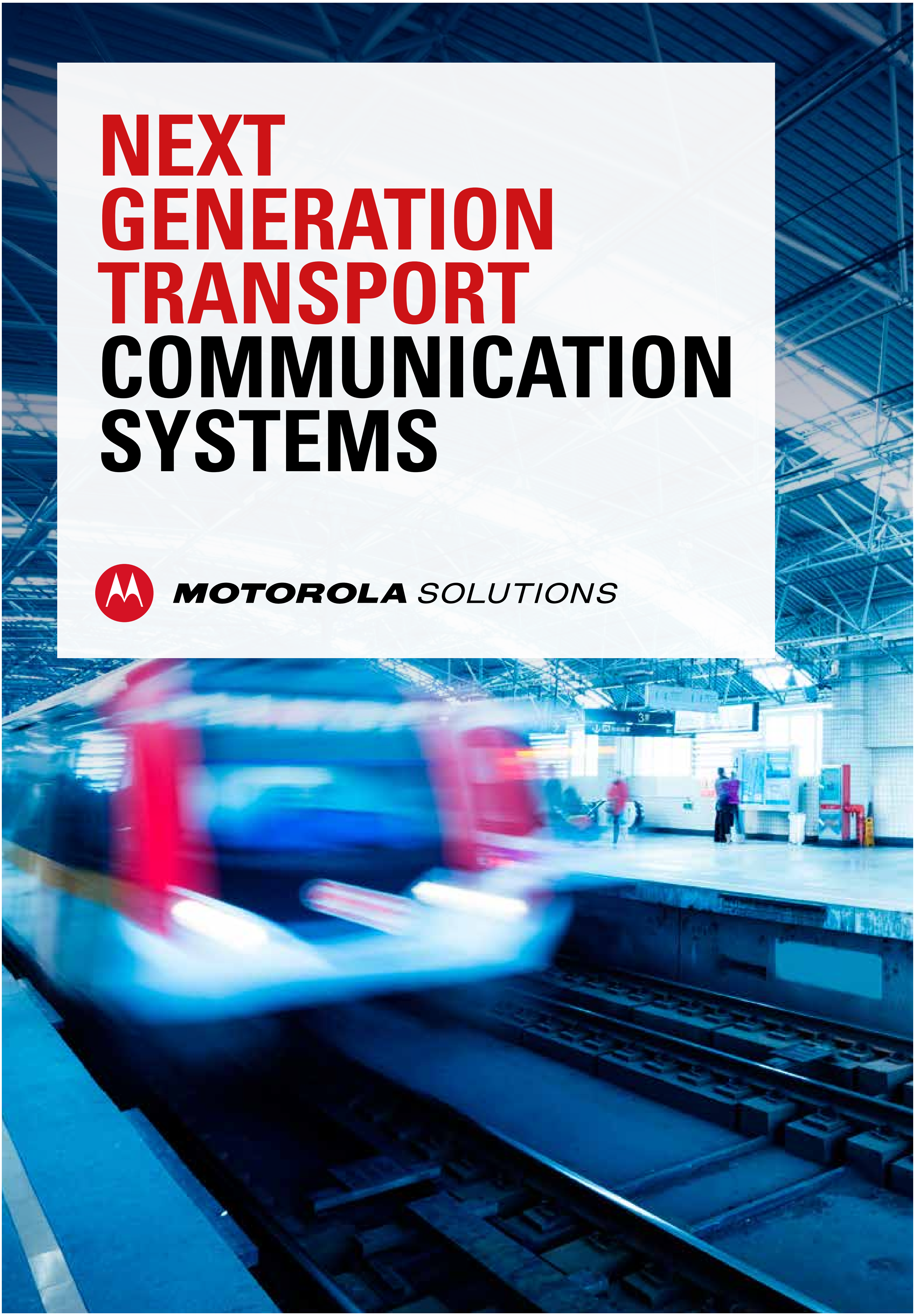
NEXT GENERATION TRANSPORT COMMUNICATION SYSTEMS

MOTOROLA SOLUTIONS



Public transport is vital to improving our quality of life. It provides mobility, can shape land use and development patterns, generates jobs and enables economic growth.

