Next-Generation DCS Solution for Digital Urban Rails

HUAWEI

Huawei NE routers: Empowering your network

Challenges

The traditional Data Communication System (DCS) uses a Wi-Fi + industrial switch solution. The Wi-Fi is prone to interference from public Wi-Fi hotspots, Bluetooth, and microwave, posing risks to train safety. Wi-Fi is not stable when train is driving at a high speed. In addition, the Wi-Fi solution needs multiple trackside devices, leading to high maintenance workload.

With the advantages of powerful anti-interference, high mobility, long inter-cell coverage, high bandwidth, less trackside devices, and high reliability, LTE has become a mainstream trend of DCS train-to-ground wireless communication.

Powerful anti-interference

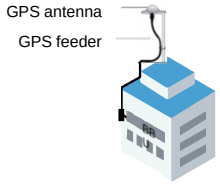
Seamless handoff at high speed

Fewer trackside devices

However, the DCS wired network still faces severe challenges in the LTE mechanism.

LTE requires high-precision clock synchronization. GPS clock synchronization is difficult to implement and expensive to maintain.

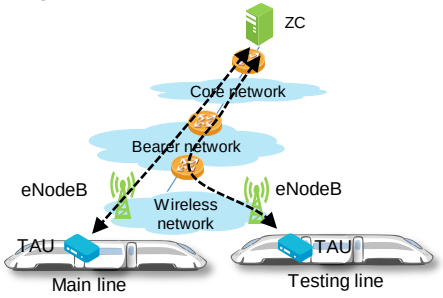
Traditional industrial switches do not support 1588v2. In the traditional GPS clock synchronization solution, each base station is deployed with an outdoor GPS antenna, and signals are introduced to a tunnel through feeders. This causes high deployment costs, implementation difficulty, and complex O&M.



- GPS feeders use coaxial cables that are prone to lightning strikes and interference.
- The transmission distance of GPS feeders is limited. The GPS feeders cannot be bent and require holes to be drilled in walls.
- GPS fails to implement clock backup.
- GPS fails in NMS management and remote maintenance. Faults cannot be discovered in time.

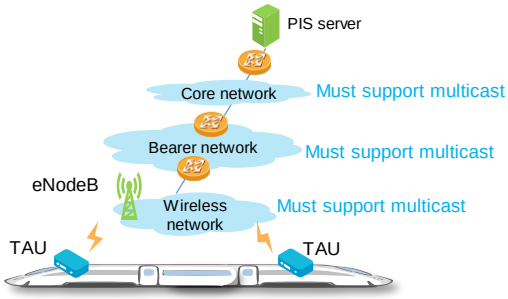
Because of the importance of CBTC services, the testing line and main line services must be isolated.

In LTE scenarios, urban rail main line and testing line services run on the same LTE core network devices and are deployed in the same service system. To prevent testing line services from interfering in main line services and adversely affecting train safety, the testing line and main line services must be isolated end to end.



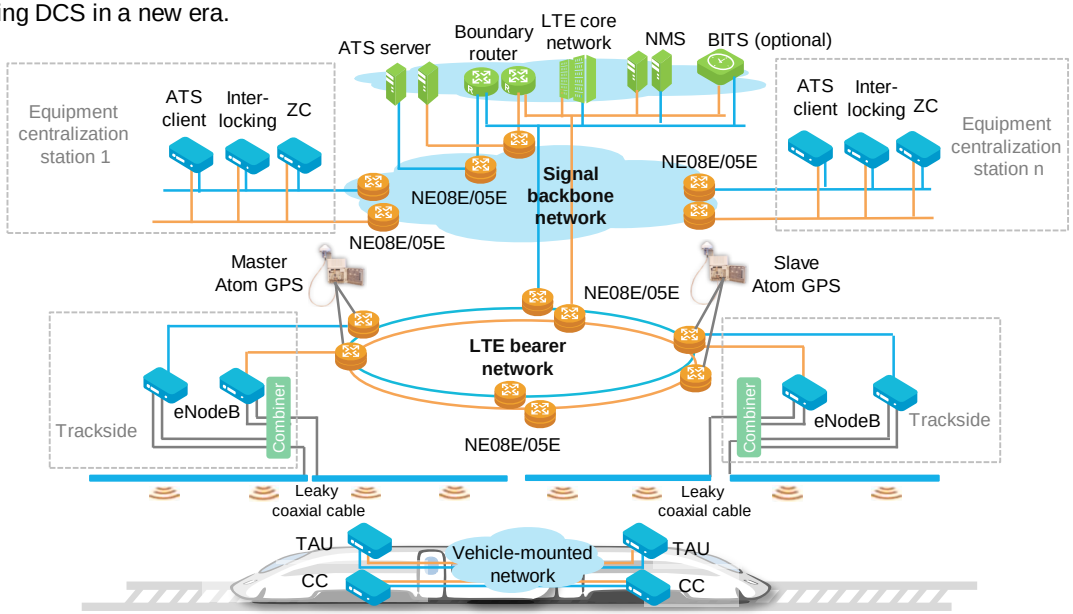
Some LTE networks do not support multicast, and device deployment is complex.

