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MPLS SD&AI NET WORLD23

IPv6 Enhanced Innovations and Practices

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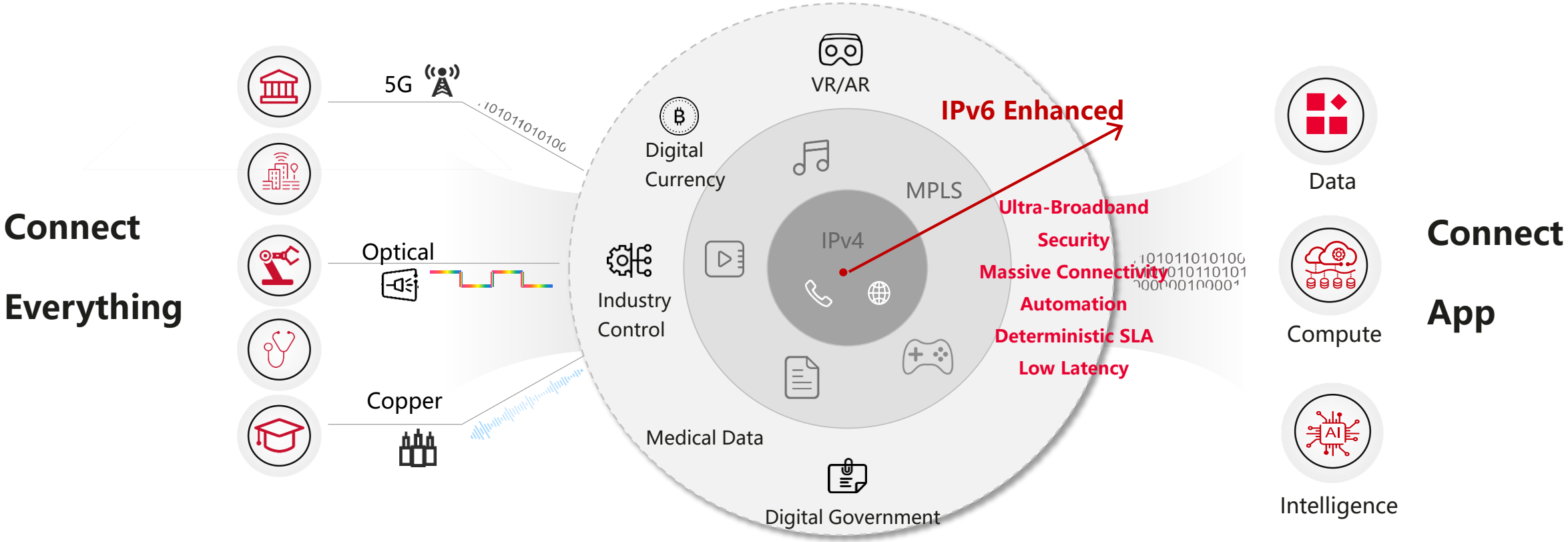
Data Communications Industry is Stepping into Intelligent Connection Era with IPv6 Enhanced



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Comparison between IPv6 Enhanced and Native IPv6

	IPv6 Enhanced	Native IPv6
Technical Base	IPv6 extension headers	IPv6 address spaces
Value-added	New network applications and Unique value comparing with IPv4	Similar functionalities like IPv4 and not enough new value.
Network Upgrade	Increment deployment based on the IPv6 network	Upgrade the whole infrastructure and complex IPv6 transition technologies have to be adopted.
Application Scenarios	Limited domains firstly.	Open Internet.
Deployments	Quick large-scale deployment in operator networks and enterprise networks.	Take 30 years and deployment is still not satisfactory.

IPv6 Enhanced is based on Native IPv6. IPv6 Enhanced takes use of IPv6 extensibility to support new network services and gains unique value than IPv4. IPv6 Enhanced will drive the large-scale deployment of IPv6.

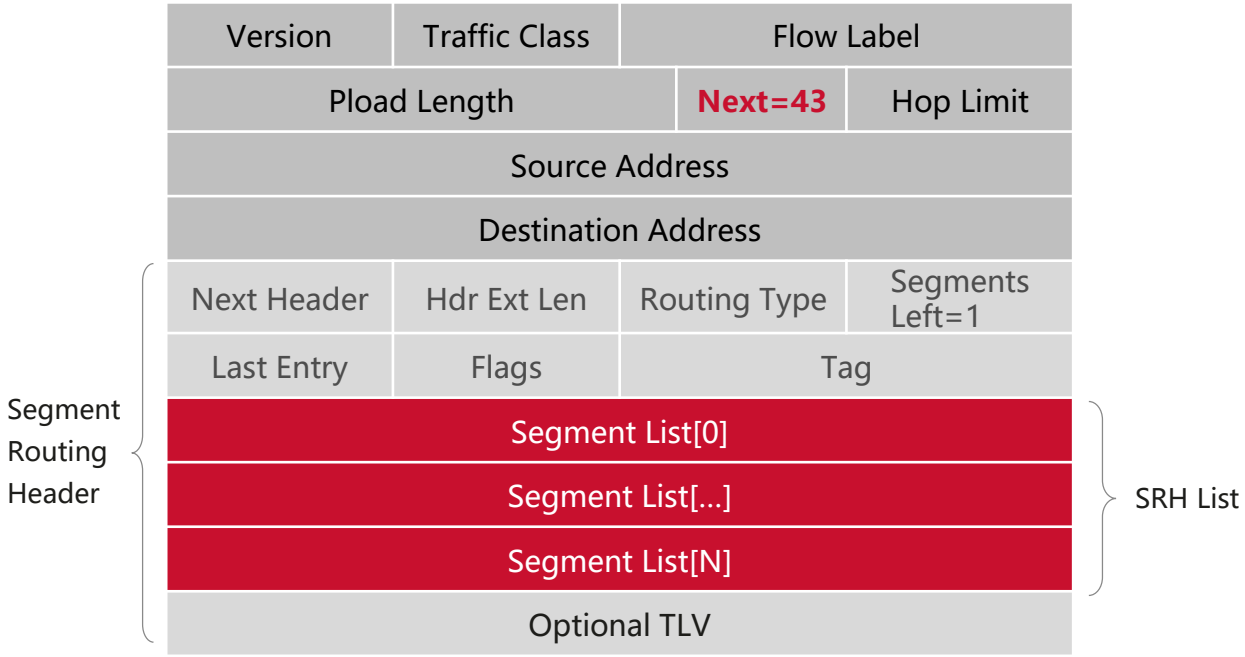
Comparison between IPv6 Enhanced and MPLS/SR-MPLS

	IPv6 Enhanced	MPLS/SR-MPLS
Simplicity	Task use of IP reachability to setup network connections easily.	Has to upgrade the whole network to support MPLS reachability beyond the IP reachability.
Inter-domains	Take use of IP reachability to set up network connections cross multiple domains easily.	Complex Inter-AS VPN (Option A/B/C/D/E) or Seamless MPLS technologies have to be adopted.
Scalability	Take use of route aggregation/summarization to reduce forwarding entries.	1. Not only IP forwarding entries, but also MPLS forwarding entries. 2. MPLS label forwarding entries cannot be aggregated.
E2E	Has similarity as VXLAN. It is possible to integrated data center networks and transport networks easily and setup E2E connections.	VXLAN for data center networks and MPLS for transport networks. Complex gateway functionalities have to be introduced to implement the transition between VXLAN and MPLS.
Convergence	Go on to simplify the technical options. Can be deployed without MPLS signaling in the transport network.	MPLS: too many technical options developed with time. SR-MPLS: Implement the convergence for MPLS.
Extensibility/Compatibility	- More extension spaces to support new services. - Forward compatibility mechanism was defined at the beginning and incremental deployment can be done easily. - Not only inherit advantages (VPN/TE/FRR) from MPLS, but also take use of IP reachability to simplify provision of these services. New services can be supported easier in the future.	- Lack of extension spaces and hard to support new functionalities. - MPLS extension header is being defined. The basic mechanism 30 years later than IPv6. Classic MPLS has not forward compatibility mechanism and need to upgrade the whole MPLS network to support the MPLS extension header. - Repeat the similar functions (VPN/TE/FRR) like MPLS seems easy. The future will be difficult to support new services.

