IPv6 Transition Technologies, Options & Use Cases

Singapore iDA IPv6 Conference

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HUAWEI

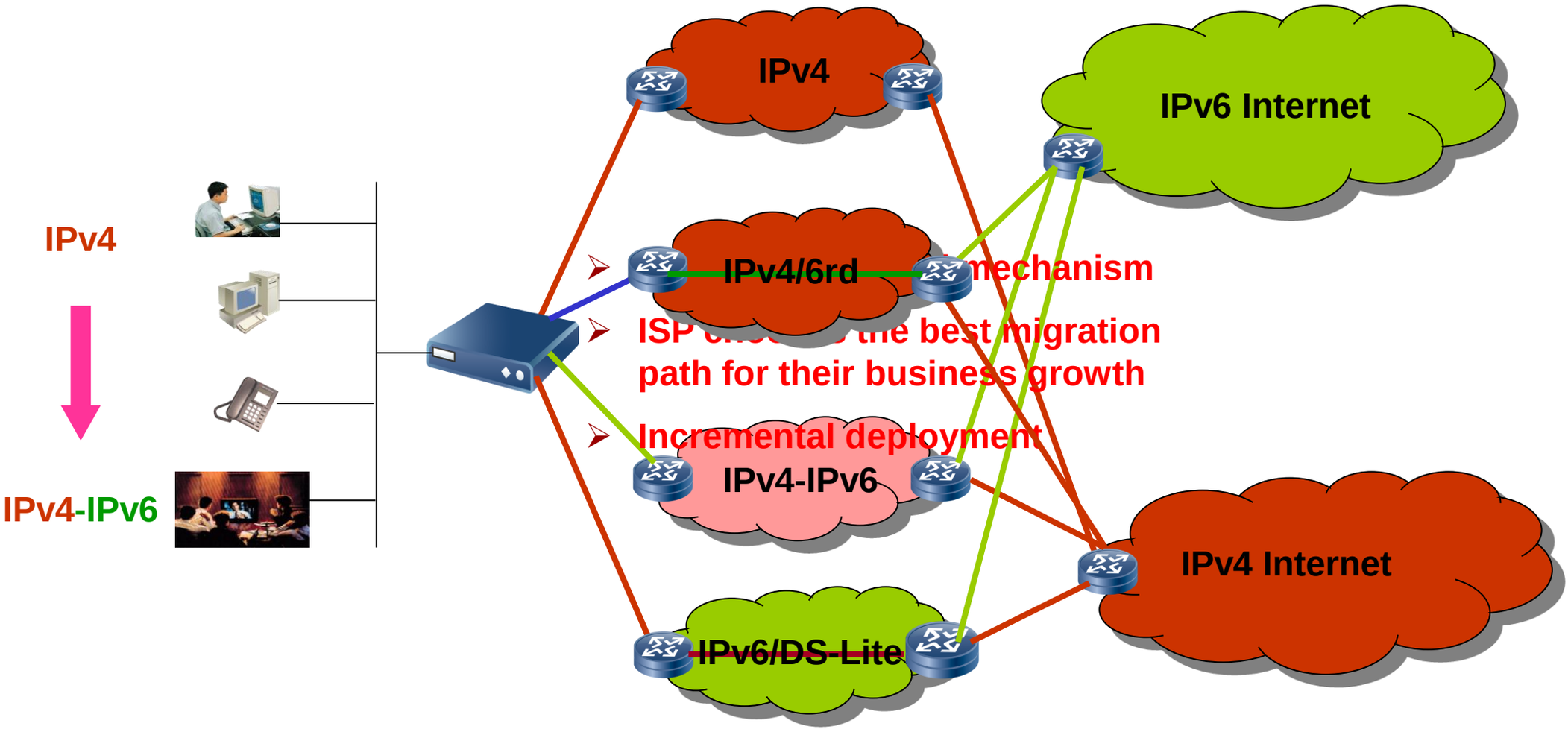
Agenda

- IPv6 transition options and their characteristics
- Technology updates
- IPv6 transition case study
- Conclusion

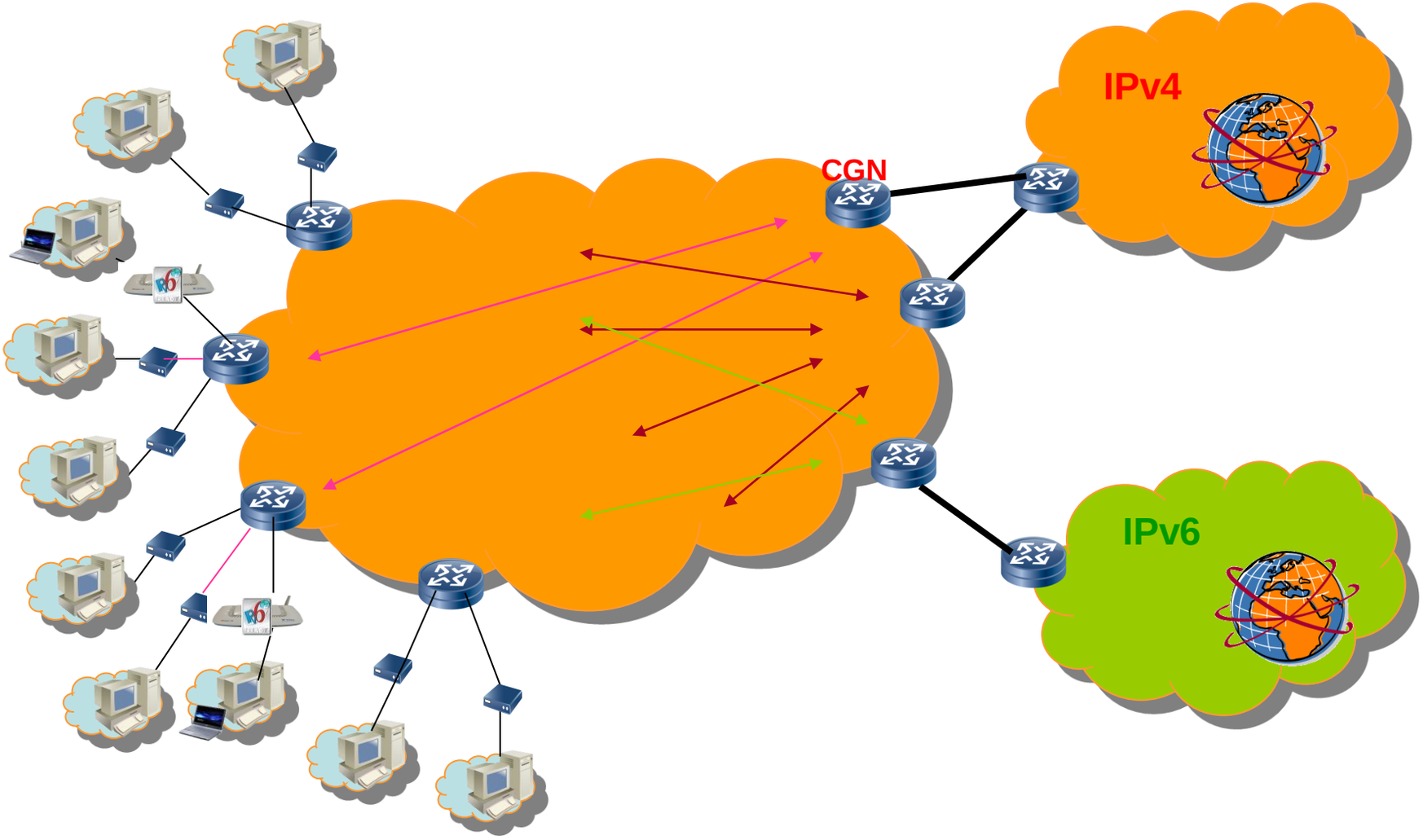
A Quick Glance at Some Transitional Technologies

