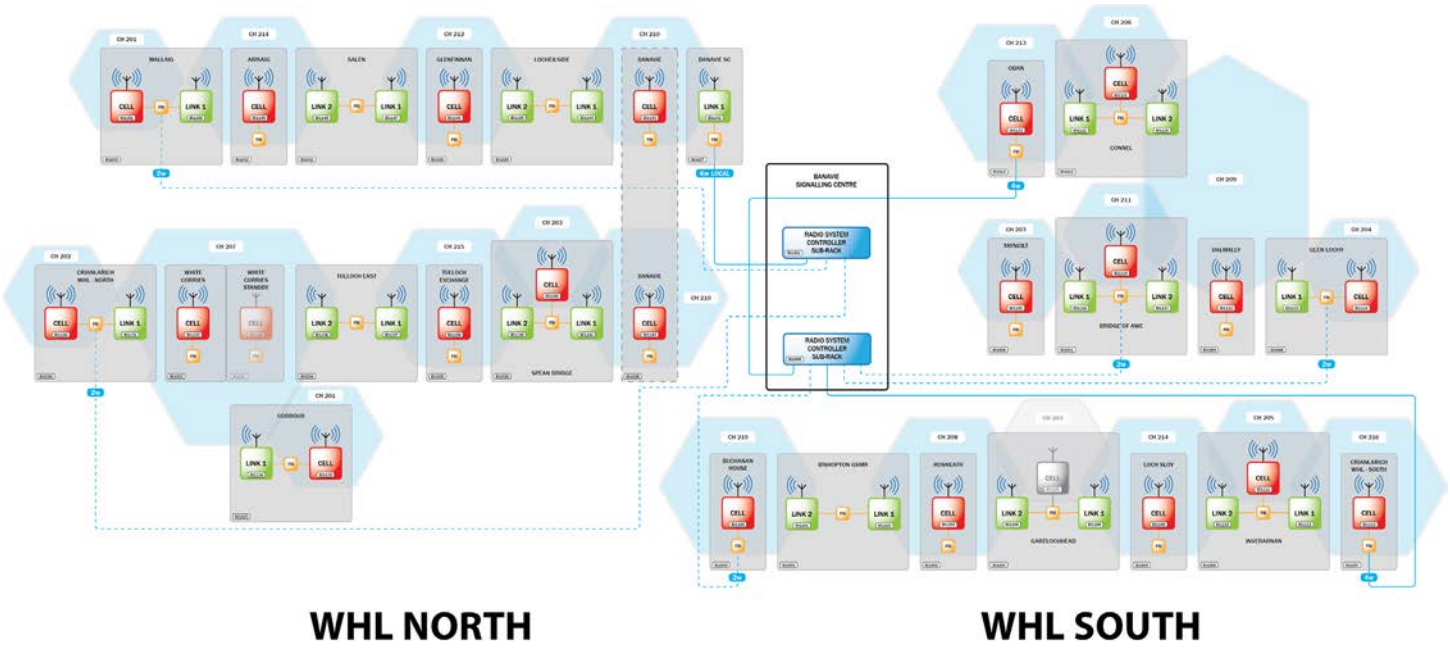

Figure 1 - West Highland Line RETB Block Diagram

First installed in 1984, the RETB system was born out of the need to reduce the renewal and operating costs of working lightly trafficked, long single lines found in Scotland, Wales and East Anglia. Figure 2 shows the lines where RETB is installed (and still operating) in Scotland.

Park Signalling, working with Comms Design Ltd, redesigned and upgraded RETB in Scotland during 2008-2010 (MK1 to MK2 RETB) and 2015-2018 (including splitting of an interlocking, requiring an additional RETB).

General Operation

All communication between the central control centre and the trains is by radio. In its most basic form there is no lineside, apparatus cases or lineside cables. One signalman is able to control up to 20 stations dependent on traffic levels. The elimination of signal boxes at stations and junctions reduces costs and manning levels, both essential to maintain the efficiency of modern railway operations.

In order to allow a train to proceed into a section, the fail-safe RETB interlocking issues an electronic token to the train for the appropriate direction of travel over the section. The drivers' cab is equipped with a Cab Display unit which receives the token in the form of a coded electronic message from the control centre which when received correctly and instructed by the signaller, provides authority for the train driver to proceed. (See Figure 3.)

At the control centre the signalman has a monitor and touchscreen keyboard which he uses to enter information into the interlocking. Typical control centre equipment is shown in Figures 4 and 5.

The fail-safe RETB interlocking checks the validity of the signaller's actions and if all the applicable criteria are met, issues the necessary token to the train. The RETB interlocking prevents the issue of more than one token to the train, and ensures that no other tokens result in a conflict.

