SelTrac® CBTC Technology

ADVANCED URBAN RAIL TRAIN CONTROL

ALCATEL

SelTrac® Solutions

HIGH PERFORMANCE • SOUND INVESTMENT

With the constant pressure to minimize operating costs and the need to bring system improvements on line faster, many transit operators are looking for the flexibility that transmission-based, or communications-based train control (CBTC) technology provides. Answering the call for modern signaling, CBTC presents the opportunity to enhance performance and safety, and lower life-cycle costs. Having applied SelTrac systems to more than 500km of urban rail around the world, Alcatel has proven this methodology for over two decades, and offers operators a straightforward and cost efficient way to benefit from intelligent CBTC technology.

Whether this benefit comes from modular upgrades and overlay re-signaling techniques to reach beyond the limitations of conventional fixed-block designs, or from a fully comprehensive solution to move more people more quickly and increase revenue potential, Alcatel and SelTrac can meet your needs.

Modular SelTrac system solutions are flexible and adaptable enabling customers to incrementally upgrade functionality over time, without disrupting operation. Transit operators retain the value of their original investment as they expand and grow their systems. SelTrac can be configured easily to meet the specific functionality needs of the operation. With built-in flexibility, SelTrac addresses the diverse requirements of operators needing basic Automatic Train Protection (ATP), cab-signaling, or CBTC-based operations. From simply replacing existing signaling, to improving the headway performance of an existing fixed-block system, SelTrac is the convenient and cost-effective solution.

At the high end of the signaling spectrum, SelTrac systems include both "logic" block and full "moving" block automatic train control solutions. These systems offer superb operational flexibility under even the most demanding of conditions. And, to meet high or increasing capacity situations, SelTrac has proven to deliver under sixty second headway, better than normally required.

The SelTrac System Spectrum

STEP-UP SOLUTIONS FOR NEW OR EXISTING OPERATIONS

		Track Circuits/ Signals	ATS	Train Operation	Headway
S40	**Automatic Train Operation and Management**	Not Required	High Performance	Unattended or Driver/Attendant On-board	Optimized Minimum Under 60 sec.
S30	**Automatic Train Operation**	Optional	Conventional	Driver Supervised	Constrained by Interlocking Layout
S20	**Automatic Train Protection**	Optional	Conventional	Drive by Cab Signaling	Constrained by Driver Response and Interlocking Layout
S10	**Speed Enforcement**	Required	Conventional	Drive by Track Signaling	Based on Track Circuit Layout

MODULAR ADD-ONS

S10 – Speed Enforcement Overlay

SelTrac S10 vitally enforces speed profiles and signal adherence and provides all the usual functions of an intermittent ATP. S10 provides an entry-level computer based train protection mechanism that enhances operational safety by supervising driver actions. Monitoring and interfacing with conventional signals, it prevents trains passing signals at danger and operating at speeds higher than mandated by civil speed limits. Information is intermittently transmitted to the train at specific locations. Look-ahead capability is to the next block only. With Alcatel's intelligent use of transponders, SelTrac S10 is an ideal overlay enhancement for existing conventional signal systems.

Our simple Signal Interface Device (SID) unobtrusively senses the state of the signal lamp circuit. It enables transponder tags located along the track to transmit signal status and permitted speed information to Alcatel's Vehicle On-Board Controller (VOBC). The advantage of this concept is its simple interfacing technique. It can be installed and brought on-line quickly and easily without complicated tie-ins to the signal circuitry, and operators do not require new skills to use and benefit from the system.

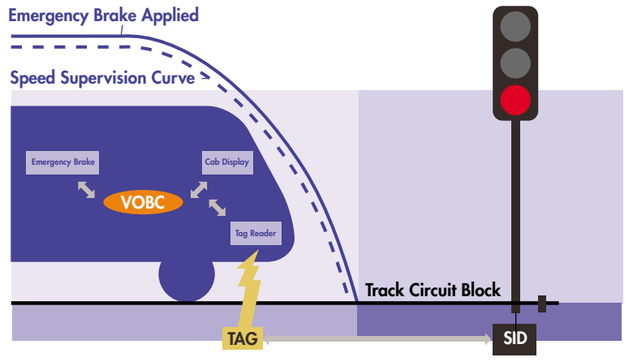
When the VOBC detects an over-speed condition, it alerts the driver and monitors the driver's reaction to the alert. Should the driver fail to respond properly, the VOBC vitally activates the braking system.

