

# Mass Transit Solutions





## Who we are

Invensys Rail, a division of the global technology group Invensys plc, is a multinational leader in delivering state of the art railway control and communication solutions.

We enable the world's railways to help meet the ever increasing demand for rail services by providing a range of solutions that safely increase the capacity of their networks by increasing frequency and maximising operational effectiveness.

Employing over 3,250 employees worldwide, Invensys Rail operates through a network of regional offices and delivers products and solutions from some of the most famous names in the rail industry, Westinghouse Rail Systems, Dimetronic Signals and Safetran Systems.

We design, manufacture, supply, install, commission and maintain a range of safety related rail automation and control systems and equipment. Our broad offering ranges from highly complex integrated control centre solutions that supervise and control complete railways, sophisticated train based systems that automate train operation and protection, interlocking systems that ensure safe running across a network and a complete range of trackside products.



## Introduction

Our combined expertise is unsurpassed in the industry and enables us to deliver a level of service and professionalism that really makes a difference to our customers' operations.

Innovation has always been the lifeblood of our business. It marks out our people as pioneers. From the patented air brake developed by George Westinghouse in 1896, to being a major player in the introduction of the world's first fully automated passenger railway a century later, the Victoria Line on London's Underground, our innovation still continues to this day.

### Our Approach

As a world leader in advanced signalling and integrated control systems for mass transit operators, our success stems from our ability to provide truly flexible solutions. Whether it's modernising and upgrading an existing installation or an entirely new project, our solutions are based upon providing the right solutions to accommodate all the challenges operators face:

#### These include:

- Shorter headways
- Lower station dwell times
- Network pinch points
- Security and safety
- Reduced environmental impact
- Real-time information and control
- Asset optimisation and management.

## "A major player in the introduction of the world's first fully automated passenger railway"

Whether a complete solution or supplying an individual project, we have a step-by-step approach, to allow an easy, manageable and cost-effective migration. And for smoother and trouble-free implementation, we have a clear upgrade path, from simple product and interlocking solutions to complex driverless Communication Based Train Control (CBTC) solutions.

Whatever the project, we put into place the correct and innovative solutions that:

- Utilise existing assets to avoid unnecessary duplication
- Minimise disruption while the project is being carried out
- Are built around proven stand-alone products that can be combined, integrated and upgraded
- Are built on our years of experience in bespoke engineering and delivering integration.



### Solution Base Technology Benefits

Solution	Core Technology	Benefits
Operational efficiency	Interlockings	Improved reliability.
Automatic Train Protection (ATP)	Distance-to-Go Radio (DTG-R)	Improved train safety.
Auto turnaround	Interlockings SIL2 ATO Auto DTG-R	Efficient operations in depots, shorter headways and fewer trains.
Driverless	Interlockings SIL2 ATO Auto DTG-R	Improved availability and reliability. Headways kept to a minimum and drivers attend to the needs of customers.
Unattended	Interlockings SIL2 ATO Auto DTG-R CBTC Integrated control centre solutions	No drivers. Improved customer service from dedicated service staff. More flexible and efficient network operation.

## Our extensive portfolio

From point machines and signals to interlockings, ATC systems and integrated control centres, Invensys Rail can supply all of the signalling solutions your organisation needs to create the safest, most efficient transportation network available today.

### Interlockings

Invensys Rail supplies a wide range of interlocking products, the most appropriate choice for metros is undoubtedly the WESTRACE™ Mk2. WESTRACE has been used on a number of metro systems throughout the world to great effect and WESTRACE Mk2 is the latest evolution of this product.

The WESTRACE Mk2 Interlocking system consists of a family of compatible modules which work together over a common communications infrastructure. The modules can be co-located, for instance, in a signalling equipment room, or distributed around the railway. The interlocking function can also either be centralised in a control centre or distributed at each station.

The modules consist of an interlocking processor and a variety of input/output modules.

The processor module is responsible for performing the interlocking logic, but it also controls all the I/O modules within the interlocking. It is also responsible for communications with other systems, including other WESTRACE interlockings, block processors and control and maintenance systems. Each WESTRACE Mk2 Interlocking consists of a processor module operating a blend of I/O modules chosen according to the needs of the specific application.

