Developing the World’s First Metro LTE Network for Train-Ground Wireless Communications

Background
Zhengzhou is a major city and transportation hub in the central region of China. Zhengzhou municipal government has decided to speed up the development of the urban railway transportation system to improve traffic conditions and support the city’s sustainable development. The government expected the metros to take 60% of the public transportation loads in the central business district of the city.

Six metro lines will be constructed in Zhengzhou as per layout of metro network, including three east-west lines, two north-south lines, and one ring-shaped line. The total length will be 202.53 km. Metro line 1 is the first metro line in Zhengzhou, 26.2 km will be constructed in Phase 1 project. The operation of Metro line 1 will relieve the city’s east-west direction traffic pressure and enhances the connection between new and old towns in Zhengzhou.

Key Challenges
The train-ground wireless transmission is a bottleneck of urban railway transportation services. The Zhengzhou municipal government faced the following challenges in determining an appropriate wireless communications system:

• Slow and unstable data transmission in the Passenger Information System (PIS)
• Traditional PIS systems use local data recording solution or using the wireless local area network (WLAN) for real-time data transmission. The data recording solution does not support real-time information services, which cannot realize the information sharing between train and ground in real time. Constrained by WLAN protocols, the WLAN solution has low bandwidth and stability, which results in frame freezing, transmission interruption, and poor user experience.

• Problems for vehicle-mounted devices to upload live videos to operation center
Due to the low uplink data transmission capacity, train-mounted communications devices cannot efficiently upload live video surveillance data to operation center, which cannot meet the requirements of public security protection.

• High fault rate and difficult maintenance
The WLAN solution uses access points (APs) to provide communications services. A single AP covers a maximum of 200 meters and has low reliability. To ensure full coverage and high reliability, a large number of devices that require power supply units must be deployed, which results in high fault rate and difficult operation and maintenance (O&M).

Solution
Based on the rich experience in developing LTE end-to-end solutions and the customer’s service requirements, Huawei has provided an all-in-one LTE wireless communications solution to provide data transmission services for the PIS and train-mounted video surveillance system.

The solution is based on professional Huawei network planning and leverages LTE’s advantages in access performance and service bandwidth in fast moving scenarios. This solution provides approximately 20 Mbit/s downlink bandwidth, which has set a good example for the live and HD PIS in the urban railway transportation industry in China. The Huawei LTE system works in Time Division Duplex (TDD) mode, which enables the system to provide large-bandwidth uplink data transmission services with limited frequency resources, meeting the requirements of the wireless transmission of live HD surveillance videos. The system also uses a comprehensive Quality of Service (QoS) mechanism to perform refined service priority management. When the network is congested, the system ensures that key services have the required bandwidth resources. The network bears the service data of the PIS and video surveillance system, which lowers the network development costs and lays a solid foundation for future wireless service expansion.

The LTE is a future-proof mobile communications technologies and mainstream technology that facilitates the evolution from 3G to 4G. The stability of the LTE technology has been tested in global markets. The mean time between failures (MTBF) of LTE remote radio units (RRUs) is not less than 150,000 hours, which is much higher than that of the WLAN APs (50,000 hours). With the boundless professional wireless broadband...