

Revolutionizing railway communications with LTE

Alcatel-Lucent



As Long-term evolution (LTE) is rolled out on commercial mobile networks across the world, LTE is also being adapted to railway communications, allowing operators to improve the efficiency of their critical communications and enhance passenger experience by offering new and innovative services.

Access to ultra high-speed broadband, high-definition and 3D TV is the future of mobile telecommunications. Within just a few years, anyone will be able to utilise these bandwidth-hungry services while they are on the move from their smart phone, game console, tablet or laptop by accessing a fourth-generation (4G) mobile network.

Long term evolution (LTE) is gaining traction as the preferred standard for 4G with more than 50 commercial networks launched between 2009 and the first quarter of 2012, and 128 expected by the end of this year.

Rail users will also expect to access these services. Indeed LTE has the potential to transform passenger experience by offering individual journey plans, tailored marketing

messages, and communication during service disruptions. However, the technology will also greatly benefit railway operators. By hosting all communications on a single platform, an LTE-based network can revolutionise an operator's critical communications while optimising traffic and reducing costs.

Operators must therefore consider investments in a high bandwidth IP backbone as the first step towards a multi-service communications network that will support LTE. This might seem a daunting prospect, but as the European Commission noted in its 2009 document A Sustainable Future for Transport, "upgrading existing infrastructure – also through intelligent transport systems – is in many ways the cheapest way to enhance the overall performance of the transport system."

platform and level crossing surveillance, and high resilience functions such as railway signalling all on a single platform.

Alcatel-Lucent is testing LTE with existing signalling systems with a view towards ultimately superseding GSM-R and Tetra communication networks. These systems were developed for the pre-IP era and are restricted to ground-to-train voice communication and early Communications Based Train Control (CBTC) with limited data exchange. Metro networks, driven by the development of CBTC GoA 3 driverless train operation and GoA 4 unattended train operation, have also adopted Wireless LAN-based networks. These systems provide improved capacity but are limited to carrying either mission-critical CBTC traffic, or non-mission critical information such as CCTV and passenger information systems. By contrast, LTE improves capacity while delivering truly mobile multiple broadband IP-based services, and in conjunction with its sophisticated Quality of Service (QoS) mechanism, is capable of prioritising traffic streams from various applications without compromising their operation or reliability.

LTE technology is based on an evolved version of the proven 3GPP network security which offers strong mutual authentication and optional end-to-end confidentiality protection of end-to-end traffic. It is a commercial off the shelf technology which does not require any modifications before installation,

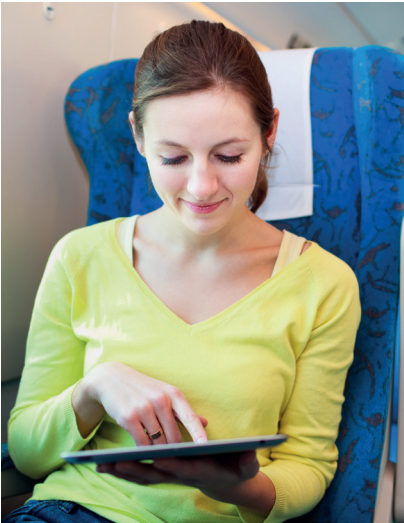
The growth of smart technology

- 90% of the world covered by mobile signal and 75% of people connected via mobile
- Broadband subscribers worldwide: 1.3 billion
- Data traffic projection: increased by 18 times from 2010 to 2015
- Machine to machine connections: increased by 10 billion in 2016 and 23 billion by 2020
- Tablets purchases: increased by 98% in 2012

(Source: Nielsen & GSMA 2012)

Real-time two-way communications for operational excellence

Advances in telemetry and machine-to-machine (M2M) interfaces that provide real-time monitoring of assets are already prompting a shift towards predictive rather than preventative maintenance. Real time traffic management and driver advisory systems will enable railways to run more efficiently. And when the time comes to upgrade the communications network to LTE, the high bandwidth on offer will be capable of supporting functions ranging from low latency VoIP for intercom, high bandwidth applications like CCTV for onboard,



reducing power consumption and operating costs. And with low latency and resilient architecture, LTE will spur the development of more advanced CBTC developments in the near future as it is already doing with Wi-Fi solutions. By leveraging the ubiquity of Wi-Fi enabled handsets, these networks can continue to act as an effective on-board distribution technology while complementing the LTE backhaul. Alcatel-Lucent lightRadio™ Wi-Fi solution is already embracing this next-generation Wi-Fi hotspot technology, and is capable of offering superior user experience with seamless login and tight LTE service integration such as voice services over LTE.