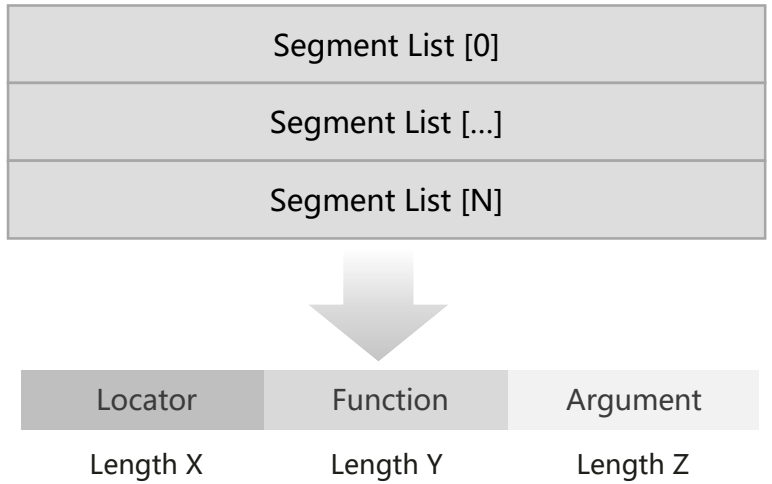
IPv6 is more promising and future-proof comparing with IPv4, VXLAN and MPLS. IPv6+ can achieve both purposes: simplify the existing network functionalities and support new network services easily.

What is SRv6?

IPv6 data packet carrying SRH



SID is addressable IPv6 address



Flexible allocation of length: X+Y+Z=128

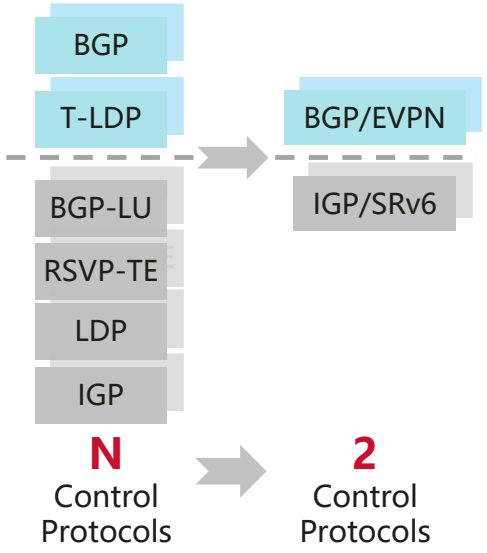
SRv6 technology adopts the existing IPv6 forwarding technology and implements network programmability through flexible IPv6 extension headers. SRv6 defines some IPv6 addresses as instantiated SIDs (Segment IDs). Each SID has its own explicit role and function. Simplified VPN and flexible path planning can be realized by using different SIDs.

SRv6, Making Ubiquitous Connections

Protocol Simplification

Simplified protocol

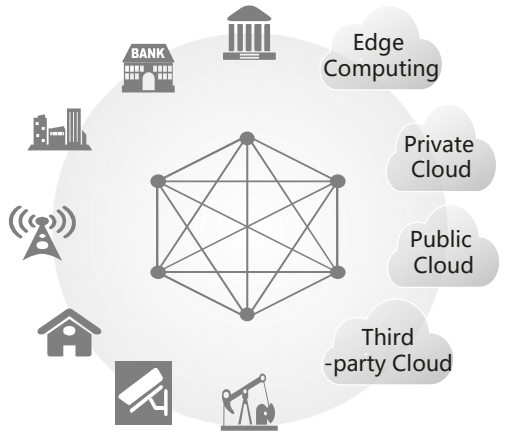
the cornerstone of network automation and intelligence.



Streamlining Cloud & Network

Streamlining device, network & cloud

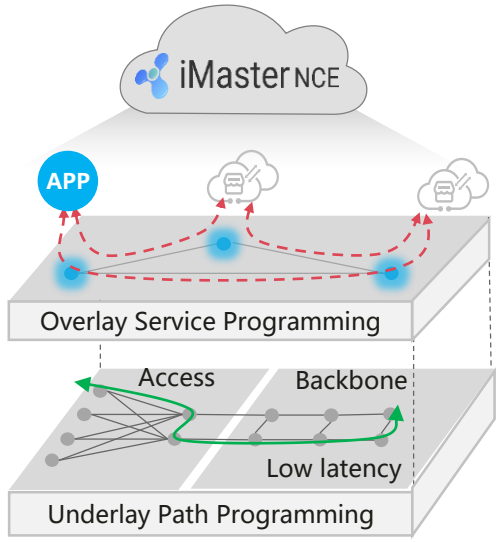
provides connectivity everywhere.



Unified Mgmt & Control

Unified network programming model

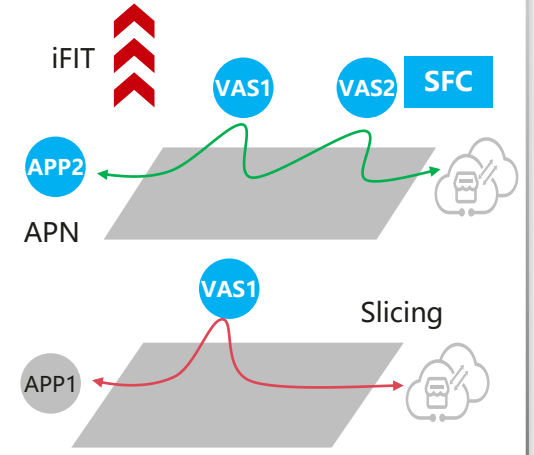
the only right way to SDN.



Application Driven

Deep integration with application

enables manageable, controllable, and visible smart connections.



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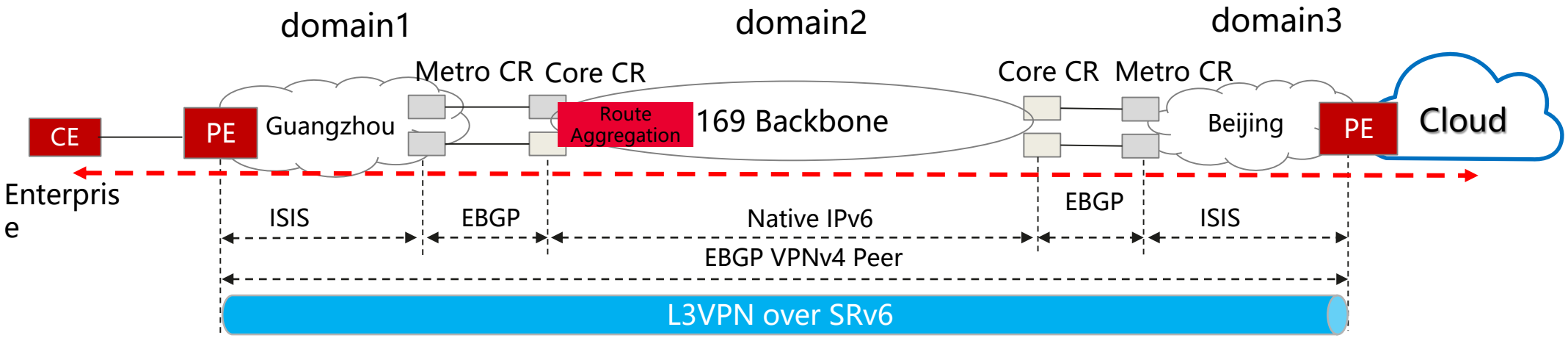
China Unicom Guangdong: Helping Operators to Launch Cloud Leased Line Service Quickly

- Huawei co-worked with China Unicom to finish the SRv6 L3VPN deployment over 169 Backbone network.
  http://www.c114.com.cn/news/119/a1083953.html



Requirement

- Cloud Leased-line solution provides users with fast access to public cloud, private cloud and hybrid cloud resources. The network is required to provide VPN service across backbone.
- With traditional MPLS solution, cross-domain configuration is very complex, sometimes need multi department interworking. TTM is long.