Technology	What are they and what they can/cannot offer?	
NAT444	draft-ietf-behave-lsn-requirements-08 draft-shirasaki-nat444-isp-shared-addr-08 draft-shirasaki-nat444-06	
	●Relieve IPv4 address pressure ●No change in home network and CPE ●Not provide IPv6 connectivity	●Limitation of IPv4 private space ●Applications impacts – double NAT44
Level-2 NAT44	draft-miles-behave-l2nat-00	
	●Relieve IPv4 address pressure ●No change in home network and CPE ●Not provide IPv6 connectivity	●Limitation of IPv4 private space ●No additional applications impacts – Single level NAT44 ●Leverage large installation base of bridge-mode RG
6rd	RFC5569 RFC5969	
	●Dual-stack at home ●CPE requires upgrade	●No saving on IPv4 address space
DS-Lite	RFC6333 RFC6334	
	●Dual-stack at home ●CPE requires upgrade	●Access network IPv6 only. ●Single level NAT44 for IPv4 address saving
NAT64	RFC 6146 (NAT64) RFC6147 (DNS64) RFC 6384 (FTP64)	
	●IPv6 host accesses IPv4 server ●CPE requires upgrade (IPv6 only)	●Home/Access IPv6 only ●Connection initiated from IPv6 only
Dual-stack	RFC4213 In the core, aggregation and access network, IPv4 and IPv6 run in SIN mode.	
	●Support both traffic in native mode ●No upgrade on equipment	●No saving on IPv4 address space ●Some overhead on operation & management
6PE/6vPE	6PE - RFC4798 6vPE - RFC4659 Core is IPv4-MPLS with IPv6 traffic tunneled through	
	●Support both traffic through core ●No upgrade on equipment	●Keep IPv4-MPLS core as is ●No saving on IPv4 address space

Dual-Stack @ Home with Transitions in Broadband Networks



Dual-Stack + Carrier Grade NAT44: A Scalable and Cost-Effective Solution



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New Work at IETF (1)

- New work at IETF Softwire Working Group
  - Stateless 4/6 solution
  - Motivation - draft-ietf-softwire-stateless-4v6-motivation/
  - IPv4 service continuity is one most pressing problem.
- What is stateless mechanism?
  - In the IPv4 address sharing context, restrict the source IPv4 port numbers on CPE.
  - Eliminate CGN in ISP networks with multiple advantages (no per session/user log, no single point failure, etc.)
- Currently there are many solutions
  - RFC6346 (A+P)
  - draft-ietf-softwire-4rd/
  - draft-ietf-softwire-map/

New Work at IETF (2)

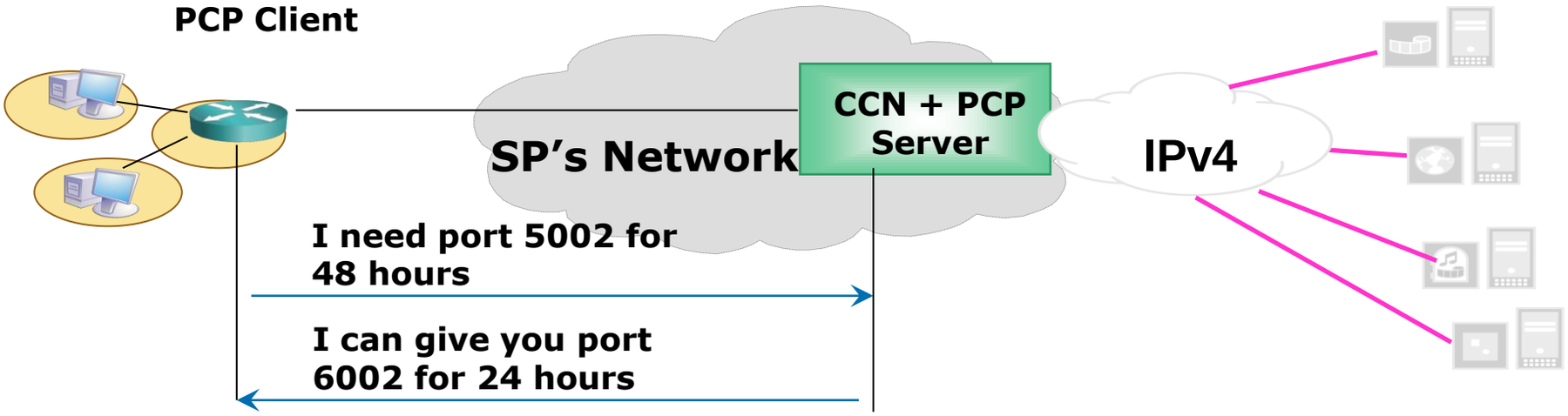
- New IETF Working Group – sunset4
- The following text is from IETF sunset4 WG WEB site:

The IETF is committed to the deployment of IPv6 to ensure the evolution of the Internet. However, the IPv4-only components of the Internet must continue to operate as much as possible during the transition from IPv4 to IPv6.

