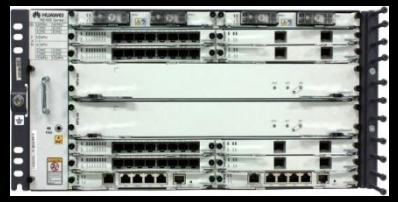
Author/Email: Константин Силиверстов k.siliverstov@huawei.com

Contents

CX600-X1/X2-M&M2 Product Positioning and Usage Scenarios

CX600 Case-shaped Device Portfolio

M2H



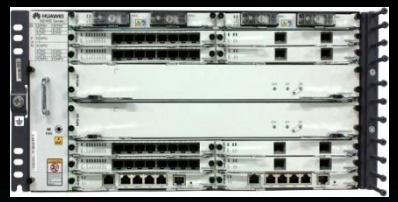
CX600-X2-M8A

CX600-X2-M16A

CX600-M2E

CX600-M2F

CX600-X1-M4



CX600-X2-M8

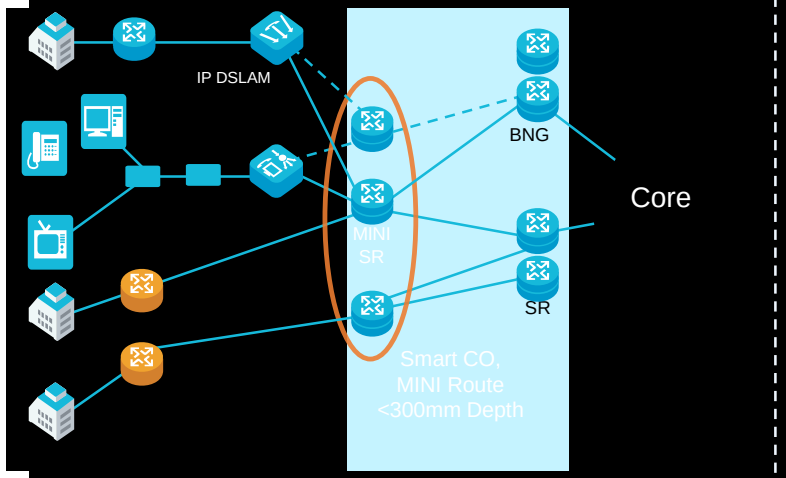
CX600-X2-M16

80G | 160G | 480G

High 100GE/40GE/10GE/GE Density	220 mm Depth	Outdoor Solution	Carrier Class Reliability	Capabilities for Value-added Services NAT, IPsec, IP hard pipe, HQoS, BNG	Virtual Access	Evolution to FMC

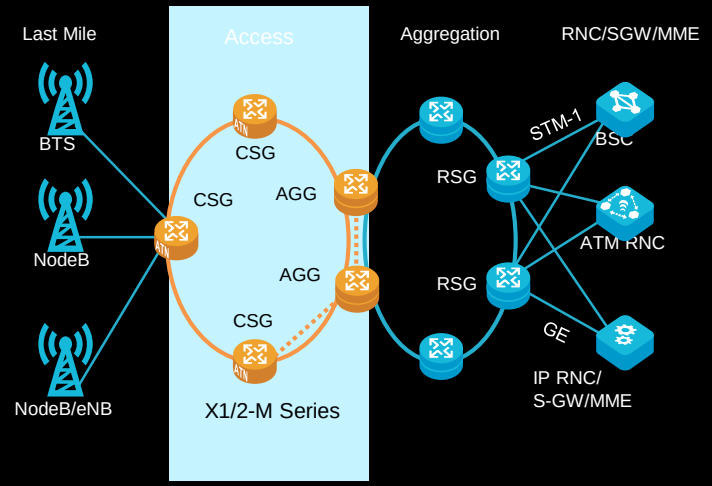
Main Usage Scenarios of Case-shaped Devices

MAN Scenario



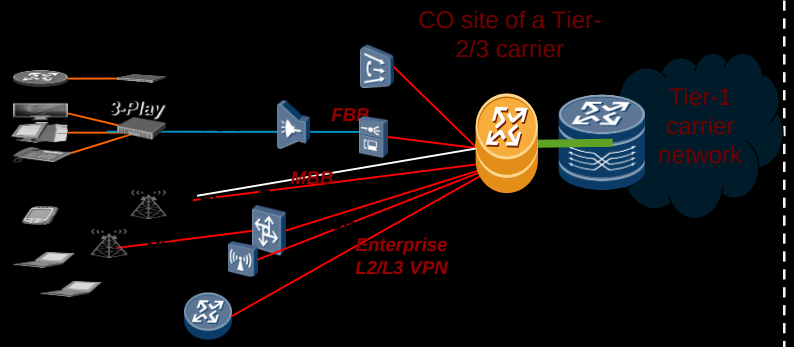
- **Customers:** integrated carriers
- **Requirements:** comprehensive aggregation for fixed broadband, enterprise private lines, and mobile bearing, legacy service migration, and excellent service experience
- **Network construction roadmap:** ultra broadband, simplified network and O&M, larger capacity, and fewer sites

Evolution of IPRAN to FMC



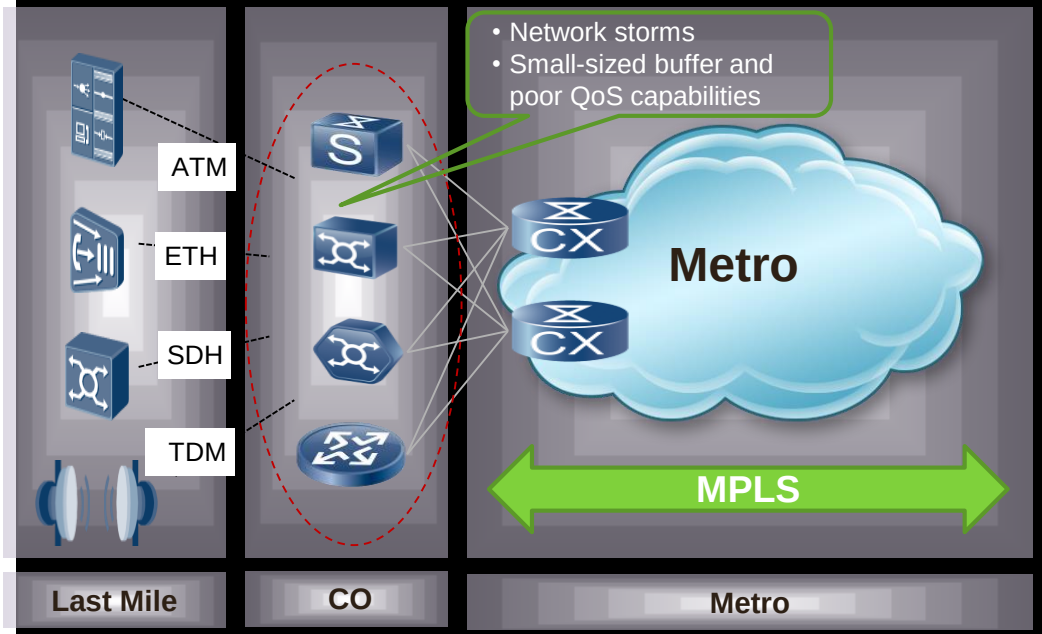
- **Customers:** FMC carriers
- **Requirements:** comprehensive bearing of mobile bearer and enterprise private lines, legacy service access, and faster service provisioning
- **Network construction roadmap:** integrated service bearing, Layer 3 to edge, flexible service deployment, and faster service provisioning

Networks of Tier-2/3 Carriers

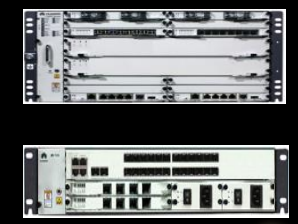


- **Customers:** Tier-2/3 carriers
- **Requirements:** leasing transmission and bearer networks of Tier-1 carriers, with switches bearing services
- **Network construction roadmap:** traffic aggregation and scheduling at the local CO site; lower bandwidth rent and TCO

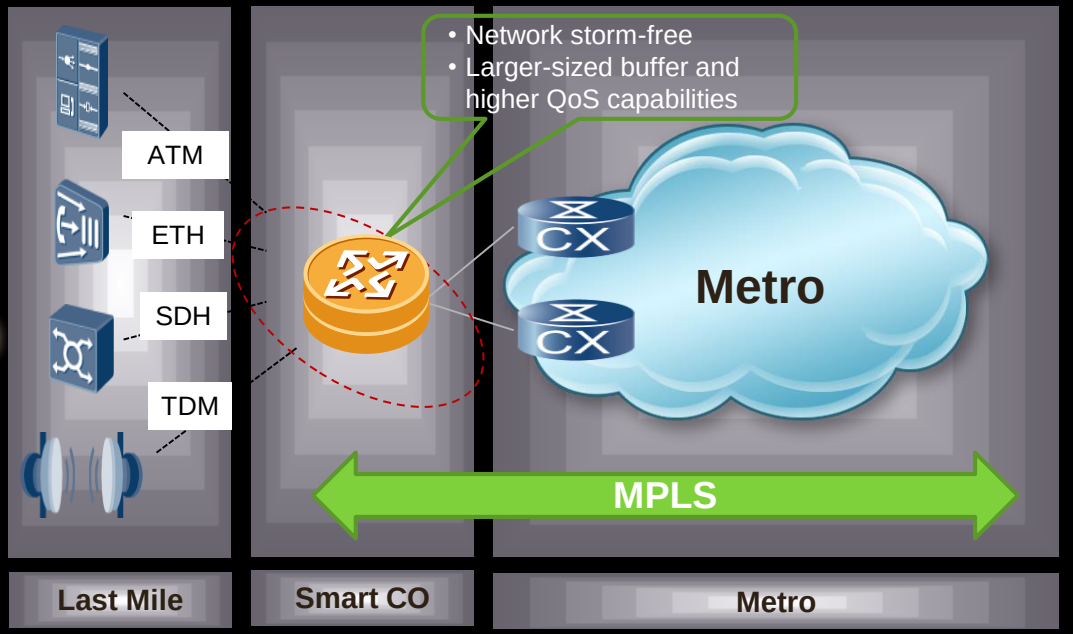
FMC Usage Scenarios



Using switches for aggregation



Smart CO



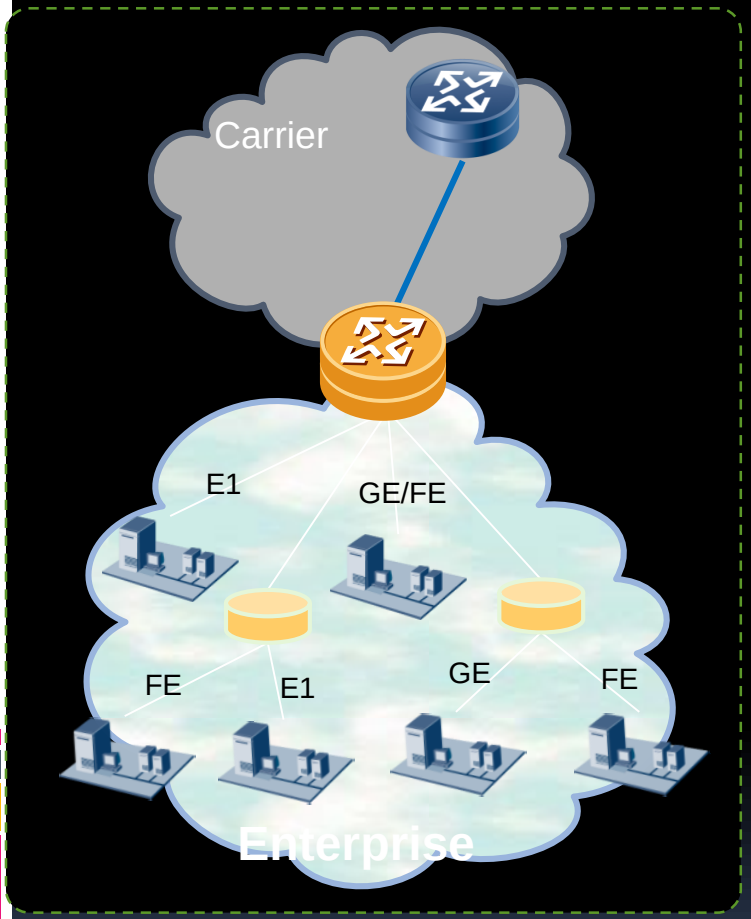
High-density interface aggregation and faster service provisioning

- Network storms may occur on the Layer 2 network.
- The small-sized buffer and poor QoS capabilities cannot meet LSA requirements of video services.
- The service deployment is complicated, and E2E service provision is not supported.

- Comprehensive FMC Layer 3 aggregation eliminates network storms.
- High-density interface aggregation reduces upstream ports.
- High-speed and low-speed service aggregation protects the existing investment on the live network.
- Larger-sized buffer and higher QoS capabilities guarantee service experience.
- E2E service provision is supported, and O&M is simplified.