Solution

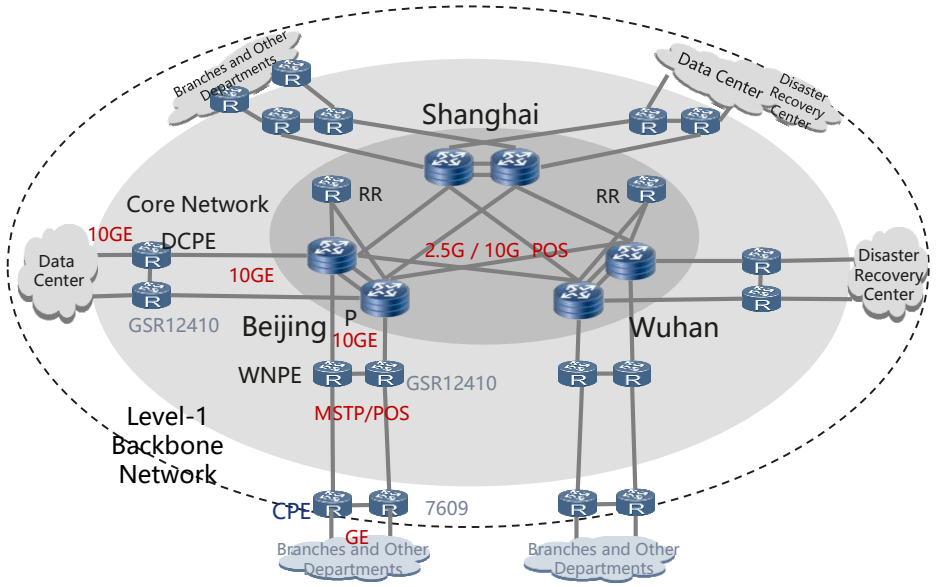
China Unicom adopts SRv6 solution:

- SRv6 and VPN service only deployed on metro PE in Guangzhou and DC PE in Beijing, inter-province cloud leased-line fast provisioning;
- No upgrade for intermedium nodes, only need provide IPv6 reachability;
- Aggregated routes advertisement among metro and backbone, suitable for large scale network.

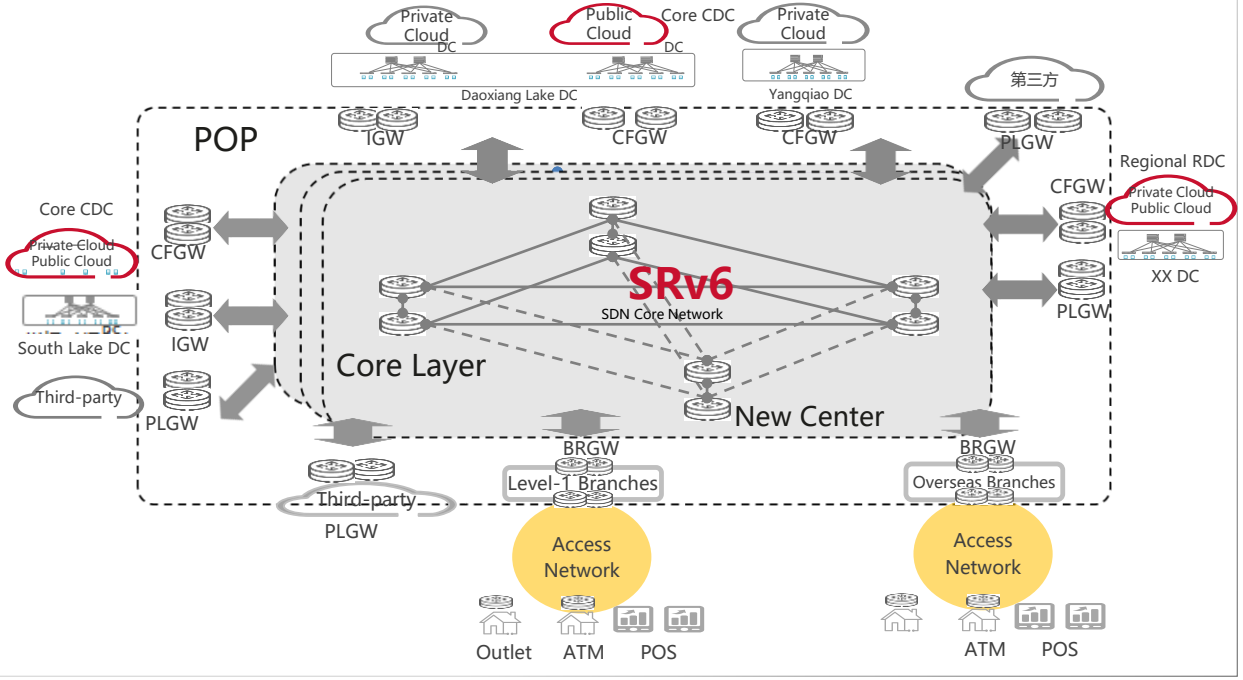
Finance: WAN with IPv6 Enhanced for Bank for Saving Investment

- China XX Bank uses three data centers in Beijing, Shanghai and Wuhan as the core nodes to form the ring backbone network architecture, covering 3 data centers and 36 first-level branch businesses;
- The core backbone network was built in 2011. The devices were outdated and need to be replaced immediately.
- Gradually transforming to network service providers, financial services will be transferred from offline to online, and public cloud and cloud leased line services will be provided for internal and external financial institutions. This poses new requirements on WAN architecture in terms of traffic scheduling, service provision, and O&M.

AS IS: Traditional MPLS technologies is lack of enough capabilities of network optimization and load balancing.



TO BE: New financial WAN backbone for intelligent optimization based on SRv6 Policy