A well-run transportation system can support public policies around energy use, air quality and carbon emissions. According to UITP (the International Association of Public Transport), investment in public transport generates a return as high as four times the capital outlay.

Today, the transport industry faces new challenges, of which urban population growth is one of the most pressing.

As more and more people gravitate into metropolitan areas, demand for transport infrastructure and mobility services soars.

Public transport will play a crucial role in this new landscape, because it is by far the most efficient way to transport large numbers of people and will always outperform other modes of transport.

For public transport authorities, achieving a sustainable public transportation system is a fundamental part of the strategy to address the public's ever-increasing need for mobility. For some authorities, this means enabling simplified and seamless multi-modal commuting and travel for all.

To encourage a modal shift away from private forms of transport, operators have embarked on extensive modernisation programmes that leverage advanced information and communications solutions.

These technologies play a vital role in helping transport operators improve system safety and service reliability, enhance passenger experience, provide higher transit capacity, and reduce operational costs.

In the rail sector, a growing number of operators are using the communications infrastructure to enable forms of automatic train control. Examples include Communications-Based Train Control (CBTC) systems which use moving block signalling, enabling an increase in line capacity by safely reducing headway between trains.

Similarly, bus and tram operators have adopted Intermodal Transport Control Systems (ITCS), which combine computer-aided dispatch and automatic vehicle location systems, to improve operational efficiency and enable greater service reliability.

At the heart of the transformation of public transport systems is the dependable flow of real-time information. For safety-critical signalling applications, high availability data communication is vital, as any disruption could potentially bring trains to a stop. Similarly, efficient incident response depends on reliable voice communication systems that can provide guaranteed access during emergencies.

To remain competitive, as commuter expectations increase, transport operators will be under greater pressure to deliver enhanced passenger experiences. Defining these experiences will be the ability to simplify multi-modal travel through seamless e-ticketing, as well as to provide accurate passenger information, on-board internet access and infotainment services.

A NEW APPROACH IS REQUIRED TO ADDRESS THESE NEW CHALLENGES

To succeed in this demanding environment, next generation transport systems will rely upon a communications system that supports three critical elements:

- Simplified application integration
- High availability communications
- Converged communication services

It is the fulfilment of these critical requirements that will inform the way transport operators select their communications technologies. While there is no one-size-fits-all solution, a unified communications system, built on a resilient TETRA technology foundation, can provide a critical enabler for transforming transport operations.

SIMPLIFIED APPLICATION INTEGRATION

Public transport systems depend on both fixed and mobile communication networks to meet primary objectives: higher service punctuality, maximised operational efficiency and superior passenger experiences. These communication networks are required to support a myriad of information exchanges, relating to both critical and non-critical functions.

Transport system throughput and safety depend on the reliable transmission of data. For rail applications, TETRA satisfies the defined performance criteria for safety-critical systems such as Automatic Train Protection (ATP), as well as supporting critical voice requirements. TETRA provides a range of data bearers that ensure the reliable transmission of vehicle location information, as required by the ITCS solutions used by bus and tram operators.

