A bright future

The GSM-R system is based on the reliable and mature GSM platform. By inheriting applicable GSM technologies accumulated over the past two decades, the GSM-R systems’ new functionality is tailored to suit various requirements for railway communications. As a digital communications platform, the GSM-R provides not only voice communications services that span wireless train dispatching, shunting yard, emergency call, and maintenance communications, but also transfers diagnostic data, freight and passenger information while delivering other value-added services.

Since the construction of trial networks in France, Germany, and Italy in 1997, the GSM-R has become the global standard for railway communications. The system has been widely deployed in the UK, Switzerland, the Netherlands and Spain. Other countries, such as India, Saudi Arabia, and Indonesia, have also actively planned to deploy the GSM-R system.

With the most population in the world, and an extensive railway network to serve them, China has made huge progress in railway construction. Stretching across this big nation, railways are playing an increasingly important role in daily life.
powerful customization and development capabilities, Huawei provides a complete range of GSM-R solutions that covers core networks, wireless networks, terminals, transmission networks, data communications networks and other auxiliary facilities. Moreover, Huawei has made remarkable achievements in standard setting, product development and project delivery.

**Tackling coverage challenges through distributed BTSs**

Due to the large coverage and complex geographical conditions of the railway network, the wireless coverage has a lot of weak fields. In addition, with the higher train speed the doppler Effect is more prominent, indeed worsening the quality of communication.

Since more GSM-R systems are deployed, issues related to wireless coverage are worsening at weak fields such as track combining and crossing areas, large railway stations, tunnels, bridges and train yards. The limited frequency resource of the 4MHz band is the major bottleneck for the traditional BTS for covering such areas.

In September 2008, at the Berlin InnoTrans 2008 Congress in Germany, Huawei launched the industry’s first GSM-R distributed BTS solution to resolve issues related to wireless coverage for railway systems. In this solution, a GSM-R distributed BTS is comprised of a baseband unit (BBU) and a remote radio unit (RRU) connected by optical fibers.

Huawei has designed a Multi-site Co-Cell sharing technology, especially to cater the railway communication needs. It helps to solve problems associated with frequent network handover and the weak fields in a high-speed environment. Controlled by the BBU, the RRU’s from multiple physical sites are homed in to the same cell. The technology reduces network handover time and increases handover success rate in a high-speed environment and substantially saves frequency resources.

For a railway operating at a speed of 300km/h or above, Huawei offers two wireless coverage solutions: dual-network coverage and neighboring BTS cross coverage. These solutions can prevent single-point failures from interrupting services in a high-speed environment.

In the dual-network coverage solution, two BTSs are deployed at the same physical site to achieve dual-network coverage. When one BTS fails, the other BTS takes over from the failed BTS to ensure consistent wireless coverage. In the neighboring BTS cross coverage solution, one BTS is deployed at a site. When the BTS of a site fails, the BTSs of neighboring cells can ensure the normal handover of wireless channels.

**Mobile sofswtich supports remote hot backup**

The security and reliability of railway communications is increasingly important, especially with expanding railway construction. As a special part of the railway communications network, a mobile switch usually covers multiple railway lines in a large area. Any operational errors, faulty devices or natural disasters can cause a mobile switch to fail and interrupt service on a large scale, putting the operation of multiple railway lines at risk. It is essential that core networks provide disaster recovery capabilities like a hot backup to ensure network security and reliability.

Mobile softswitch can be deployed on core networks to address these issues. Features include: excellent disaster recovery capability, remote separated installation of a MSC server and a media gateway (MGW), plus support for N+1 disaster recovery backup. In China, typically four to five backup softswitches are deployed in an area-by-area basis along nation-wide railway lines to serve as hot backup for switches for 18 railway administrations.

To further secure networks and enhance the disaster recovery capability, the GSM-R system also offers two softswitches for key lines to achieve 1+1 disaster recovery backup. These two softswitches work simultaneously and serve as the active and backup devices respectively, synchronizing data through a heartbeat link. When one softswitch fails, the other immediately takes over to independently switch services for the entire line. When the failed softswitch recovers, services...
are automatically switched back to resume the load sharing mode.