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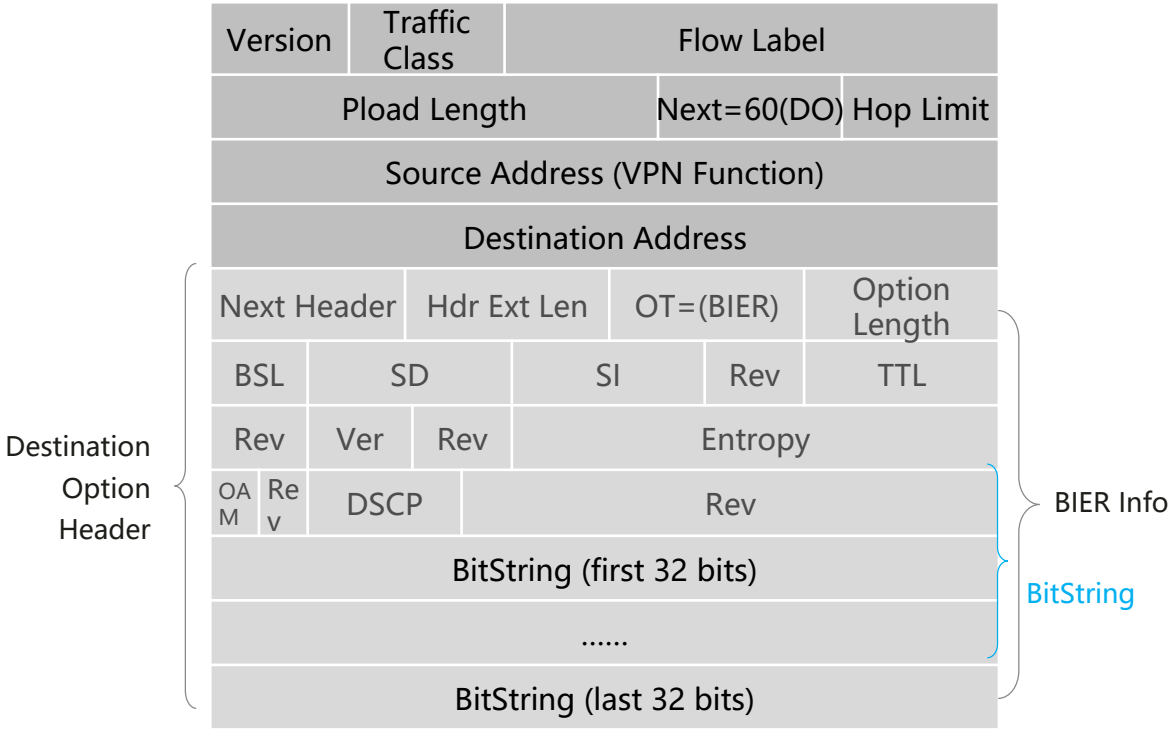
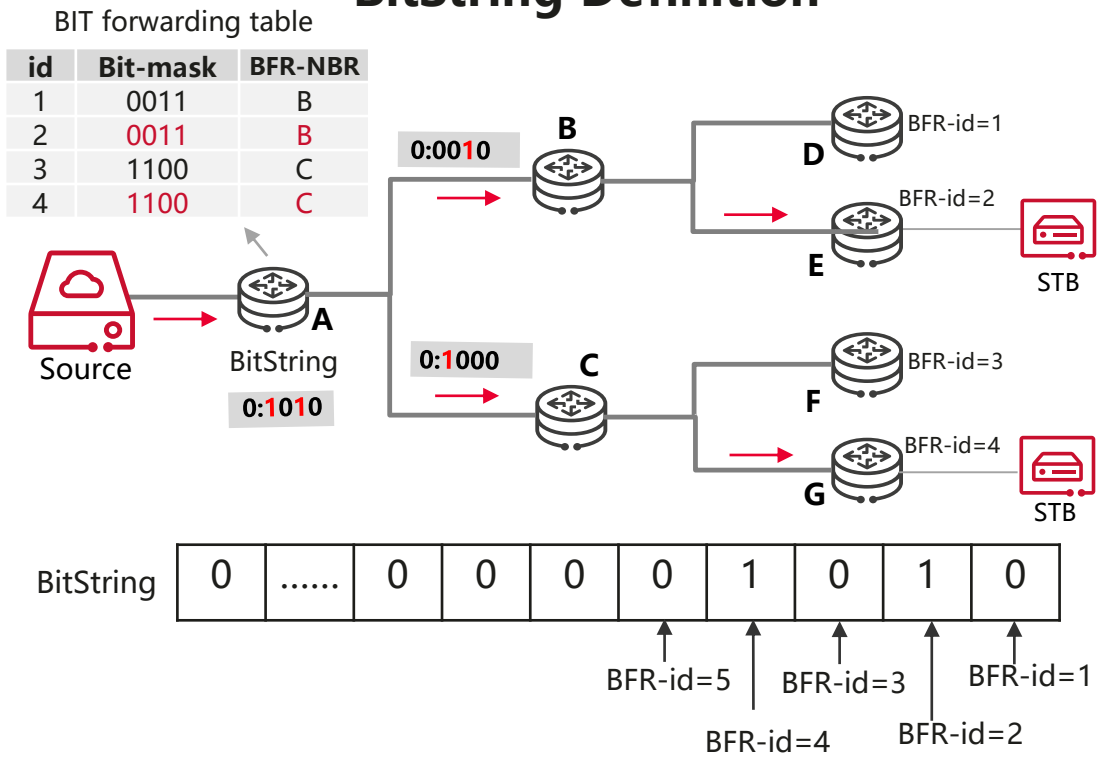
What is BIERv6

IPv6 data packets carrying BIER information

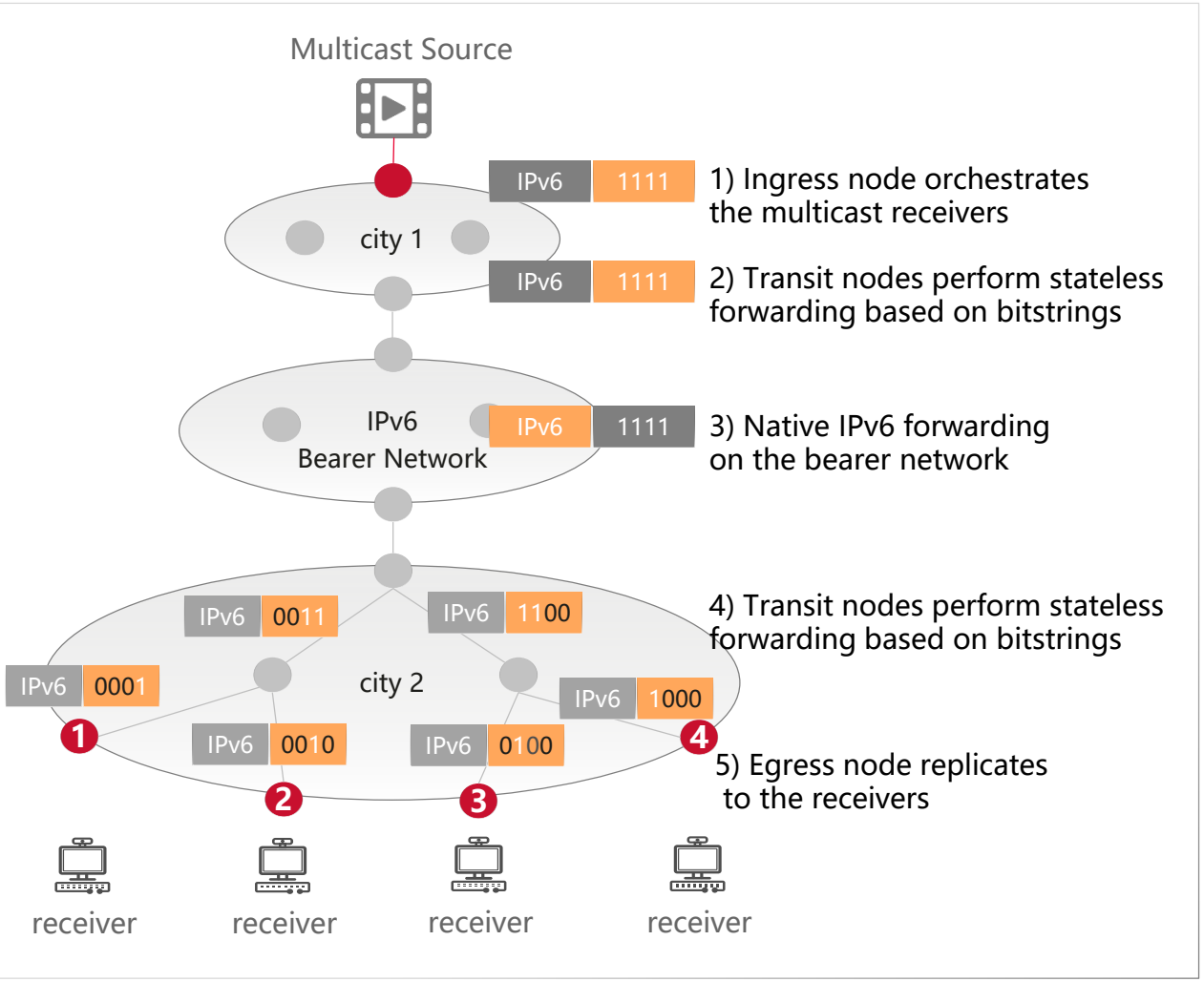


BitString Definition



- BIER information is carried in the IPv6 Destination Options header. Multicast service VPN or public network instance information is carried in the IPv6 SA. Network forwarding is unified into the IPv6 architecture as SRv6, which is simple and converged.
- The BIERv6 ingress orchestrates the receiving nodes to form a bit string. The BIERv6 node still complies with the bit replication mechanism of the BIER. The BIERv6 node replicates and forwards received multicast packets based on the bitstring and bit forwarding table.

BIERv6: Efficient and Simplified P2MP Connection



Protocol Simplification

- Only IGP/BGP is required. PIM/mLDP/P2MP RSVP-TE are not required
- No multicast distribution tree, or complicated processing of RP, shared tree, and source tree switchover

Easy to Build Large Networks

- The transit node requires only one forwarding table, and no forwarding table based on multicast streams is required
- Device resource is saved and multicast is easy to be deployed in the large-scale network.

Simple Configuration

- Services are configured only on the ingress node and are delivered at a single hop. Few entries and simple OAM.
- Carriers only need to provide IPv6 forwarding, facilitating cross-domain networking.
- Nodes that are not BIERv6-capable can forward over IPv6, facilitating network evolution..