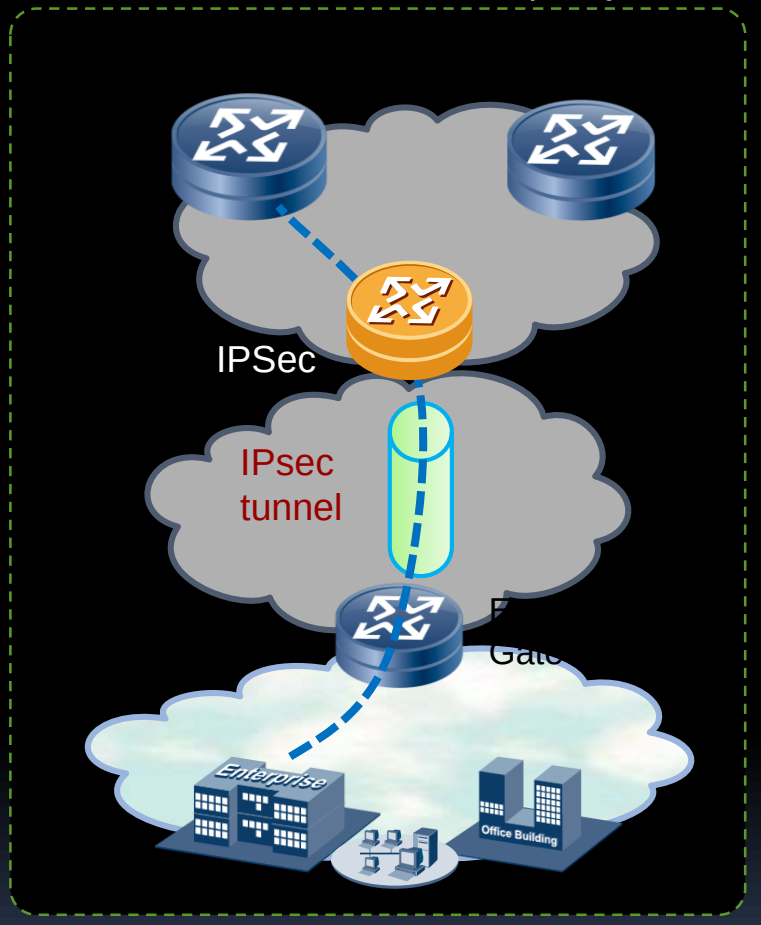
Usage Scenarios of Enterprise Private Line and Value-added Services

Enterprise private lines



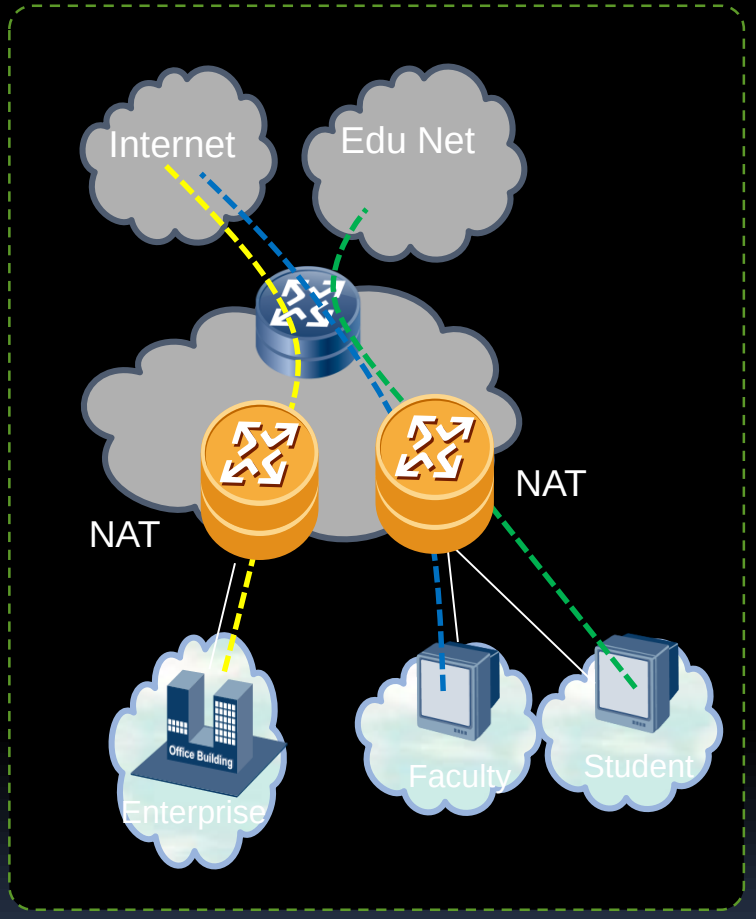
- Multiple access modes require comprehensive aggregation.
- Aggregation through switches cannot meet HQoS requirements.

Guaranteed service quality



- Communication content transmitted along the private line that traverses the public network is open to interception risks.
- IPsec is used for encryption protection.

Value-added services



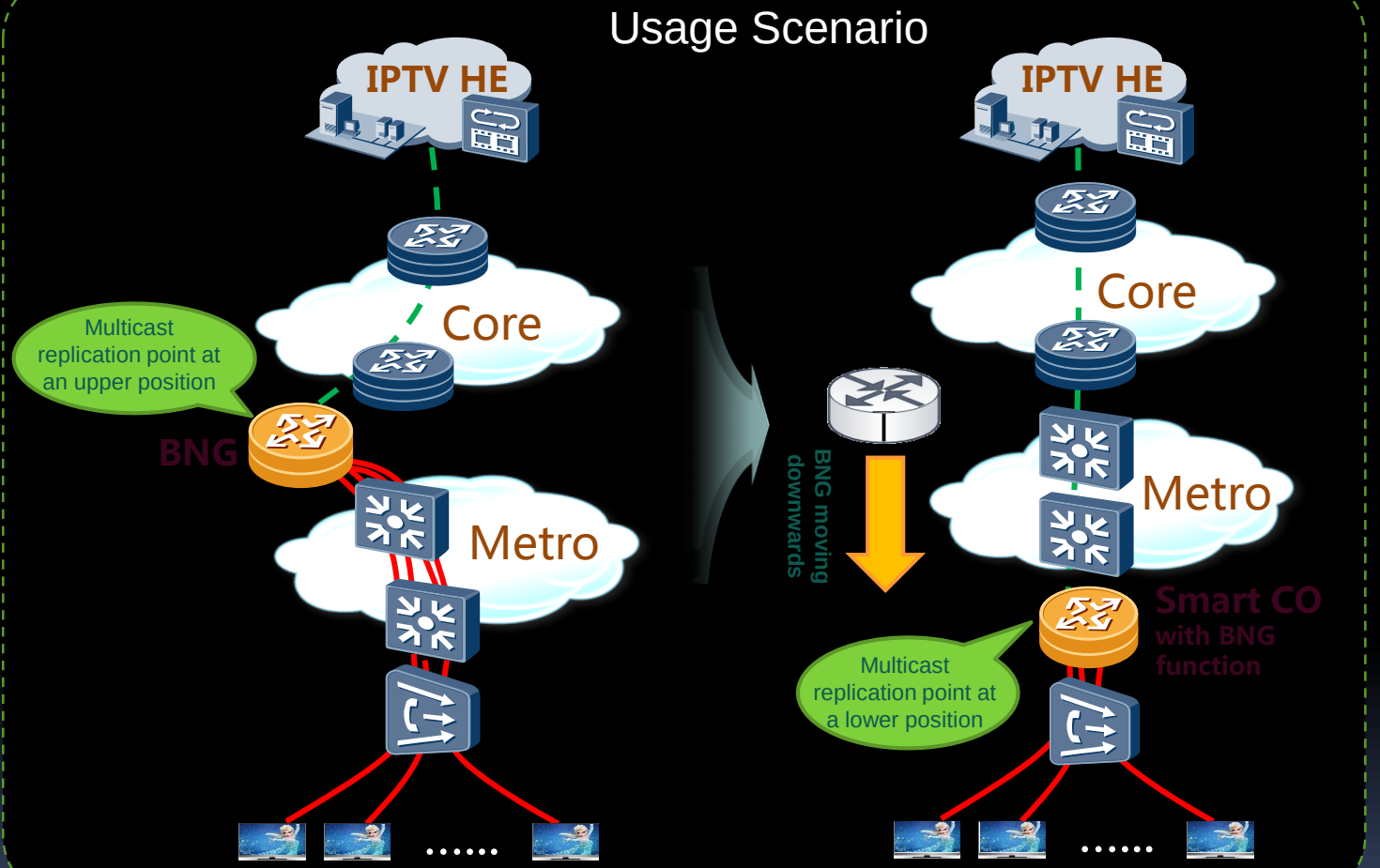
- Translation between public and private addresses conserves public network addresses.
- Access control and traffic distribution are implemented based on NAT.
- Through NAT, internal network addresses are not transparent to external networks, which improves security.

BNG to Edge and Mini-BNG Usage Scenarios

Carrier Requirements

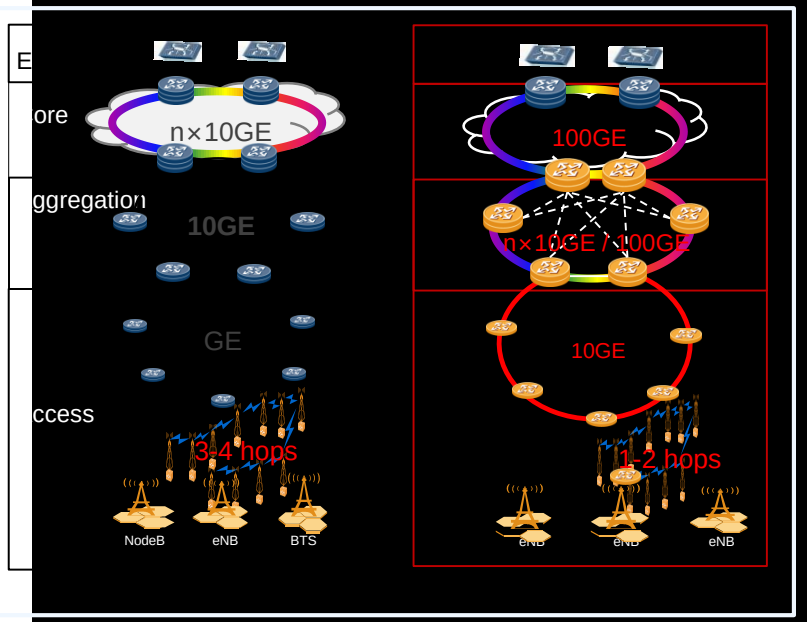
- **BNG moved downstream to conserve MAN bandwidth**
  The PPPoE multicast replication point resides on the BRAS. If the BRAS is deployed at the edge of the backbone network:
  MAN bandwidth consumed by IPTV = Number of users x Number of channels x Channel bandwidth
- **Small-sized BRAS, low power consumption, and outdoor application**
  A 300 mm-deep access cabinet can house the mini-BNG to reduce the rent.
- **Dynamic user identification**
  To identify user flows and priorities, the mini BNG supports dynamic QinQ swap, offset, and pop actions.
- **High multicast/HQoS capabilities**
  8K users can watch IPTV programs online.

Usage Scenario



Mobile Bearer Usage Scenario

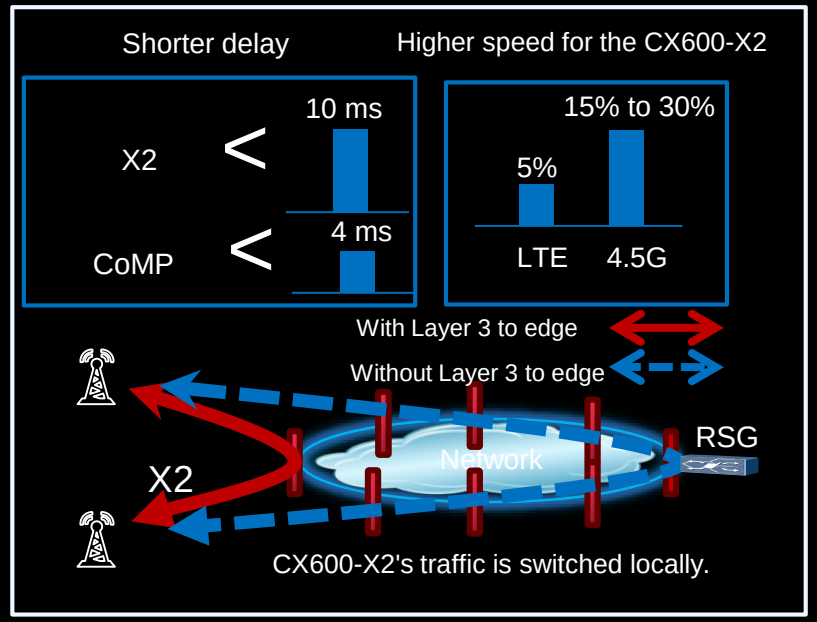
High bandwidth and high-density 10GE interfaces



GE to site is evolved to 10GE to site.

- The commercial deployment of 4.5G wireless networks becomes maturer. The number of commercial deployment cases is expected to exceed 60 in 2016.
- Aggregation devices require a higher capacity.
- Interfaces of 100GE or higher need to be bundled to increase bandwidth.
- More than half IP RANs in China use 10GE access rings.