The Working Group will standardize technologies that facilitate the graceful sunsetting of the IPv4 Internet in the context of the exhaustion of IPv4 address space while IPv6 is deployed. These technologies will likely be less optimal than equivalent technologies for IPv6-only and dual-stack networks. The Working Group works only on IPv4 protocols to facilitate IPv4 sunsetting.

New Work at IETF (3)

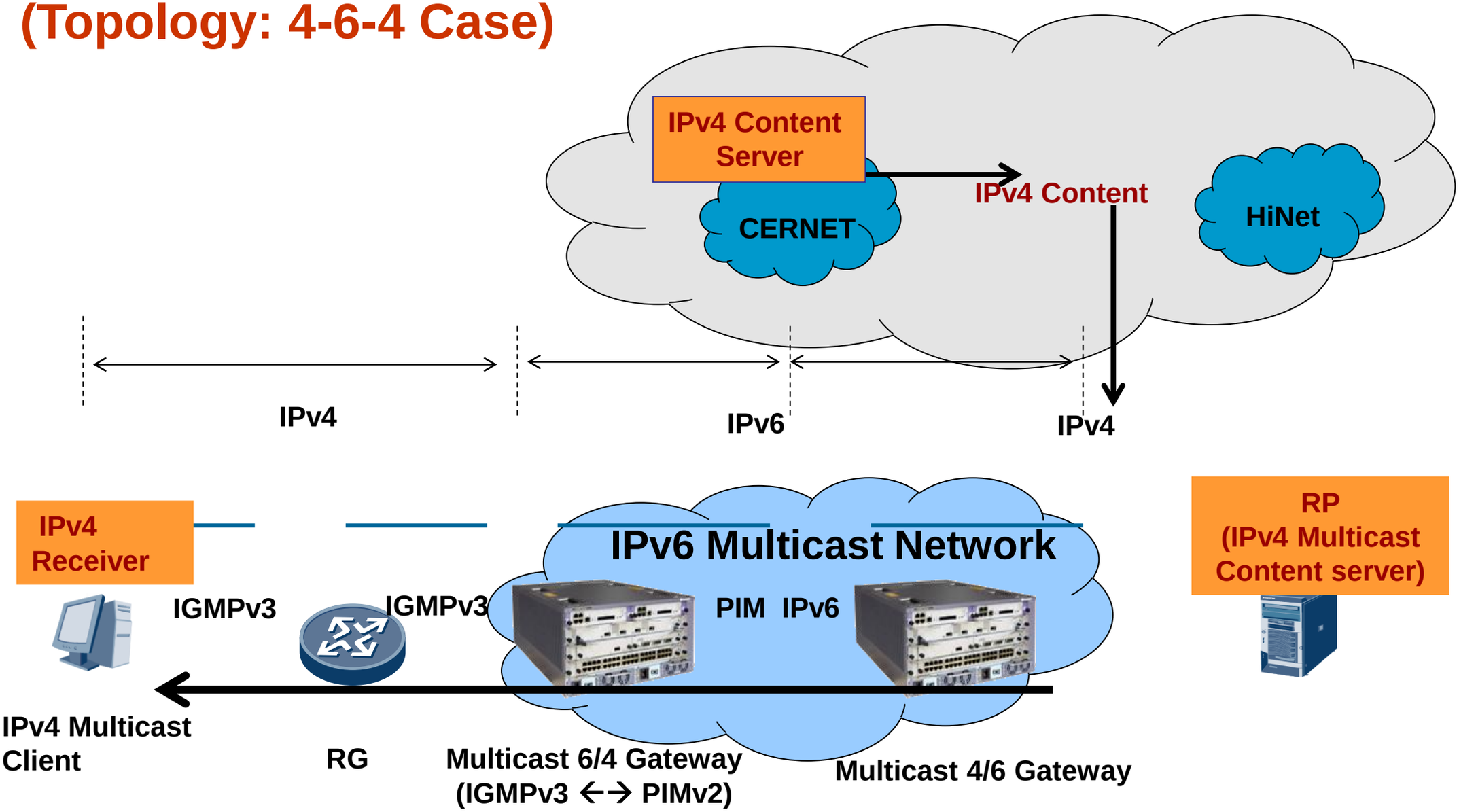
- PCP (Port Control Protocol) Working Group
- draft-ietf-pcp-base-26



- A client-server protocol with the server usually sits on a CGN device, and the client sits on a host or RG.
- A PCP client initiates a communication with a PCP server for the purpose of pre-allocate a TCP/UDP port on a NAT device, so that communication can be initiated for some applications from the network side.
- PCP can be used for NAT44, NAT64, etc.

