Urban growth, combined with the political and social imperative of environmental action, has presented renewed opportunities and challenges for those involved in mass transit operations.

Significant technological advances in the area of automatic train control (ATC) are facilitating advances in system performance, allowing more frequent services and increased flexibility at reduced cost and without compromising safety.

Modern ATC systems can improve cost-effectiveness by minimising the need for wayside signalling equipment and, in many instances, the need for driver intervention. This is applicable for both traditional fixed block systems and communications-based traffic control (CBTC).

ATC has continued to evolve towards reduced human intervention in the control of train traffic by providing varying levels of automated functionality for the following:

- Automatic train protection (ATP), which controls vital, safety-critical functions
- Automatic train operation (ATO), which controls the actual train driving functions
- Automatic train supervision (ATS), including routing, schedule adherence and fault monitoring functions

*BOMBARDIER*° CITYFLO° solutions cover the full range of ATC technology and operating modes, whilst providing the highest safety standards and cost-effective service to our customers:

**CITYFLO 150**

Suitable for tram-based systems, where manual train operation is typical, the driver operates the train/tram using lineside signals with the option on segregated sections to use a simple ATP system to safeguard train operation.

**CITYFLO 250**

Designed primarily for light rapid transit (LRT) and metro applications, cab signalling utilises onboard ATP with signal aspects displayed in the driver’s cab and provides track-to-train communication via balises.

**CITYFLO 350, CITYFLO 450 or CITYFLO 650**

Semi-automatic train operation (STO) with onboard ATP and automatic driving, where limited action is required from the driver, such as opening and closing doors.

**CITYFLO 550 or CITYFLO 650**

Widely used for metro, automated rapid transit, automatic people movers and regional commuter operations, CITYFLO 550 and CITYFLO 650 offer driverless train operation (DTO) and unattended train operation (UTO).
CITYFLO 150 provides consistent performance in city and commuter rail systems where, specifically with respect to light rail operations, superior service is through traffic prioritisation, system regulation, point calling and passenger information.

Specialist experience
Bombardier Transportation’s experience in the specialist field of light rail/tram signalling and communications has been demonstrated in the successful completion of Phase 2 of the Manchester Metrolink as well as the Nottingham Express Transit project, several of the most successful tramways in the United Kingdom.

Applying its global experience, Bombardier Transportation has developed a standard “off the shelf” solution to meet today’s light rail requirements.

It is based on best practice of systems delivered and in operation and can employ loops, wi-fi or GPS for tram detection.

At the heart of the CITYFLO 150 system is the BOMBARDIER® EBI* Screen control room. This system provides integration of all signalling and management systems.

CITYFLO 150 components

<table>
<thead>
<tr>
<th>EBI Screen Control Room</th>
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</table>
The **CITYFLO 250** system is a standard ‘off the shelf’ solution to meet today’s light rail and metro requirements for segregated or non-segregated tracks, based on best practice.

**Wayside systems**
The **CITYFLO 250** balise based system uses **EBI** Track train detection and **EBI** Link balises as the transmission link for vital ATP messages from wayside to trains. The **EBI** Lock computer-based interlocking system detects trains through the track circuits, controls the **EBI** Switch point machines, the **EBI** Light signals and any **EBI** Gate level crossings within the solution. The interlocking also gives movement authorities to the onboard ATP.

**Onboard equipment**
The **EBI** Cab onboard equipment ensures that the train does not exceed the permitted speeds or pass beyond the end of a movement authority. This enables onboard ATP to use distance-to-go supervision of the train’s movements.

**Increased traffic capacity**
Compared with a speed code system, the **EBI** Cab onboard distance-to-go supervision provides higher traffic capacity and increased passenger comfort thanks to shorter headways between trains, faster approach to line terminals and only one smooth braking curve towards a restriction or stop. All indications to the driver are given via the in-cab display.

The **CITYFLO 250** system uses the **EBI** Screen control room which gives the metro operator total overview and control of the traffic and the transit system.

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**CITYFLO 250 components**

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The CITYFLO 350 automatic train control (ATC) system increases traffic capacity and safety in metro systems, allowing higher speeds and shorter headways between trains with the system’s continuous distance-to-go speed supervision.

CITYFLO 350 uses the EBI Lock computer-based interlocking which detects trains through the track circuits, controls the EBI Switch point machines and any EBI Light signals within the solution. The interlocking also gives movement authorities to onboard ATP through EBI Track audio frequency track circuits.

EBI Track allows speed values, distances, gradients and other information to be transmitted. This enables onboard ATP to use distance-to-go supervision of the train’s movements. The ATP also ensures that the train does not exceed the permitted speeds or pass beyond the end of a movement authority.

The EBI Drive automatic train operation (ATO) system, part of the onboard equipment sub system, fully exploits the capacity of the metro system as the train travels between two stations at a safe distance from other trains. The driver’s actions can be limited to opening and closing the doors of the train.