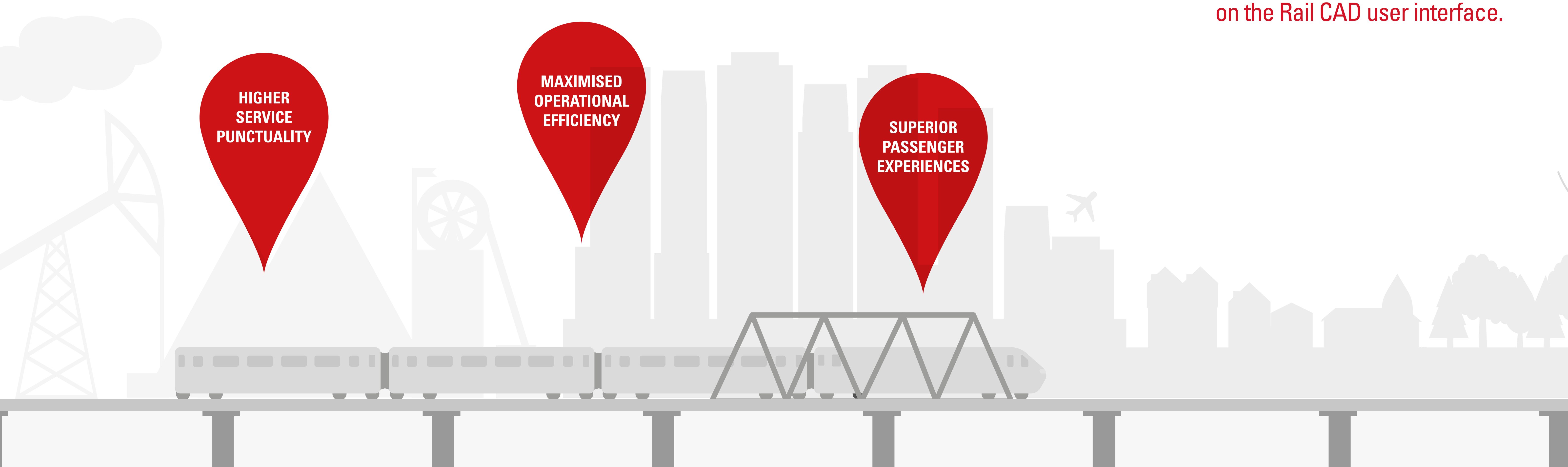
Train protection systems such as CBTC and the European Train Control System (ETCS) are implemented as layered models, which means it is technically feasible to change the physical communications channel without adversely impacting the rest of the system. Thus, train protection systems in the application layer can benefit from the data capacity and high reliability provided by TETRA.

The interfacing of on-board systems with TETRA radio equipment is simplified through the provision of a standardised peripheral equipment interface (PEI). On the network side, TETRA systems are readily integrated with IP packet data networks and can support data transmission speeds in excess of 90kbit/s, through the use of TETRA Enhanced Data Service (TEDS). As such, TETRA provides an excellent platform for reliable data transport.

Through the use of application programming interfaces (API), TETRA voice communication services can be seamlessly integrated with existing operations control centre (OCC) applications, such as those used by line controllers or bus dispatchers. By presenting TETRA audio and control signalling as a single IP data stream, integration with the OCC's existing IT infrastructure can be simplified.