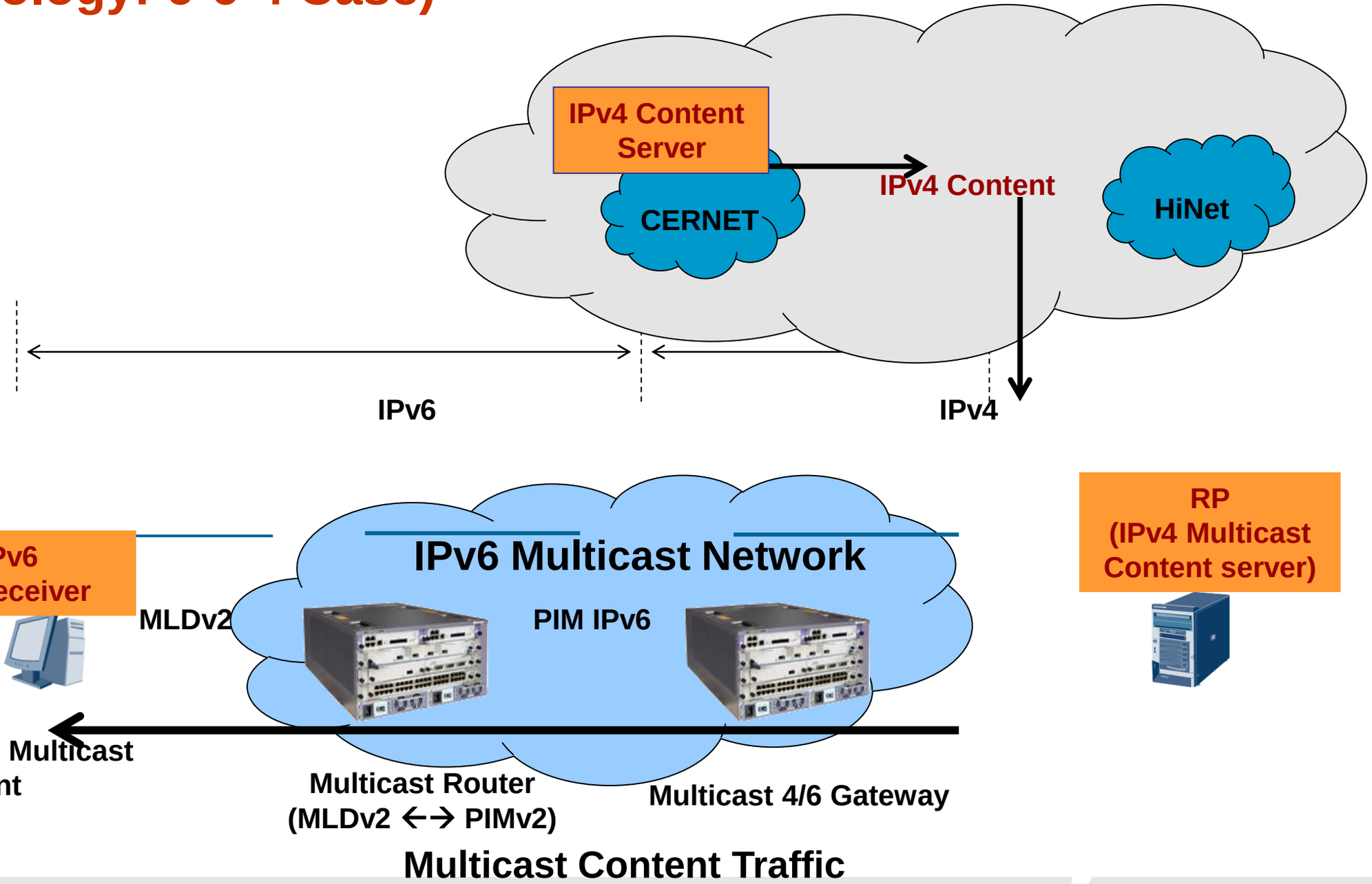
Multicast for IPv6 Transition Demo (IETF 82)

(Topology: 4-6-4 Case)

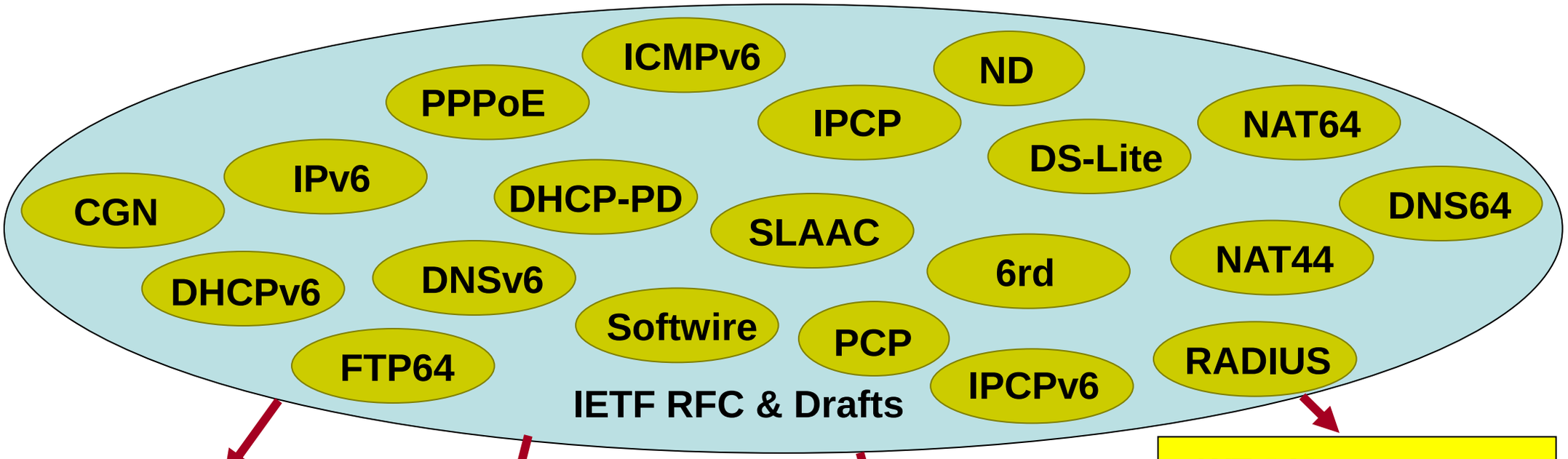


Multicast for IPv6 Transition Demo (IETF 82)

(Topology: 6-6-4 Case)