Experience Assurance

- Transit nodes are unaware of services, and protocol convergence is fast (ms-level).
- New users join the network in one hop and quickly obtains services.

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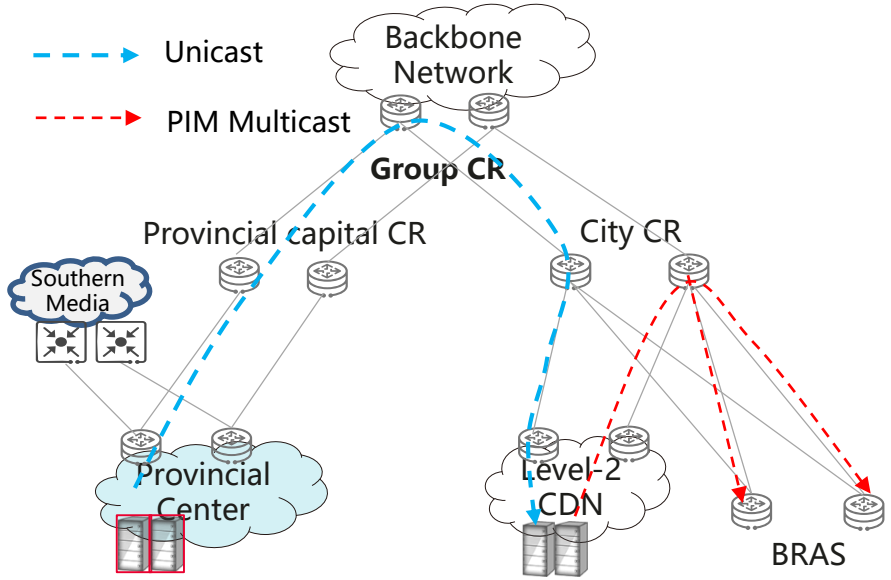
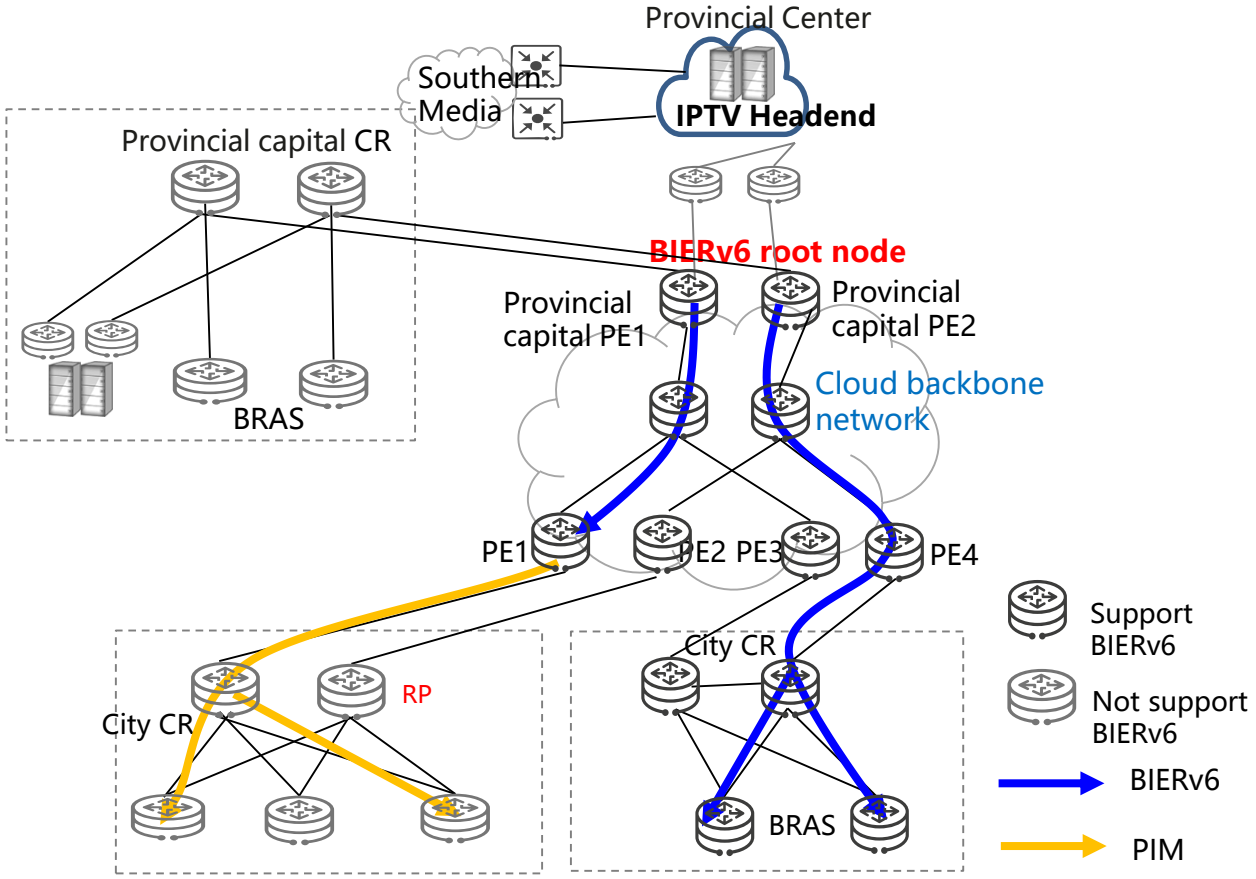
China Unicom Guangdong: BIERv6 E2E Multicast Replication Saves Bandwidth and Provides Live Broadcast Services with High Reliability and Low Latency

The IPTV live service was unicasted from the provincial center to the city, and the multicast replication was used in the city. The backbone network **bandwidth was wasted**, and **the latency of live TV was large**. As the definition of live TV channels increases and the channel bit rate increases, the level-2 CDN has to be upgraded and the **investment increases**. After reconstruction, IPTV live services are directly replicated from the provincial center to municipal users through multicast and traverse the cloud backbone network, **saving bandwidth**. The multicast replication **layer is reduced from seconds to milliseconds**. Level-2 CDNs in different cities do not need to expand live TV capacity, **saving investment**.

AS IS: Unicast forwarding from the provincial center to the level-2 CDN, high-cost CDN capacity expansion, and large latency



TO BE: BIERv6 E2E multicast replication reduces CDN costs and latency



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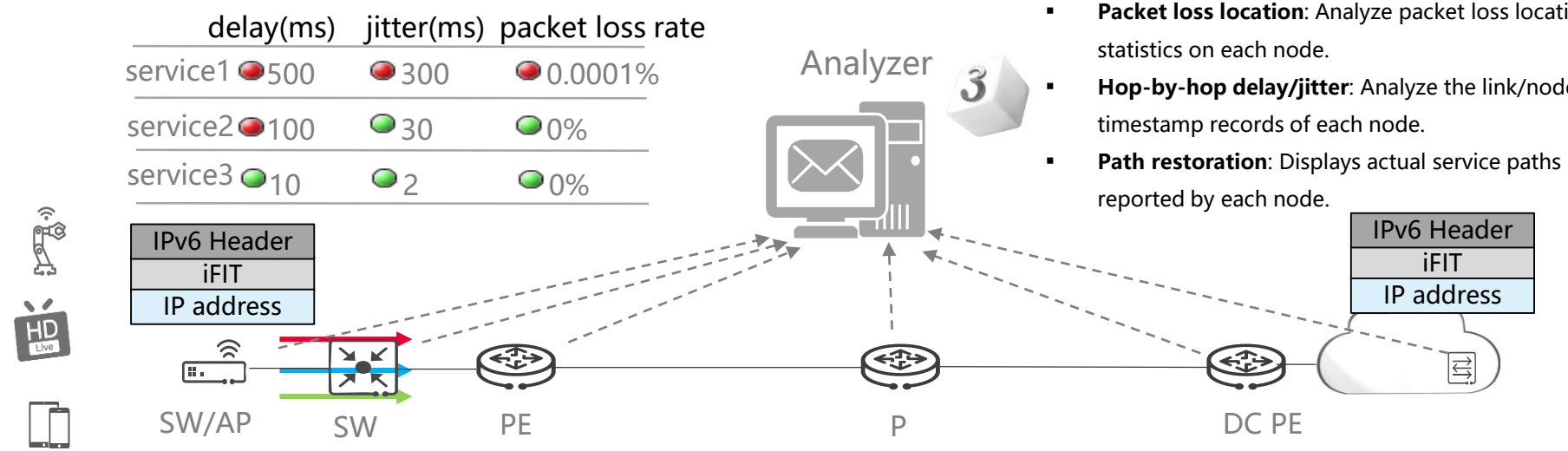
What is iFIT



- **Packet loss location**: Analyze packet loss location based on packet statistics on each node.
- **Hop-by-hop delay/jitter**: Analyze the link/node delay based on the timestamp records of each node.
- **Path restoration**: Displays actual service paths based on information reported by each node.