Deploying PIS multicast services requires that all devices between the PIS server and the TAU support multicast. However, some devices on the core, transport, or wireless network do not support multicast. Even if all the devices support multicast, deployment is complex and O&M is difficult.



Solution

With technical strength in ICT and accumulated experience in the railway industry, Huawei has developed an innovative agile DCS solution, using the architecture of LTE + industrial NE router to anticipate the data transport requirements of the urban rail signaling system, leading DCS in a new era.



- The train-to-ground wireless network uses LTE, and the wired network uses NE series routers.
- NE08E/05E routers are configured on the control center, depot/parking lot, and signal site to construct two independent networks.
- MPLS VPN is used to carry services and achieve E2E service isolation.
- The Atom GPS + 1588v2 clock synchronization solution is used to meet the high-precision LTE requirements on network-wide clock synchronization.
- The signal backbone network uses ERPS for ring network protection.

Benefits

Highly reliable network, train safety

- Excellent mobility of the LTE network, multiple anti-interference mechanisms.
- Multiple ways of redundancy protection for the wired network, E2E service switching within 50 ms, fast self-healing.

IP/MPLS network, easy to expand

- MPLS VPN is used for unified bearer and ensures E2E security isolation of services, which meets the requirements for fast growth of urban rail services.
- The NE Series routers have powerful performance and support large-scale GRE deployment, which effectively meets the challenges of the urban rail signaling system.

Easy deployment, low investment costs

- GPS feeder is replaced by optical fiber, not requiring holes to be drilled in walls and simplifying engineering deployment.
- Few LTE trackside devices required, less investment costs.
- NE routers use self-developed chips, supporting smooth evolution.

Remote centralized O&M, low costs

- NE series routers provide plug-and-play to support remote deployment and maintenance.
- The wired and wireless networks are co-managed by the U2000, simplifying O&M.

Key Technologies

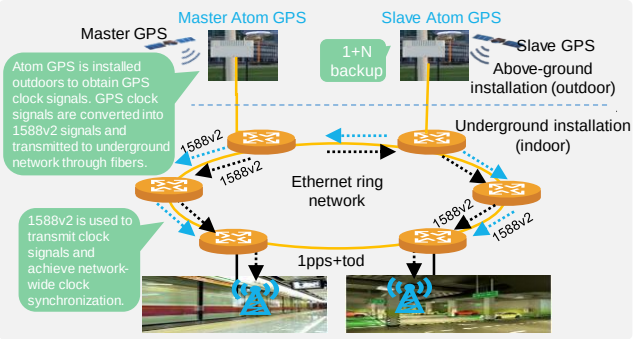
Atom GPS + 1588v2 clock synchronization

Easy to deploy: 1588v2 is deployed on the bearer network, and clock signals are flooded to the entire network through fibers. This is measurement-free and feeder-free and features one-click acceptance. Fibers can be deployed remotely and are not limited by the feeder length. Site selection does not depend on the base station installation environment.

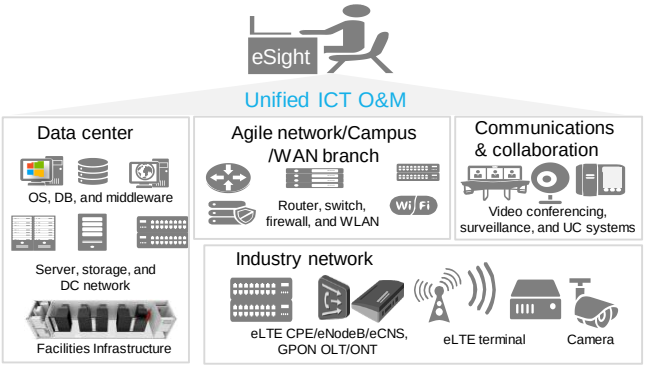
Low TCO: Only two or three Atom GPSs are required on the entire network. This solution reduces the costs compared with the traditional 1:1 ratio of base station and GPS.

