

Case Study

China's high-speed railway lines

From Beijing to Guangzhou in just 8 hours
COMLAB GSM-R repeaters make it possible

The project

On December 26, 2012, the world's longest line for high-speed trains, from Beijing to the southern Chinese city of Guangzhou, entered service along its full length for the first time. The media showed great interest in this historic event. Since then, trains have been making their runs on the 2298 km line in just 8 hours. Previously, the same trip had taken 22 hours. The top speed of 400 km/h and the corresponding control of operations by the Chinese Train Control System (CTCS) were only possible because of the high-performance and absolutely reliable communication system architecture from COMLAB.

The challenge

In addition to the enormous dimensions of the nearly 2230-km line between Beijing and Guangzhou, the project offered additional challenges for the provision of radio communication services. The line's roughly 600 km of tunnels required installation of an extremely reliable tunnel radio system. This system had to deal with the train's extraordinary average speed of 350 km/h.

600 km of line in tunnels

Between Beijing and Guangzhou, the line's challenging route includes a large number of bridges and tunnels. Given the strong attenuation of radio waves beneath the Earth's surface or within a mountain, supplying a tunnel with radio communication from outside is generally impossible. This is particularly true in railway tunnels, whose cross-section is smaller than those of highway tunnels. A train in a tunnel acts as a shield that prevents radio waves from passing. The longest tunnel on the Beijing-Guangzhou line is 30 km; their total length is 600 km.

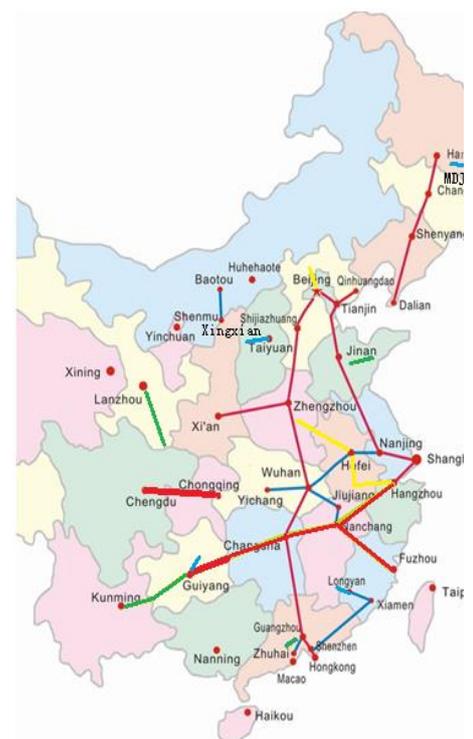


Image:

COMLAB has equipped 95% of all high-speed railway lines in China

In order to guarantee radio coverage in the deepest interior of the tunnels given these distances and these challenging conditions, a high-performance and highly redundant tunnel radio system was indispensable.

Speeds up to 400 km/h

In addition to the difficult conditions of the long railway tunnels, the high train speeds of up to 400 km/h posed an enormous challenge. At this speed, a train driver cannot read lineside signals. The signaling system must therefore reliably display movement authorities to the driver in the cab. This means that the driver must be able to rely on the radio communication system. A frequency fault in the GSM-R signal or a loss of connection would be disastrous for high-speed trains.