Ingress:

- Customized detection capability
- Performs service-level SLA monitoring by coloring on service packets.

Transit/Egress:

- Automatic statistics: packet statistics and delay
- Periodic Reporting of Statistical Results (Based on Telemetry)

10^{-6} High Precision and Real Services

- Coloring based on real service flows
- High precision: The 10^{-6} packet loss rate

Various Scenarios and Metrics

- KPIs: delay, packet loss rate, jitter, and path restoration
- Service mode: SRv6/L3VPN/EVPN
- Monitoring model: end-to-end, hop-by-hop

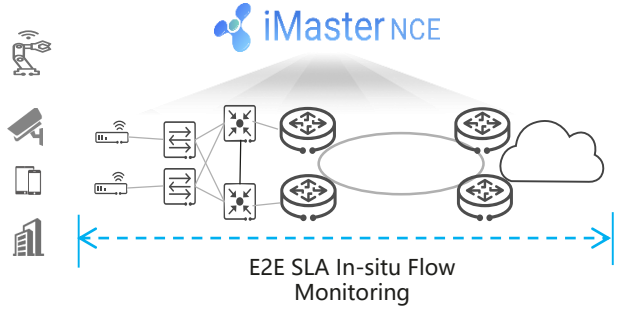
Easy Deployment and O&M

- The ingress node customizes iFIT. The transit and egress nodes are globally enabled with iFIT.
- On-demand monitoring and hop-by-hop demarcation

iFIT: In-situ Flow Monitoring, Visualized and Manageable Service Experience

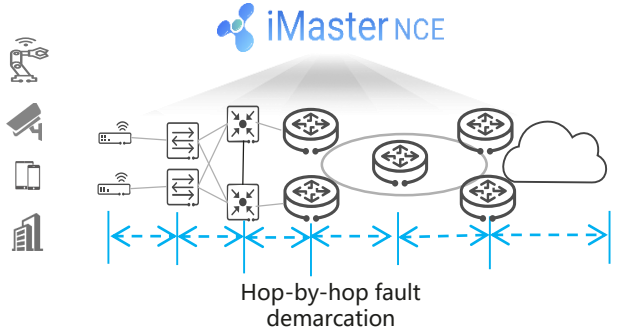
Real-time Visibility

In-situ flow monitoring, data collection in seconds, and real-time display of service quality such as packet loss rate and delay



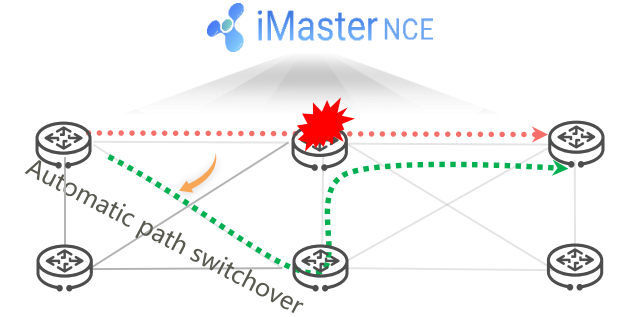
1-Minute Demarcation

iMaster NCE +iFIT hop-by-hop analysis, automatic service path restoration, massive fault algorithm, fast fault location, and precise port- and link-level fault location



Service Self-healing

Based on the demarcation and analysis results, iMaster NCE delivers automatic recovery policies and intelligent self-healing.



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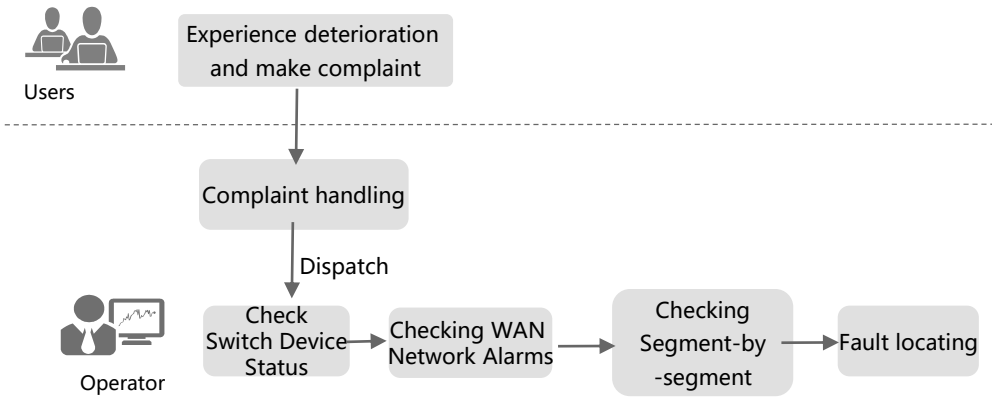
China Unicom: Private Line Services Quality Visualization Deeply

High SLA requirements for private line services

Live Video	voice	VR
Packet loss rate: < 0.1% Delay: < 20 ms	Packet loss rate: < 0.1% Delay: 20 ms	Packet loss rate: < 0.1% Delay: 50 ms

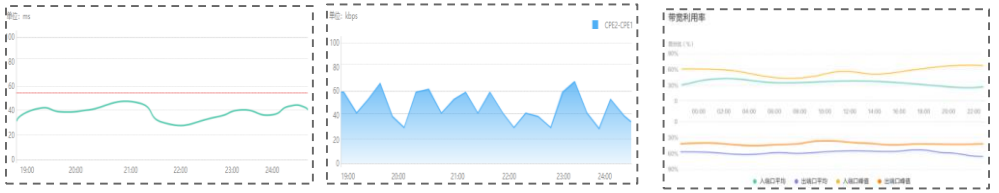
Passive response to customer complaints, fault locating time-consuming



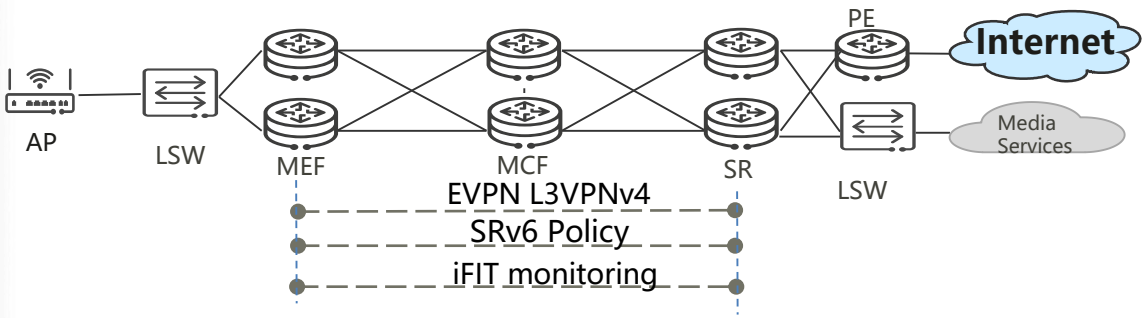
Few methods for demarcating WANs and campus networks

Network checking segment by segment
Long fault demarcation time

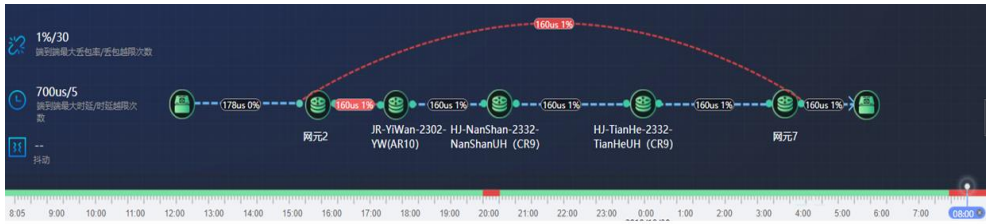
Multi-dimensional visualization of private line service quality and proactive warning for poor quality service



Abnormal VPN KPI Analysis | Abnormal VPN Traffic Analysis | Access Point KPI Analysis



Fault demarcation Automatic and accurate



- Private line service paths Visualization + hop-by-hop fault demarcation, helping O&M engineers to troubleshoot faults quickly.
- 7x24 historical playback of private line services, facilitating on-demand fault analysis.