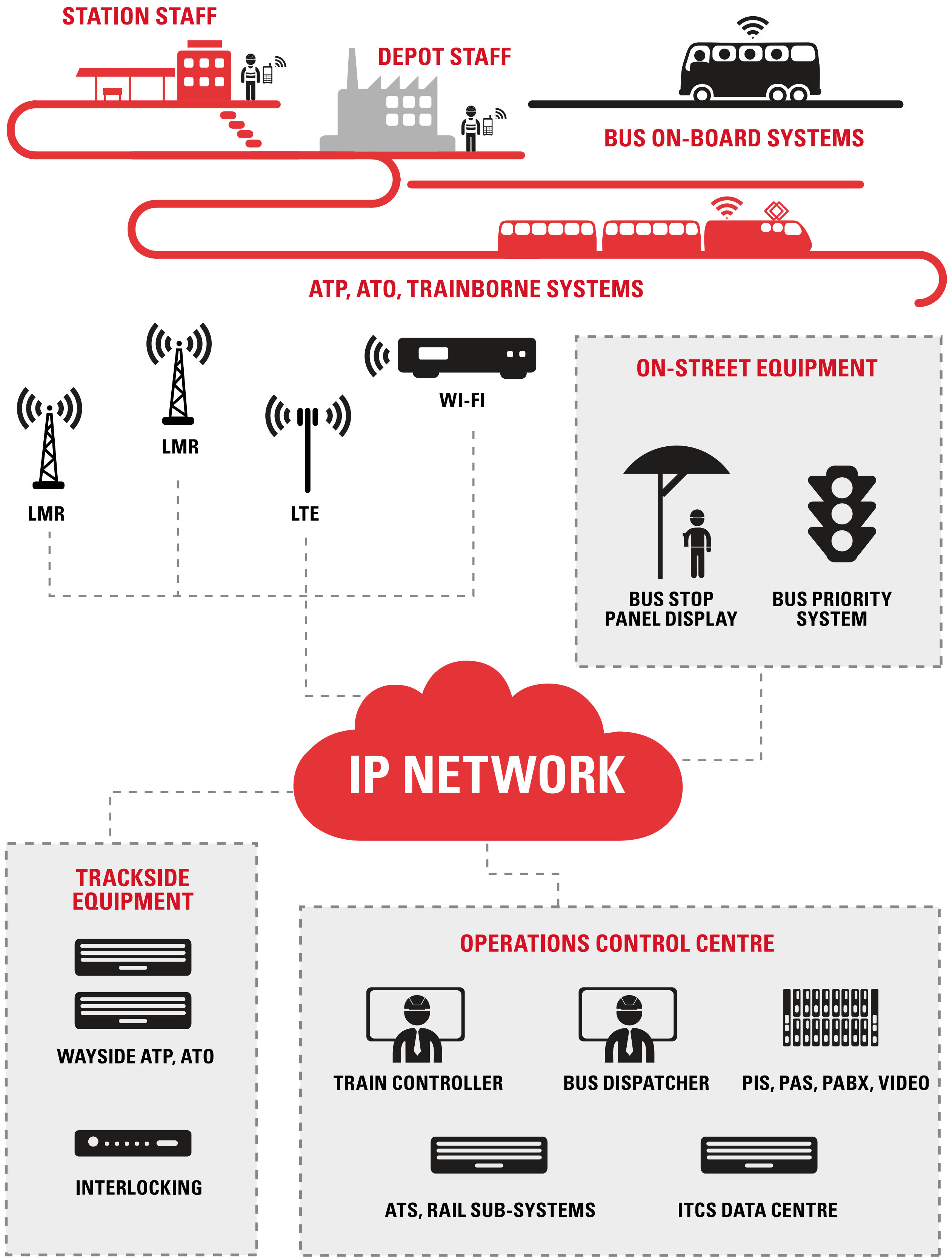
In addition to safety-critical applications, transport operators are harnessing mobile data communications to drive transformation in day-to-day operations. In general, these relate to passenger experience services and business-supporting applications such as ticketing, high-speed internet access, remote maintenance and CCTV. Such applications have less stringent Quality of Service (QoS) requirements and their bandwidth requirements vary depending on the type and volume of information being exchanged.