The EBI Drive ATO generates additional benefits including:
- Improved passenger comfort through smooth braking and acceleration
- Lower life cycle cost through reduced power consumption and less wear on the track and vehicles
- Precision stopping to offer a high degree of accuracy and provide automatic door enabling or operation as required
- Automatic turnback allowing the train to change direction at the terminals

CITYFLO 350 uses the EBI Screen control room, providing decision makers responsible for traffic administration with immediate access to up-to-date information.

<table>
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The CITYFLO 450 solution is a communications-based train control (CBTC) and semi-automatic train control (ATC) system which does not require track circuits.

Since train-to-wayside communication is provided via two-way radio, the CITYFLO 450 solution can be used as an overlay radio-based train control system to upgrade existing fixed block systems.

**Design features**
The CITYFLO 450 solution fulfills the requirements of a communications-based system in a mass transit environment with the following features:
- Reliable radio communications
- Fully operational redundant configuration
- Industry standard interfaces
- Lower life cycle costs

**Simple and effective**
Inexpensive to install, the CITYFLO 450 solution eliminates wayside equipment due to its simple, reliable, contactless train-to-wayside communications system, permitting shorter, more consistent headways.

The CITYFLO 450 system is based on the successful CITYFLO 350 platform. The EBI Cab onboard ATP ensures that the train does not exceed the permitted speeds or pass beyond the end of a movement authority.

**Meeting passenger needs at low life cycle cost**
The EBI Drive semi-automatic train operation (ATO) system, which is part of the EBI Cab onboard equipment, fully optimises the capacity of the system as the train proceeds along the line at a safe distance from other trains. The ATO ensures smooth braking and acceleration, resulting in energy savings and less wear and tear.

The ATO system provides precision stopping at platforms with high accuracy and automatic door operation. In semi-automatic mode, an operator may initiate station departures and close doors.

CITYFLO 450 uses the EBI Screen control room to give the metro operator total overview and control of the traffic.
The CITYFLO 550 solution is a track circuit based system for unattended (UTO) or driverless (DTO) train operations designed for mass transit and airport people movers (APM).

CITYFLO 550 is one of the most proven and widely used microprocessor-based interlocking systems introduced to the market. The system is used for automatic running of trains on segregated tracks.

**Design features**

CITYFLO 550 is a dual-channel, vitally cross-checked solid state interlocking computer system. The operationally redundant configuration performs vital route interlocking functions including the crucial control of track switches and the assurance of safe train separation through speed command generation.

**Proven service**

The CITYFLO 550 system is in service at approximately 30 mass transit and people mover systems worldwide, including the world’s first automated train control at Bay Area Rapid Transit System (BART) in San Francisco, and Atlanta airport, USA which carries more than 85 million passengers every year.

**Advantages**

- Well proven traditional technology
- Systems successfully operating in different environments on three continents
- Minimal installation cost for medium size systems, with quickly configured layout
- Field operations record of high reliability
- Can be configured for rubber tyre or steel wheel applications
- Redundant equipment design

**CITYFLO 550 components**

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The CITYFLO 650 solution is a computer-based radio controlled, moving block ATC system which does not require track circuits or an onboard operator. Since train-to-wayside communication is provided via two-way radio, the CITYFLO 650 solution can be used as an overlay radio-based train control system to upgrade existing fixed block systems.

Design features
CITYFLO 650 comprehensively fulfils the requirements of a communications-based system in a transit environment. The system can be employed with driver or driverless depending on the customer requirements. It uses the most advanced technology in the world:
• Moving block
• Automatic restart feature
• Train integrity system
• Safety-verified automatic train control design
• Fully operational redundant configuration
• Comprehensive monitoring and diagnostics systems
• Industry standard interfaces
• Distributed system architecture
• Low life cycle costs

Increased safety
The CITYFLO 650 solution is inexpensive to install and eliminates wayside equipment due to its simple, reliable contactless train-to-wayside communications systems, thereby permitting shorter, more consistent headways.

Wayside equipment
The system uses a reliable radio system to transmit vital information to trains, and train position information to the EBI Com radio block centre. EBI Link wayside equipment ‘tags’ are used as norming points to correct position measurement errors.

EBI Cab onboard
The EBI Cab onboard ATP ensures that the train does not exceed the permitted speeds or pass beyond the end of a movement authority.

Greater capacity at low life cycle cost
The automatic train operation (ATO) system fully exploits the potential capacity of the system as the train travels at a safe distance from other trains. It reduces energy consumption and wear on the track and vehicles. The ATO system provides precision stopping at platforms, automatic door operation and automatic turnback at terminals. The CITYFLO 650 solution is inexpensive to install and eliminates wayside equipment such as track circuits and signals.

