Cloud Computing for Railway Automation

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China’s first fully automated driverless metro, Beijing’s Yanfang line, started testing this year and is expected to be fully operational by 2017. The technology driving the Yanfang line is Huawei’s Traffic Control Integrated Automation System (TIAS), developed in cooperation with HollySys Automation Technologies, a Beijing-based provider of automation control technologies and applications.

In 1998, the world’s first fully automated driverless metro line was put into operation in Paris, France. In 2008, the Copenhagen Metro in Denmark was recognized as the world’s best driverless metro system. Currently, fully automated driving technology is implemented in over 50 metro lines worldwide and promises to become the future for urban metro systems. The International Union of Public Transport (UITP), a nonprofit international network of 1,400 member companies located in 96 countries that covers all modes of public transport, estimates that by 2020, 75 percent of new metro lines and 40 percent of existing lines will use automated driving technology.

With continuous innovation, improvements in metro automation are the result of vehicle integration with signals, communications, and monitoring. Traditional metro information systems consist of multiple subsystems that include the Passenger Information System (PIS), environment and equipment monitoring system, and signal and communications systems. Typically, the control of these subsystems has not been managed centrally and has mainly used power supply/loop control for the relatively small amounts of integrated monitoring in previous technical generations.

At the core of TIAS is the controlling traffic command, which uses a uniform software and hardware network platform. TIAS is capable of intelligently monitoring every specialized subsystem to improve scheduling efficiency by automating operational processes for handling situations like disasters and failure modes. TIAS has reached a Grade of Automation 4 — the highest level for metro automation as defined by the UITP.

Pushing Upgrades

Many challenges arose from the limited availability of "big picture" information prior to sophisticated Information and Communications Technology (ICT) architectures. With traditional metro information systems, data could only be linked through physical ports due to the independent functioning of each subsystem. Relative to contemporary standards, these older configurations were inherently less efficient and incapable of sharing data to the degree that is now expected for fully automated systems. Traditional systems waste server resources while older IT architectures are unable to support the type of integrated development necessary for today’s automated urban rail traffic.

In recent years, maturing ICT platforms have added more process control technologies to address these issues. The Yanfang subway line, for example, requires over 128 PC servers and more than 150 workstations to cover about 30 kilometers. The TIAS with Automated Train Stop needs hundreds of additional on- and off-track components to be included on the data and communications network.

Fast Cloud TIAS

The disadvantages of traditional IT architectures led Huawei to its cloud computing solution for TIAS, which updates service capabilities and meets established reliability standards for metro information systems. ICT infrastructures built on open cloud platforms are designed to make planning easier for future service expansions, particularly larger scale Smart City projects.

The cloud architecture for TIAS manages the control center-level and station-level requirements. Additionally, a cloud platform in the Operations Control Center (OCC) provides data computation and storage for various service systems of the entire line. A cloud desktop is set up at each service node to meet service processing and dispatching needs across the system. Industrial-grade Access Routers (ARs) are installed system-wide at the device layer for real-time data collection, distributed computing, and secure, reliable data transfers.

Virtualization for Automation

Huawei’s solution includes a FusionCube virtualization platform deployed at the OCC. FusionCube manages multiple service application servers, deploys TIAS real-time and historical processes, allows simulation training, and simplifies many other service systems. The TIAS platform creates a logical isolation between services by using different security levels. Automatic Train Stop (ATS), Building Automation Systems (BAS), power Supervisory Control and Data Acquisition (SCADA), and other service systems are integrated and distributed among virtual data centers. TIAS requires installation of many specialized workstations at each site with devices that are exposed to security risks. The Huawei desktop cloud technology with multiple virtual machines uses workstation software to connect with the OCC cloud platform. Line dispatchers employ cloud desktops with three-screen displays, while dispatch operators for power, hoop, passenger, and train monitoring use desktops with two-screen displays. The direct connection feature for graphics processing units is especially beneficial for the graphics-heavy displays that are typical for railway line, power, and ring dispatchers.

Riding Digital Railways

Because TIAS has high data security requirements and many interconnected systems on the front-end, Huawei provides custom, x86-based AR IoT gateways to distribute computation and secure critical data at the network edge. TIAS uses Huawei’s cloud architecture technology to improve hardware resource utilization. The cloud computing platform standardizes each service type to reduce costs significantly for power and facilities.

As the urban rail industry rides into a fully automated future, Huawei will continue to expand and refine the key components for cloud computing, Big Data, and other ICT technologies. The goal is to assure that global metro operators are able to procure high security, energy efficiency, and best-in-class services for the intelligent transit systems under their control.

"Today, powerful technologies are rebuilding the transport industry," said Yuan Xilin, President of the Transportation Sector of Huawei’s Enterprise Business Group. "By using cloud computing, Big Data, and LTE technologies, we enable customers to achieve visualized train dispatching and the efficient management of railway assets and resources."