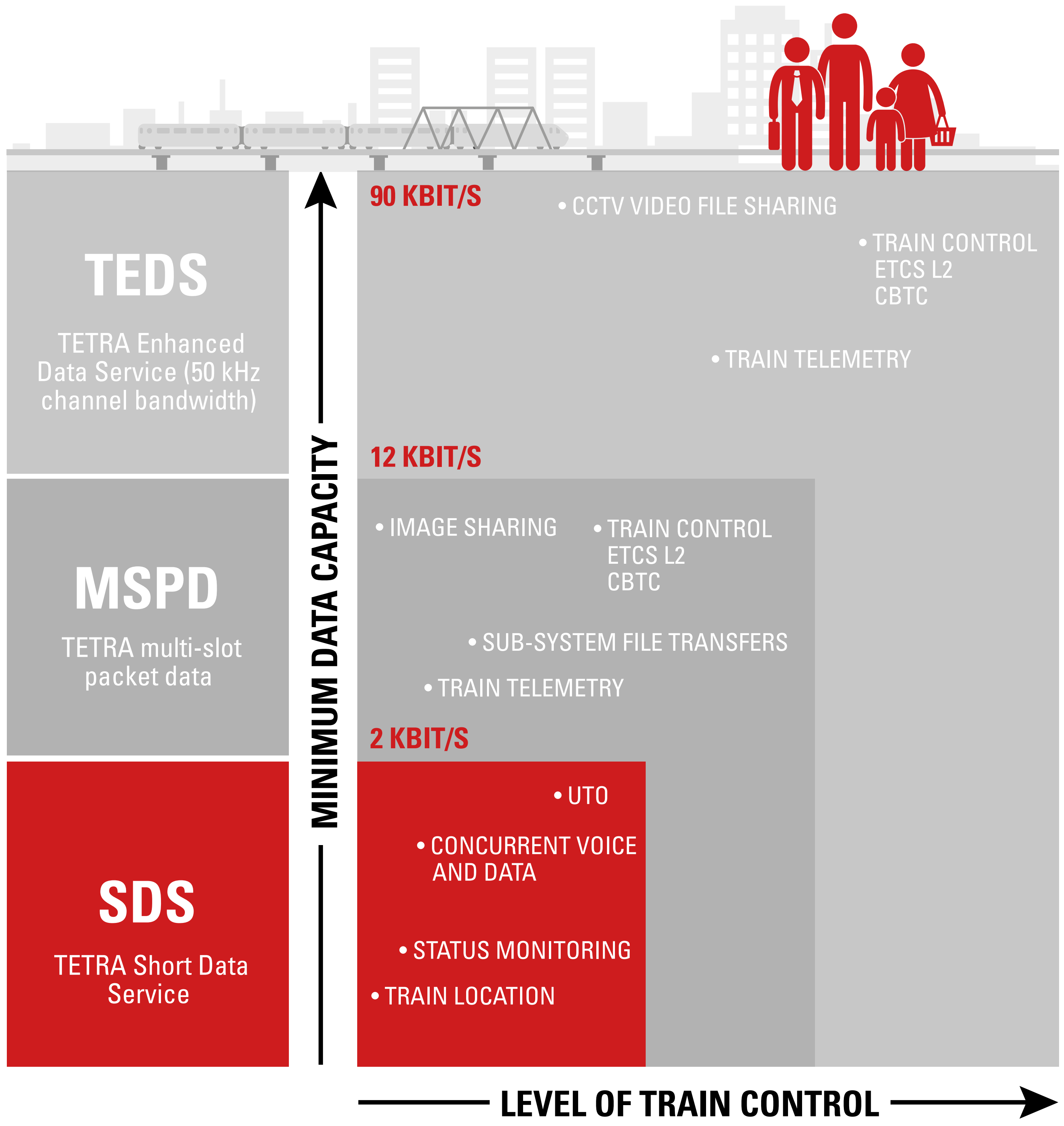
TETRA system APIs provide the necessary implementation flexibility to ensure that OCC applications, such as Rail CAD, are intuitive. For example, TETRA system APIs can allow dispatchers to perform numerous functions such as announcements on specific trains, or private calls to drivers, using pull-down command menus and point-and-click options on the Rail CAD user interface.



INTEGRATED TRANSPORT COMMUNICATIONS SYSTEMS

Applications deemed to be non-critical can be integrated into the same TETRA network that connects low-bandwidth, safety-critical sub-systems, so as to maximise return on investment. Where additional bandwidth is required, alternative bearers such as Wi-Fi and LTE can be deployed to increase the system's data capacity.





HIGH AVAILABILITY COMMUNICATIONS

SCENARIO 1

CHALLENGE:

Maintain bus service punctuality during periods when road traffic is heavy.

SOLUTION:

Install GPS-enabled TETRA mobile radio on all vehicles, to reliably transport real-time location updates via the Short Data Service. These location updates are provided to the ITCS which is integrated with the city's traffic management system.

Traffic light priorities are adjusted accordingly using a balanced algorithm that takes into account private as well as public transport modes. This means that a late-running bus service would benefit from extended green phases, based on real-time location information provided by the ITCS.

Critical transport functions relate not only to safety, but also to operational efficiency and emergency response. In order to support these operations, a secure and reliable voice and data communications network is vital.