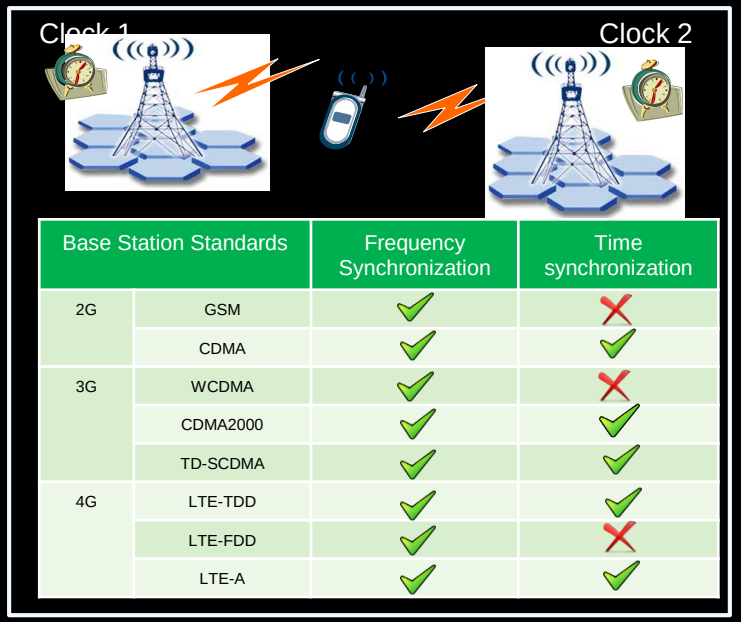
Layer 3 to edge



Mobile video growth and IoT require higher bandwidth and a shorter delay.

- Subway and bus scenarios require more traffic on the CX600-X2.
- To meet 3GPP's requirement that in the LTE phase, the delay of the CX600-X2 is less than 10 ms. In the LTE-A phase, the COMP delay is less than 4 ms.
- With Layer 3 to edge, more bandwidth resources are conserved, and the delay on the CX600-X2 is reduced.

Clock synchronization



Base Station Standards		Frequency Synchronization	Time synchronization
2G	GSM	✓	✗
	CDMA	✓	✓
3G	WCDMA	✓	✗
	CDMA2000	✓	✓
	TD-SCDMA	✓	✓
4G	LTE-TDD	✓	✓
	LTE-FDD	✓	✗
	LTE-A	✓	✓

Mobile services require clock synchronization, and GPS has many problems.

- Difficult deployment: The GPS antenna has high requirements for the installation environment.
- The failure rate is high, and no backup protection is available.
- Poor maintainability: Any hardware failure requires onsite replacement, and remote maintenance is not supported.
- Security risks: If GPS is disabled, a breakdown of the entire network may occur.

Introduction to CX600-X1/X2-M&M2 Products

Highlights of Case-shaped Devices

CX600-M2E CX600-M2F CX600-M2H

CX600-X1-M4 CX600-X2-M8 CX600-X2-M16

CX600-X2-M8A CX600-X2-M16A

Larger capacity and higher performance and reliability

- 50G, 120G, 240G, and 480G to evolve to 1T in the future
- Key components are in 1:1 backup, which ensures high service reliability.

Full service bearer and flexible access

- Bear fixed home broadband, mobile bearer, and enterprise private line services.
- Provide high-density GE, 10GE, 40GE, and 100GE interfaces for aggregation.
- FE/E1/ATM low-speed interface aggregation meets legacy service migration requirements.

Compact design, and applicable to environments of a wider range of temperatures

- Can share the same cabinet with an access or transmission device, which reduces the network construction cost.
- Are applicable to environments of a temperature range of -40ºC to + 65ºC.

Reduced TCO and higher VAS capabilities

- Virtual access reduces O&M costs.
- NAT, IPsec, IP hard pipe, HQoS, 1588v2

CX600-M2E/M2F Products

Integrated architecture

CX600-M2E

- Fixed 10GE interfaces: 2x10GE
- Fixed GE interfaces: 24xGE
- Control interfaces: ETH maintenance, AUX/Console, TOD clock, CLK
- Fan modules in N:1 mode
- Interface card slot 2
- Power modules in 1+1 mode
- Capacity: CPU: 1.2G, SDRAM: 4G

CX600-M2F

- Fixed 10GE interfaces: 4x10GE
- 2x10GE/GE adjustable interfaces
- Fixed GE interfaces: 38xGE
- Control interfaces: ETH maintenance, AUX/Console, TOD clock, CLK
- Fan modules in N:1 mode
- Interface card slot 2
- Power modules in 1+1 mode
- Capacity: CPU: 1.2GHz, 8 cores, SDRAM: 8G

Higher capacity

- CX600-M2E, 80G switching capability, 256K FIBs/256K MAC/24K QoS queues
- CX600-M2F, 160G switching capability, 1M FIBs/1M MAC/128K QoS queues
- CX600-M2E, 44xGE+2x10GE interfaces
- CX600-M2F, 60xGE+4x10GE interfaces, 40xGE+12x10GE (maximum capacity)
- IP hard pipes, IP FPM, 5-level HQoS, NAT, IPsec, and 1588v2
- PICs, power modules, and fan modules support hot swap.
- CX600-M2E/M2F full configuration, power consumption (175 W/259 W), noise (55 dB/63 dB)
- Power redundancy backup, overtemperature, overcurrent, short-circuit protection, and overvoltage/undervoltage protection

Capacity Comparison

Manufacturer	HUAWEI	HUAWEI	CISCO	Juniper NETWORKS
Device	CX600-M2E	CX600-M2F	ASR903	MX80
Switching	80G	160G	55G	80G
Route	256K	1.5M	80K	512K
HQoS	5-level	5-level	3-level	3-level
Interface	Multi-link	Multi-link	Low-speed interfaces	Low-speed interfaces

CX600-M2H Product

Integrated architecture

Higher capabilities

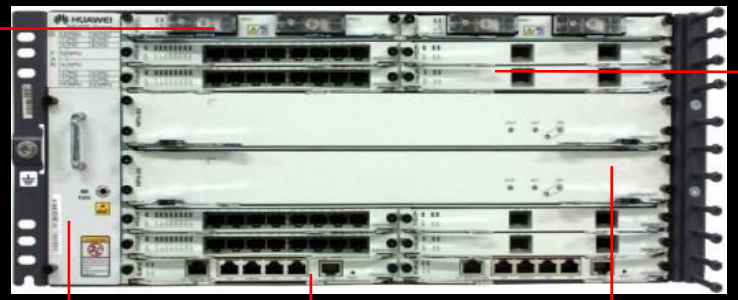
1. A maximum of 26x10GE+38xGE ports on an M2H.
2. IP hard pipe, IP FPM, 5-level HQoS, NAT, IPsec, and 1588v2 are supported.
3. PICs and power and fan modules are hot swappable.
4. With the green design, a fully configured device provides a maximum power consumption of 400 W, reducing energy consumption.
5. Power redundancy is supported, implementing overtemperature, overcurrent, short circuit, over-voltage, and under-voltage protection.

Key Capabilities

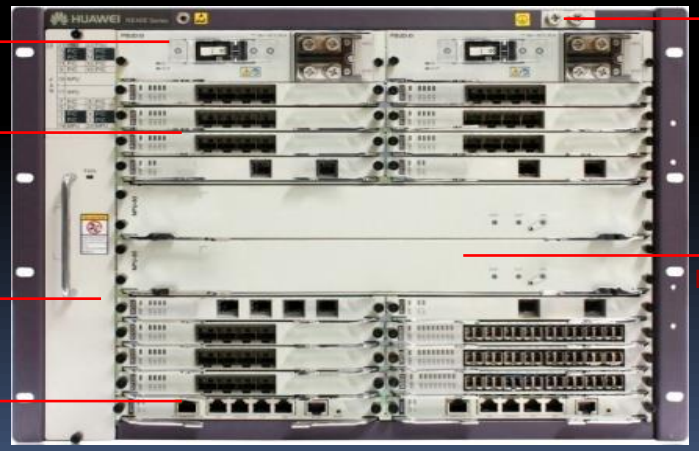
Device	M2E	M2F	M2H
Switching capacity	160G	320G	960G
FIB	256K	1.5M	4M
HQoS	5 levels	5 levels	5 levels
Port capacity	Multiple types of links	Multiple types of links	Multiple types of links
BNG	Not supported	Supported	Not supported

CX600-X1/X2-M&M2 Products

CX600-X2-M8



CX600-X2-M16



CX600-X1-M4

Leading Industrial Design

Compact: CX600-X1-M4, 3U high (DC)/4U high (AC), 220 mm deep
CX600-X2-M8, 5U high (DC)/6U high (AC), 220 mm deep
CX600-X2-M8, 8U high, 220 mm deep
Advanced architecture: control and forwarding plane separation, main control board redundancy, SFU redundancy (M8/M16)
Comprehensive authentication: MEF CE2.0, IPv6, VCCI, NEBS, and NRTL

Powerful service access and aggregation capabilities

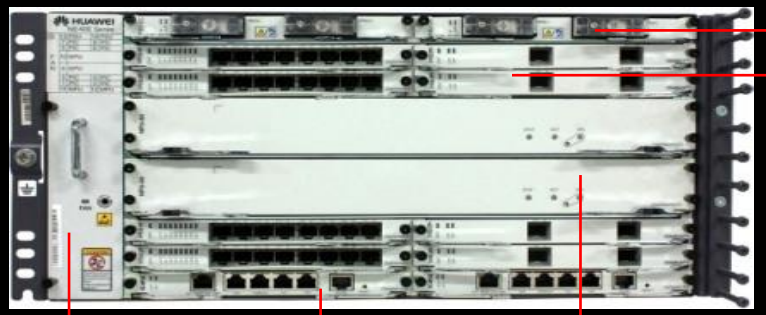
Large capacity: 480G switching capability, 25M BGP routes, and 1M IPv4 FIB
Abundant interfaces: 40GE/10GE/GE/FE/POS/CPOS/E1/ATM

Diversified maintenance and management methods

NMS: U2000
Management interface: MGMT-ETH/Console /AUX/RS-485
Maintenance methods: 802.1ag/802.3ah/Y.1731/MPLS-TP OAM/IP FPM/MPLS OAM

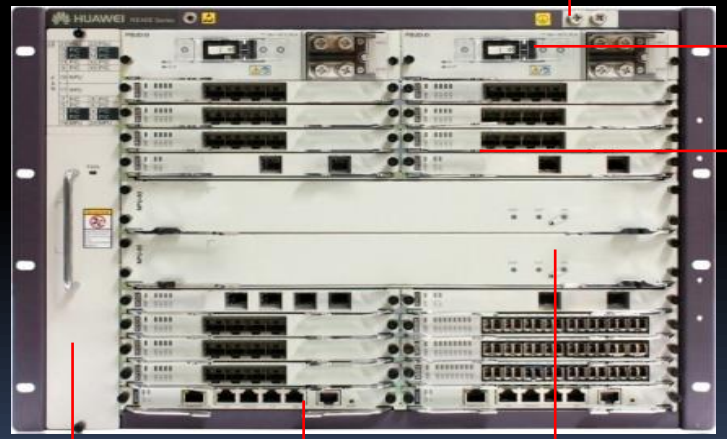
CX600-X2-M8A/M16A Products

CX600-X2-M8A



Higher backplane capacity and 1T outlet capability

CX600-X2-M16A



Leading Industrial Design

Compact: CX600-X2-M8A, 5U high (DC)/6U high (AC), 220 mm deep
CX600-X2-M16A, 8U high, 220 mm deep
Advanced architecture: control and forwarding plane separation, main control board redundancy, SFU redundancy
Comprehensive authentication: MEF CE2.0, IPv6, VCCI, NEBS, and NRTL

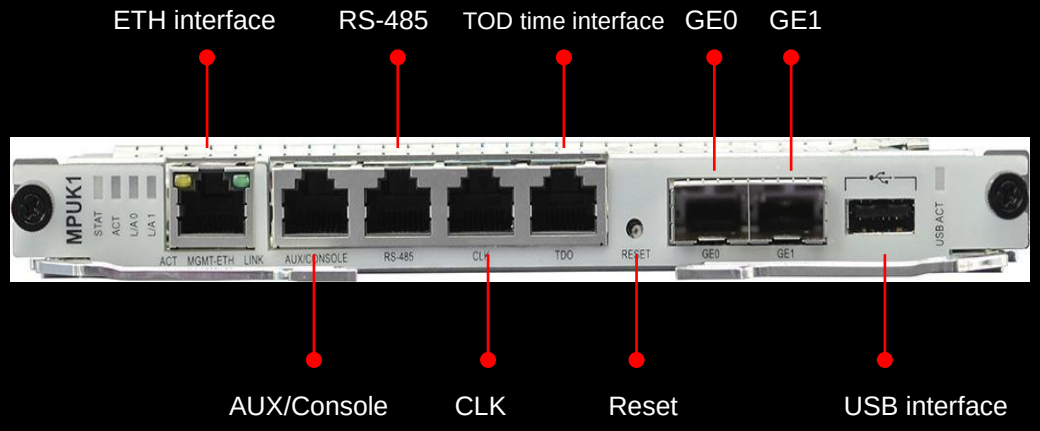
Powerful service access and aggregation capabilities

Large capacity: 480G switching capability, 25M BGP routes, and 1M IPv4 FIB
Abundant interfaces: 40GE/10GE/GE/FE/POS/CPOS/E1/ATM

Diversified maintenance and management methods

NMS: U2000
Management interface: MGMT-ETH/Console /AUX/RS-485
Maintenance methods: 802.1ag/802.3ah/Y.1731/MPLS-TP OAM/IP FPM/MPLS OAM

MPUs of Case-shaped Devices



Manufacturer	HUAWEI	cisco	ALU	Juniper Networks
Device	CX600-X1/X2	ASR903	7750-A4/A8	MX104
Memory	8GB	4GB	4GB	4GB
CPU	1.5GHz, 8 cores	1.2GHz, dual core	-	-
BGP	25M	80K	4M	4M

