All-IP Universal Bearer Solution for Railways

HUAWEI

Huawei NE routers: Empowering your network

Challenges

With rapid growth in passenger and freight rail over the past few years, railways now play an increasingly important role. Traditional communications networks, the infrastructure on which railways have been digitalized, face the following challenges:

1 Continually Emerging, Bandwidth-heavy Services

The rapid development of rail transportation, digitalization, and services has resulted in significantly higher bandwidth usage. An increasing number of services are bursty, require high bandwidth, and involve multipoint transmissions.

In-person monitoring of a fixed location

Trend

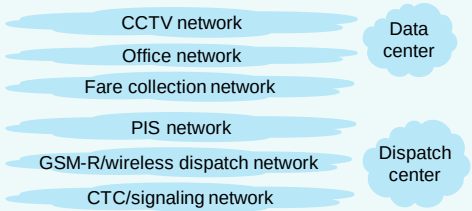
Video surveillance of multiple locations
High bandwidth and low packet loss

Traditional SDH/PDH networks have the following issues:

- Insufficient bandwidth and limited transport capability
- No support for multipoint transmissions (P2P only)
- Lack of vendor support and difficulty in transmitting new services

2 Lower Communication Costs to Enable Efficient OAM

Railway services have traditionally been carried by multiple networks, which are expensive to construct, operate, maintain, and manage.



Costs	A large number of stations, devices, and fibers must be added. Multiple networks coexist, and their resources cannot be shared.
Mgmt.	Concurrent use of different network technologies and devices requires additional labor or more-specialized and expensive O&M.
O&M	Multiple network management systems are required to manage the various networks, which increases costs.

3 Clear Trend Toward IP Evolution

UIC Issues IP White Paper

The International Union of Railways (UIC) has issued two white papers about moving to IP:

IP Introduction to Railways 1.0 (2012)

IP Introduction to Railways 2.0 (2013)

Major Operators Embrace IP

Railway operators such as DB, ADIF, OBB, and SBB have begun deploying IP networks.

SBB

Systems Integrators Push for IP

Thales, Bombardier, and Alstom are promoting IP solutions.

4 All-IP Universal Bearer Guarantees SLAs of Critical Railway Services

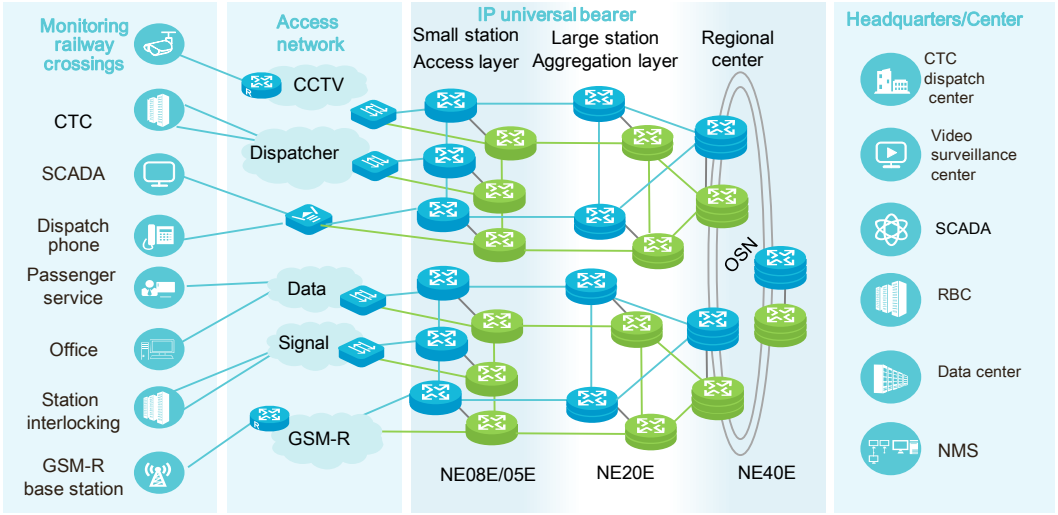
For critical railway services, the main issues with IP transport are latency, jitter, and reliability.

Application	Traffic Type	Latency	Jitter
ETCS	P2P	< 500 ms	< 30 ms
Operations and control	P2MP	< 150 ms	< 30 ms
Signaling	P2MP	< 100 ms	< 20 ms
Dispatch telephone	P2P, P2MP, and MP2MP	< 150 ms	< 30 ms
Landline telephone	P2P, P2MP, and MP2MP	<150 ms	< 30 ms
Video surveillance	P2MP	< 150 ms	< 30 ms
PA system	P2P, P2MP	< 150 ms	< 30 ms

Source: UIC, IP Introduction to Railways 2.0

Solution

Huawei has developed an all-IP universal bearer solution based on the requirements of railway customers. The solution helps construct a network that is flat, secure, efficient, has high bandwidth, and supports many types of services for railway communications.