High reliability: As long as one single Atom GPS antenna works properly, the network can keep lock synchronization, reducing the risks of GPS failures.

Easy to maintain: Plug-and-play and automatic rollout can be configured through the U2000.



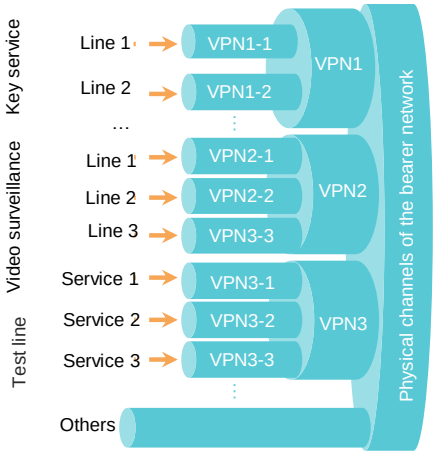
eSight to manage the LTE and datacom networks



- eSight is used to manage both the wired and wireless networks, simplifying O&M.
- eSight can also be extended to manage firewalls, servers, and storage devices, implementing integrated ICT management.

MPLS VPN multi-service E2E security isolation

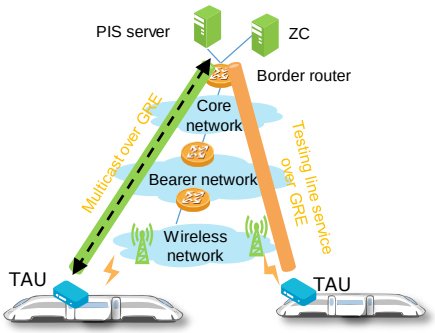
Different services are planned to different VPNs for security isolation. QoS is configured based on priorities of services to guarantee the quality of high-priority services.



The GRE tunnel is a solution to carry PIS multicast services and isolate testing lines

The NE series routers support large-scale GRE deployment, effectively meeting the challenges of the urban rail signaling system:

- GRE tunnels are established between border routers and TAUs to carry multicast services. Wireless network and core network devices do not have to support multicast, simplifying deployment.
- GRE tunnels are established between border routers and routers of testing lines to carry CBTC services. Main line services are end-to-end isolated from testing line services, and testing line services are prevented from interfering in main line services.



Recommended Products

Atom GPS

NE05E-SL (outdoor), IP65

(Maintenance cover opened)

Aggregation nodes of signal bearer network

NE08E-S9

NE08E-S6/S6E

Access nodes of signal bearer network

NE05E-SQ

NE05E-S2

NE05E-SN

NE05E-SJ

Border router of control center

NE20E-S16/S16A

NE20E-S8/S8A

NE20E-S4

NE20E-S2E/S2F

Product Highlights

Highly reliable architecture

- Redundant main control boards, switch fabrics, power supplies, and fans
- Hot-swap and hot-standby support on all key components
- CPU + NP architecture, control-forwarding separation

Self-developed chips

- Solar 5.0 chipset developed in-house, offering good extensibility in products and features, and controllable evolution
- Chip-based BFD, supporting 3.3 ms packet-sending interval and large-scale detection, link protection switching time ≤ 50 ms

Any-scenario protection

- Support for fast reroute (FRR)
- Support for E2E VPN service isolation
- Support for BFD, FRR, and TE-HSB to provide carrier-grade reliability