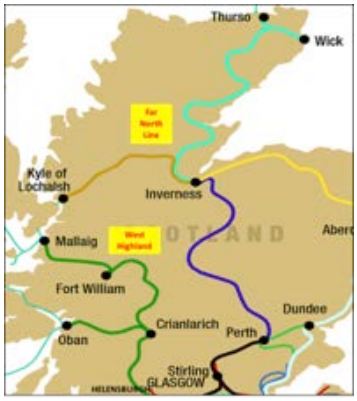

Figure 2 - Far North Line & West Highland Line

Equipment

The RETB interlocking is based on the well proven SSI hardware, fitted with special RETB operating software and configuration data. SSI has the largest installed base of any interlocking in the United Kingdom and comprehensively in many other countries, worldwide. It is a standard microcomputer based triplicated interlocking system that provides fault tolerance whilst assuring safety. The RETB interlocking software is common to each installation. Geographical data to suit each application is programmed into the RETB for each particular installation. Special interfaces are provided to allow connection to radio equipment and also to conventional signalling (if necessary).

Figure 3 –
Train Radio and Cab Display Unit

A logging computer at the control centre keeps a record of all token transactions. A voice recorder is provided to record all voice transactions between the control centre and trains.

Communication with the trains can be over a fixed system of radio base stations positioned at suitable locations along the route. The base stations can be connected using radio repeaters or using voice frequency channels over the telephone network if required. Other forms of communication are possible for instance GSM or Satellite communications should they be more suitable or available,

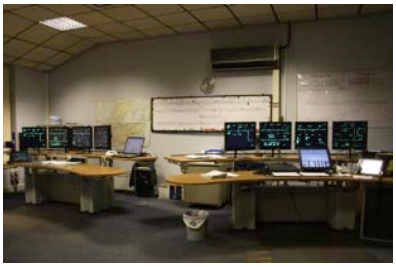

Figure 4 – Inverness Control Room

Figure 5 – Inverness
Equipment Room

Each train is equipped with:

- Radio transceiver (Figure 3)
- Loudspeaker and handset.
- Power supply
- Cab Display Unit (Figure 3)

Operation of the Cab Display Unit is by means of use of the RELEASE Key, the SEND and RECEIVES buttons. The Cab Display Unit accepts an Annett's key which may be used to release the mechanically operated points under the control of the system.

The small Kaba key can be removed from the Cab Display Unit to operate mechanically operated points under the control of the system. No token transactions can take place to the Cab Display if the key removed.

Train Operated Points

At passing loops a simple form of points operation is available which dispenses with the need for expensive local power supplies. These Train Operated Points, refer Figure 6, are trailled by the train leaving the section and are restored automatically using stored hydraulic pressure after a delay. Manual control is available for shunting. The points are provided with indicators (Figure 7) to advise the drivers of oncoming trains that the points are restored fully.

Figure 6 - Train Operated Points

Figure 7 - Points Set Indicator

Operating Principles

When entering an area under RETB control the train driver uses his radio to contact the signalman, who co-operates with the driver to enter the trains' identity into the system using the touchscreen keyboard (Figure 8).

Figure 8 – Touchscreen keyboard

The RETB interlocking checks that that the identity is valid and that no train having that identity is already entered into the system. When the procedure has been completed successfully the signallers monitor shows that the train has been accepted and that tokens are able to be issues to it (Figure 9).

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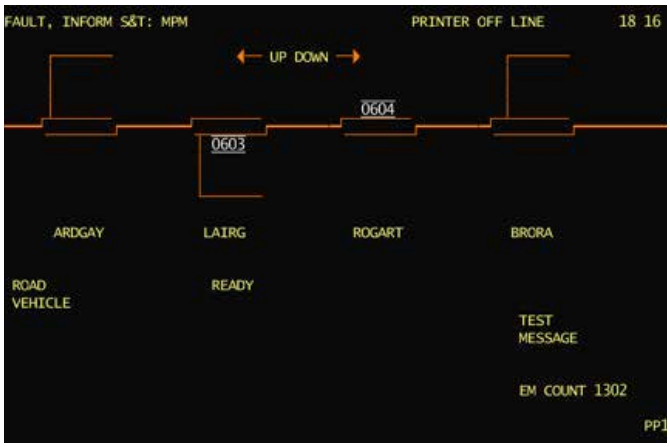

Figure 9 – Signalmans Monitor

When a train requires authority to enter a section, the driver contacts the signalman and requests a token for the particular movement. Assuming the token is available and valid, the driver and signalman co-operate by simultaneously operating their controls to allow the transfer of the token to the train. When the Cab Display Unit receives the token it shows the station names of the start and finish of the token authority, providing an unambiguous indication of the section for which he had authority to enter. The signallers monitor shows that the section is occupied until the token is released.