### ATP and ATO

Invensys Rail's Communication Based Train Control (CBTC) solution is a sophisticated, next-generation system. It is designed to allow easy enhancement from GOA2 (ATO operation) to GOA3 (driverless operation) and GOA4 (unmanned operation). The functionality required at the various levels is defined by IEC 62290-1.

The Invensys Rail CBTC solution is built on a proven and highly flexible platform specifically designed for a range of train control ATP and ATO systems for both new and existing metros. It can be configured to operate as a speed signalling system, a distance-to-go system or a moving block system.

Where appropriate it can even be configured to use a selection of these modes under different circumstances. It is a SIL4 system, with all modules developed in line with CENELEC standards EN50126, EN50128 and EN50129, ensuring compliance with ISO standard EN61508. The base platform has proven itself in service on a number of the world's major metro networks. Moreover, its modular design and flexible system architecture ensure that it is genuinely "future proof".

"CBTC solution is built on a proven and highly flexible platform specifically designed for a range of train control ATP and ATO systems"

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#### ATS

WESTROL is a centralised suite of train control applications that allows operators to control and monitor trains safely, efficiently, and reliably. It provides real-time operational awareness of the entire rail network. WESTROL applications utilise the Systemat/CS platform which allows them to be integrated with other railway application suites such as the Integrated Supervisory Control System (ISCS) family and RailSCADA family as well as external third-party applications to provide a thoroughly comprehensive solution for any network.

#### The Systemat/CS platform features:

- Common HMI
- Common services such as integrated alarming, data persistence, historical storage
- Monitoring of application status and hardware with bump-less failover for applications
- Configurable "N" levels of redundancy.

These allow the Systemat/CS platform to provide the metro network with a highly reliable, integrated and efficient control system.

"WESTROL allows operators to control and monitor trains safely, efficiently, and reliably"



### Track Circuits

Our FS2550 series track circuits are ideal for track-code based ATP systems. These are robust audio frequency jointless track circuits; they transmit ATP codes with optimum efficiency. Their powerful microprocessors analyse incoming signals from the track itself and thereby achieve exceptional standards of immunity from traction interference and are ideal for use with VVVF traction systems.

The FS3000 is a digital track circuit suitable for secondary detection on CBTC systems. The FS3000 series of track circuits will operate on any rail gauge - using AC, DC - or its own internal power supply. And each track circuit operates from a single, configurable transceiver. Multiple receivers ensure full train detection over all point legs without complex serial or parallel bonding. Transceivers plug install for simple maintenance, with all configuration maintained on the rack-mounted socket.

### Point Machines and Signals

Introducing Surelock - the latest Invensys Rail point machine for metros. Surelock was designed for simplicity and strength. Its robust housing and lockable, flood-resistant enclosure contains four independently replaceable modules - motor, drive assembly, escapement and control. In addition, the extremely low profile of Surelock allows it to be mounted between the running rails for metro applications or trackside for conventional applications.

Though extremely durable, the comparatively light weight of each module means the total machine weighs only 170kg, aiding maintenance and movement.

Invensys Rail also supplies a wide range of signals, both conventional and LED, for a wide range of applications. The range includes special low profile signals for tunnel applications.



## Case Studies

### London

Project Management is recognised as one of our key strengths and was an important factor when we were chosen to overlay new signalling systems onto one of the oldest and largest metro networks in the world. This means we can upgrade and install the new systems during a very limited window each night but still hand back the railway for full service each morning without any disruption to passenger service.

We successfully adopted this approach when awarded the contract to provide new signalling, Automatic Train Control and Control Centre for the busy Central Line. This project was accomplished despite trackside access being restricted to only three hours a night. We are currently upgrading the signalling and train control systems on the Victoria Line, where this approach is ensuring service disruption is kept to a minimum.

### Madrid

We have played a pivotal role in the Madrid Metro's Enhancement Plan, installing our innovative Signalling and Automatic train control systems both in the metro lines and the rolling stock.

WESTRACE electronic interlocking, FS Jointless Track Circuits and electric point machines were installed, along with Distance-to-Go Automatic Train Control systems, along all 53 kilometres of the city's conventional metro track. In addition, the company's ATC system has now been installed in over 140 trains. This system allows the trains to run both Distance-to-Go and Speed Code ATP, depending on the equipment installed track-side.