Industrial-grade design

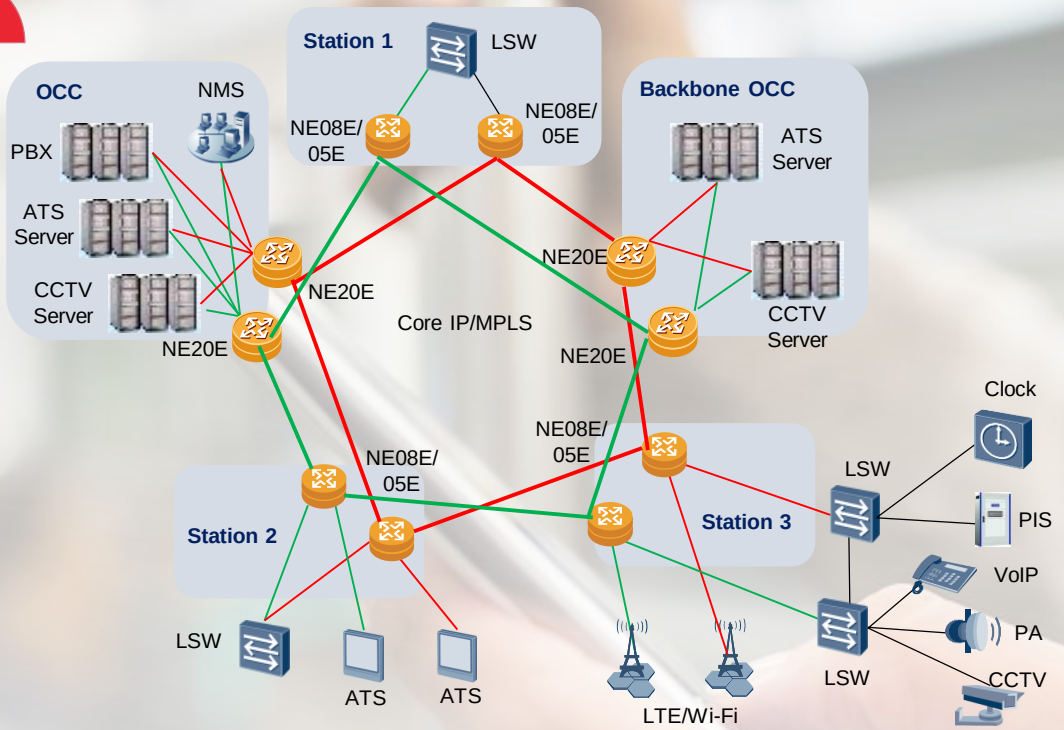
Reliable industrial design to meet high requirements for harsh environments of urban rail

- Dual-power and dual-main-control-board redundancy design
- Wide temperature, powerful anti-interference and radiation-proof
- Certification by authorities around the globe

Industrial router	NE05E/NE08E
Wide temperature	-40 to 70°C
Humidity range	5% to 95%
Protection level	IP65, EN50121-4, IEC61000-4-1-4-6 IEC61000-4-10/4-18 /4-16/6-2/6-4
Professional certification	IEC/EN 60950-1, UL 60950, EN 50121/50155/50125, VCCI V-3 CLASS A (Japan) ICES-003 Class A (Canada)

Case

Huawei Collaborates with Alstom to Build the Lyon Urban Rail Signaling Network



Requirements

- The ATS service of France Lyon Urban Rail used Layer 2 access, and the newly constructed network needed to isolate Layer 2 services to ensure that they did not interfere with each other.
- Considering the importance of the ATS service, the network needed to provide high reliability. Specifically, service switching must be performed within 100 ms, and the E2E mean time between significant failures (MTBSF) must reach over 1 million hours.