The driver advises the signalman that the train has passed a 'Loop Clear' marker board (Figure 10) that indicates that the rear of the train is clear of the station from which it has departed.

Figure 10 – Loop Clear Marker Board

This allows the signalman to perform a 'loop clear' procedure using the RETB touchscreen keyboard, which permits the RETB interlocking to free up the station area for other train movements. As the train driver approaches the end of the movement authority, it will pass a fixed distant board which indicates that he is approaching station limits (Figure 11).

Figure 11 – Fixed distant Board

When the train driver reaches the end of his movement authority, and is stationary at the stop board (Figure 12), he advises the signaller that he is ready to hand back the token to the Interlocking.

Figure 12 – Stop Boards

The driver and signalman again co-operate to release or return the token to the system. On successful, return the signalman's monitor will show that the section is now clear and also the drivers' display on the CDU also has Clear. The driver is then able to request a new token to allow him to proceed into the next section.

In order to reduce the number of transactions necessary at certain Token Exchange Points a simplified exchange procedure is available to allow return of a token and issuing of the next in one transaction.

The system can also provide for 'long section' tokens which permit the train to pass straight through stations when no other trains are to be crossed.

Separate tokens are available to cater for shunting movements in the station and to allow for 'track blocked', 'vehicle on line' and for Engineering tokens used to allow for track workers safe access to the line or to allow track maintenance machines to enter and leave midsection.

Possible Options and Enhancements

It is possible to enhance the basic RETB to provide additional facilities and features.

Train Protection and Warning System (TPWS)

In the UK, where TPWS is mandated, all rail vehicles are fitted with TPWS equipment which interfaces to the trains braking system.

In 2003 Railway Safety legislation mandated that RETB areas were to be fitted with the nationally introduced TPWS. This presented a challenge, as the trackside RETB equipment consisted of only reflectorised marker boards. To overcome this Park Signalling Limited designed, developed, manufactured and deployed a system which allowed TPWS to be deployed on RETB lines. TPWS has two separate but related functions:

a) To stop trains that are approaching a red signal at a speed resulting in a "signal passed at danger" (SPAD) being likely to occur. This is termed the 'speed trap function'.

b) Stop any train that passes a signal at danger. This is termed the 'trainstop function'.

The concept of system was simple. By listening to the RETB tokens with an eavesdropping device it would be possible to decode the token messages and assuming the message was pertinent to particular TPWS site could be used to control the TPWS equipment. The eavesdropping device is the Trackside Radio Control Module (Figure 13) and the system is Trackside Radio Control Unit (TRCU).

The fitment of TPWS trackside equipment at RETB Token Exchange Points (TEPs) is generally as required by the conventional TPWS equipment installation standards, with the exception that the RETB stop board replaces the signal as the prime reference point for the positioning of TPWS equipment.

As the section tokens are issued directly to the train driver, additional equipment is required to control and indicate the status of the TPWS system. This additional equipment consists of the Trackside Radio Control Unit (TRCU) that is mounted in a standard location housing.

Other equipment is required at the side of or on the track, being Lineside Status Indicator and treadles to trigger activation and the cancellation of the TPWS.

Trackside Radio Control Unit (TRCU) describes the whole system, including the TRCM, the Global Positioning System (GPS), the Location Identity Device (LID), and the Trackside Functional Modules (TFMs). A typical installation is shown in Figure 14.

RETB antennae are attached to lattice masts, close to the apparatus cases, or on masts attached to the RETB, Figure 15.

Figure 13 – Trackside Radio Control Module (TRCM)

Figure 14 –
Typical TRCM Installation

Figure 15 –
Typical TRCU Installation

Lineside Status Indicators (LSIs) are installed below the stop board (Figure 16). TPWS transmitter loops and train detection treadles (where required) are installed in the four-foot.

The LSI is a single aspect blue LED indicator located below the RETB stop boards that are fitted with TPWS, and indicates the status of the TPWS equipment to the driver.

The indicator operates as follows:

a) steady blue LSI indicates that the TPWS equipment is NOT suppressed and will stop the train.

b) flashing blue LSI indicates the TPWS equipment is in a suppressed state (that is to say, TPWS is not energised)

c) LSI showing no indication, indicates a fault with the TRCU or TPWS equipment. In this case the TPWS equipment may or may not be suppressed.

Figure 16 – TRCU Lineside Status Indicator

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