



## By Chen Jinzhu

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# Building a 400GE backbone network for the smart era

*Huawei's Global Industry Vision 2025 predicts that there will be 40 billion smart devices and 100 billion connections globally by 2025. Massive traffic and high-value connections will become ubiquitous. Ubiquitous connections will inevitably lead to a constant rise in network bandwidth, in particular on backbone networks – as the core of the network – and traffic will rise at a CAGR of over 45 percent. In addition to this rapid growth in traffic, new services, such as 5G and cloud, will bring unprecedented challenges to IP backbone networks.*

**S**ervice and traffic uncertainty: By 2025, 85 percent of enterprise applications will be deployed on the cloud. Service types will number in the thousands and network traffic flows will be more dynamic and disordered. This will lead to a high level of uncertainty in services and traffic. Mass online shopping days rich with discounts such as Black Friday in the UK and 11.11 in China or Chinese New Year tend to cause sudden surges in network traffic. In addition, the development of new technologies, such as cloud computing, VR, 5G, and AI, mean that operators will be faced with a larger number of

uncertain service forms and different network service quality requirements. However, existing networks are unable to sense user needs in real time and thus dynamically configure network resources.

**User experience will be difficult to guarantee:** Interactive services like smart telemedicine, distance learning, and Cloud VR are all experience-sensitive services. The traditional IP network principle of "nearby forwarding" leads to uneven network loads and low overall utilization, resulting in wasted investment. And the "best effort" mechanism of IP networks makes the network vulnerable to congestion and packet loss, resulting in

a poor user experience.

**O&M challenges are getting worse:** In the future, the form, quantity, and service diversity of network elements will increase network complexity at least tenfold. As such, O&M expenditure will remain operators' biggest challenge. Today, OPEX for operators is three times as high as CAPEX, 80 percent of configurations are done manually, 90 percent of issues are handled after user complaints, and O&M efficiency is incredibly low compared with OTT companies.

To overcome these challenges, Huawei's backbone network solution represents a new generation that

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will meet the needs of upcoming services in the smart era through ultra-broadband, simplification, and smart capabilities.

## Ultra-broadband for massive traffic growth

According to Moore's Law, to maintain optimal forwarding per-bit costs, it's necessary to continuously increase the port rate, board capacity, and device capacity of routers.

With standardization completed in 2017, 400GE is the industry's latest Ethernet port technology. In 2017, Huawei released the first 400GE port and 4 Tbps board in the industry. In December 2018, Huawei won the world's first 400GE commercial contract, marking the official arrival of the 400GE ultra-broadband era.

Board capacity is determined by chips, and Huawei offers industry-leading chip technology. Huawei's backbone router 4-Tbps board is based on the industry's first 1T NP chip (Solar 5.0) and is fully programmable. New software features are supported through software upgrades, protecting customer investment.

Maximum rack capacity depends on the rack's backplane capabilities. With Huawei's cable backplane, racks can support 20 slots with a 14.4 Tbps single-slot capability. Huawei's backbone routers have an industry-leading capacity of 288 Tbps, which is enough to support operators' traffic growth requirements over the next 10 years.

## Multi-network convergence, unified protocols

Huawei's backbone solution simplifies network architecture and network protocols.

In terms of network architecture, Huawei's backbone routers can virtualize one physical system into multiple MDSs (multi-domain systems). The control plane, management plane, and service plane of each MDS are completely isolated, enabling multiple services to be carried in a unified way and isolated from each other. At the same time, Huawei's backbone routers support complete P and PE functions, allowing operators to reduce network levels and flatten the network through P&PE integrated configuration.

LDP/RSVP-TE/GRE/L2TP protocols are replaced with the end-to-end (E2E) SRv6 protocol on the live network, enabling the unification of bearer network protocols and seamless network connections, which can reduce configuration workloads by 60 percent.

## Congestion-free, zero service interruptions

The intelligent world will have two defining characteristics. The first is that AI acts as a general-purpose technology. The second is that the intelligence provided by ICT will lay the foundation upon which all industries innovate.

Huawei has designed its +Intelligence smart capabilities for backbone network solutions to help operators improve O&M efficiency, optimize user experience, and run networks that are congestion-free, self-healing, and automated.

**Congestion-free:** AI-based traffic predictions

and real-time tuning can boost network bandwidth utilization to 80 percent. Huawei's backbone network solution is based on machine learning and neural networks. It can predict traffic patterns with 90 percent accuracy, helping operators to carry out traffic management. Real-time traffic adjustments can be performed using real-time network O&M data acquisition and Huawei's self-developed ROAM (Routing Optimization Algorithm based on Matrix) algorithm, enabling network-wide load balancing, no congestion, and zero packet loss – maximizing resource utilization and enhancing user experience.

**Self-healing:** Active O&M enables fault location and recovery in minutes so that services are not interrupted. The Network Cloud Engine (NCE) senses network status in real time and performs predictive maintenance. The NCE can generate visualized reports on link status and equipment operating states. When network status is abnormal, the NCE issues an SR policy to the device to specify a new SRv6 forwarding path for traffic. This allows traffic to avoid faulty nodes and links, so that the network automatically recovers from faults, and services are not interrupted.

**Automation:** Cross-domain collaboration improves network O&M efficiency. Planning and O&M in both the IP layer and the optical layer had in the past always been layered, reducing network-wide

O&M efficiency and lengthening new service provision. The NCE enables unified management on IP devices and transmission devices, IP and optical cross-layer network planning, cross-layer service distribution, cross-layer network indicator visibility, cross-layer issue detection, and network end-to-end automated O&M, significantly improving efficiency. In addition, Huawei's backbone network solution also supports cross-WAN and DC domain collaboration for minute-level service provisioning.

## Huawei continues to lead industry development

Today, Huawei leads the development of the backbone router industry thanks to its continuous investment in R&D and technical innovation. In addition, Huawei works with its industry partners in standardization work and continues to promote and lead the development of the backbone network industry.

Huawei is a leading contributor to 400GE standardization. As early as 2011, Huawei launched research into 400GE technology and contributed to the IEEE 802.3 400GE standard proposal, submitting more than 50 technical papers as chair of the 400GE standard working group. Huawei has also taken the lead in R&D of PAM4 (four-level pulse amplitude modulation) physical layer optical transceiver system.

The system enables optical modules to achieve 400G transmission without increasing the bandwidth of existing optical devices while minimizing the number of optical paths, serving as one of the fundamental technologies of the 400GE standard.

Huawei is also promoting the development of the SRv6 industry. As a next-gen network protocol technology, SRv6 has become the preferred choice for future network architecture. Huawei contributed to SRv6 standardization, leading and participating in 35 IETF SRv6 contributions, 85 percent of the total number. Huawei is working on joint innovation projects in this area with a number of operators, including China Telecom. Huawei offers the most complete SRv6 capabilities in the industry, and is accelerating the simplification and smartification of the backbone network.

In the future, connectivity and intelligence will be ubiquitous. With its backbone network solutions, Huawei will keep leading the development of the IP backbone. Leveraging the mix of technological innovation and customer demand, Huawei will continue to upgrade backbone network ultra-broadband, simplification, and intelligence capabilities, helping operators to maximize network value and sustain business success in the 5G and cloud era. 