Solution

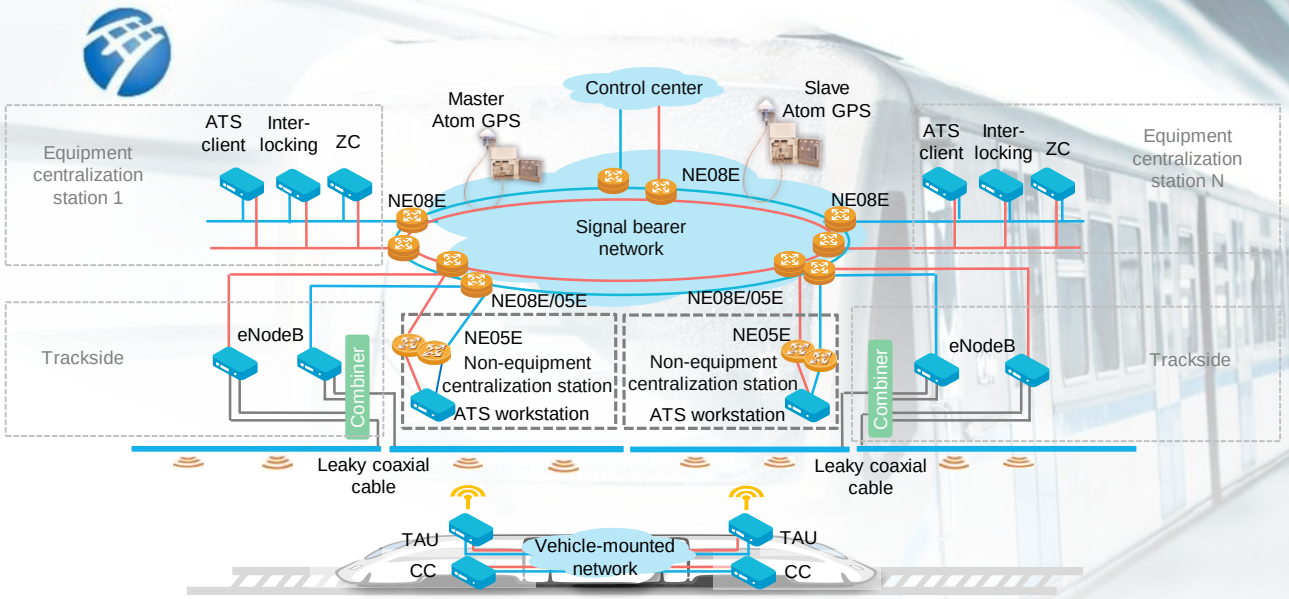
- The NE08E and NE05E are used to construct the IP ring dual-network (red and blue networks).
- MPLS VPLS is used to achieve E2E service isolation and ensure Layer 2 reachability of network-wide services.
- BFD is deployed to detect link and node failures and works together with MPLS TE hot standby to achieve fast E2E switching.

Benefits

- The flexible dual-plane architecture and ring networking ensure service continuity in case of link or node failures. The high-reliability hardware architecture and 3.3 ms BFD provided by NE series routers ensure that the network-wide MTBSF can reach over 1 million hours, which guarantees normal operations of trains.
- MPLS VPLS is used to carry signal services and works together with the powerful MPLS/VPN function provided by NE routers to ensure Layer 2 reachability of network-wide services and avoid the inherent issues of loops and broadcast storms on Layer 2 networks.
- The Layer 3 network features excellent scalability. NE series routers use Huawei-developed NP chips that feature high performance and low power consumption, supporting evolution and reducing customer investments.

Case

Huawei Facilitates Ningbo Urban Rail Line 3 to Achieve Reliable Bearer



Requirements

- Ningbo Urban Rail Line 3 used LTE to carry signals, which required clock synchronization with the accuracy of 0.05 ppm and phase offset of less than ±1.5 us to be deployed underground.
- Network devices had to meet temperature, humidity, waterproof, and dustproof requirements for tunnels in harsh environments.
- The DCS transport network needed to support a self-healing time of less than 50 ms, unidirectional transmission latency of no more than 150 ms, inter-cell handover latency of no more than 100 ms, and packet loss rate of no more than 1%.

Solution

- Two NE08Es are deployed in the control center, rolling stock depot, and parking lot, respectively, to construct transmission networks A and B, which are independent of each other.
- Two NE05Es are deployed on the non-equipment centralization station and are directly connected to the backbone nodes of the neighboring equipment centralization station through fibers.
- MPLS TE hot standby and chip-based BFD are deployed to ensure E2E route convergence of less than 50 ms.
- The Atom GPS is deployed at the rooftop site of the equipment centralization station to obtain clock signals and uses feeders to connect to the nearby NE05E. The NE05E synchronizes high-precision clock signals with the transport network through fibers. The bearer network then uses 1588v2 to send clock information to base stations.

Benefits

- The Atom GPS + 1588v2 solution does not require long-distance feeder deployment, which greatly simplifies implementation and ensures high-precision clock control and stable line operation.
- Industry-grade routers that anticipate the urban rail EMC environment requirements are used, which handles the harsh tunnel environments of Ningbo Urban Rail Line 3.
- The dual networking provides route convergence of less than 50 ms, which ensures stable operation and fast service recovery of related urban rail services.

Jointly presented by
Router Ethernet Marketing Support Dept & Network Information Dept

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