Connected Mobility:

On Track and Online when on the Move.

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Today's rail industry is waking up to the fact that passenger's, staff and systems require powerful connectivity as the demand for high speed data continues to grow, with increasing expectations of a seamless broadband experience, even when on a fast-moving train through the middle of the countryside, or in dense urban locations, over- and underground.

Train control, operating and information systems are becoming ever more sophisticated and passenger comfort and entertainment are key drivers in increasing rail attractiveness in today's multi-modal mobility world. Therefore train operators and train builders need new solutions to meet these demands. This is where Connected Mobility makes its arrival and specifically in the rail sector.

"Connected Mobility" is about connecting people and connecting trains. It provides a comprehensive communications solution that not only allows connected trains to achieve better operational efficiency and increased safety for passengers and staff within the rail network, but also provides a seamless connected experience for passengers. Increasingly the demand from passengers is that – even when they are travelling – they want to be able to communicate and access information to allow them to continue their work, access entertainment, or stay in touch with family, friends and colleagues, anytime and anywhere.

Connected Mobility brings the worlds of communication and railway together, covering passengers, rail staff and railway operations. It covers various aspects of high speed data communication systems, including data transmission along the track, data transfer between the train and track and also data transmission in the train, such as on– board Wi-Fi for both passenger convenience and operational purposes.

A New Approach Enabling Connected Mobility

Until very recently train operators have mainly relied on narrowband analog communication technologies. The rapid development of IP-based broadband digital

communication technologies is now drastically changing the industry landscape and requires a new generation of connectivity components.

Using the term Connected Mobility allows us to encompass all aspects of communication within the rail environment: connected trains, connected passengers, connected staff and connected infrastructure.

As trains increasingly transition from mere people moving objects to also becoming communication objects, train operators have to deal with constantly increasing amounts of operational data and also set the train as an open data and open application platform, just like a smart phone.

The Connected Train

A connected train is a train, whether local, regional or Inter-city, that has the ability to exchange data with its surrounding environment. Depending on the nature and critically of the data to be exchange, various scenarios can be envisaged in terms of communication infrastructures and various technologies can be used depending on bandwidth requirements.

There are a number of examples of how this can be done: Train control systems: the aim of such systems(CBTC for mass transit, ETCS for mainline, for example) is to enhance safety and optimize the traffic on a given line or group of lines. This is achieved by ensuring continuous data exchange between the trains and the control centre resulting in adequate and safe train movements in any situation. The critical data exchanged is mainly the speed and the exact position of each train. The ultimate evolution step of these systems is the fully unattended train operation (UTO) with a minimum time interval between trains (e.g. 60 seconds for metros). The role of the data communication system is obviously central in the overall performance of such systems.

Train operations: the amount of sensors used on a train has significantly increased in recent years. The general objective is to collect a variety of data to enable remote monitoring of the status of the train by the control centre. This may be for preventive objectives or to enable faster corrective actions. This applies for passenger security with video cameras (CCTV) or for train equipment (e.g. brakes, speedometers, energy consumption, amongst others) where effective systems can help to shorten maintenance cycles and increase train availability for commercial operations. Here also a comprehensive data communication system is needed to

enable the collection of data from sensors, as well as their transfer to the relevant authorities.

Infotainment: providing valuable information to passengers has become a must in modern trains. Travel routes, timetables, connections at the next station are all important data enabling passengers to enhance their travel experience. Additionally, advertisements, news, weather forecasts and other entertainment contents are also likely to generate attractiveness and revenues to train operators. There infotainment functions also often require the train to have access to data coming from the outside world.

The Connected Passenger

Passengers today expect a continuous broadband access to the network, anytime, anywhere and expect trains to provide an equivalent connectivity capability to that provided either at home, in an office or on the street with 4G cellular network. Since trains are moving objects, this brings its own industry-specific technical challenges and specialized solutions are increasingly becoming available to meet these needs.

Connected Staff

Railway staff, both on trains and in stations, control centers and also maintenance engineers in the field all need access to information, whether to provide better customer service or better operational efficiency with shorter maintenance downtimes for example.

Connected Infrastructure

Behind all this is the need for a reliable and robust infrastructure that ensures the highest degree of safety and availability throughout the year. This includes supervision and protection of critical infrastructure equipment (track switches, level crossing, and power substations) with the help of dedicated SCADA systems, but also passenger protection in train stations with CCTV systems, passenger information with updated stationary timetables and management and storage of all operational and supervisory data within data centers.

A New Departure

Clearly there are many opportunities for companies to support the rail industry and many new technologies that support the goal of comprehensive connected mobility within the railway environment.

In former days, due to the nature and size of data to be exchanged, the use of conventional copper cables and basic SISO (Single input single output) wireless designs was sufficient to address the data and signal transmission needs of train operators. Now the demand for high speed data communication systems continues to grow. On the connectivity component level, new technologies are combined to provide the requested network and system performance: fiber optics and high-frequency twisted pair CAT7 cable systems for train gigabit backbones, fast Ethernet CAT5 or gigabit Ethernet CAT7 assemblies for connections of end devices (cameras, passenger counting systems, multimedia servers, network video recorders, displays,..), MIMO antennas, MIMO wireless radios (Multiple inputs multiple output) and low-loss coaxial cables either for true broadband passenger Wi-Fi or for train-to-ground wireless connections.

Today connectivity components for data communication have become key enablers for the implementation of new applications and services on-board rolling-stock.

In the UK, Germany, France, the USA, China, India and Australia, rail operators already have several projects underway in this field. One such example is the Changchun Railway Vehicle and Tangshan Railway Vehicle Companies who decide to equip 100◇8 train units (800 carriages) of the high-speed train type CHR380 in China with a passenger entertainment system. Thanks to this entertainment system, passengers in the trains are able to watch or play videos.

HUBER+SUHNER supplied 10,000 meter of coaxial cable for this system, which is laid as backbone cable through all carriages to transmit the data along the length of the train 200,000 meters of network cable were also installed. These cables distribute the data from the backbone cable to devices, such as computer screens, located in the individual carriages.

An additional characteristic example of how Connected Mobility works is in CBTC systems (Communication Based Train Control)-these are train control systems that provide real-time information on traffic to control centers and individual trains by means of continuous data communication. As a result, the driving speed of each individual train can be adjusted to the actual traffic conditions and the headway can be significantly reduced. Capacity utilization of tracks can be improved and rail transport safety can be increased.

A CBTC system relies on a data communication system that consists of the on-board network within the train, the radio network between the train and the trackside and the backbone network along the track.

Most of the metro systems in the world are migrating to this technology, where fiber optic cables and fiber optic management systems are used for the backbone network along the track. To establish the radio network between the train and the trackside, all passive components, such as antennas on the train roof and along the track, radio frequency cable assemblies and accessories such as power splitters are used.

The on-board network within the train often uses fiber or copper-based Ethernet backbone for a reliable Cab-to-Cab transmission. All these radio frequency and fibre optic components ensure continuous interference-free data transmission between the trains and the trackside.

The CBTC systems of line1,2 and 3 in Sao Paulo are fully equipped with all of these HUBER+SUHNER components. The CBTC systems in cities such as New York, Shanghai, Beijing and Paris all have a similar configuration.

These are just a few examples of how the rail industry is meeting the challenges of a more connected future and how technologies can support the aspirations of both train operators and their passengers for a more connected future on the move.