Technical Reports @ BBF and RFC/drafts @ IETF



TR-124i3
RG Requirements

IPv6 Transition

TR-187
IPv6 over PPP

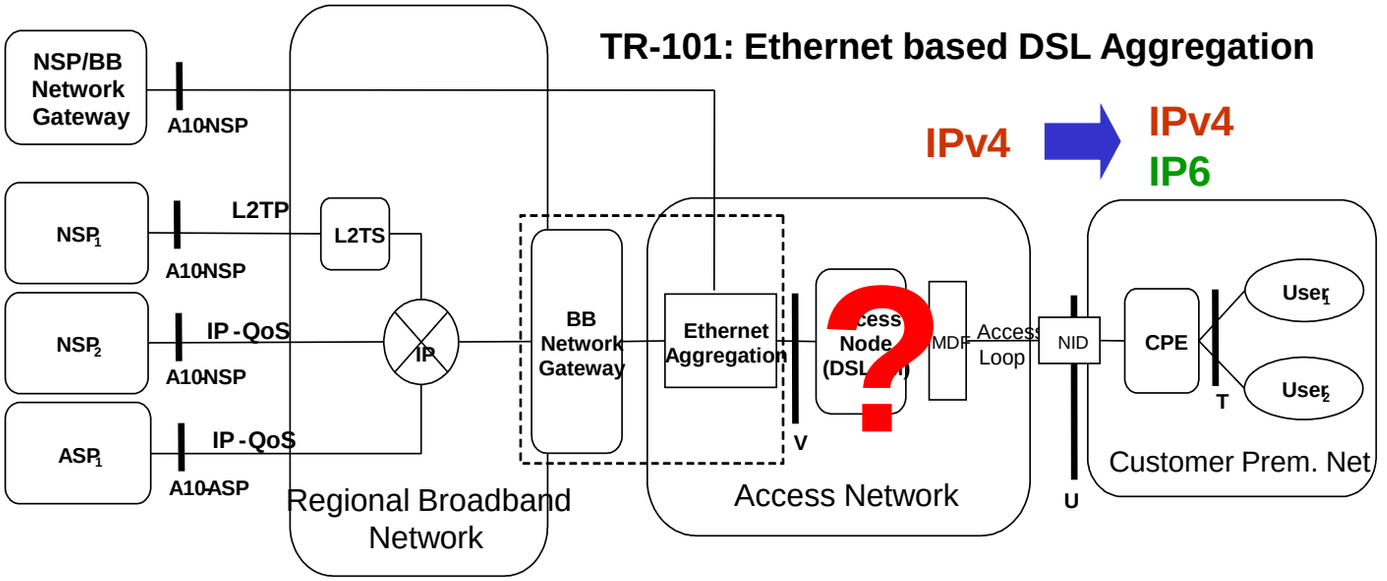
TR-177
IPv6 over Ethernet

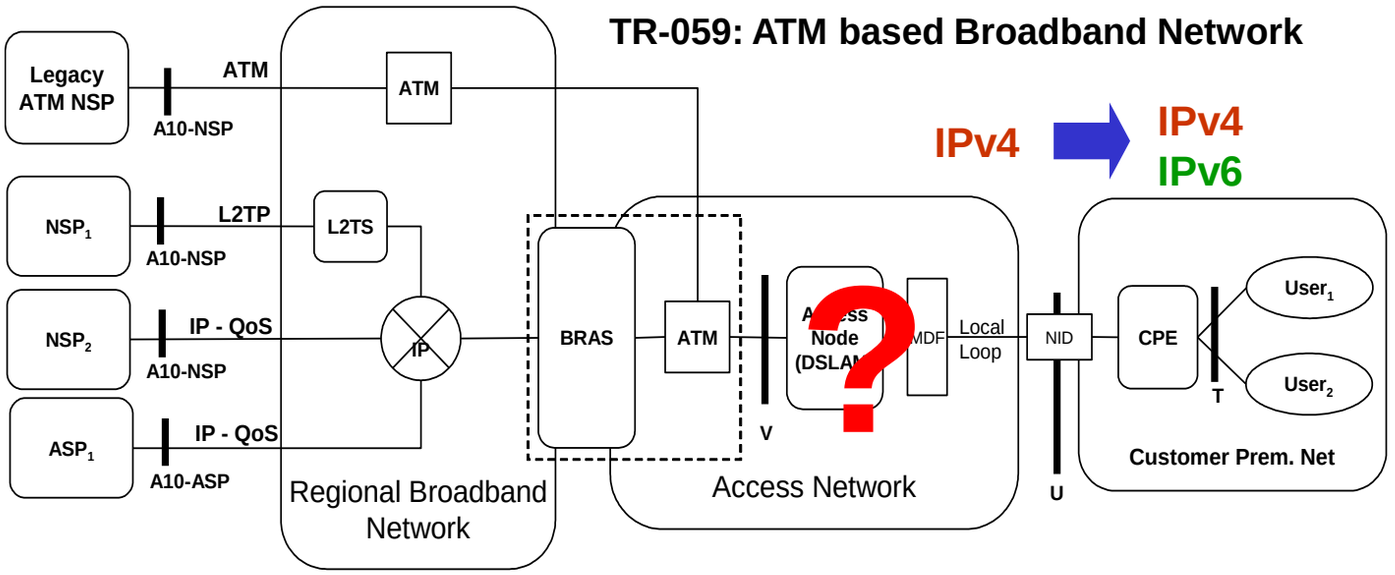
WT-242
IPv6 transition mechanisms

WT-269
Interoperability test for IPv6 transition

Deployment @ Carriers' Networks

Promoting IPv6 in Existing Broadband Networks





- TR-124 Issue 3
  - RG updates
  - Dual-stack at home
  - Varies transition mechanisms
- TR-187
  - IPv6 for PPP broadband access
  - Dual-stack support
- TR-177
  - IPv6 for Ethernet broadband access
  - Dual-stack support
- WT-242
  - IPv6 transition mechanisms
- WT-269
  - Interoperability test for IPv6 transition mechanisms