In the case of radio-based train control systems, a basic safety requirement is to provide uninterrupted data communications between train-borne sub-systems and wayside equipment, at all points along the track. These systems must meet minimum QoS requirements to guarantee performance.

In addition to QoS management, other criteria need to be assessed in order to select an appropriate radio communication system. These include the cost of deployment (based on the required number of sites), maximum supported vehicle speed, data capacity, critical voice services and protection from radio interference.

Today, transport operators can choose from a wide range of digital radio technologies. Based on functional and performance requirements, TETRA, which operates in the licensed UHF frequency band, is well suited to supporting critical transport operations.

GENERIC TRANSPORT REQUIREMENTS	TETRA (UHF)	GSM-R (800/900MHz)	Proprietary CBTC Data Communications Subsystem	Public Cellular Network
Protection from interference	Yes	Yes	No	Yes
Critical voice services	Yes	Yes	No	No
RF site coverage radius	10 to 25 km	5 to 10km	~250 to 450m	Up to 10km
Data throughput	14.4 kbit/s - 90 kbit/s* * Using TEDS with 50kHz channel bandwidth	9.6 kbit/s	+10Mbit/s	+10Mbit/s
Guaranteed coverage in operational areas	Yes	Yes	Yes	No Dependent on operator business model.
Guaranteed access	Yes	Yes	Yes	No Designed for best effort.
Choice of suppliers	High	Limited	High	High

RAIL SPECIFIC REQUIREMENTS

GENERIC TRANSPORT REQUIREMENTS	TETRA (UHF)	GSM-R (800/900MHz)	Proprietary CBTC Data Communications Subsystem	Public Cellular Network (3G/4G)
Support for train signalling (per EIRENE FRS for 2.4 kbit/s)	Yes Using Packet Data service	Yes	Yes	No
Support for train signalling (based on 50 kbit/s CBTC requirements)	Yes Using TEDS	No	Yes	No
Mobility: Standardised seamless handover (less than 300ms break in connection)	Yes	Yes	Proprietary	Yes
Mobility: Support running speeds of up to 500 km/h	Yes	Yes	No Typically up to 120 km/h	Yes

CONVERGED COMMUNICATION SERVICES

The need for increasing levels of automation, smarter asset maintenance and improved security will drive demand for on-board video surveillance and greater data bandwidth. Applications that enhance the commuter experience, such as eTicketing and passenger Wi-Fi, are also contributing to this growth in data demand.

To address these additional data communication requirements, transport operators are deploying dedicated mobile broadband systems, such as private LTE, or harnessing public cellular networks. A key benefit of LTE is its ability to support prioritisation and QoS differentiation, allowing operators to consolidate multiple services onto a single data communications network.

Now that private radio communications and LTE can support critical transport operations, the challenge for operators is in achieving voice and data convergence across multiple networks.

For example, applications such as Rail CAD must function consistently regardless of the underlying network.

With a converged communication services framework, applications are network and device independent and access shared services across multiple communication platforms. For example, a Messaging API could be accessed by an OCC application in order to update a passenger information display in a specific bus over an LTE connection. The same Messaging API could be used to update the passenger information display panel in a different bus over the TETRA network.

The converged communication services framework also extends to voice communications. It ensures that workgroups can communicate seamlessly and securely across different networks. As transport operators digitalise their operations, this capability will be vital in ensuring interoperability with legacy analogue communication systems.

Converged communication services help to improve transport operational efficiency by simplifying the task of integrating data with workflows. For example, using a Group Management API, an engineering supervisor's smartphone application can create a dynamic talkgroup comprising trackside workers within a specific geographical area to share task-related information. In this example, the exact locations of all workers can be shared via a common Location API and visualised on the smartphone app's geospatial user interface.