Specifications	MPUK	MPUK1
CPU	1.2GHz	1.5GHz
Number of CPU cores	1	8
Memory	2G	8G
Number of OSPF routes	1M	3M
Number of IS-IS routes	1M	3M
Number of BGP routes	1M	25M
	10K/S	20K/S
Number of VLLs	NPU-480:16K	NPU-480:64K
Number of VPLS VSIs	NPU-480: 8K	NPU-480: 32K
BNG	Not supported	Supported

SFUs of Case-shaped Devices

NPU-50/50-E

Switching capability: 100 Gbit/s

Forwarding capacity: 50 Mpps

Flash: 64M

Buffer time: 82 ms

IPv4 FIB entries: 512K

ACL rules: 10K

QoS queues: 128K

Supported devices:

- CX600-X1-M4
- CX600-X2-M8/M8A
- CX600-X2-M16/M16A

NPU-120/120-E

Switching capability: 240 Gbit/s

Forwarding capacity: 180 Mpps

Flash: 64M

Buffer time: 100 ms

IPv4 FIB entries: 1M

ACL rules: 32K

QoS queues: 128K

Supported devices:

- CX600-X1-M4
- CX600-X2-M8/M8A
- CX600-X2-M16/M16A

NPU-240/240-A

Switching capability: 480 Gbit/s

Forwarding capacity: 180 Mpps

Flash: 64M

Buffer time: 100 ms

IPv4 FIB entries: 1M

ACL rules: 32K

QoS queues: 128K

Supported devices:

- CX600-X1-M4
- CX600-X2-M8/M8A
- CX600-X2-M16/M16A

NPU-480

Switching capability: 960Gbit/s

Forwarding capacity: 360 Mpps

Flash: 64M

Buffer time: 100 ms

IPv4 FIB entries: 1M

ACL rules: 128K

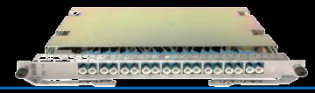
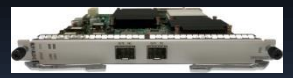
QoS queues: 128K

Supported devices:

- CX600-X1-M4
- CX600-X2-M8/M8A
- CX600-X2-M16/M16A

Independent SFU, forwarding and control plane separation, and NPU 1:1 redundancy

Case-shaped Device Subcard Portfolio

High-speed subcard	100GE	1x100GE  New					
	40GE	1x40GE 					
	10GE	4 x10GE 	2 x 10GE 	1x10GE+8xGE 	2x10GE -H 	10x10GE  New	
	GE	20x GE 	10x GE 	8x GE 	8x GE-RJ45 	8xGE -H 	8xCWDM OD/OM 
Low-speed card	POS	1x622M /2x155M POS 	4x155M POS 				
	CPOS	4x155M CPOS 	1x155M CPOS 				
	ATM	2x155M ATM 					
	E1	32xE1 (120 ohm) 	32xE1 (75 ohm) 	16xE1 (120 ohm) 	16xE1 (75 ohm) 		

- -H subcards support IP hard pipes, **which satisfies key service resource requirements.**
- High-density GE/10GE/40GE/100GE aggregation capability is supported, **applicable to the full service access scenario.**
- FE/E1/ATM low-speed port aggregation is supported, **which allows for legacy service migration.**
- OM/OD subcards are used to save optical fibers and **reduce CAPEX.**

Case-shaped Device Interface Capacities

- High GE/10GE/40GE 100GE density
- Powerful L2&L3 function
- LTE Ready
- MPLS-TP Ready
- Mini BNG

FMC Service

X1-M4

X2-M8

X2-M16

X2-M8A

X2-M16A

Product	X1-M4			X2-M8				X2-M16				X2-M8A				X2-M16A			
Port Density	40G Port	10G Port	GE Port	100G Port	40G Port	10G Port	GE Port	100G Port	40G Port	10G Port	GE Port	100G Port	40G Port	10G Port	GE Port	100G Port	40G Port	10G Port	GE Port
NPU-120	4	16	40	-	4	24	80	-	-	24	118	-	4	24	80	-	-	24	118
NPU-240	4	16	40	-	4	24	80	-	-	24	118	-	4	24	80	-	-	24	118
NPU-480	-	-	-	-	8	32	80	2	4	44	118	2	8	44	80	2	4	44	118

M2E

M2F

M2H

Product	M2E		M2F			M2H			
Height	2U		2U			2U			
Switching Capacity	160Gbps		320Gbps			960Gbps			
Port Density	10G Port	GE Port	40G Port	10G Port	GE Port	100G Port	40G Port	10G Port	GE Port
	6	44	2	12	60	2	2	48	48

CX600-X1/X2-M Slot Capacity At a Glance

	NPU 50G	NPU120/240G	NPU 480G
AccessCapacity	80G	160G	
M4	20G 20G 20G 20G NPU-50	40G 40G 40G 40G NPU-120/240	
AccessCapacity	160G	240G	320G
M8	20G 20G 20G 20G NPU-50 NPU-50 20G 20G 20G 20G	20G 20G 40G 40G NPU-120/240 NPU-120/240 40G 40G 20G 20G	40G 40G 40G 40G NPU-480 NPU-480 40G 40G 40G 40G
AccessCapacity	176G	248G	448G
M16	2G 2G 2G 2G 20G 20G 20G 20G NPU-50 NPU-50 20G 20G 20G 20G 2G 2G 2G 2G	2G 2G 20G 20G 20G 20G 20G 20G NPU-120/240 NPU-120/240 20G 20G 20G 20G 20G 20G 2G 2G	2G 2G 20G 20G 20G 20G 40G 40G NPU-480 NPU-480 100G 100G 20G 20G 20G 20G 2G 2G

	NPU 50G	NPU120/240G	NPU 480G
AccessCapacity	160G	240G	440G
M8A	20G 20G 20G 20G NPU-50 NPU-50 20G 20G 20G 20G	20G 20G 40G 40G NPU-120/240 NPU-120/240 40G 40G 20G 20G	40G 40G 40G 40G NPU-480 NPU-480 40G 40G 100G 100G
AccessCapacity	176G	248G	480G
M16A	20G 20G 20G 20G 2G 2G 2G 2G NPU-50 NPU-50 2G 2G 2G 2G 20G 20G 20G 20G	20G 20G 20G 20G 20G 20G 2G 2G NPU-120/240 NPU-120/240 2G 2G 20G 20G 20G 20G 20G 20G	10G 10G 20G 20G 20G 20G 100G 100G NPU-480 NPU-480 40G 40G 20G 20G 20G 20G 10G 10G

Important notes:

- If the capacity of a subcard inserted into a slot exceeds the slot capacity, the subcard cannot register.
- For M16A+NPU480，40G slots cannot have subcards of lower than 20G capacity installed.

Basic Specifications of Case-shaped Devices

Feature \ Model	M2E	M2F	M2H	X1-M4	X2-M8/M8A	X2-M16/M16A
			 New			
Dimensions HxWxD	89 mm x 442 mm x 220 mm	89 mm x 442 mm x 220 mm	89 mm x 442 mm x 220 mm	132 mm x 442 mm x 220 mm	222 mm x 442 mm x 220 mm	354 mm x 442 mm x 220 mm
Switching capability	160 Gbps	320 Gbps	960 Gbps	960 Gbps	960 Gbps	960Gbps
Forwarding performance	70 Mpps	150 Mpps	360 Mpps	180 Mpps	360 Mpps	360 Mpps
Main control board	Embedded in chassis	Embedded in chassis	Embedded in chassis	2 boards, in 1:1 redundancy mode	2 boards, in 1:1 redundancy mode	2 boards, in 1:1 redundancy mode
SFU	Embedded in chassis	Embedded in chassis	Embedded in chassis	1 independent SFU	2 independent SFUs 1:1 redundancy	2 independent SFUs 1:1 redundancy
Interface board	2	2	2	4	8	16
Number of power modules	2 boards, in 1+1 redundancy mode	2 boards, in 1+1 redundancy mode	2 boards, in 1+1 redundancy mode	2 boards, in 1+1 redundancy mode	2 boards, in 1+1 redundancy mode	2 boards, in 1+1 redundancy mode
Fan board	N+1 redundancy	N+1 redundancy	N+1 redundancy	N+1 redundancy	N+1 redundancy	N+1 redundancy
Outdoor application	-	- New	-	Supported	Supported (M8 only)	-
BNG	Not supported	Supported	Not supported	Supported	Supported	Supported

Why Huawei CX600-X1/X2-M&M2 Products

Why Huawei Not ALU

The ALU device has a smaller forwarding capacity and no SFU backup.

	7750-SR-A8	CX600-X
Height	7U	5U
SFU	1+1, no backup	1:1, with backup
Forwarding capacity	200G	240G

1. ALU 7750-SR-A8 has a smaller forwarding capacity than Huawei CX600-X.

SFUs in 1+1 mode

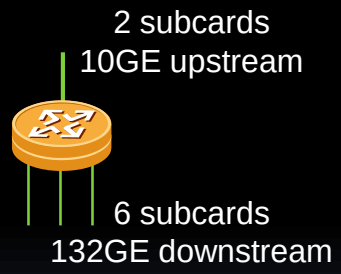
No backup

2. The aggregation node (ALU device) does not have SFU backup, and the reliability cannot be guaranteed.

The high-density GE interfaces on the ALU device cannot reach the line rate. Congestion may easily occur, causing packet loss.

Type	Subcard	Slot	Maximum Specification
			352

3. The A8 352GE cannot reach the line rate. Congestion may easily occur, causing packet loss.



4. The A8 176GE high-density GE interfaces can reach only 132GE (downstream).

The ALU device has poorer key specifications and lower VAS capabilities.

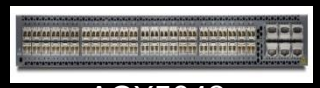
Manufacturer	**Huawei**	**ALU**
Device	CX600-X1/X2-M	7750-A4/A8
IPv4 FIB	4M	1M
HQoS	5-level	3-level
ACLv4 rules	128K	2K
NAT	Supported	Not supported
IPsec	Supported	Not supported

5. The ALU device has poorer key specifications (in IPv4 FIB entries and ACL rules) and lower VAS capabilities (in NAT and IPsec).

Why Huawei Not Juniper

Juniper ACX5000 series:

ACX5048 48x10GE+6x40GE (1U)
ACX5096 96x10GE+8x40GE (2U)



ACX5048

ACX5096

ACX5000 series have a large size and cannot share a cabinet with an access device. FMC usage scenarios are limited.

ACX5048: 44.09 cm x 4.37 cm x **52.02 cm**
ACX5096:44.09 cm x 8.8 cm x **57 cm**

Switch in a router's clothing
Low performance and specifications
Not future-oriented

	CX600-M2F	ACX5048	ACX5096
IPv4 scalability	1.5M	128K	128K
ACL	20K	512	512
IPv4 multicast	16K	1K	1K
LDP LSP	128K	16K	16K
L3 VPN instance	4K	1K	1K
L3VPN FIB	1M	128K	128K
VLL	16K	1K	1K
VPLS VSI	8k	1K	1K
H-QoS	5 level	NA	NA

The Chinese official website of Juniper reveals the true identity (a switch) of the ACX5000.

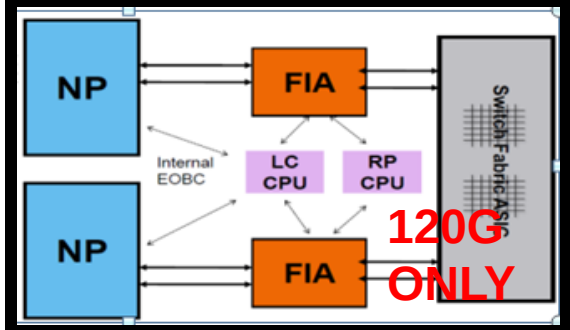
http://www.juniper.net/cn/zh/products-services/routing/acx-series/acx5000/

- The MX104 evolves from the MX80, but the forwarding capacity does not increase, remaining at 80G.
- The MX104 has backup on the control plane, but not on the forwarding plane.
- Electrical interfaces do not support Eth-syc or 1588v2. The usage scenarios of mobile bearer are limited.

Why Huawei Not Cisco

ASR9001

- Due to the 600-mm depth, the ASR9001 cannot be installed in the 300-mm cabinet. As a result, outdoor application is not supported.



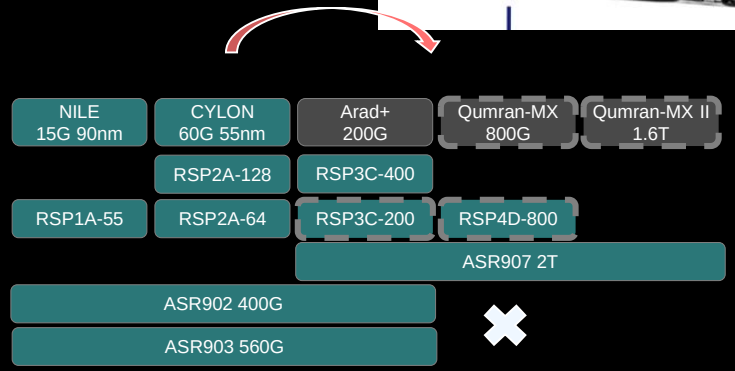
- Poor switching capability (only 120G)

- No low-speed subcards, low comprehensive aggregation capability

- IPsec not supported, poor security

ASR90X

- Switch chip, low specifications



- Cisco-developed chips are replaced by BCM chips. Smooth evolution is not supported.