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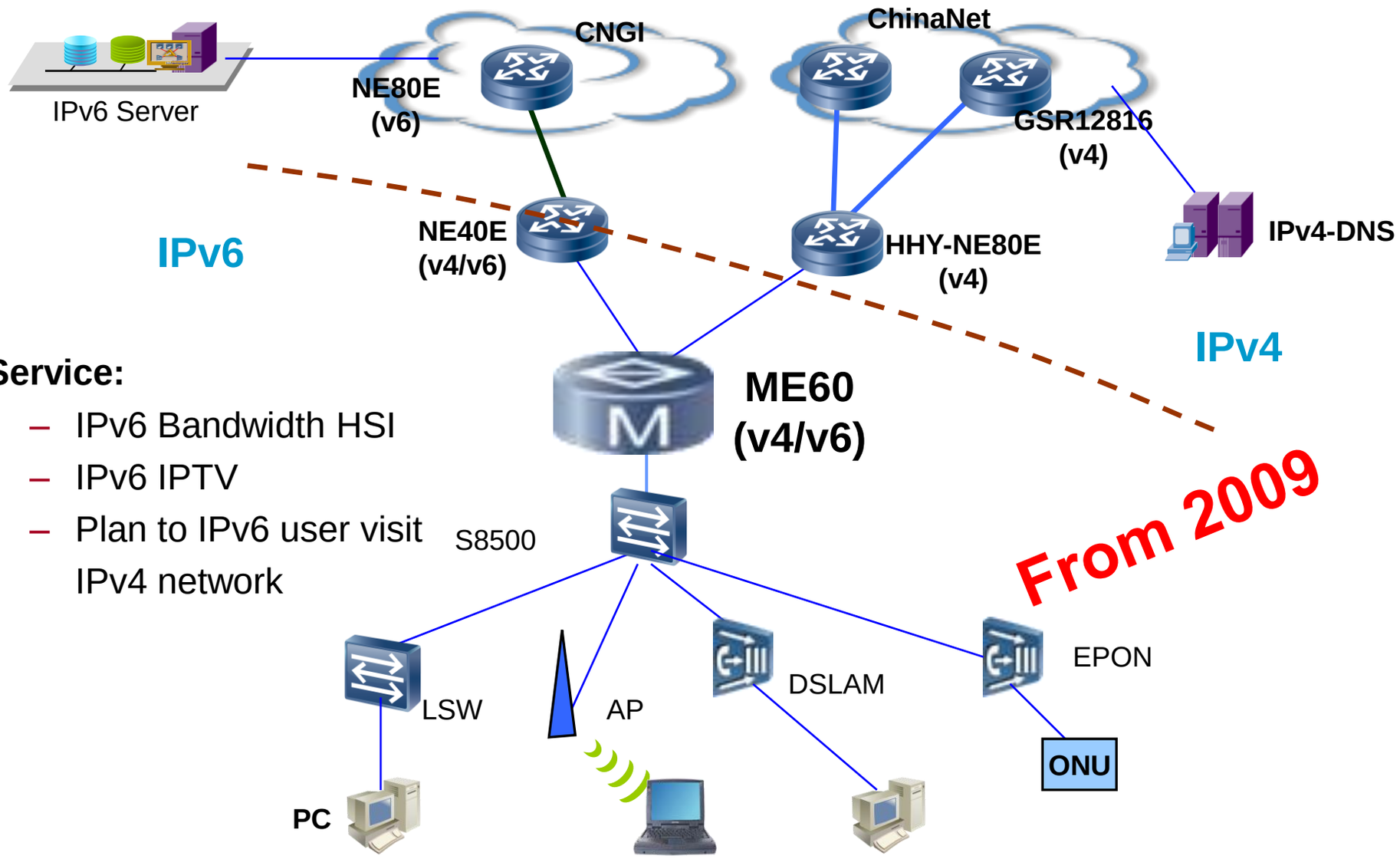
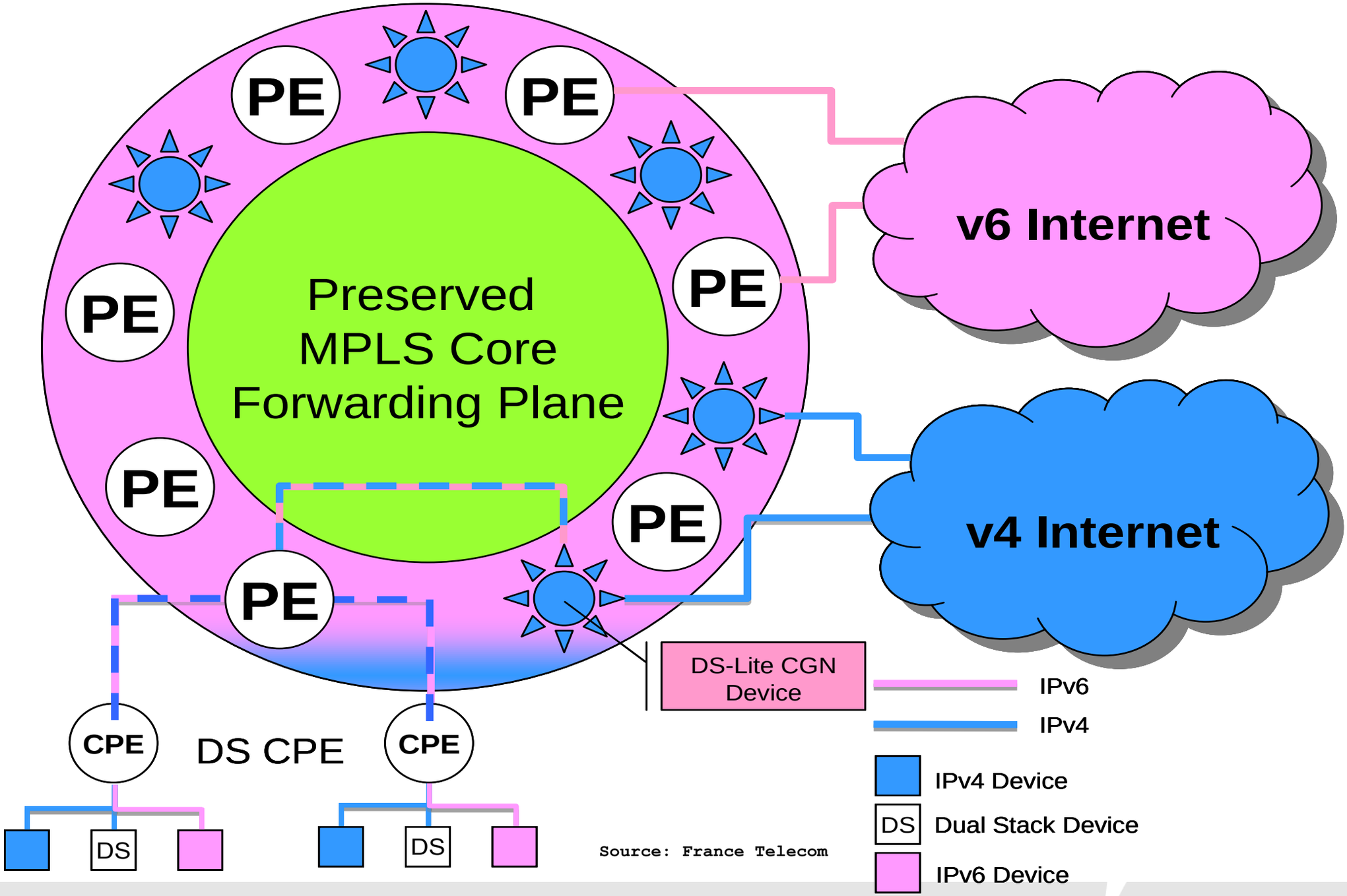
CHINA TELECOM ChangSha IPv6 METRO