In all, we were contracted to upgrade nine lines, with the focus to ensure the seamless integration of the nine line terminals to the existing lines without causing any service disruption.

### Hong Kong

We created the world's first fully Integrated operations Control Centre System (ICCS) for the Kowloon Canton Rail Corporation (KCRC) East Rail in Hong Kong.

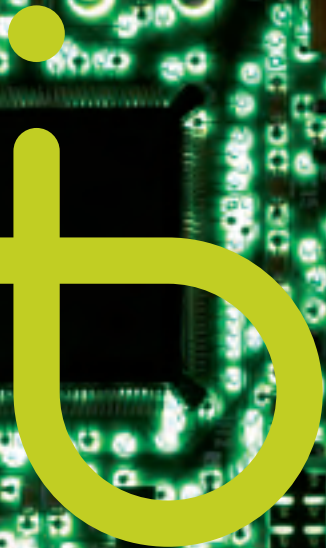
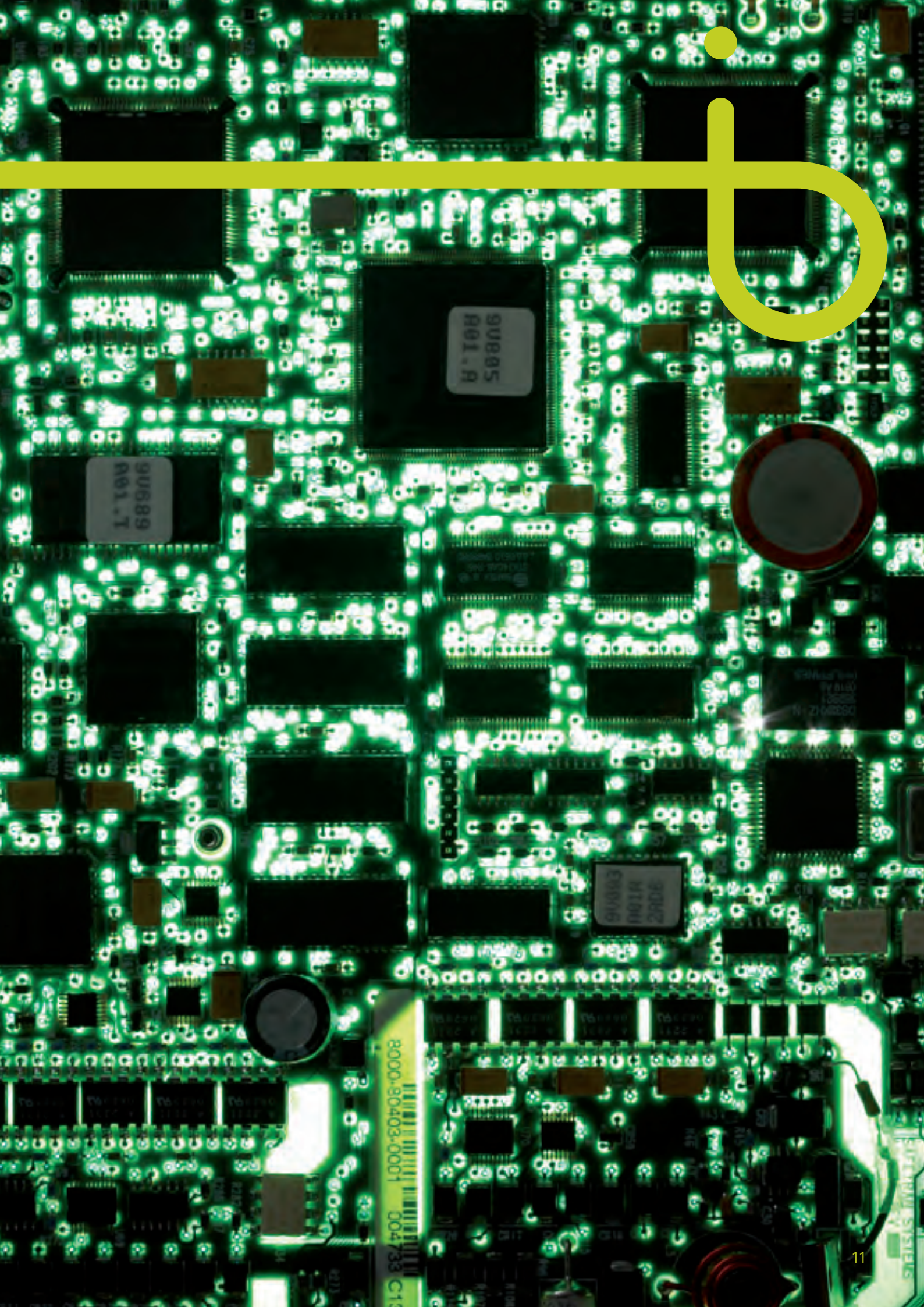
Integrating with the existing railway without disruption and allowing for future expansion, the ICCS has proved highly reliable with less than one hour's unscheduled downtime since its commissioning in 1998, allowing KCRC to achieve 100% on time running while carrying over one million passengers each day. The system's innovations have allowed KCRC to reduce maintenance and operation costs, while improving safety standards.