- Low QoS capabilities, small buffer, no upstream HQoS, 3-level downstream HQoS

- 100G and 8x10G subcards are not compatible with GE and COMBO subcards.
- If a 100G subcard is installed in slot 7, an 8x10G subcard cannot be installed in slot 11.
- If a 100G subcard is installed in slot 8, an 8x10G subcard cannot be installed in slot 12.
- If an 8x10G subcard is installed in slot 3, a COMBO subcard cannot be installed in slot 5, 9, 13, or 15.
- If an 8x10G subcard is installed in slot 4, a COMBO subcard cannot be installed in slot 2, 6, 10, or 14.
- If a 4x155 POS subcard is installed in slot 3, a COMBO subcard cannot be installed in slot 9 or 15.
- If a 4x155 POS subcard is installed in slot 4, a COMBO subcard cannot be installed in slot 2 or 14.
- If a 2x10G or 8x10G subcard is installed in slot 11, no subcard can be installed in slot 1, 5, 9, 13, or 15.
- If a 2x10G or 8x10G subcard is installed in slot 12, no subcard can be installed in slot 0, 2, 6, 10, or 14.

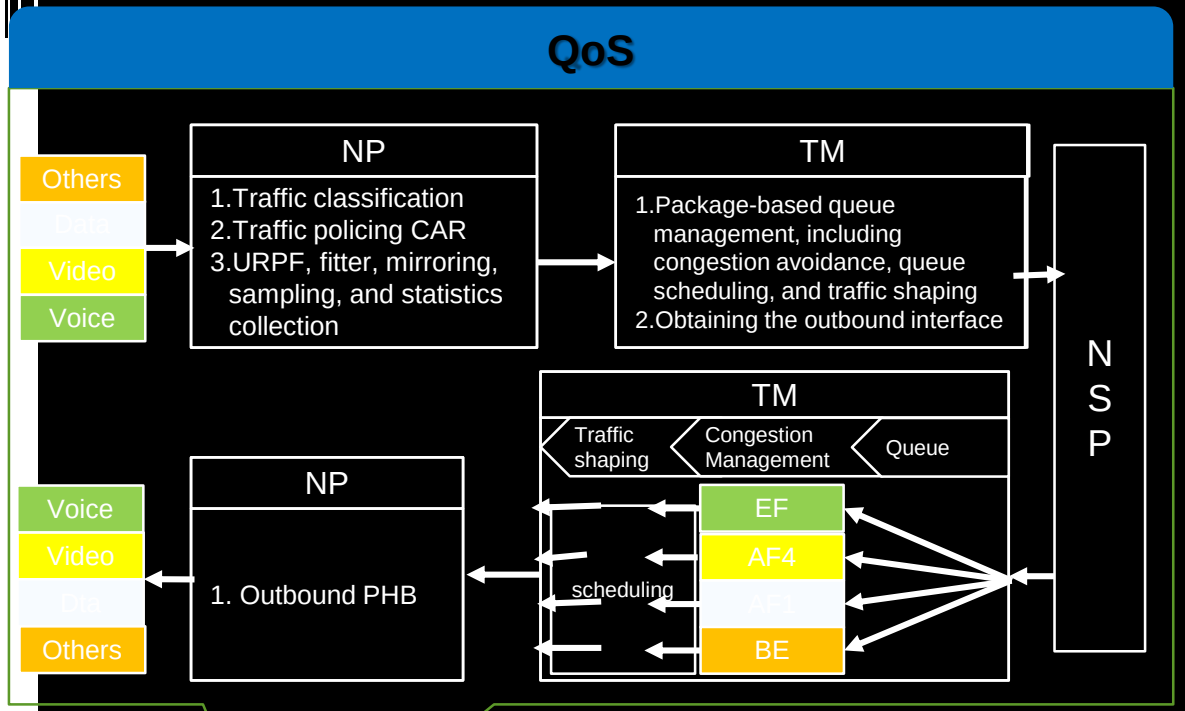
- Slot exclusiveness is a problem, complicating configuration and maintenance.

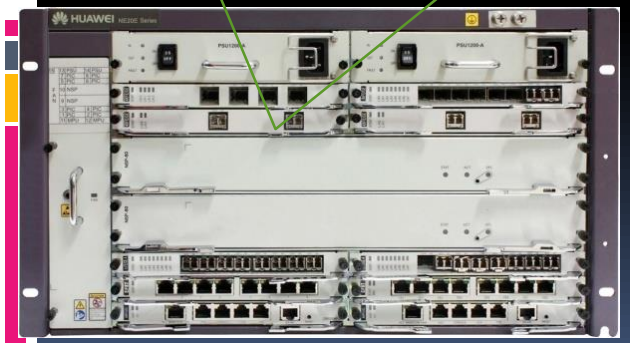
CX600-X1/X2-M&M2 Product Highlights

QoS

QoS Scenarios

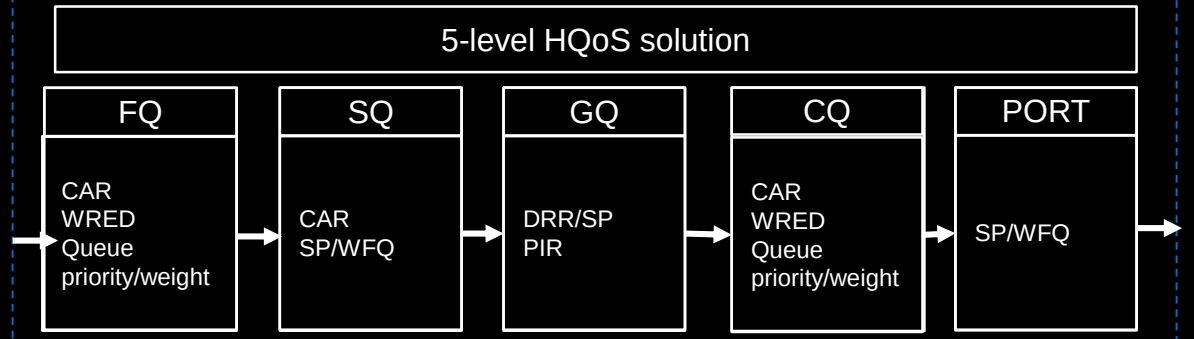
QoS





1. Precision deviation 1%, industry-leading
2. QoS functions:
   - IPv4/IPv6 BA classification
   - IPv4/IPv6 MF classification HQoS
   - BAS HQoS
   - Multicast HQoS
   - CAR
   - QPPB
   - MPLS TE QoS

HQoS

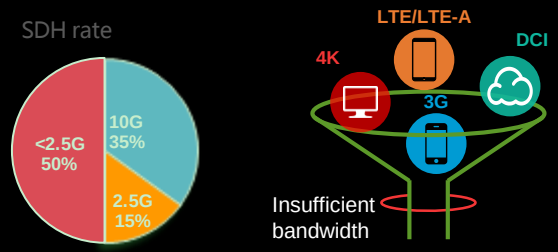


	HUAWEI	CISCO	Juniper NETWORKS
Precision	1%	2%	1%
PQ	8 (maximum value)	3 (maximum value)	8 (maximum value)
VPN QOS	✓	✗	✓

IP Hard Pipes

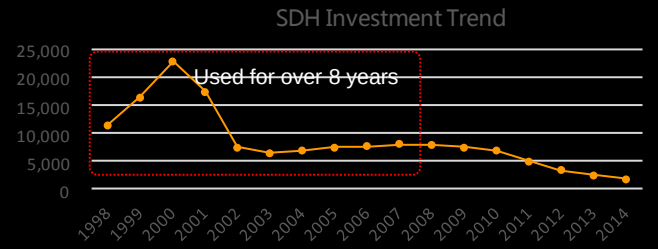
IP Hard Pipe Usage Scenarios

Low bandwidth, difficult development of new services



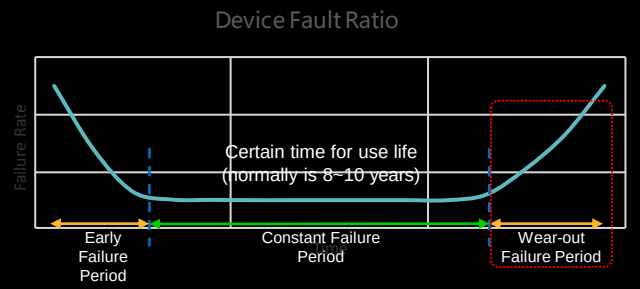
- SDH devices have poor packet capabilities, and the rate is less than 10 Gbit/s, which cannot meet the development requirements of packet services that require higher bandwidth.

EOS, difficult maintenance



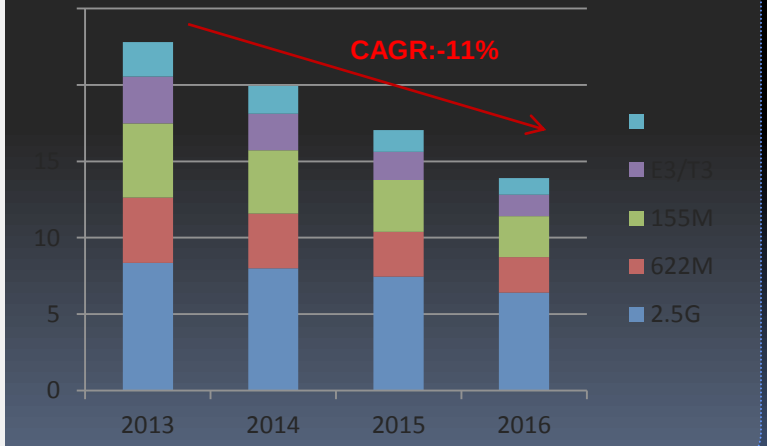
- The SDH network was constructed before 2008, and most devices have entered the EOS phase, without spare parts, which complicates capacity expansion and maintenance.

Old devices, high network risks

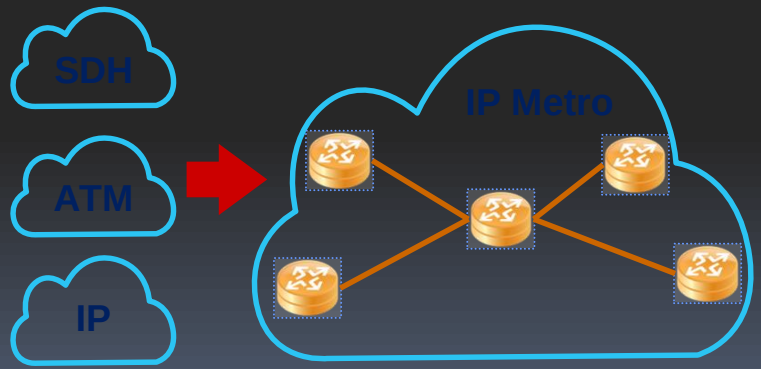


- Telecom devices have a life cycle of 8 to 10 years. If they have been used for more than 10 years, stability cannot be ensured, and high network risks exist.

SDH Private Line Market Capacity (100 million $)

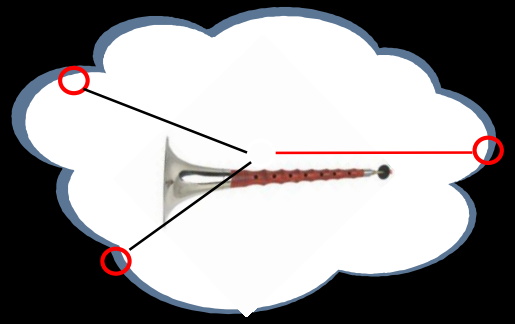


- As a large number of old SDH devices must be upgraded or replaced, IP hard pipe can help SDH transit to IP while maintaining the service performance.
- Customers only need to deploy new services on IP networks, without extra investment on ATM and SDH networks, saving investments.
- With SDH, ATM, and IP convergence, customers only need to maintain IP networks, simplifying O&M and saving costs.



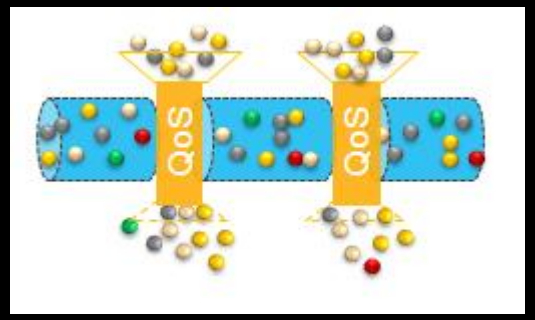
IP Hard Pipes Versus QoS

IP QoS



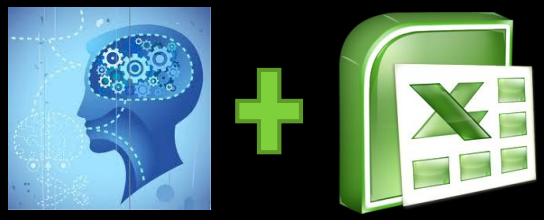
Network overbooking+QoS only on the border

Congestion on the aggregation P node



Scheduling resource sharing

High-value services are affected by common services.