In addition to signal enforcement tags, other tags are installed at appropriate locations along the track to provide for continuity of positioning information and speed enforcement.

Operating data is fed to a high definition Driver Display Unit, allowing the driver to confidently monitor train performance and status. By providing speed and signal information to the driver in the cab, the system allows minimized headway while ensuring safety.

SELTRAC S10:

- Provides braking profile supervision and enforcement
- Supports temporary speed restrictions (e.g. Work Zone)
- Supports travel direction reversal
- Determines permitted and actual train speed
- Determines travel direction vs. expected travel direction
- Provides compensation for wheel slip/slide
- Provides automatic wheel size calibration to maintain accurate speed and position determination
- Records events in real time
- Can display distance traveled and distance to go
- Can be configured for ETCS Level 1 function compatibility and compliance



SelTrac technology can save an operator significant costs when compared to other options. The equipment used with the S10 implementation can be upgraded to full Automatic Train Operation (ATO).

METROS/LIGHT RAIL/APMs

S20 – Train Protection Overlay

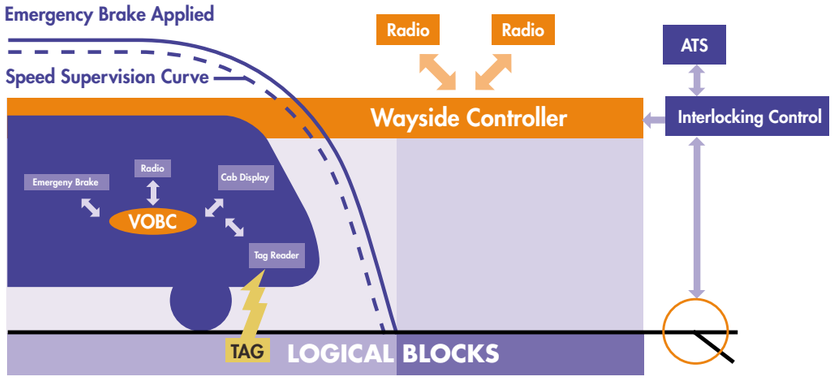
Enhancing S10 capability, SelTrac S20 provides the added value of improved headway while maintaining safe train separation without depending on track circuits. S20 will automatically generate movement authorities based on the actual locations of moving obstacles (i.e. trains) and fixed obstacles such as switch protection signals.

The system is used in conjunction with existing interlockings and provides a replacement for automatic separation signals between the interlockings. S20 can operate seamlessly with existing track circuits which provide an inherent mechanism to operate mixed mode traffic (S20 equipped and non-equipped trains). Drivers are provided with a display in the cab that presents information about the operating conditions ahead of the train. Information is continuously transmitted to the train using a radio-based Data Communications System (DCS).

SELTRAC S20:

S10 FUNCTIONALITY PLUS...

- Improves headway by way of overlay signaling technique
- Provides continuous ATP and cab-signaling
- Provides high availability
- Allows multiple trains per physical track circuit and fully protected bi-directional operation (requiring no additional hardware)
- Reduces track-side equipment
- Incorporates digital spread-spectrum radio technology
- Provides integrated communication capability between wayside and train with fully redundant configurations



S30 – Automatic Train Operation Overlay

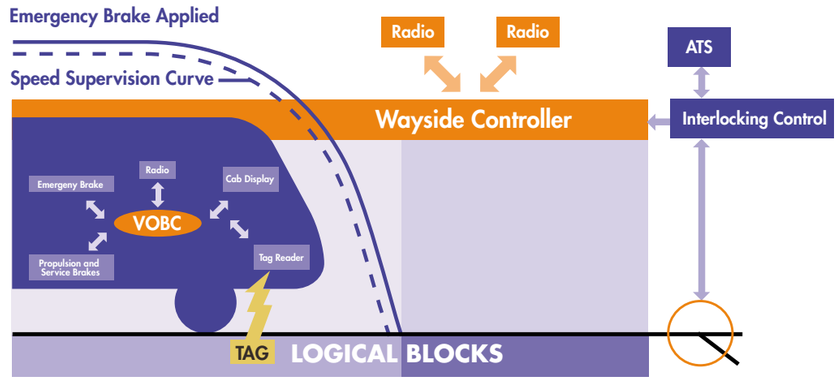
Extending S20 capability, SelTrac S30 adds automatic train movement control capability. This feature offers the driver the ability to select the automatic control of the train's propulsion and service brakes. Applying this automation can improve running performance and station stopping accuracy.