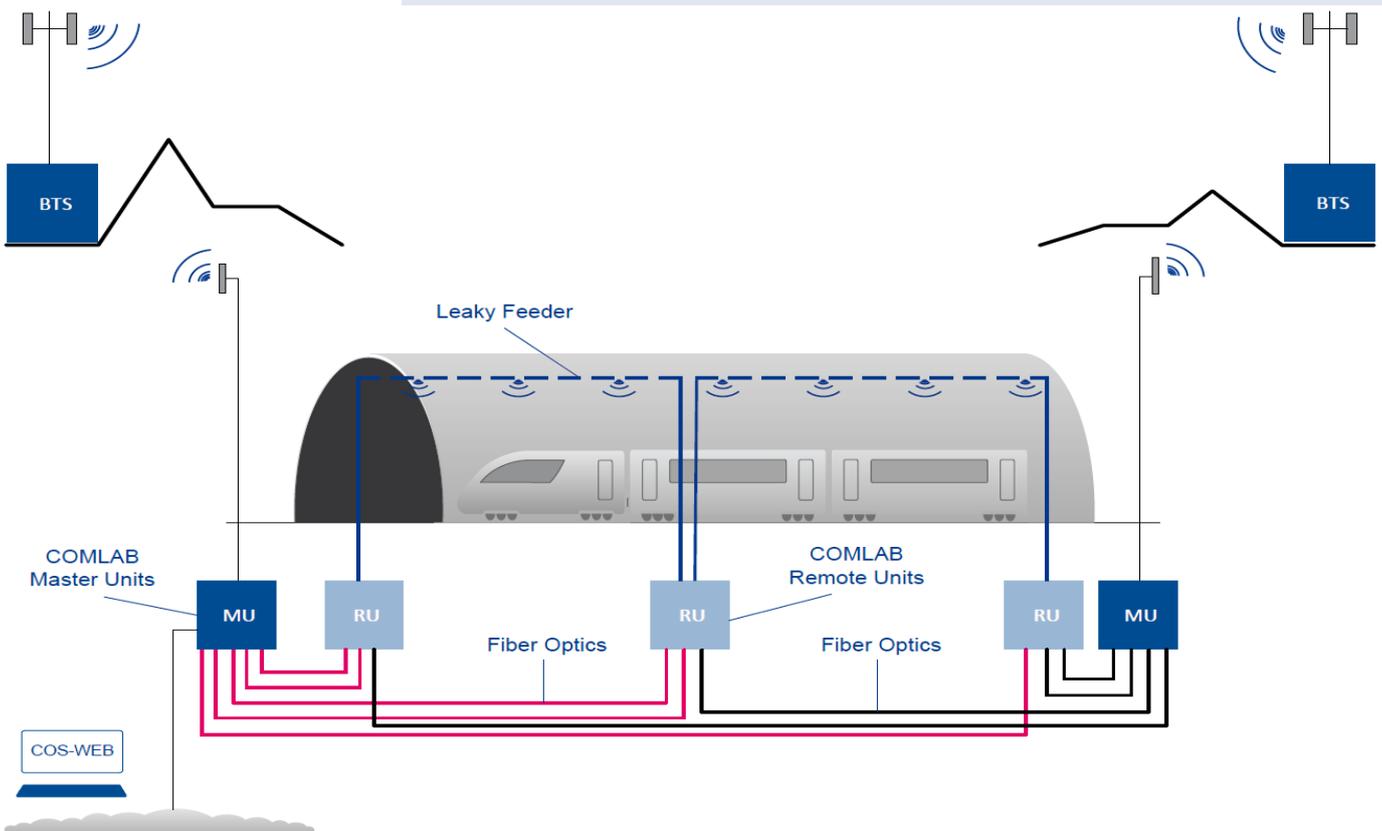
The solution

The solution for radio communication in the tunnels of the Beijing-Guangzhou line was a highly redundant GSM-R repeater system that COMLAB specially designed for China's high-speed lines. It covers all voice and data services for train communication and is a result of Swiss quality and Chinese efficiency.

The GSM-R repeater system from COMLAB consists of two master units (MUs) located at the entry and exit of the tunnel. They receive signals from a base station and forward those via fiber-optic links to remote units (RUs) located every 1000 m inside the tunnel. Each RU receives signals via a total of three fiber-optic links and has two power supplies and two Power Amplifier Units. A leaky-feeder cable ensures evenly distributed coverage throughout the tunnel and prevents a possible loss of connection. Feeding the leaky-feeder cable with signals from both ends of the tunnel and providing each repeater with two power-supply modules and two outputs makes the system highly redundant. If a component or cable fails, another takes over. This ensures a radio meantime between failures (MTBF) of 211 years.

Image:

COMLAB's highly redundant GSM-R repeater solution for Chinese railway lines



The COMLAB Operations and Maintenance Control System for the GSM-R repeaters enables to read alarm messages and modify the configuration of the master units and remote units easily and remotely. The interface shows the whole line from Beijing to Guangzhou. In case of a problem in the tunnel, the affected MU or RU immediately turns red on the interface. And the service staff knows exactly where the potential problem is. The repeaters' control system can be integrated within a larger system management application.

The benefits

Reliability and high availability

The triple signal provision via fiber-optic links ensures the highest redundancy and thus the absolute reliability of the GSM-R repeater system, which COMLAB designed specifically for the Chinese high-speed lines. The leaky-feeder cable distributes the signal evenly throughout the tunnel, which avoids a loss of connection at any time. The system also allows extremely clean handovers from one cell to the next. Data exchange between the driver's cab and the train control system CTCS occurs in real time, even at very high speeds. This guarantees maximum safety. In addition, the GSM-R repeater system from COMLAB ensures also communication for maintenance people and passenger information. Thanks to the absolute redundancy communications can even be guaranteed when an incident puts a component out of service.

Speed

The highly redundant repeater architecture from COMLAB enables reliable data exchange in real time even at speeds of 400 km/h. The former 22-hour train trip between Beijing and Guangzhou was shortened to just 8 hours. This made the Chinese high-speed trains competitive with airlines.

COMLAB has equipped 95% of all Chinese high-speed lines

The success of the Beijing-Guangzhou project and its communication system architecture is directly visible in the additional orders that have followed. COMLAB has now equipped 95% of all high-speed railway lines, 20% of all lower-speed lines and 10 of the largest railway stations in China with repeater systems.

Further projects are foreseen in China that will bring even greater time gains in railway travel.

COMLAB – your customer's safety and comfort is our mission



COMLAB GSM-R Repeater-System

- High reliability thanks to an absolute redundant system with 3 fiber optic links, 2 power supply and 2 power amplifier units
- High power efficiency
- Complies with train driving with CTCS-3 (ETCS-2)
- Enables data exchange in real time (even at speeds of more than 400km/h)
- Web based operations and maintenance control system
- Remote control



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