Human brain +Excel document

Complicated deployment and O&M, error-prone

VS

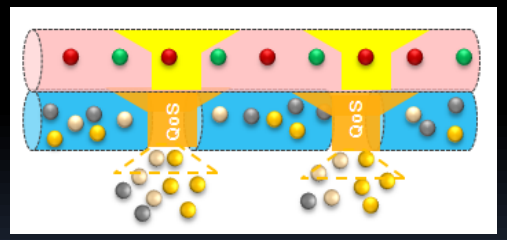
VS

VS

IP hard Pipe

E2E bandwidth plan

No overbooking or congestion



Isolation based on the bandwidth or priority

Meeting SLA requirements of high-value services

U2000 E2E one-click service provisioning

Keeping the original SDH O&M habits

IP Hard Pipe Versus RSVP-TE

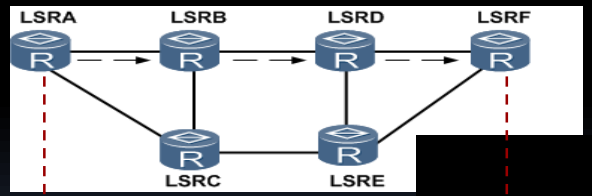
RSVP-TE

Software-based isolation

Scheduling is implemented based on the priority, and traffic within or outside the tunnel share one queue. When congestion occurs on an interface, preemption and packet loss occur.

TE bandwidth for rate control, not reserved

In the case of traffic burst, preemption occurs between traffic within and outside the tunnel.



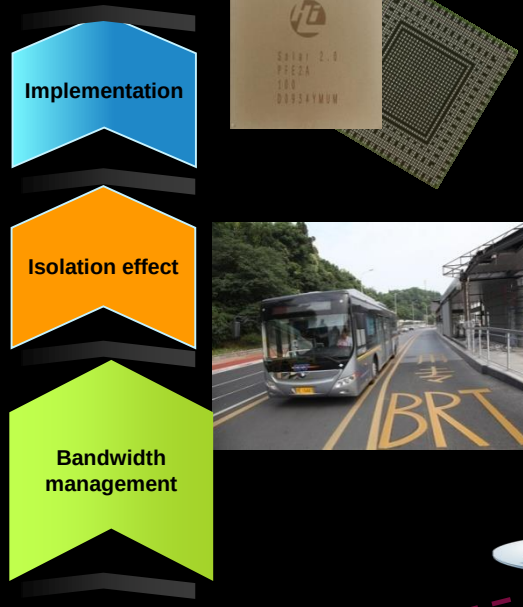
Knows only local bandwidth allocation.

Knows only local bandwidth allocation.

The NMS does not know the bandwidth of each device.

Dynamic bandwidth reservation

IP hard pipe

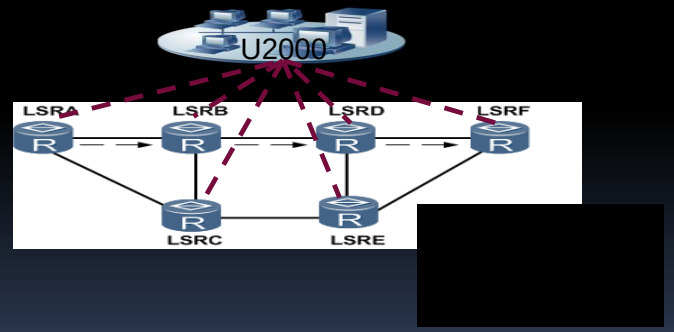


Hardware-based isolation

Bandwidth is reserved though the rear TM subcard hardware.

Bandwidth reserved

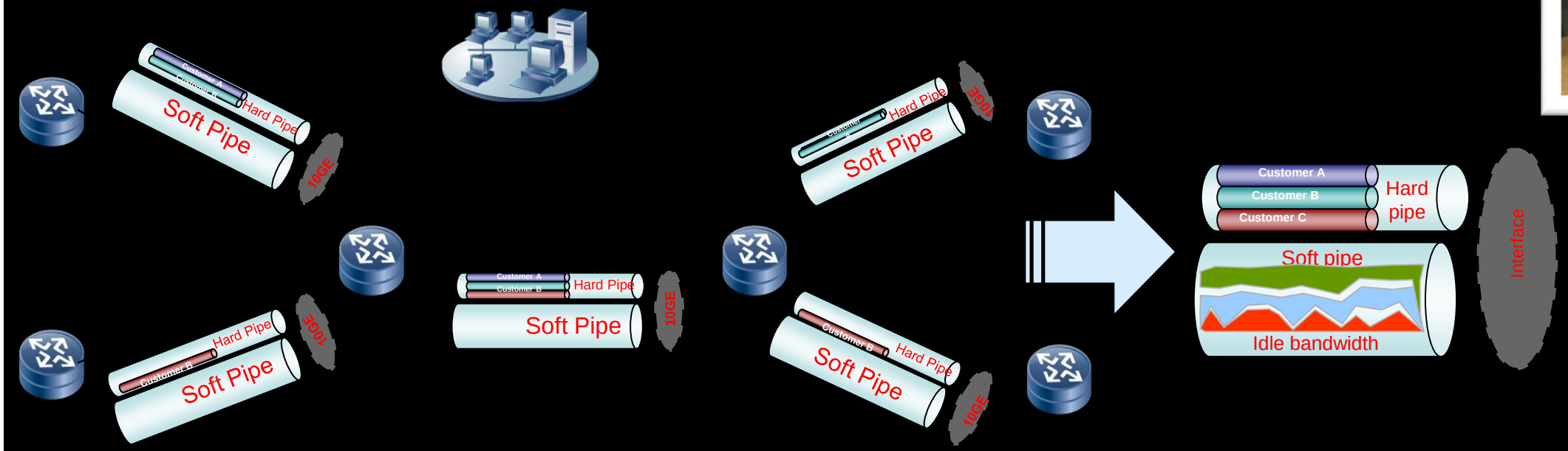
Soft pipes do not preempt hard pipes for bandwidth in the case of traffic burst.



Controllable bandwidth management

The U2000 manages bandwidth resources of the entire network.

IP hard Pipe Solution Overview



Pipe Isolation

- Soft and hard pipe bandwidth is strictly isolated by hardware and cannot be preempted.
- Soft and hard pipe priorities are also strictly isolated, and soft and hard pipe traffic cannot be scheduled together. Packet priorities are not differentiated on hard pipes.

NMS-based configuration

- The NMS is used to configure primary and secondary PWs and selects a hard pipe path for each private line of enterprises.
- The NMS uniformly manages bandwidth, ensuring that bandwidth is efficiently and accurately allocated.

Automatic Monitoring

- IP FPM or uTraffic implements service-specific real-time SLA monitoring.
- The MPLS TP solution provides tunnel OAM detection.

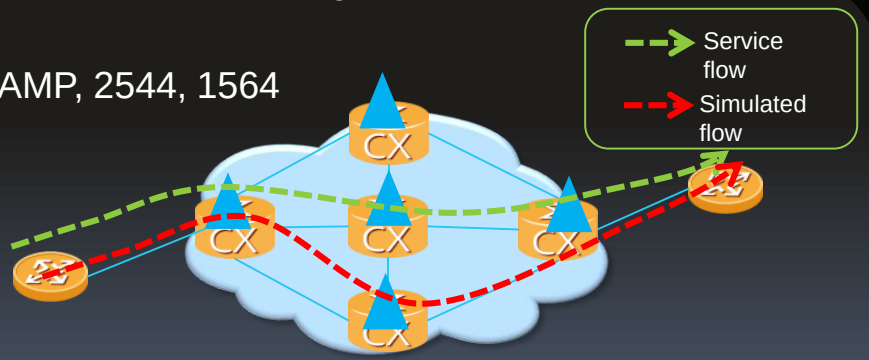
IP FPM

IP FPM: E2E SLA-compliant Measurement Through Service Packets

- Direct measurement: Measurement packets are added to service packets.
- Y.1731, MPLS-TP

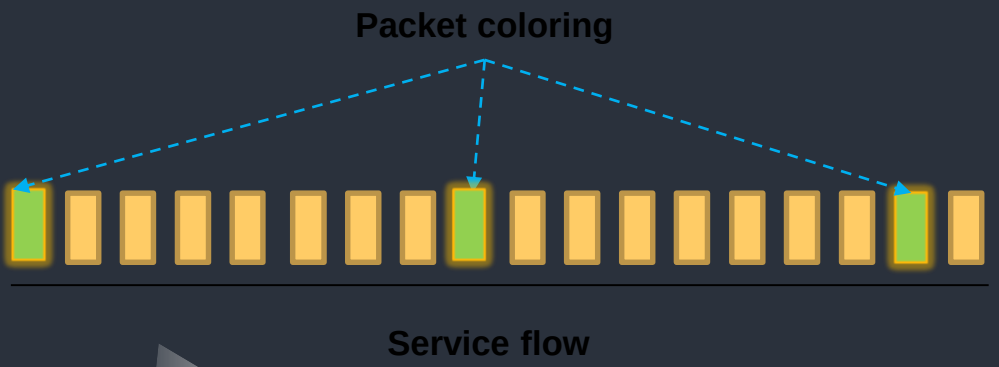
- Pipe-based detection: Service types cannot be identified.
- Low precision: Requirements of high-quality services cannot be met.

- Indirect measurement through a simulated flow
- TWAMP, 2544, 1564



- The simulated flow and service flow are independent.
- The paths of the two flows are different.

- IP FPM: innovative, service packet measurement



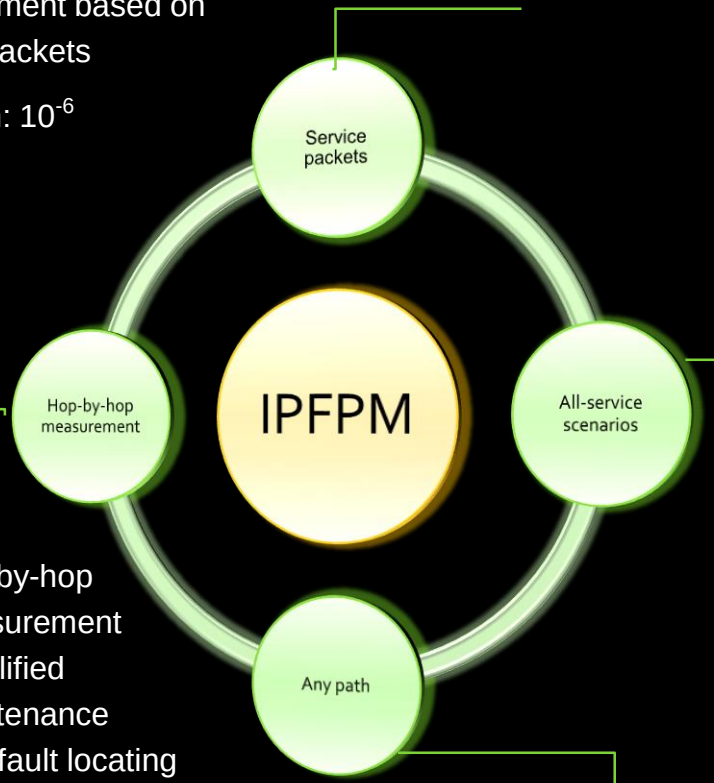
•High precision: 10^{-6}

•Any path: P2MP, MP2MP Trunk, ECMP

•E2E, hop-by-hop fault locating

IP FPM Competitiveness: Huawei's Innovative Technology, Industry-leading

- asurement based on service packets
- Precision: 10^{-6}



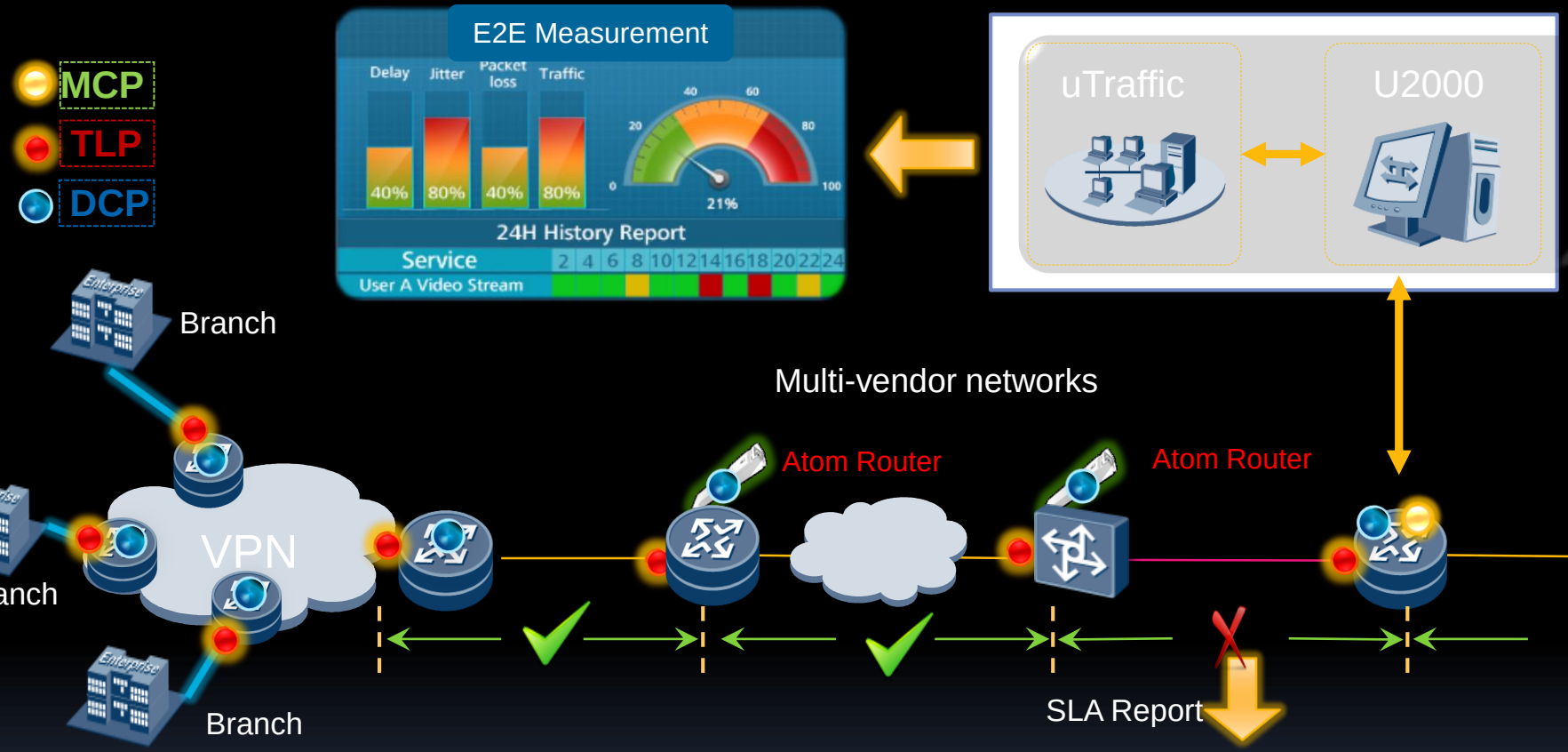
- Hop-by-hop measurement
- Simplified maintenance
- Fast fault locating