Ensuring safe operation, the train will perform at optimal speeds relative to operating conditions ahead of it. This functionality is considered non-vital, with S20 features providing the safety net.

SELTRAC S30:

S20 FUNCTIONALITY PLUS...

- Provides automatic train movement control functionality
- Governs automatic speed control to traffic and track conditions
- Can provide additional functions such as coordinated train and platform door control



SOLUTIONS FOR INTEROPERABILITY

SelTrac technology incorporates open architecture, system modularity, standard interfaces, and commercial off-the-shelf data communications components based on Open System network solutions that facilitate component interchangeability strategies. Safe train control functionality is specifically designed to be independent of the communication subsystem. Overlay designs facilitate cost-effective system cut-over and deployment, allow mixed-mode operation, and provide an easy evolutionary path to higher level functionality.

More advanced SelTrac configurations bring additional functionality and features into play, enabling operators to significantly enhance performance and service frequency with shorter headways and automated operation. These solutions are based on a "logic" block design – the system is not dependent on, or restricted by track circuits (i.e. two trains can occupy the same physical block but not the same "virtual" or "logic" block). Alcatel offers choice from bi-directional, continuous ATP to continuous ATO – with or without drivers.

Vehicle-centric "block logic" is built into software that can be customized to different train types and track designs. This allows more efficient block lengths to be set within the parameters of the fixed-block locations. The operator can safely run two trains closer together to improve throughput.

Alcatel's "logic" block technology has advanced further in the re-signaling segment and is now especially effective in resolving urban interoperability and mixed-mode requirements faced by major transit operators. For overlay applications, SelTrac is designed to work in concert with the operator's presently installed interlocking devices. The technology is applied in a modular, distributed fashion.

ENHANCED SAFETY/GREATER THROUGHPUT/SIGNIFICANT COST SAVINGS

S40 – Automatic Train Operation and Management

SelTrac S40 integrates the features of S20 and S30 with interlocking and central control functions to provide fully driver-less train control capability. Train supervision is optional – either unattended or with an attendant/driver on board. All train control operations are self-supervising. S40 performance can be achieved either from the modular build-up process utilizing a distributed system architecture, or directly from an integrated design utilizing a centralized system architecture.

Flexibility and modularity of design make SelTrac S40 an economical, high-performance alternative for almost any fixed guideway or rail transit system, new or existing. For high-capacity heavy rail metros, rapid transit, light rail and people-mover applications, it provides all the functionality and flexibility necessary for safe, automatic train supervision and is capable of delivering under 60 second headway. Its unique capacity for remote health-status monitoring and for control of all vehicle systems – including doors (both train and platform), couplers and auxiliaries – makes it an attractive choice for the operator with either a fully automatic (driver-less) or driver-assisted network in mind.