- One network carries all production and office services. IP hard pipe technology ensures low delay and high reliability of services such as signaling and GSM-R. Soft pipe technology provides high bandwidth for office services and video surveillance.
- Built-in PCM subcards provide low-speed interfaces that directly access services such as SCADA and dispatch phone services. In this way, traditional TDM and IP services can be carried over MPLS VPNs.
- Chip-based BFD technology coordinates with patented VPN FRR technology to implement fast protection switching at the IP layer. This prevents network faults from causing emergency stops and reducing speeds when required for safety.
- The IEEE 1588v2 protocol is used to transmit time information to meet clock synchronization requirements for the future evolution from GSM-R to LTE.

Benefits

Facilitate new services

- IP/MPLS technologies are advanced, have high scalability, and support multicast, which modernizes the grid
- NE routers provide high performance and high bandwidth, and easily cope with the increasing pressure of services

Ensure reliability of key services

- IP hard pipe technology provides SDH-like low latency and high reliability for key services
- FRR, BFD, NSR, NSF, and ISSU help prevent service interruptions, effectively preventing network faults from causing emergency stops and reducing speeds when required for safety

Minimize investment costs

- A unified network reduces the cost of investments in sites, devices, and optical fibers
- Built-in PCM subcards provide low-speed interfaces that permit direct access to traditional services without PCM devices

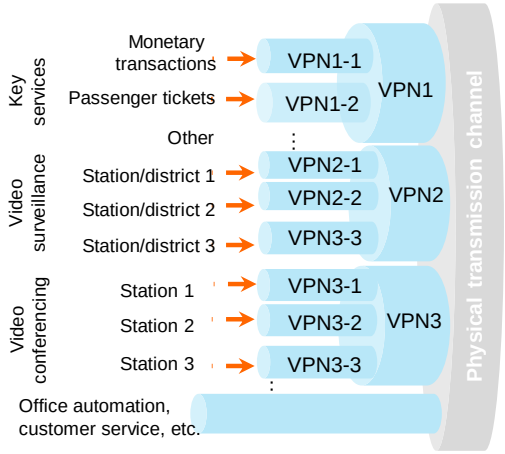
Reduce O&M costs

- U2000 is used to unify management of devices and simplify O&M
- uTraffic and IP FPM implement visualized O&M and fast fault locating

Key Technologies

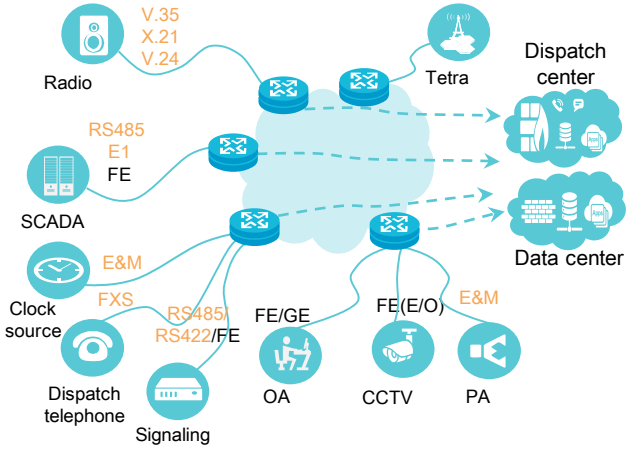
MPLS VPN: Unified Transmission for Different Services

Services are securely isolated through dedicated VPN channels. QoS classes can be set to ensure that high-priority services are transmitted.



Built-in PCM Subcard

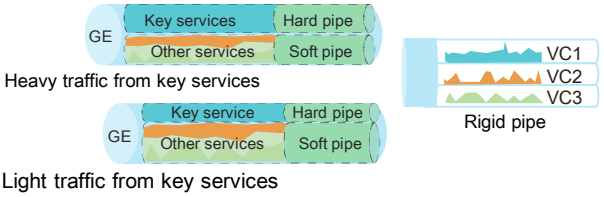
Low-speed interfaces such as FXS/O, E&M, V.24/V.35/X.21, RS232/485/422, C36.94, and G.703 are provided to implement unified access of multiple services, avoiding the need of independent PCM devices. This saves device investment and equipment room space, reduces network nodes, and simplifies network management.