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Network Slicing: Commitment to Diverse Services


Manufacturing


Telepresence


Public Security


Smart Office

Diversified Service Requirements

High-reliability Zero loss Low-latency

High-bandwidth Large burst

Network Slicing in Campus & WAN
Guaranteed Experience for Valuable Services

Enterprise Campus

Manufacturing

Telepresence

Public Security

Internet

Office

WAN

Network Slice 1

Network Slice 2

Network Slice 3

...

Intelligent Orchestration of Micro-Services

Cloud/DC

Manufacturing Cloud

Decision & Control Platform

Internet

MCU meeting platform

Monitoring Platform

HQ or Branch

Flexible on-demand Network Slicing, fulfills diverse service requirements

Independent Service Operation

- Service customization
- KPI visualization
- User management
- Independent upgrade

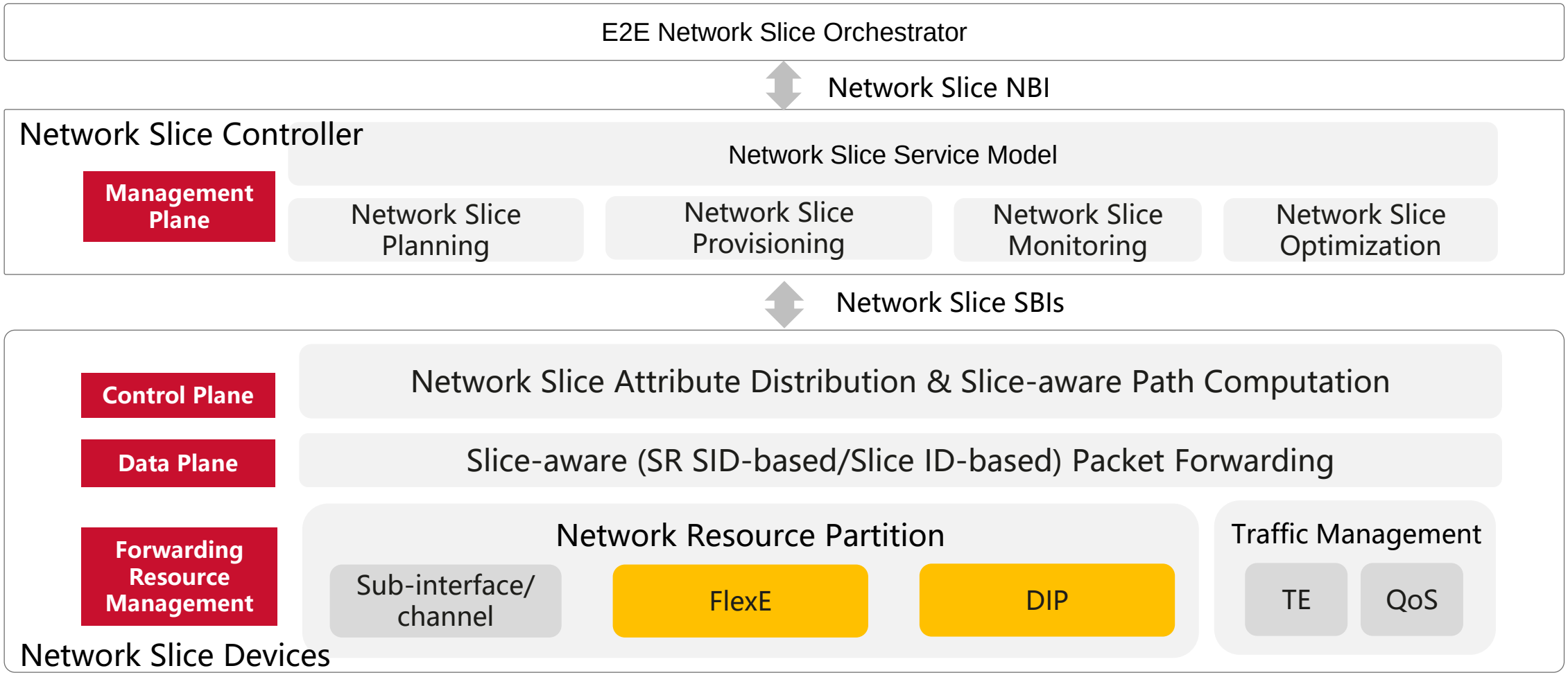
Security Isolation

- Smart grid
- Industrial control
- Autonomous driving
- Game assurance

Assured SLAs

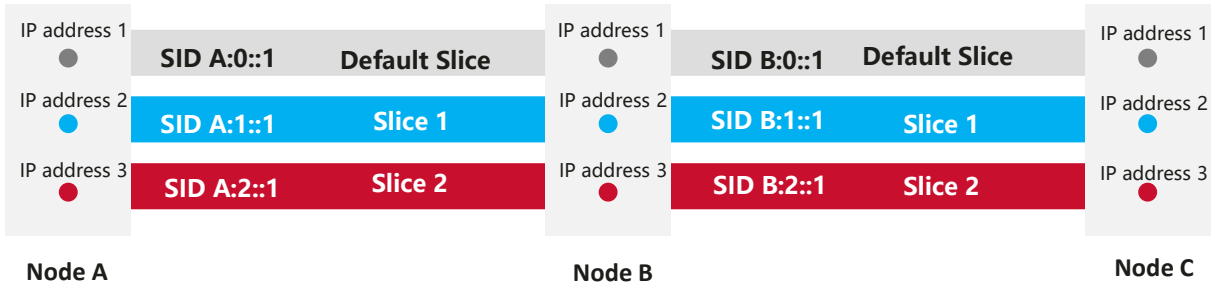
- Ultra-high bandwidth
- Ultra-low latency
- Massive connections
- Ultra-high reliability

Network Slicing Architecture



SRv6 + IPv6 Programmability Enables Massive Network Slicing

Provision independent SR SIDs/IP address for each network slice



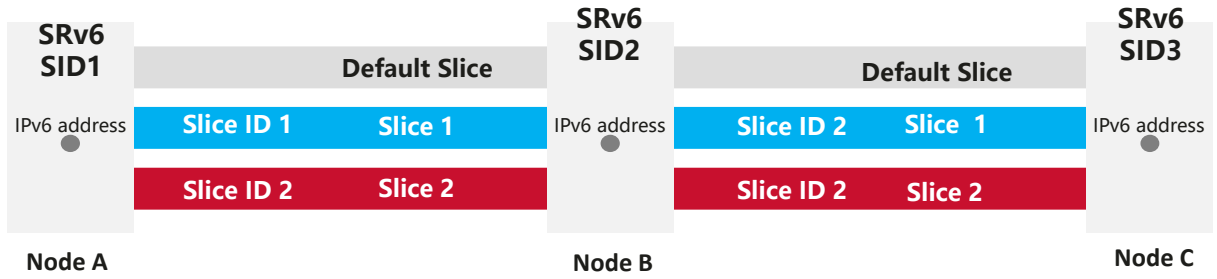
N network slices, N sets of SIDs/IP addresses

Resource SID based Network Slicing

- Per-slice SR SIDs and IP addresses, independent routing
- Per-slice Flex-Algo/SRv6 Policy for path management
- Forwarding path and resources are determined based on per-slice SR SIDs

The number of network slice relies on the scalability of control plane (IGP)