### Beijing Metro

Invensys Rail has been involved in the full programme to upgrade the Chinese capital's metro system, with major modifications and extensions needed for the 2008 Olympics, including installation of ATP and ATO systems.

The project has demonstrated our ability to liaise and integrate with local suppliers. The contract for the 27.6 km Beijing Metro Line 5 utilises Distance-to-Go version ATP and ATO, which is in full service on line 13 and the Ba Tong Line.

"Integrating with the existing railway without disruption and allowing for future expansion, the ICCS has proved highly reliable with less than one hour's unscheduled downtime"



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#### Singapore Mass Rapid Transit Authority

Invensys Rail has been involved in providing signalling and train control for the Singapore Metro since 1984. The original project was completed ahead of schedule and below budget. As a consequence, we have become the natural choice for the Metro's subsequent extensions. Automatic Train Control equipped trains and integrated control systems play a vital role in maintaining the Metro's excellent reputation for punctuality and reliability.

“Automatic Train Control equipped trains and integrated control systems play a vital role in maintaining the Metro's excellent reputation for punctuality and reliability”

In 2008 we were delighted to be awarded the contract to provide the signalling for the country's new Downtown Line. We will be responsible for providing the signalling system and platform screen doors, including automatic train operation and automatic train supervision (ATS). The system will include our CBTC solution for automatic train control, WESTRACE electronic interlockings and a SystematICS ATS.

#### Barcelona Metro

When Barcelona Metro wanted to pilot driverless operation, they naturally chose Invensys Rail, who have more than 20 years experience of working on the Barcelona network. We installed our Driverless System on Line 11 which, at just over 2km long, contains 5 stations and connects to Line 4 at Trinitat Nova in the outer zone of Barcelona.

The Driverless System, built on the renowned TBS platform that's in use across the world's leading mass transit systems, uses an integrated automatic train control (ATC) system based on the "target distance" principle. Using this function, the equipment on board the train interprets the track codes as free blocks in front of the train allowing the train to approach the preceding block without reducing its speed, to a distance permitting it to brake before the block occupied by the train ahead.



The system also includes automatic train protection (ATP) and automatic train operating (ATO), allowing many tasks to be performed automatically such as opening and closing of doors, starting the train, running on sections of line between stations and turnarounds at termini. It also controls the opening and closing of the platform gate system which is being installed on the line.

The flexibility, capacity and performance of the solution will improve capacity, reduce headways and free up on-board personnel to focus on customer service and assistance.

#### Canada Line, Vancouver

We were awarded the contract to design, install and commission the Integrated Control and Communication System (ICCS) for the Canada Line Rapid Transit Project in Vancouver by SNC-Lavalin. The line links downtown Vancouver with Richmond and the Airport and is a key part of the transport infrastructure for the Winter Olympic Games in 2010.

At the heart of the ICCS is our Systemat/CS control system. This will manage the integration of each of the power, tunnel ventilation and communications sub-systems, which will come together in a single operator

interface. From this point, the operator will be able to control and monitor these functions for the entire rail network. Systems that will be integrated include: traction power supply; tunnel ventilation; electrical and mechanical monitoring; CCTV; public address; passenger information display; passenger counting; voice communications; passenger alarm and the fibre optic transmission systems.

"Manage the integration of each of the power, tunnel ventilation and communications sub-systems"

# A world of experience





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Rail

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