- L2/L3/MPLS
- L2VPN/L3VPN

- Trunk/ECMP
- P2P/P2MP/MP2MP

Feature	Service Packet	All-Service	Any Path
Y.1731	✓	✗	✗
TWAMP	✗	✗	✗
2544	✗	✓	✗
IP FPM	✓	✓	✓

IP FPM E2E Hop-by-Hop Measurement and Real-Time Monitoring



- E2E hop-by-hop measurement
- Multi-vendor networks are supported.
- 5-second collection and real-time monitoring

Measurement Control Point (MCP)

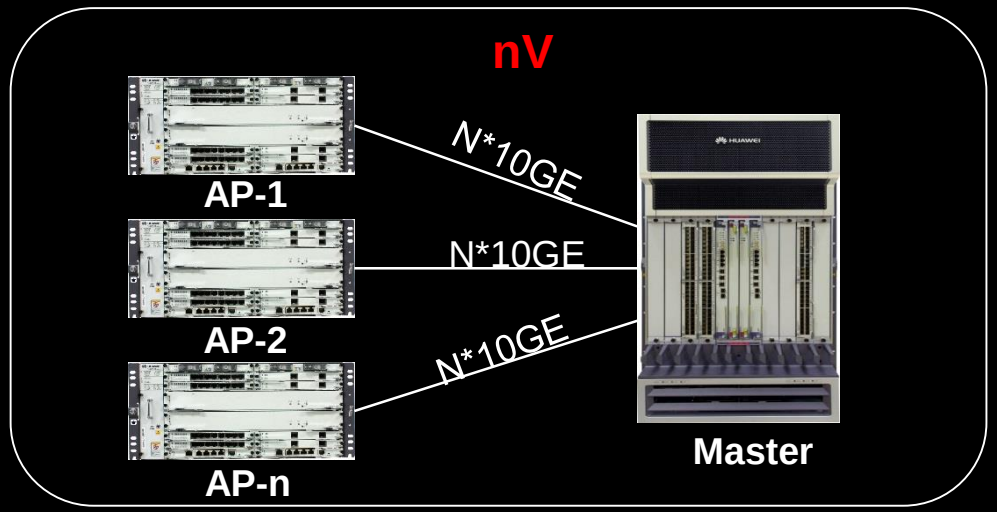
Target Logical Port (TLP)

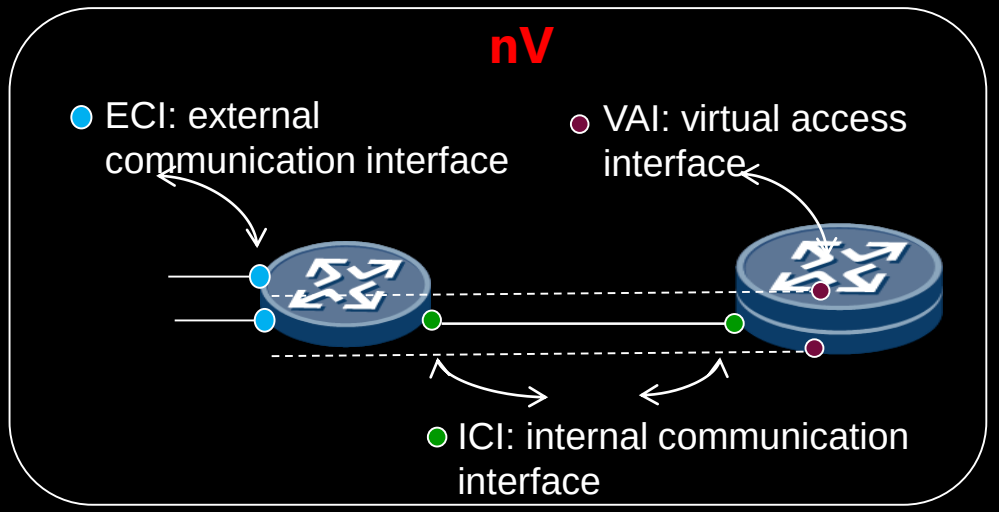
Data Collecting Point (DCP)

Instance	Delay (ms)	Jitter (ms)	Packet Loss Rate (%)	Traffic (Mbit/s)	Traffic Utilization (%)
P to PE	550	87	0.55	221	65%

Virtual Access

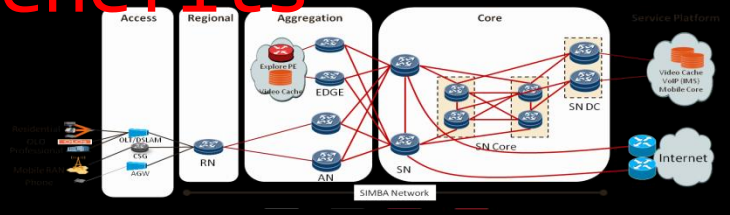
Virtual Access (nV) Definition



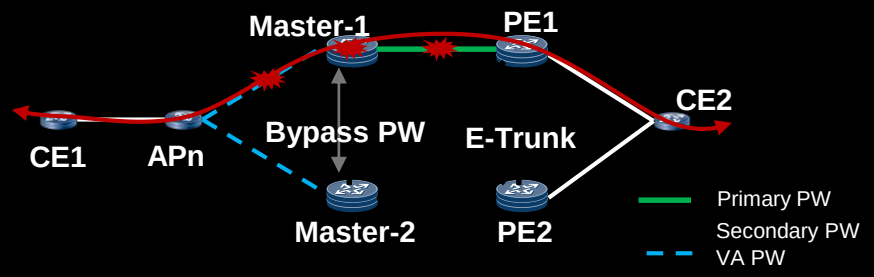


- nV: simplifies a network comprising one or more master and several APs into one or more logical devices from the users' perspective so that service provisioning and O&M are implemented only on the specific logical devices, simplifying network management.
- Physically, an nV system comprises a master and a maximum of 256 APs. The master and APs are deployed at different locations, without any limitations on the distance in between.
- Logically, an nV system is considered a logical device, and APs are automatically virtualized as boards on the master.

Virtual Access Benefits

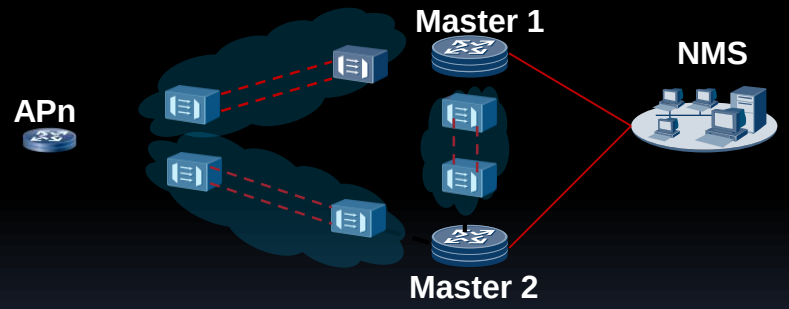


All-service scenario



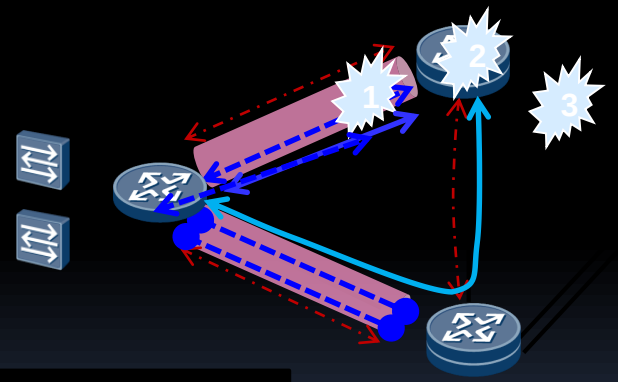
- MAN scenarios
  - ✓ BRAS
  - ✓ SR
- Enterprise scenarios
  - ✓ VLL enterprise private line
  - ✓ VPLS Layer 2 enterprise private network
  - ✓ L3VPN enterprise private network
- IP RAN scenarios

Traversing a third-party network



- Deployed between the AP and each master and between the two masters
- Traversing a network of third-party transmission devices

High reliability of the nV system



✓ The link between the AP and master 1 fails.
✓ Master 1 fails.
✓ Master 1's network-side link fails.

CX600-X1/X2-M&M2 Success Stories

Triple-T MAN in Thailand

Background and Challenges

- Triple-T is one of fixed network carriers that grow the fastest in Thailand.
- Layer 2 loops exist in the case of switch aggregation, and network storms may occur.
- Devices of different vendors use different L2 loop detection mechanisms (RRPP, STP, and ERP), complicating maintenance.

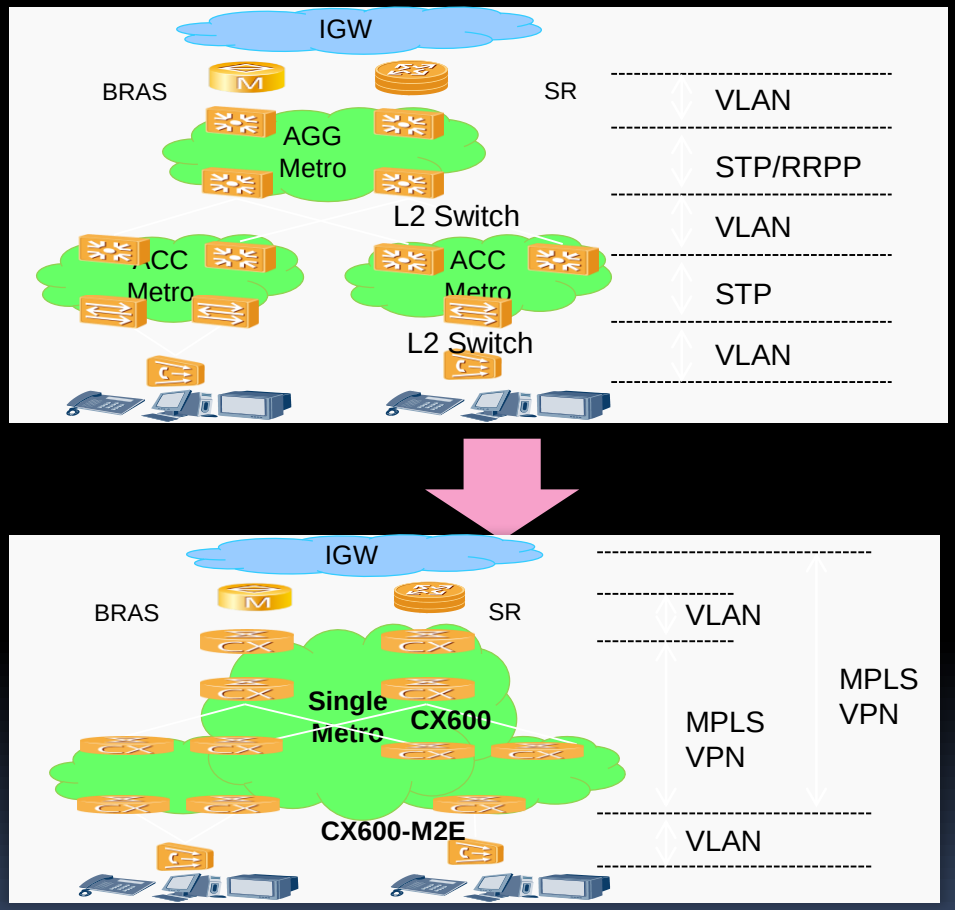
Huawei Solution

- VLL/H-VPLS services are deployed on the MAN, preventing Layer 2 network storms.
- X1/X2-M series products support large-capacity L2 Ethernet functions.
- X1/X2-M series products support powerful OAM and PM. IP FPM can measure service indicators, such as the delay, jitter, and packet loss ratio.