In 2003, Huawei debuted the world’s first mobile softswitch solution based on the 3GPP standard architecture. Through years of steady development, Huawei has set the pace in the global mobile softswitch market. By Q3 2009, Huawei’s mobile softswitch has served 1.6 billion users in more than 100 countries. Also, Huawei has established long-term partnerships with leading operators in the core network area, including: China Mobile, China Telecom, China Unicom, Vodafone, Orange, KPN, Telenor, Reliance and Etisalat.

Securing railway communications

Smooth communications for heavy haul railways

As one of the most important heavy haul railways in China, the Datong-Qinhuangdao line (Da-Qin line) is the first line integrating the GSM-R system. On the Da-Qin line, the 2700-meter-long train has 214 coaches and provides a transportation capacity of 20,000 tons and a single train is driven by multiple engines operating synchronically.

In 2004, Huawei was awarded a contract to deploy the GSM-R networks for the Da-Qin line. All trains on this line must communicate at the same time with high quality wireless coverage. Within less than a year, Huawei successfully delivered this national-level key project to the Taiyuan Railway Administration. The annual transportation capacity of the Da-Qin line has increased from 100 million tons in 2002 to 340 million by the end of 2008, making it the most important coal transportation line in China.

In 2008, the Da-Qin Railway Heavy Freight Transportation Technologies and Applications project was awarded the First-Class National Science and Technology Progress Prize and Huawei’s GSM-R communications technologies were highly recognized. The award encouraged Huawei to devote more effort to GSM-R networks. Following the Da-Qin line, other branches, such as the Qian-Cao line and Beitongpu lines have also been covered by GSM-R wireless networks. Therefore, Huawei has paved the way for the telecommunication development of heavy haul transportation in China.

Providing coverage solutions for high-speed passenger railways

As one of the world’s fastest passenger railways, the Guangzhou-Shenzhen Express, with a speed of 350km/h, is some of the most advanced technology in use today. This line transports millions of passengers each year along 110 kilometers of track. Moreover, this line serves as one of the two arteries in the inter-city railway network of the Guangzhou-Shenzhen area, and is also an important part of the Beijing-Hong Kong passenger railway.

To ensure wireless coverage quality in a high-speed environment, the neighboring BTS cross coverage solution is adopted for the entire Guangzhou-Shenzhen Express. This helps ensure normal operation when single-point failure occurs. In addition, due to the complicated geographical conditions along the line, Huawei has conducted field surveys on the Guangzhou-Shenzhen section many times to work out wireless coverage solutions for weak-fields.

The 10.8 kilometer long Lion Ocean tunnel located on this section is the first underwater railway tunnel in China. For working within the limited space inside the tunnel caused by its shuttle-shaped shield design, Huawei mapped a solution where the two shuttle-shaped ends share the same cell (thus avoiding cell handovers) and all the BTSs are deployed outside the tunnel. This ensures wireless coverage and simplifies device maintenance.

In addition to fulfilling high coverage requirements, the GSM-R system on the Guangzhou-Shenzhen Express is also required to carry the train control information for the Chinese Train Control System Level 3 (CTCS-3), posing great challenges to relevant QoS indexes such as E2E delay in the entire GSM-R system.

In response, Huawei GSM-R system provided a signaling carrier system at a high security level for this line. With this system, trains can operate without traffic lights, and the security of train dispatching on the line is ensured.

Currently, Huawei experts are devoted to the R&D of GSM-R technologies and actively participate in standardizing GSM-R technology. So far, Huawei has submitted more than 60 proposals to relevant international organizations. Developed on the widely-used GSM platform, the Huawei GSM-R system completely complies with the EIRENE specifications and is highly compatible. Its maturity and reliability have been fully recognized.

In December 2009, Australia’s largest rail engineering company UGL Ltd. has chosen Huawei as its sole supplier of GSM-R system technology and equipment. As technology advances, so does Huawei and the GSM-R system is ready to fulfill the requirements for railway communications on trains with faster, safer, more customized solutions.

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