CITYFLO 650 components

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**CITYFLO sub systems**

*CITYFLO* solutions cover the full range of possibilities, from basic to complex solutions, using a set of standard products and constantly providing the highest safety standards. Our products can be integrated with systems from other suppliers.

**Traffic Management**
The *EBI* Screen control room is a traffic management system for efficient and economic management of mass transit networks. The system is flexible, with an open interface to peripherals such as passenger information, ticketing machines, power supplies and SCADA, giving the operator total management of the traffic.

**Wayside equipment**
*EBI* Link wayside equipment utilises balises that provide either fixed or variable data from track to train. The balise is activated by an antenna mounted under a passing train, thus avoiding the need for a power supply to the balise. Only the balises with variable data need a cable connection to a control unit.

**Computer-based interlocking**
The *EBI* Lock computer-based interlocking system ensures maximum availability and safety by using redundant interlocking computers. The interlocking system is of a modular design for high flexibility, and is easy to adapt to different signalling principles. The interlocking system is equipped with an advanced function for diagnostics and self tests, allowing a fault to be quickly discovered and identified. Diagnostics information is sent to traffic management service personnel via a PC based terminal.

**Train detection**
The Bombardier range of *EBI* Track train detection equipment consists of train location systems, jointless and coded jointless track circuits and axle counters.

**Point machines**
Bombardier Transportation has a complete range of *EBI* Switch point machines which includes sleeper-integrated point machines, conventional end-of-sleeper machines and machines mounted in a recess between the rails, providing the flush finish required in a street type environment.

**Signals**
The *EBI* Light range of optical signals includes colour light multi-aspect, fibre optic searchlight, fibre optic alpha numeric and tunnel signals.

**Onboard equipment**
*EBI* Cab onboard equipment ensures that train movements are carried out safely in accordance with the movement authorities. The train speed is continuously monitored by the system and if necessary the *EBI* Cab system initiates braking to keep the train at a safe speed.

**Engineering and maintenance**
Engineering for *CITYFLO* solutions can be achieved quickly and efficiently with *EBI* Tool design and maintenance. Site data and manufacturing schedules for cables and object controller cabinets are generated automatically. *EBI* Tool is also ideal for reconfiguring existing interlocking systems when the system is upgraded or extended.

**Radio block centre (RBC)**
The *EBI* Com radio block centre converts train positions sent by radio to positions of the trains on a track plan which is then presented to the interlocking(s). Information about train routes is then sent to the *EBI* Com RBC and converted into movement authorities and sent out to the individual trains.
With a century’s experience in developing, engineering and installing advanced rail control and signalling systems, Bombardier is recognised as a world leader in this field. A measure of our success is our extensive list of satisfied customers.

Through our reputation for delivering excellent levels of service and performance, we have earned our place as one of the top providers of signalling systems. The following references demonstrate that our solutions can be customised according to market demands.

### CITYFLO 150
Manchester, UK
Nottingham, UK

### CITYFLO 250
Gautrain, South Africa
Manchester, UK
Nottingham, UK

### CITYFLO 350 / CITYFLO 450
Bangkok, Thailand
Barcelona, Spain
Bilbao, Spain
Bucharest, Romania
Busan, Korea
Delhi, India

### CITYFLO 550
Airports:
Atlanta, USA
Beijing, China
Frankfurt, Germany
Houston, USA
Madrid, Spain
Tampa, USA

Metro systems:
San Francisco, USA
Sao Paolo, Brazil
Singapore LRT

### CITYFLO 650
Airports:
Dallas, USA
Guangzhou, China
Las Vegas, USA
London, UK
Sacramento, USA
San Francisco, USA
Seattle Tacoma, USA

Metro systems:
Madrid, Spain
Neihu, Taiwan
Philadelphia, USA
Shenzhen, China
Yong-In, South Korea
Over 100,000 vehicles in operation worldwide attest our unique strengths in project management and innovation, design and technology. For decades we have enabled millions of people everyday to reach their destinations in comfort and style.

Bombardier is a truly international business, which provides local support. Present in more than 60 countries and with more than 30,000 employees worldwide, we strive to be the partner of choice for all the world’s rail operators.

Headquartered in Berlin, Germany, Bombardier Transportation is part of Canada based Bombardier Inc. It generates annual revenues in excess of US$ 7 billion.

As the global leader in rail technology, Bombardier places environmental sustainability firmly at the top of the agenda. Our products and services combine energy conserving technology with optimal safety, reliability and cost efficiency. They are designed for sustainable mobility throughout their lifecycle.

Our portfolio of rolling stock and services encompasses passenger vehicles for urban and mainline operations, locomotives, bogies, rail control solutions, propulsion and complete transportation systems, as well as vehicle modernization and maintenance.
Bombardier Transportation has an active set of environmental print guidelines, for further details click onto: www.transportation.bombardier.com

Learn more about our commitment to sustainable mobility on: www.theclimateisrightfortrains.com

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