



# TETRA powers Shanghai Metro's complex system metro

Digital communications system introduces cost savings, flexibility and improves productivity, efficiency and responsiveness

A networked rail transportation system demands a professional networked wireless communication system to support its complex citywide transit operations



Shanghai Metro is a massive citywide public transportation system with a total of 10 urban rail lines, including those under trials currently deployed. These are Metro Lines 1, 2, 3, 4, 5, 6, 7, 8, 9 and 11. On average, more than 3.5 million commuters travel daily on the metro, with peak traffic volume reaching up to 5.27 million in end 2009.

Shanghai Metro currently spans 390 kilometres of track, and will reach up to 420 kilometres by the time the World Expo takes place in Shanghai mid 2010. In 2012, the metro system will exceed over 500 kilometres of track and will grow to an estimated total of 22 lines before 2020.

To manage this complex rail system, Shanghai Metro turned to a TETRA (TERrestrial TRunked RAdio) digital trunking solution for its wireless communications system to handle networked train scheduling, operations management, production safety and rescue and disaster relief to provide wireless dispatch communication security.

The importance and complexity of the wireless communications system project, which started in 2005, required an innovative design philosophy and construction on an unprecedented scale in the history of China and even in Asia Pacific's rail construction industry.

## Customer Profile

### Company

Shanghai Metro

### Location

China

### Industry

Transportation

### Solution

- Full Dimetra-IP System supports over 5,000 users
- Extensive RF coverage across 13 lines
- Customised train-CAD applications

## Features of Shanghai Metro TETRA Rail Network

- The switching mechanism of the leading and supporting switching centres are in different locations
- Degraded operation mode for basic communications during emergencies
- Well planned coverage design guaranteeing complete coverage and seamless communications
- Coverage design of elevated area (unilateral cable) to guarantee the coverage under, or above ground, and in-train coverage in the event of crossing trains
- Internal coverage between stations to avoid interference of same spectrum as little as possible under limited spectrum sources
- Various user APIs to meet customized need



### Complex Transit Network calls for system enhancement

A networked rail transportation system demands a professional networked wireless communication system to support its seamless operation.

The construction of the communications system faced a number of challenges. Due to the sheer scale and complexity of the system, it required extensive planning and research. It also needed to meet the requirements of the daily rail transportation network operations for train dispatch, but also that of urban emergency response.

To undertake a project of this scale, with a long timeframe and complexity, Shanghai Shentong Metro Group required a strategic communications partner who could provide the leading-edge technology, coupled with rich relevant experience and strong local support to ensure the project's success.

Despite strong competition, Motorola won the bid to construct the massive professional radio communication system with Shanghai Shentong to build the system over the next 10 years.

### Addressing the Challenge. Ensuring Operational Safety.

Shanghai Metro adopted two switching centres for backup in different locations, which will provide stable and reliable support to dispatching, operation management, safe production and emergency response for all urban rail lines in Shanghai.

The full system includes over 110 enhanced base stations, two all-IP MSOs (Mobile Switch Offices), over 5,000 user terminals (handheld mobile radio devices, TETRA subscribers and mobile radios), Central Operations Command Centre, RF coverage system, repeater stations, as well as various train CAD applications that are customized for the rail network.

The system would be integrated with the 800MHz Shanghai Government Radio Network to realize a wireless network encompassing the entire city.

Authorized users can work freely on both networks. This will allow the city emergency response centre to achieve centralized dispatch and command while ensuring effective communications support for the city's safety and rail emergency rescue teams.

Leveraging upon the available features and functions of the system and taking into account the unique user requirements, Motorola designed a network that fully utilizes the system advantages and channel resources while avoiding the conflict of different applications.

As the system integrator and technology planner, Motorola is responsible for system design, equipment and material delivery, supply management, project execution, system integration, project management, quality control and system maintenance. Its strong local technical support, rich system design and execution experience in urban rail transportation, excellent integration capabilities and project management are clearly reflected as customer benefits in this project.

In order to plan, design and implement the network while reducing risks associated with the project, Motorola and Shentong Metro Group conducted extensive research and testing in advance. Tests were conducted along a eight-kilometre stretch of rail at the Line 3 and Line 4 interchange at Hongqiao Road in 2005.

The research provided large amounts of statistics and data, which contributed to the design and further optimization of the Shanghai Metro wireless communication system. The results provided an important frame of reference for the implementation and construction of other urban rail transit systems. This fully demonstrates the strategic decision making leadership of the Shentong Metro Group.

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Motorola helped Shanghai Metro overcome unexpected problems with its rich experience. The scheduled plan was to locate a leakage cable on the power line gantry crane in an elevated area. This plan may cause disruption to the construction and maintenance efforts. Coverage of the elevated area became a challenge. Based on data gleaned from prior tests, Motorola proposed a coverage plan based on unilateral cable, which proved to be a success.

Motorola set up a special project execution organisation – The Shanghai Metro Project Office, staffed with full-time employees to manage the complex project that needed much coordination efforts. Motorola also worked out a customized management mechanism, which included a technology administration team and risk management plans.

The project staff members are highly reliable professionals who enjoy over 10 years of rich experience with keen knowledge of both radio communications and project management. They are specially allocated for this project to respond quickly to customer needs and closely monitor project developments, ensuring successful project execution.

### Outstanding Performance

Shanghai Metro has to-date successfully deployed the master switching centre, reserve switching centre, Central Operations Command Centre and fully operational communications wireless systems for Lines 1, 2, 3, 4, 5, 6,7,8,9 and 11. The systems include 82 base stations, approximately 1,200 MTM800 data terminals and 3,000 sets of MTP850 handheld devices. The MTM800 data terminals were developed for operations, scheduling, subway car management and emergency responses to operational faults. The handheld terminals were primarily used for voice and SMS applications.

Currently, Line 10 East, West and West extension of Line 2 and the Expo Section of Line 13 have undergone stress tests wireless connectivity and communication coverage, and has since started full operations since 2009.



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