SCENARIO 2

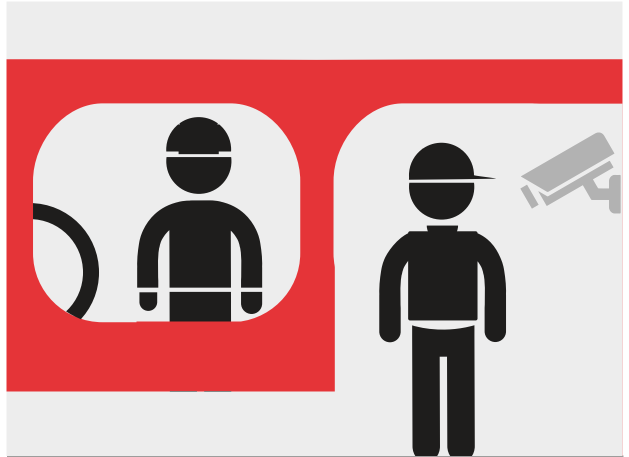
CHALLENGE:

Reduce response time to emergency situations on public transport.

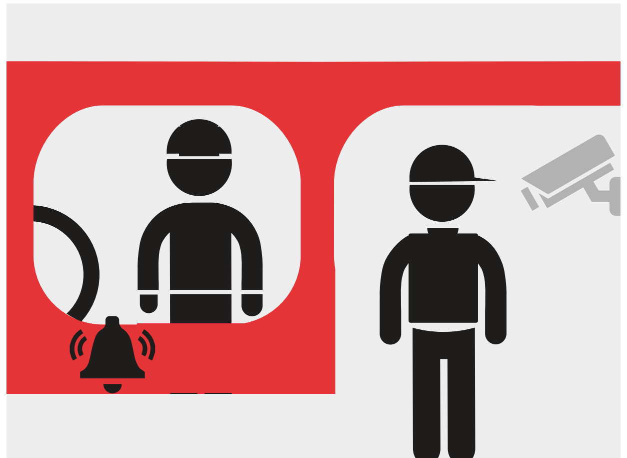
SOLUTION:

Leverage the unified TETRA and broadband network to rapidly deliver the actionable information to the emergency responders.

1 Passenger enters the bus without a valid travel pass.

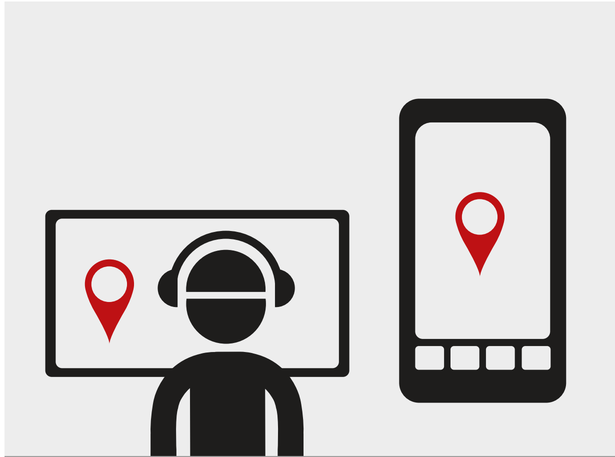


2 Passenger is challenged by the driver after he refuses to pay the fare.



3 Passenger becomes verbally aggressive and driver presses the emergency button on her TETRA radio.

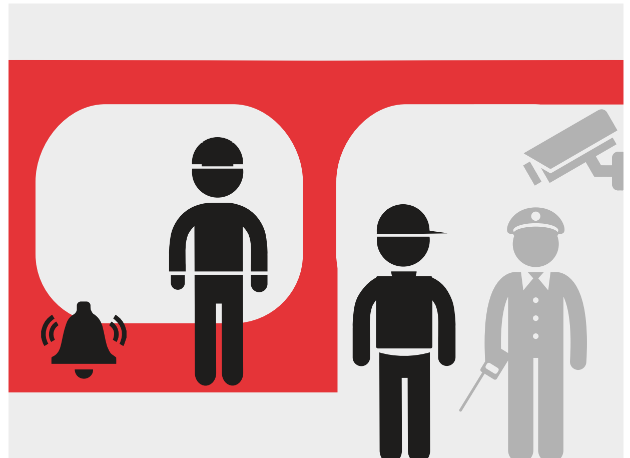
4 The emergency alert is received at the OCC and video from the CCTV streamed via the LTE network to the operator.