Operators must be ready to capitalize

With such substantial changes on the horizon, railways must be ready to capitalize. However, given the transformation required, and the slow-moving nature of the railway industry, it will take time for operators to formulate the most appropriate LTE adoption strategy. Choosing a supplier with suitable experience is therefore crucial to getting this right from the start.

"LTE is key to transforming the current fractured train-to-wayside communications infrastructure" says Olivier Andre, Transport Market Vice President at Alcatel-Lucent, a company offering one of the most complete LTE product portfolios in the industry. Alcatel-Lucent has already deployed some of world's largest commercial LTE networks, including AT&T and Verizon in

Partnership with Railway industry and research centers on LTE

Alcatel-Lucent is collaborating with ADIF, *Madrid Metro*, *AT4 Wireless* and several Spanish Universities on the "TECRAIL" project. Research is underway at a laboratory in Adif's Railway Technology Centre in Malaga on using and adapting LTE as well as IP convergence to standardize and improve railway communication. Tests are also being carried out at Adif and Metro Madrid's facilities on providing GSM-R over a single converged IP-MPLS network and using an integrated multimedia solution to improve passenger communications.

The aim of the program is to demonstrate the capability of IP and LTE to support signalling, automatic operations, and onboard train-to-ground communications, while contributing to the standardization and development of these essential technologies.

the United States, and was selected to deploy the 700 MHz LTE public safety solution in Charlotte, North Carolina which will be rolled out in July 2013.

For railway operators a variety of solutions are available, with selection dependent on several factors including the availability of LTE bandwidth relative to cell sector capacity, the availability of Wi-Fi based TWC infrastructure, their desire to reuse current Wi-Fi infrastructure, and of course the general risk appetite of the operator.

For instance an operator that already has a Wi-Fi based CBTC network with moderate network capacity and a risk averse mindset might choose to install LTE single-layer architecture which carries no mission critical CBTC traffic over LTE, no SPOF protection at RAN, and leverages a single carrier up between 1.4MHz and 20 MHz. Operators with higher capacity might also install fully redundant end-to-end architecture providing single point of failure protection at RAN, and leveraging a single carrier between 1.4MHz and 20MHz.

The natural upgrade for these operators is to handle mission critical traffic through LTE, with the option to duplicate the service over two layers; a larger one carrying all traffic, and a second smaller carrier for mission critical traffic. Beyond this operators with extremely high traffic might want to install two large carriers for both critical and non critical traffic across both layers.

Overcoming obstacles and adopting LTE

A lack of dedicated infrastructure for the railway industry is one of the key obstacles to an immediate adoption of

LTE. However, there are a several ways to overcome this. "Alcatel-Lucent has already shown through its LTE 400MHz solution, a joint development with Cassidian, that it is possible to lower the barricade by tapping into TETRA civilian bands, rather than the competitive 3GPP bands," Andre says. "Operator should also look to establish co-op relationships with Telcos to address backhaul costs and spectrum challenges. Alcatel-Lucent has an extensive knowledge of both railway applications and the network capabilities to fulfil mission critical requirements in a shared network environment."

Future developments

Alcatel-Lucent is already working with Adif and several Spanish universities as part of the 'Tecrail' project, to identify the most effective transition of LTE to high-speed rail networks. It is also assisting Metro Madrid and several other metro operators to develop the most appropriate application with current CBTC technology. These each emphasise an end-to-end solution and interoperability with legacy networks, meaning that any operator upgrading to an intelligent transport system will receive a comprehensive package, providing both an enhanced experience for passengers, and improving the efficiency of operations. ■

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