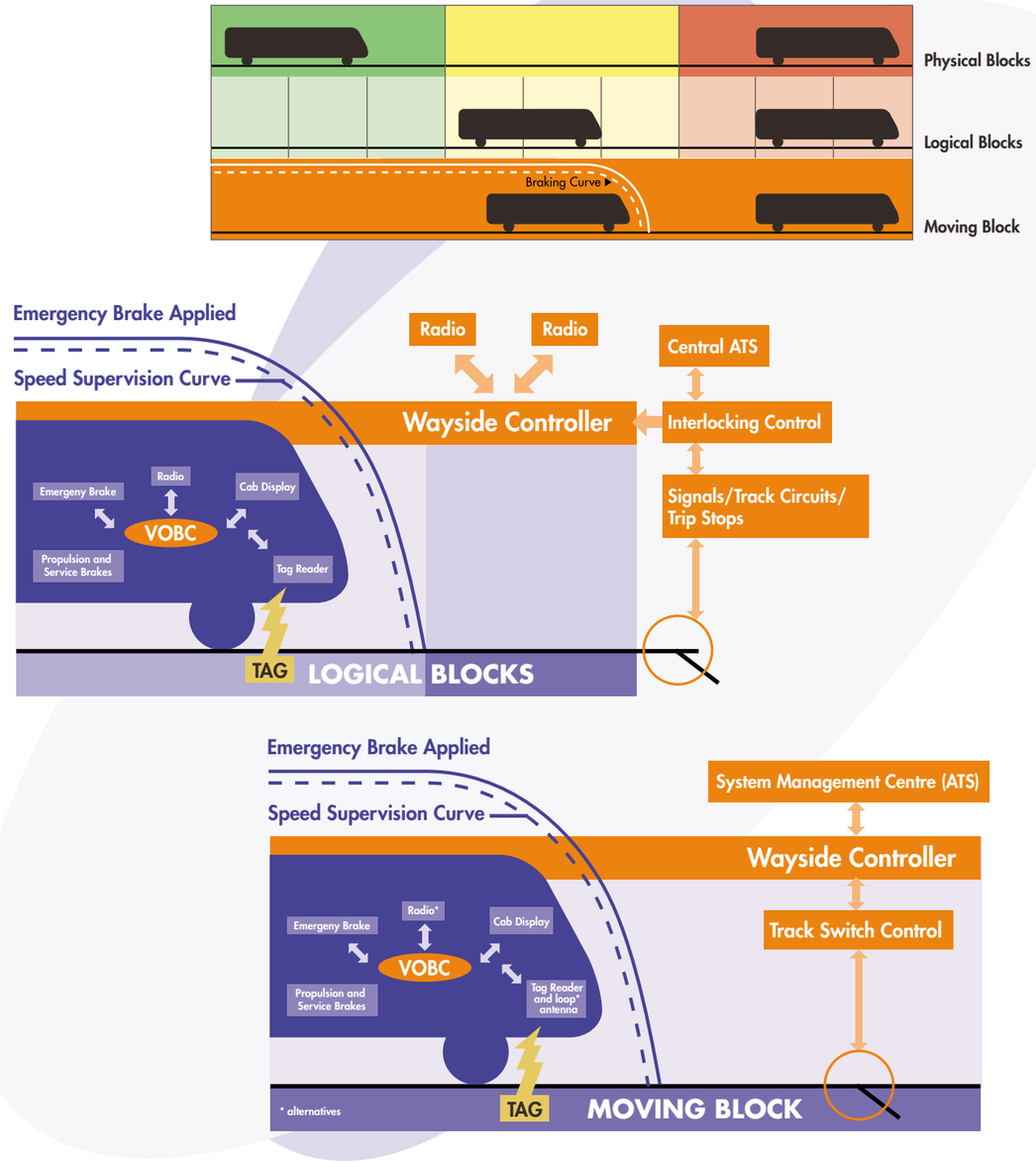
Existing fixed-block systems can be upgraded to S40 cost effectively to provide greater reliability and shortened headways. Installation is performed as an overlay in parallel with the existing system. Our cut-over strategy allows operators to phase in the new system with the least amount of disruption.

SELTRAC S40:

S30 FUNCTIONALITY PLUS...

- Unattended or driver/attended operation including cab-signaling modes
- Logic or Moving-block technology
- Automatic performance modification (including speed and station dwell)
- Fully redundant train-to-wayside configurations
- Fully protected bi-directional operation (requiring no additional hardware)
- Can include solid-state interlocking and remote switch control
- High availability
- Automatic route setting
- Quick-start reset
- Can include automatic coupling/uncoupling

		Central Control	Driver	Interlocking	Automatic Door Enabler	Automatic Door Control
S40	**Automatic Train Operation and Management**	Integrated	Not Required	Integrated	Optional	Included
S30	**Automatic Train Operation**	Optional	Required	Not Included	Optional	Not Included



MODULAR UPGRADES

For applications requiring operation with existing interlocking and/or fixed-block signaling, modular SelTrac solutions are ideal. For new installations or upgrades, Alcatel's LockTrac electronic interlocking and ATS platforms are easily added to the configuration to provide fully integrated train control. Either "logic block" or "moving block" technology can be applied; both dispense with the restrictions of fixed-blocks and provide high-end performance.