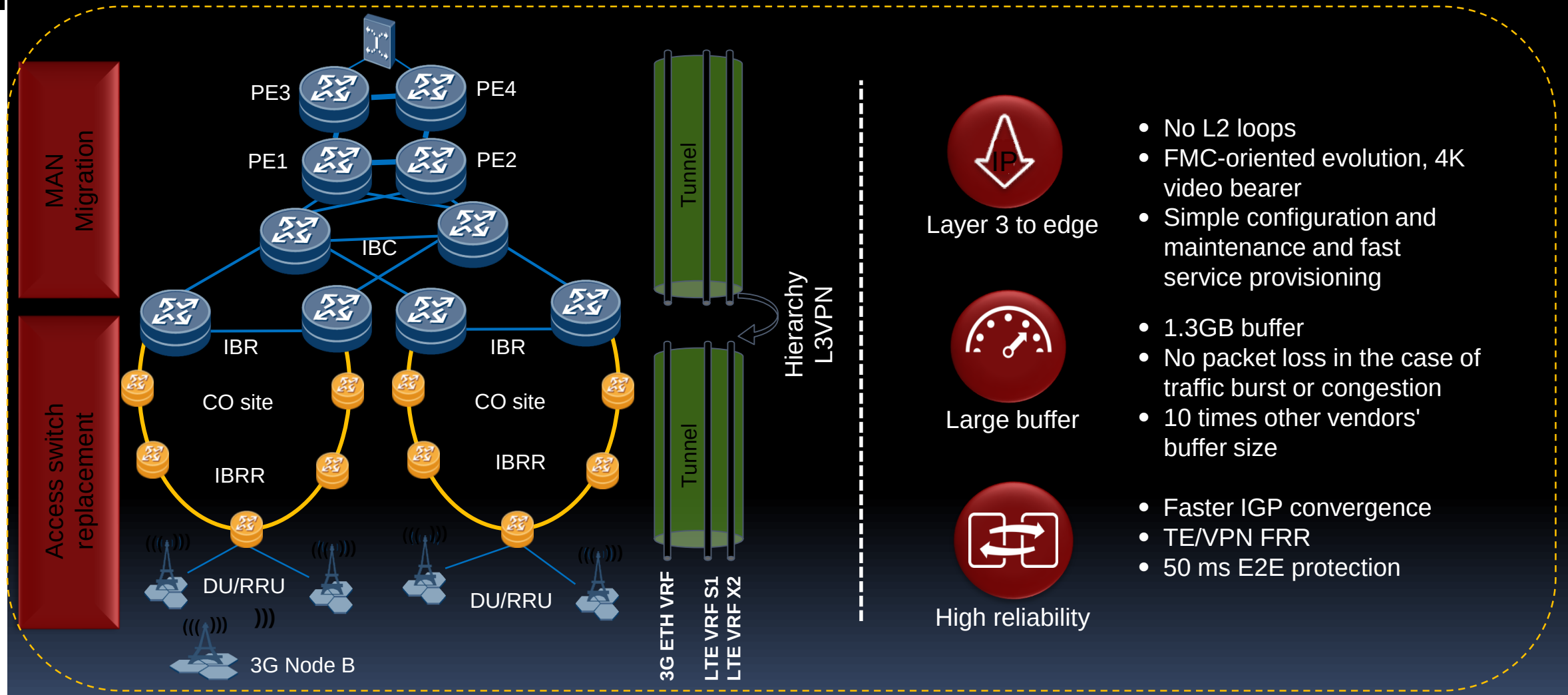
Improved User Satisfaction

- Standard MPLS L2VPN (VLL and VPLS) MAN solution
- Powerful OAM/IP FPM provides performance measurement with 10^{-6} precision, which meets requirements of enterprise private line services.

Network Deployment



SKT Layer 3 to Edge All-Router Network



Layer 3 to edge

- No L2 loops
- FMC-oriented evolution, 4K video bearer
- Simple configuration and maintenance and fast service provisioning

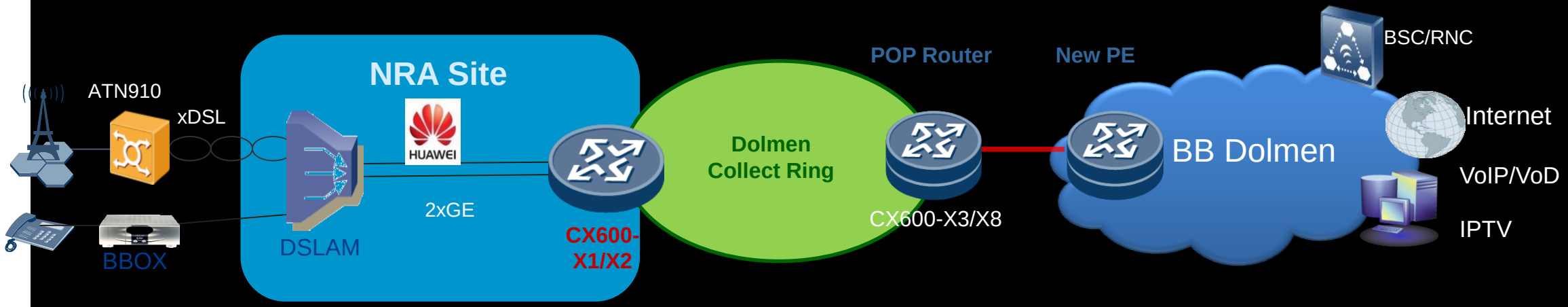
Large buffer

- 1.3GB buffer
- No packet loss in the case of traffic burst or congestion
- 10 times other vendors' buffer size

High reliability

- Faster IGP convergence
- TE/VPN FRR
- 50 ms E2E protection

France Bouygues FMC Solution



Background and Challenges

- France Bouygues is one of the three major telecom carriers in France. It provides mobile phone, Internet, and IPTV services and has more than 5 million users.
- The mobile data volume reaches the third peak. The bandwidth of HSPA services triples within 2 years.

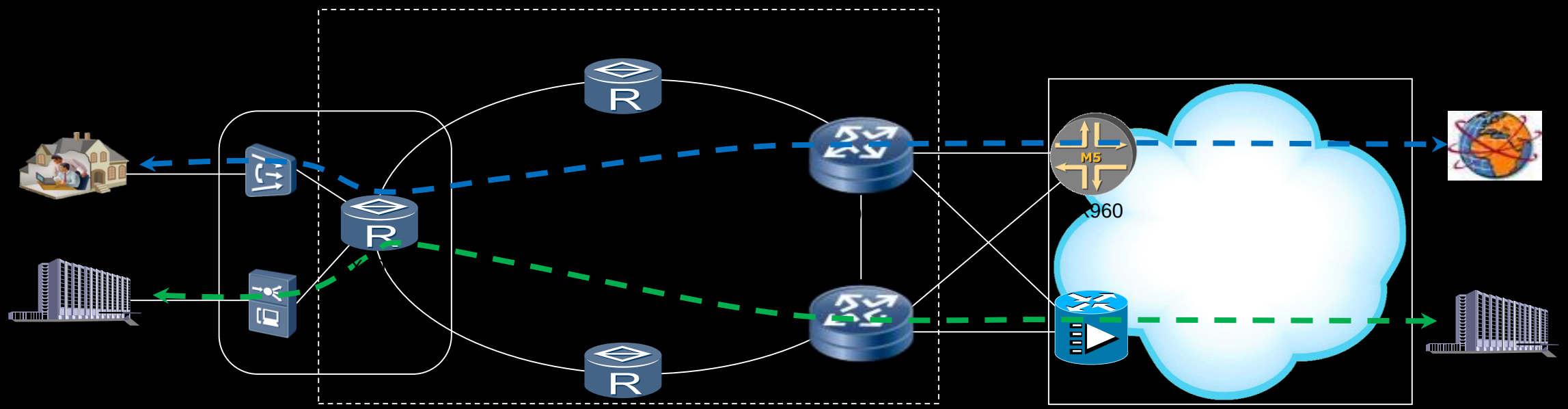
Huawei Solution

- Integrated NRA website management (through DSLAM+NRA routers)
- Carrier-class protection (control board/power supply/fan redundancy)
- Capacity (NRA website 8x10GE, future-oriented traffic growth -> 40G ring)
- Convergence (mobile and fixed network services)
- Evolution to IPv6 (IPv4/IPv6 dual-stack and 6PE)

Benefits

- The FMC solution has been deployed.
- Promote bandwidth evolution of mobile, 2G, 3G, 4G, and IP Ethernet services. Use xDSL and mobile service resources to reduce the CAPEX.
- Improve the triple play service QoE to meet FMC evolution requirements.

Italy's Fastweb: E2E Smart CO Solution



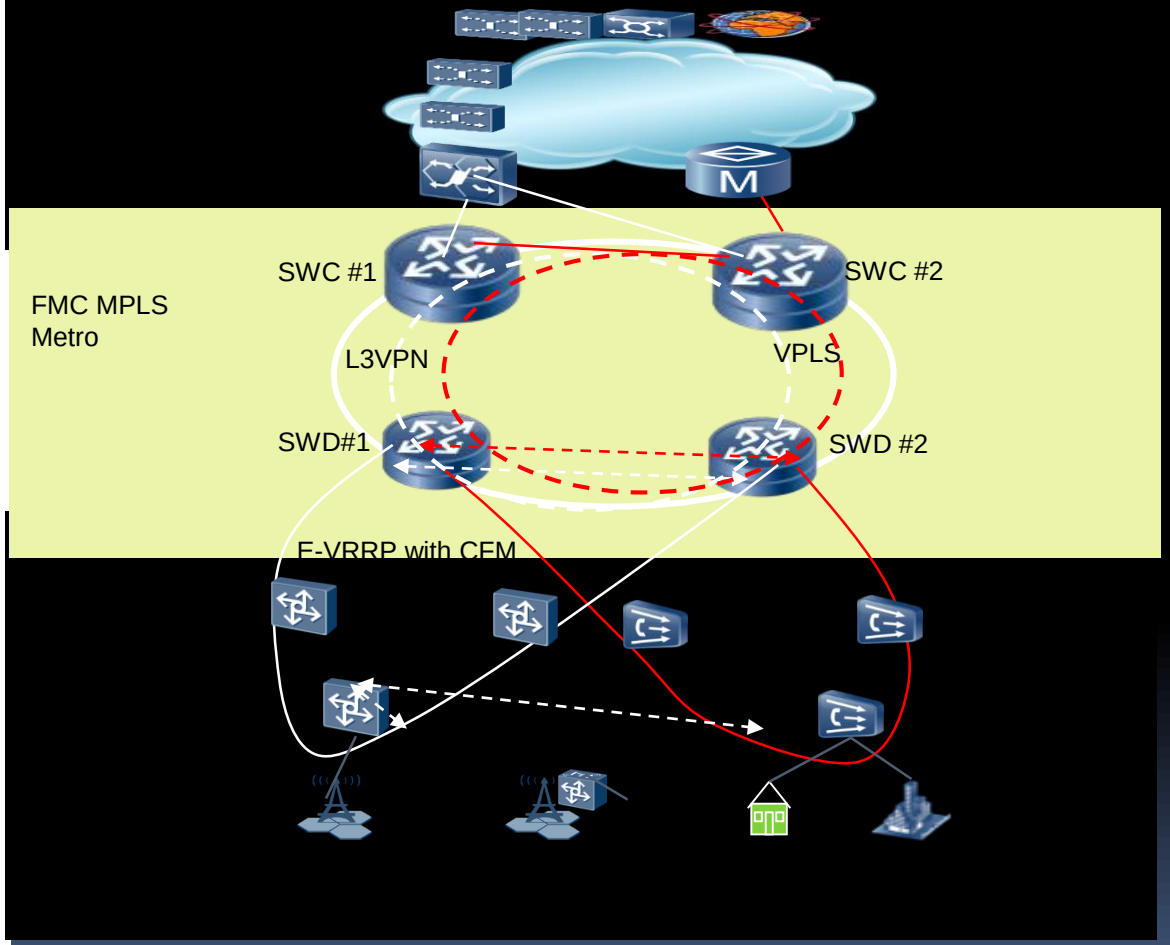
Background and Challenges

- Fastweb is Italy's second largest fixed network carrier based in Milan. Fastweb currently has 2.1 million broadband users, and enterprise leased line services are the most profitable services of Fastweb.
- In the face of fierce competition in the fixed network market, Fastweb is encountering customer churn, even though it is a top fixed network carrier. To provide higher broadband access, Fastweb requires a brand new FTTx access network as a substitute for the existing access network.
- However, due to limited optical fiber resources and high optical fiber construction costs, Fastweb's ultra-broadband plan is hard to implement.

Huawei Solution

- Deploy the CX600-M2F, which is 2 U high and can be deployed in a 300 mm deep cabinet. It provides 160G full-service forwarding capability and supports a large number of TDM services of enterprises.
- Large-capacity aggregation, with less COs required; wide deployment of smart COs for multi-service aggregation, with less optical fibers required
- Deploy 10GE BIDI interfaces to increase the capacity and also reduce optical fiber consumption.
- Deploy E2E MPLS and tunnel protection switching within 200 ms to ensure reliable service running.

Germany's TO2 SDN Network Optimization for Comprehensive Service Access



Background and Challenges

1.

2.

3.

Huawei Solution

1.

2.

3.

4. Evolution of Layer 3 to the edge for metro/mobile backhaul networks

Benefits

1. Full-service access for E2E FMC from the core to metro on IP/MPLS networks, with TCO reduced by 40%
2. Flexible customized solutions, such as HQoS and VRRP-based CFM, with O&M simplified and efficiency improved by 30%