IP Hard Pipe

Dedicated channels on the chip provide SDH-like performance (low latency, zero packet loss, and high availability) and simplify deployment and OAM.

IP hard pipe differs from rigid pipes in that its bandwidth can be manually specified on demand.



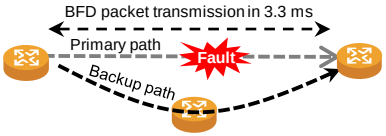
Huawei & Alstom joint innovation: IP hard pipe carrying signaling services

Test Results: IP hard pipe can fulfill signaling services requirements

Item	Scenario	Hard Pipe	Soft Pipe
Connectivity	Mixed background traffic	Normal	Normal
	Long-packet high-priority background traffic	Normal	Abnormal
Channel latency	Mixed background traffic	1.437 ms	1.467 ms
	Long-packet high-priority background traffic	1.467 ms	Abnormal
Tripping delay	Mixed background traffic	26.46 ms	28.56 ms
	Long-packet high-priority background traffic	27.1 ms	Abnormal
Path switchover	E2E service switchover	10–15 ms	10–15 ms
Stability (72 hours)	Mixed background traffic	No packet loss	Packet loss
	Long-packet high-priority background traffic	No packet loss	Abnormal

Notes: Mixed background traffic: 64 bytes to 1,518 bytes, BE + AF1 + EF
Long-packet high-priority background traffic: 1,518 bytes, EF

Chip-based BFD and 50 ms E2E Switchover



Chip-based BFD enables devices to exchange simple detection packets over any kind of channel. Packets can be sent in 3.3 ms and faults can be detected in as little as 10 ms. Interoperation with FRR/TE-HSB permits rapid protection switchover and fast self-healing.

BFD packets are processed by the NP so that CPU performance is not affected. BFD packets occupy no more than 100 bytes, consuming only a small amount of network bandwidth.

Recommended Products

NE40E service routers (for HQ or core nodes)

Core layer


NE40E-X3


NE40E-X8


NE40E-X16


NE40E-X16A


NE40E-X8A


NE40E-X3A

NE20E aggregation routers (for local offices or major stations)

Aggregation layer


NE20E-S2E/S2F


NE20E-S4


NE20E-S8


NE20E-S16


NE20E-S16A


NE20E-S8A

NE05E/08E access routers (for railway stations)

Access layer


NE05E-SJ/SM


NE05E-SE/SG


NE05E-SQ


NE05E-S2


NE08E-S6


NE08E-S6E

Product Highlights

Highly reliable architecture

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

Huawei-designed chipset

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

Comprehensive protection

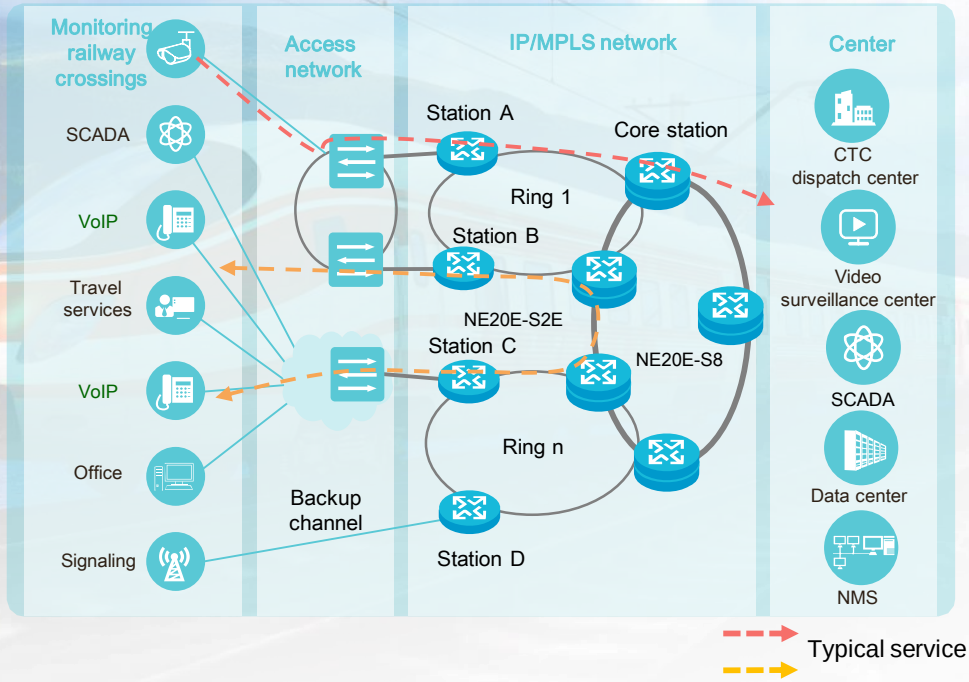
- Fast route convergence
- End-to-end L3VPN service isolation
- BFD, FRR, and TE-HSB provide carrier-grade reliability