OVERLAY CBTC FOR PERFORMANCE IMPROVEMENTS

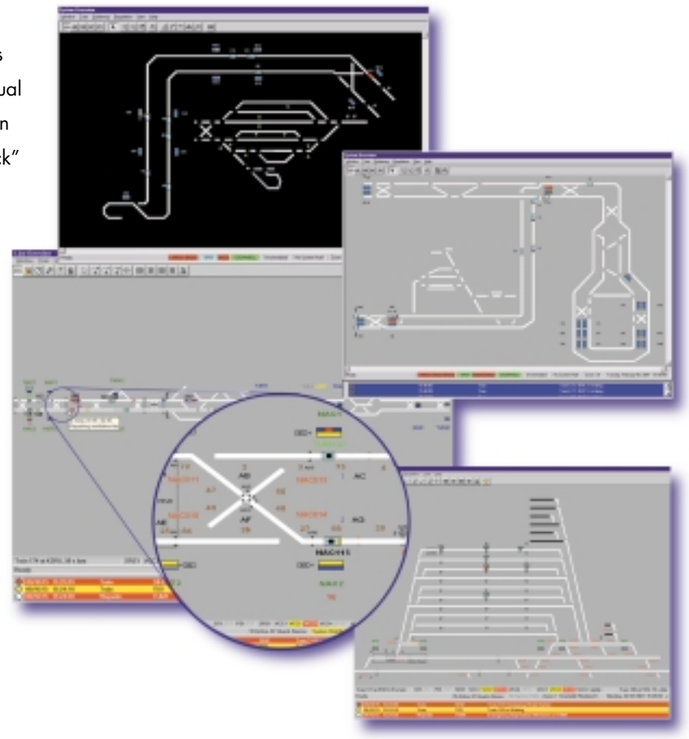
Based on principles and techniques proven for decades with Alcatel's low frequency inductive loop-based technology, SelTrac S30 and S40 solutions can incorporate high bandwidth, spread-spectrum radio communication technology to deliver the most advanced, most efficient Automatic Train Control solution available today.

NetTrac MT System Management Centre

Through Alcatel's advanced NetTrac MT platform (based on commercial off-the-shelf PCs and LAN technology), the System Management Centre (SMC) supervises the automatic, cab-signaling or manual operation of the entire rail fleet. NetTrac MT is designed to provide automatic control of all train operations under normal conditions without operator intervention. It is easy to use and enables operators to handle system disruptions quickly. Standard features include sophisticated failure management capabilities, high system availability, redundancy, complex alarm handling, and data logging.

SMC workstations display the track layout together with icons individually identifying all elements under SelTrac control. At a glance, central controllers monitor the location and schedule adherence of each train within the system. Icon colour changes alert dispatchers to changes in the status of trains, platforms, track switches and tracks. Situations requiring urgent attention trip visual and audible alarm messages. Dispatchers use pull-down command menus, "drag and drop" and "point and click" options to perform numerous functions, including:

- **Assigning and launching a schedule**
- **Monitoring status**
- **Routing trains to a specific track location or station**
- **Assigning trains to a line or run assignment, or to a shuttle service**
- **Holding trains at specified locations or by-passing platforms**
- **Diverting trains around an impassable area**
- **Changing train velocity**
- **Triggering automatic announcements in stations and on trains**
- **Interfacing with other suppliers' subsystems.**



RADIO COMMUNICATION TECHNOLOGY

The driving force behind the advancement in applying broad-band radio technology to rail transit has been the need to move train control to a much simpler infrastructure while maintaining constant communication as trains move along the track.

Major benefits to a radio-based communication system include ease of installation and maintenance, faster recovery times due to single component failure detection and replacement, and low susceptibility to vandalism. As well, the technology allows enhanced capabilities such as on-board video surveillance, arrival/departure information, and video broadcasting.

Proving radio communication viability to urban rail transit operations, Alcatel demonstrated its Data Communication System (DCS) in 1996 to New York City Transit. We will apply it to at least a new monorail in Las Vegas, and to RATP's Line 13 in Paris within in the next two to three years.