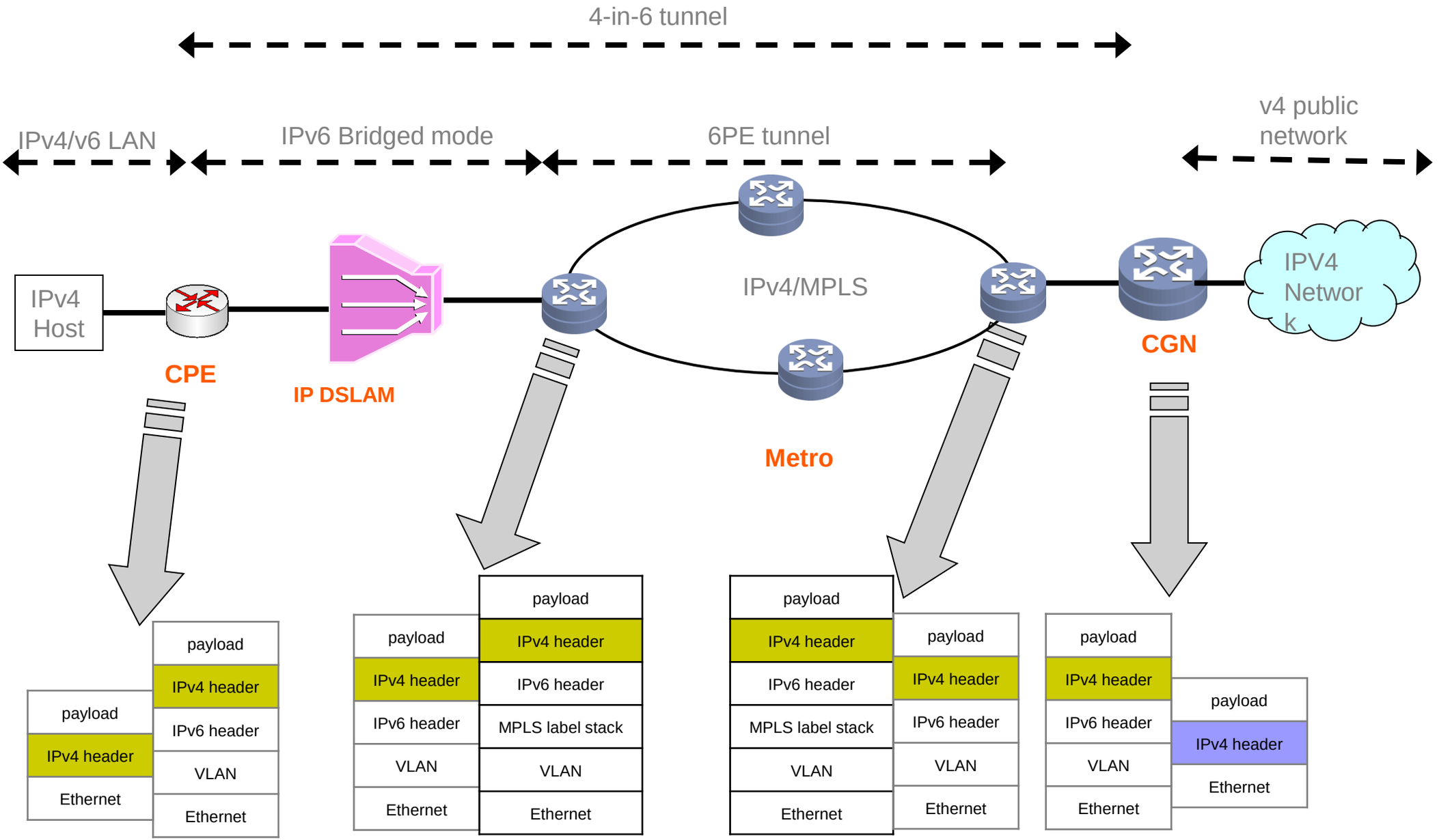
- **Service:**
  - IPv6 Bandwidth HSI
  - IPv6 IPTV
  - Plan to IPv6 user visit IPv4 network

- **Network：CNGI ChangSha Access Node、ChinaNet ChangSha Access Node**
- **Huawei Equipment：NE40E、NE80E、ME60、S8508、MA5605、S2403H、WiFi AP**

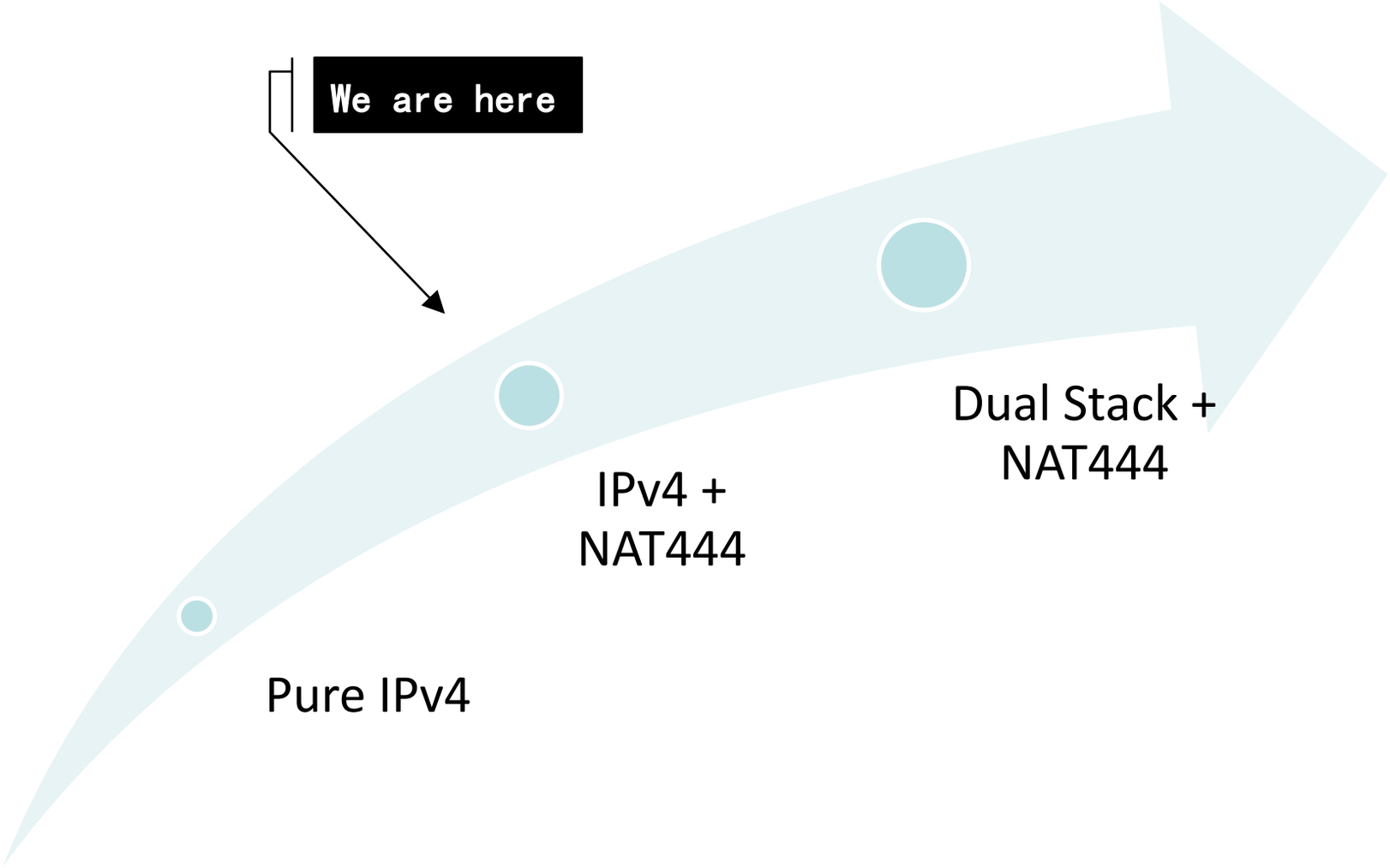
France Telecom IPv6 solution based on DS-Lite