Data plane programmability allows sharing of SID and IP address



N network slices shares 1 set of SIDs/IP addresses

IPv6 Slice-ID based Network Slicing

- SRv6 SIDs identify the topology of network slices
- IPv6 HBH based Slice ID indicate the forwarding resources
- Shared control plane for K network slices

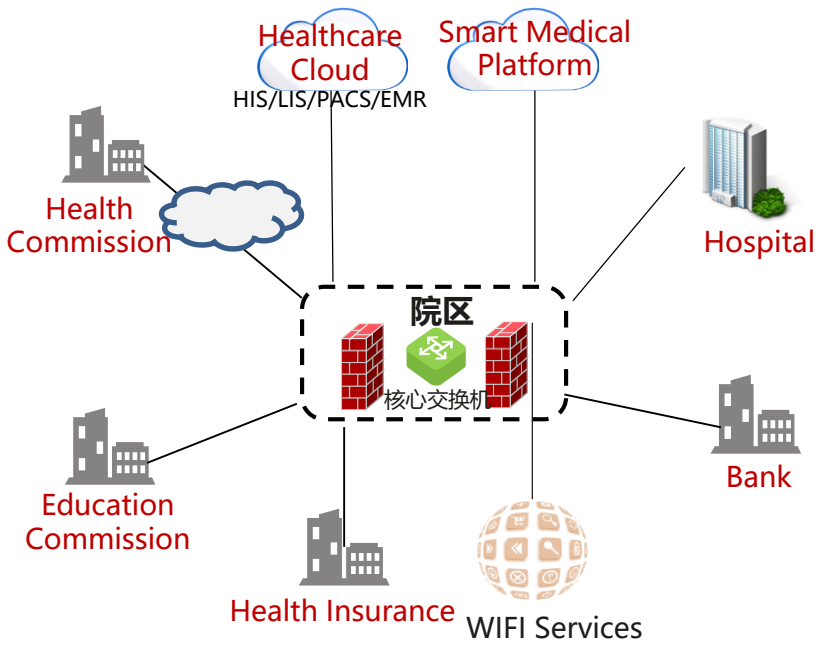
Network slice decoupled with control plane
Enable massive network slices

China Telecom Ningxia：Hierarchical Slicing Ensures Service Experiences for Multiple Industries

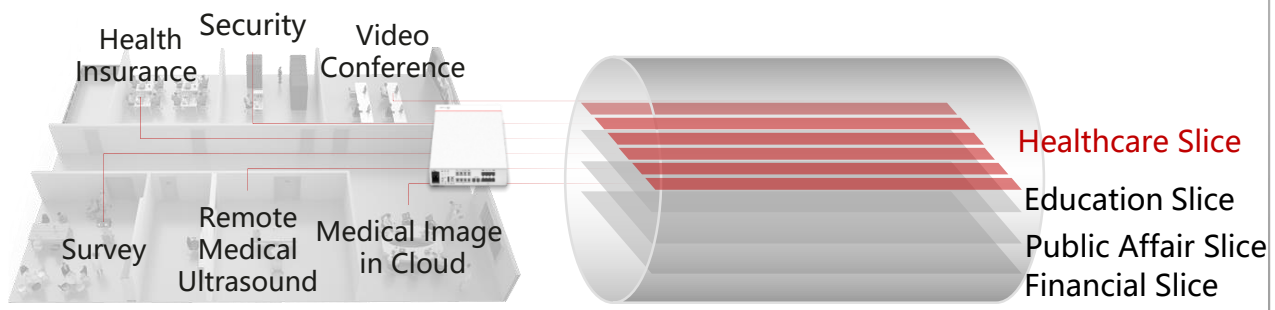
Solves the pain points in current network deployment and operation

· High TCO · Difficult to troubleshooting · No guarantee to diverse SLAs · Throughput degradation due to packet loss

AS IS: Dedicated networks
Waste of Investment



TO BE: Massive Hierarchical Network Slices
Assured multi-service experiences



One Hop to Multiple clouds

· Slice-capable 10GE interface, end-to-end network slices for industries
· AI + iFIT automatic fault localization

Hierarchical Network Slicing

· Fine-granularity network operation
· 1K+ network slices，new business model

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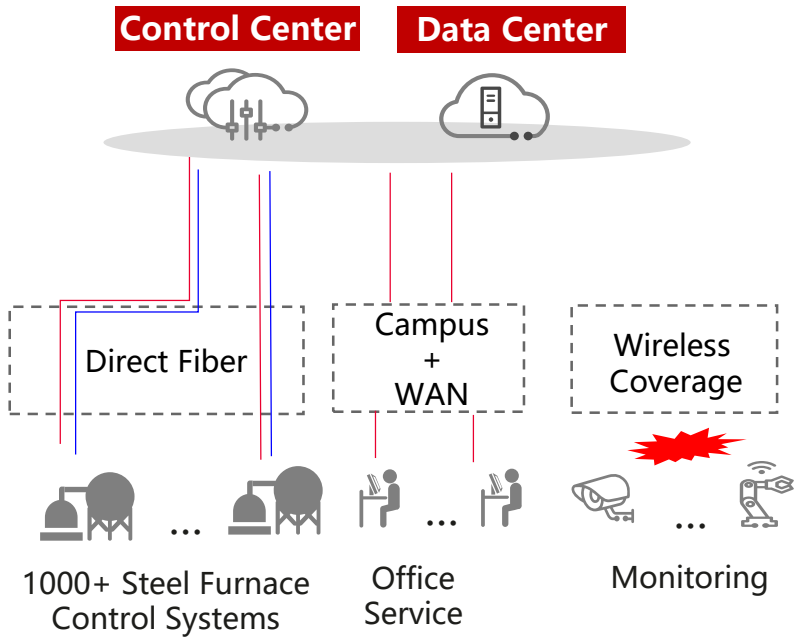
X Iron and Steal Group：IPv6 Network Slicing enables New Manufacturing

In advancing the smart manufacturing strategy, the control & operation center is established to strengthen the multi-service integration and coordination, so as to realize the high efficiency and flat production organization model

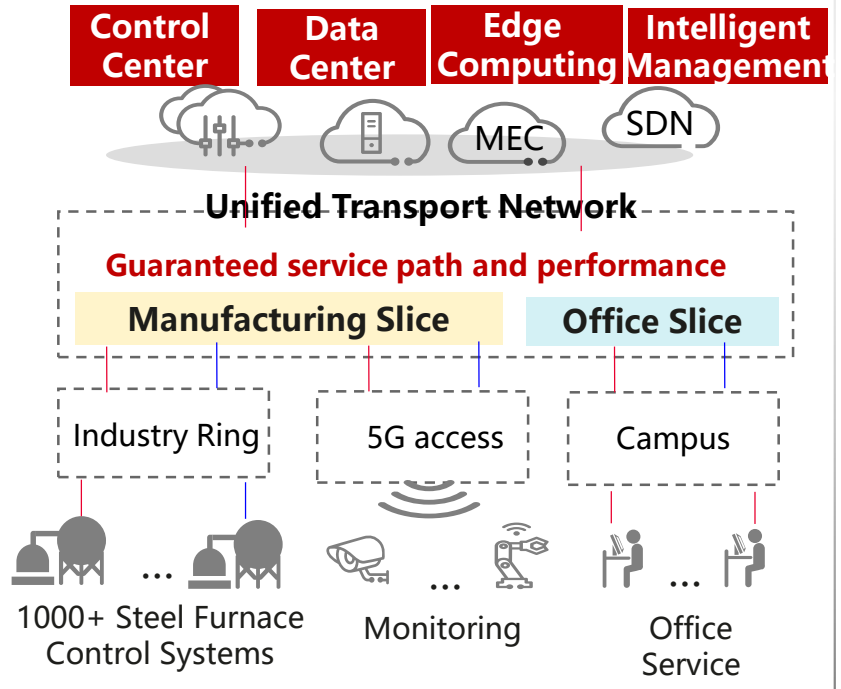
Past Network

Multiple networks: High Cost, Complex Management, No full coverage, challenge in digitalization



Current Network

Unified Network: Lower Cost, Simplified Management, Guaranteed Performance, High extensibility



1 network

100G IP Backbone

1 week

Service online time

35%

TCO Reduction

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Thank You