5 Converged communication services provide real-time location of the bus to the OCC and the cloud-based data sharing application.

6 The cloud-based data sharing application allows the bus operator to share real-time incident data with the police response team.

7 The police response team armed with information about the suspect approach the bus.



8 The police response team enters the bus and arrest the disruptive passenger.

SCENARIO 3

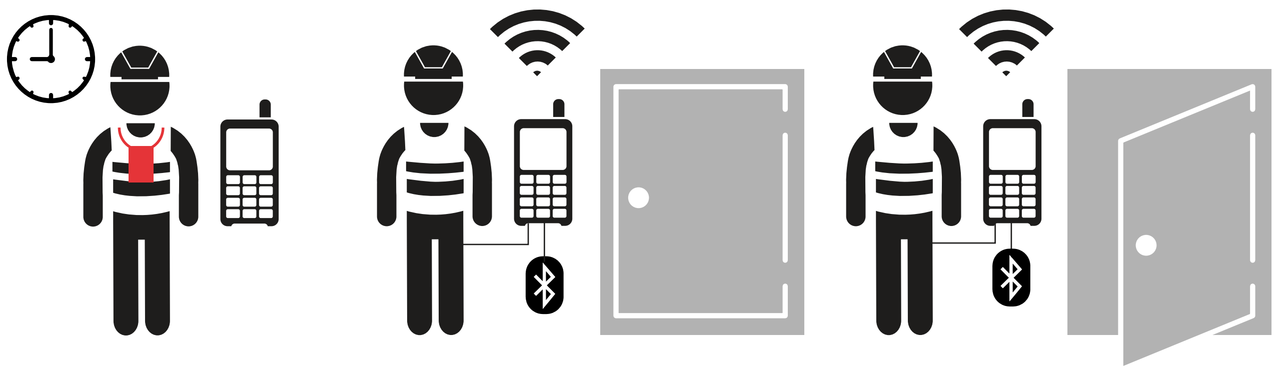
CHALLENGE:

Implement centralised access control for train operator's equipment room.

SOLUTION:

Harness real-time context and location information delivered using converged communication services.

ACCESS SECURITY APPLICATION



1 Maintenance Engineer starts shift. His staff ID is associated with his Radio ID in the TETRA system.

2 Using Bluetooth LE, his location, presence and context are shared with the Access Security application via converged communication services.

3 Based on the configured access policy, the Access Security application grants him access to the secure area on the basis of the time of entry, key fob pairing, location and Radio ID.

A FLEXIBLE COMMUNICATIONS PLATFORM IS THE KEY

A high availability communications platform is vital for supporting critical transport operations, as well as business-supporting processes. Modern TETRA systems provide functionality that can readily be adapted for transport operations.

By leveraging the converged communication services framework, TETRA systems can be integrated with broadband networks to create a unified network that supports additional data capacity. By embracing this open and flexible framework, transport operators can seamlessly expand the capabilities of their TETRA platform to support future use cases and enable the continuous improvement of service quality.

MOTOROLA SOLUTIONS

Motorola Solutions is the leader in mission-critical digital voice and data communications. Solutions include dedicated and customised communication infrastructures for transportation operators such as metros, rail services and buses.

Motorola Solutions' current focus of integration is around converged communication services; The Convergence Suite. This enables transport operators to integrate existing narrowband investments in two-way radio systems with mobile broadband capabilities. This integration platform is based on two components: WAVE for push-to-talk and voice services interoperability, and Intelligent Middleware, for data interoperability and security.

Intelligent Middleware provides a set of common data services such as Location, Presence, Group Management, Messaging and a common security framework. Critically, this platform ensures that data is accessible via open standards-based API. This ensures that the same data is utilised across multiple applications, independent of the application developer.

Working with customers around the world in the development and provision of these advanced networks, Motorola Solutions ensures the industry priorities of safety, efficiency and improving the passenger experience are met through reliable, effective communication.

Visit motorolasolutions.com/transportation

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