Industrial-grade design

- Dynamic energy-saving design
- IP65-rated (NE05E)
- Industrial-grade wide temperature range (NE20E/NE08E/NE05E)

Case

MPLS/IP Universal Bearer for ADIF High-Speed Rail



Owns the world's second-largest high-speed rail network

Requirements

- Different services must be isolated. SCADA and surveillance platforms must be integrated to automatically detect site status and deliver warnings.
- The IP MPLS network used as a backup channel for signaling services must provide high reliability and low latency.
- Link convergence cannot exceed 50 ms and node convergence cannot exceed 200 ms.

Solution

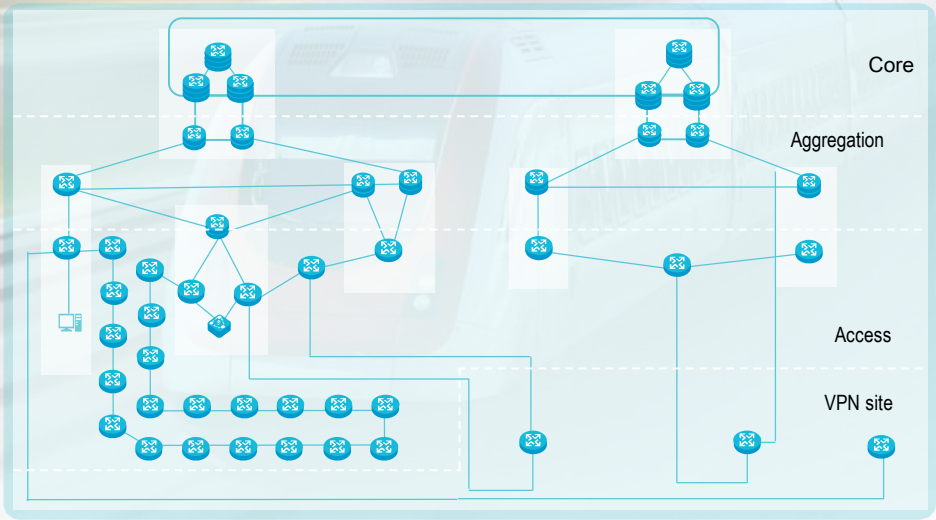
- BFD every 3.3 ms with VPN FRR ensures switchover time within 50 ms for operations and dispatch services.
- Different MPLS VPNs isolate services, and cross-VPN access enables service associations.
- IP hard pipes provide signaling services with hardware isolation without preemption, and low latency without packet loss.
- HQoS and a large buffer enable refined management of services of different priorities to meet higher SLAs.

Benefits

- Carrying multiple services on one IP MPLS network reduces network deployment and maintenance costs.
- The solution enables future evolution to all-IP networks and protects customer investment.
- Unneeded bandwidth can be leased to other customers, offering railway operators a new profit stream.

Case

Network Restructuring at JSC Russian Railways



World's second-largest railway corporation

Requirements

- Existing SD devices need to be upgraded to HD to improve communication and decision making on rapidly growing video-conferencing systems. However, the network is incapable of handling this.
- Company executives often need to hold video conferences, even though network devices are outdated and unreliable.
- Sites are not equally modernized, and TDM, ATM, and Ethernet networks all coexist. Converged networks need to be upgraded and restructured, provided that existing investments are preserved.
- A unified management platform should be created that simplifies system management and operations while lowering O&M labor costs.

Solution

- Medium and large train stations are backbone convergence sites. NE routers and all-IP universal networks are used at these sites, while VPNs isolate services.
- A P2MP video-conferencing system is deployed that uses MPLS multicast VPNs.
- VPN FRR, TE FRR, and hardware BFD are deployed to ensure the reliability of service transmission.
- U2000s are deployed at local offices to manage configurations, performance, faults, and security.

Benefits

- The all-IP universal bearer solution protects existing investments and permits flexible investments in the future.
- The powerful routing and unicast/multicast inter-domain VPN capabilities of NE routers enable interconnection between Russian Railways' 17 districts.
- Huawei's NMS centralizes management and visualizes O&M, offering the simplified global O&M desired by the customer along with data collection and management functions and simple and precise network quality monitoring.

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

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