The communication technology follows an open-system philosophy that complies with well-recognized industry standards and protocols which provide a stable future migration path.

SelTrac CBTC – High Performance Advantages

PERFORMANCE AND THROUGHPUT

- Headway from 5 minutes to under 60-seconds is economically feasible
- No hardware additions are necessary for adjusting headway to meet future growth demands
- Peak-service train launches are centrally planned and coordinated with full knowledge of each vehicle's condition
- Changes in vehicle make-up for operational, maintenance, or failure-recovery reasons can be automated to reduce manpower requirements or executed manually to address coupling problems
- Maintenance planning and execution can be coordinated with revenue operations
- Precise station stopping

FLEXIBLE SYSTEM OPERATION AND MANAGEMENT

- Centralized performance control ensures shorter delays, quicker schedule recovery and lower energy consumption
- Real-time control of train parameters facilitates centralized dispatching and route setting, performance evaluation (train and crew), on-line corrections, off-line analysis, passenger announcements providing advance information, and service removals in accordance with scheduling, hardware failure, or emergency conditions
- Continuously variable speed monitoring and control
- Temporary speed restrictions controlled by central dispatchers and automatically supervised
- Compliance with civil speed restrictions or other guideway parameters requires minor changes to software parameters only

SAFETY

- Over two decade track record of safe operation.
- Designed and tested to meet international safety integrity requirements.

COST SAVINGS

- Lower life-cycle costs
- Fewer wayside and train-borne subsystems, and no complex, relay-based interlocking designs.
- Fewer subsystems exposed to harsh environmental conditions
- No insulated joints or track bonds, for lower track noise and maintenance costs

ENVIABLE TRACK RECORD

Continually evolving to meet the changing needs of mass transit operators around the world, SelTrac technology has provided safe, reliable, revenue-efficient operation for over two decades. The leading communications-based train control technology on the market, SelTrac sets the quality and performance standards that all others strive to reach. Alcatel CBTC systems are proven with over 10 million train operating hours of revenue service.

PROVEN TECHNOLOGY

Solution Excellence

Real mass transit solutions begin with people. Alcatel assembles the right teams with the right people to tackle the unique challenges and complexities of your project. Our people listen and respond, tailoring Alcatel's proven technology to your special needs and helping you make the right decisions now and for the future. With more experience in advanced communications-based train control technology than anyone anywhere, your Alcatel team offers exceptional expertise and integrated solutions for maximizing capacity, minimizing cost and enhancing safety. Our support is wide-ranging; our commitment is long-term.

In 2002 RATP selected SelTrac S30 CBTC overlay technology to upgrade Line 13 – the longest and most over-crowded line in Paris. Criteria included improved headway from 105 seconds to 90 seconds, improved safety, reduced track-side equipment and multiple trains per physical track circuit.

The overlay design facilitates cost-effective system cut-over and deployment with no impact on normal operations, allows mixed-mode operation, and provides an easy evolutionary path to higher level functionality including driver-less operation.

Revenue service for Line 13 is slated for 2006.

To expand outlying areas for economic development, the Kowloon-Canton Railway Corporation will bring their West Rail system into revenue service in 2003 and their East Rail Extension Ma On Shan line into service in 2004. Both heavy metros will be state-of-the-art CBTC systems relying on SelTrac S40 with moving-block technology, the solution of choice to meet demands of high performance, operating efficiency and capital investment savings.

SelTrac S40 solutions provide very short headway allowances, flexibility for peak hour service, significantly reduced hardware and maintenance costs, and can be extended easily to meet growth demands.

West Rail and Ma On Shan Rail will be operated with on-board attendants.

Around the World... it's SelTrac CBTC

Ankara Rapid Transit

Detroit Downtown People Mover

Hong Kong KCRC

- West Rail
- East Rail Extension Ma On Shan Line

Jacksonville ASE

JFK International Airport APM

Kuala Lumpur LRT II

Las Vegas Monorail

London Docklands Light Railway

Newark International Airport APM

Paris RATP Line 13

San Francisco Municipal Railway

Tampa International Airport APM

Toronto Scarborough RT Line

Toronto Subway

Vancouver SkyTrain

- Expo and Millennium Lines

Walt Disney World Monorail

Wuhan Metro

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