IPv4 traffic flow details
(DS-Lite with IPv4-MPLS Metro Core)



IPv6 Migration Planning
Wuxi Telecom, China

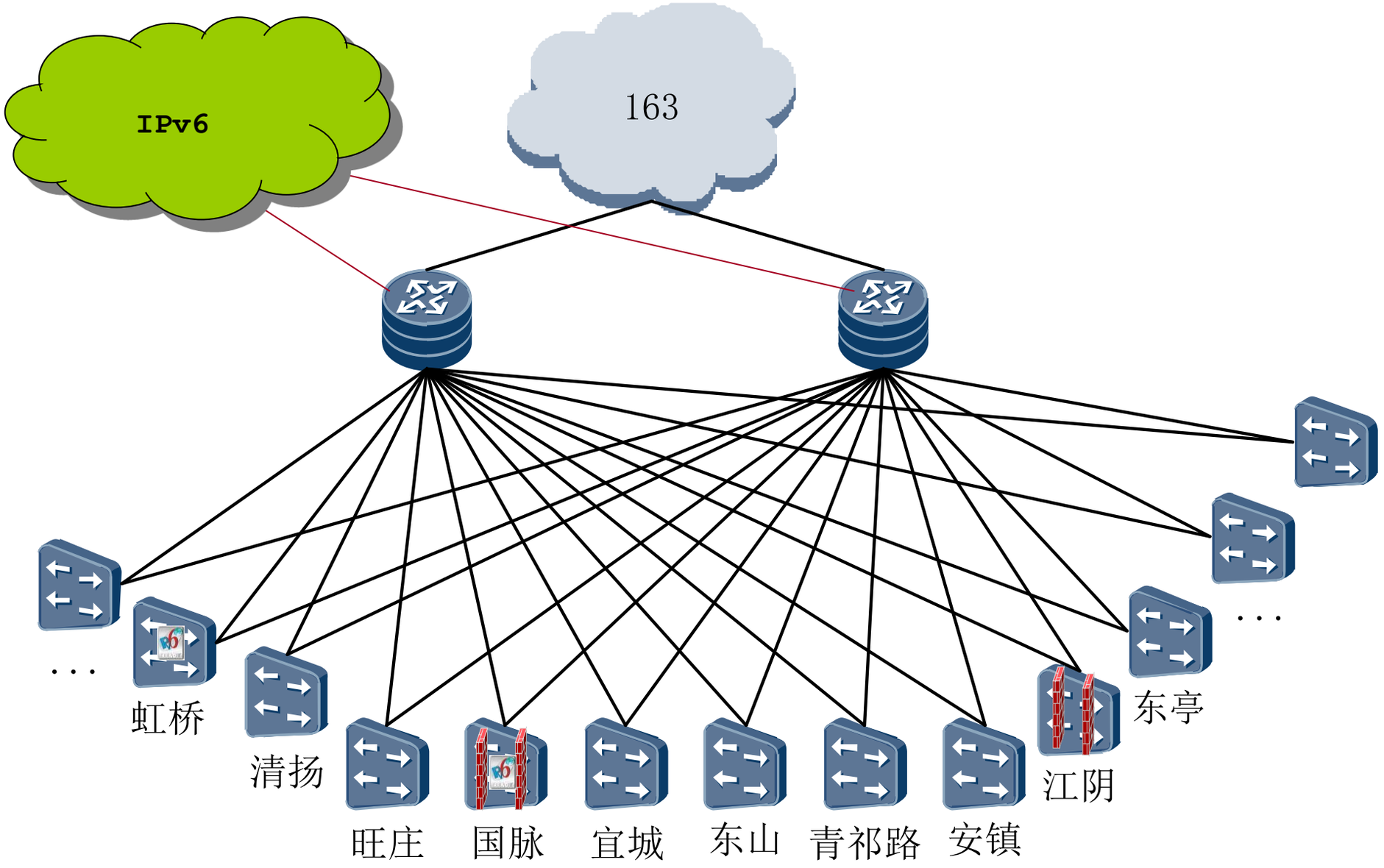


NAT444 Deployment – Goal & Strategy
Wuxi Telecom, China

- **IPv4 address demand trends:**
  - Gradual transition to IPv6, reduced demand for IPv4 addresses.
  - Within 5 years, old BRAS equipments will be gradually replaced by new ones capable of insertion of NAT cards,
  - With NAT44, it will greatly reduce the rate of consumption of IPv4 public addresses.

- **NAT444 deployment goal：**
  - Solve the current address shortage of demand, support at least five years of the IPv4 address needs.
- **Overall strategy：**
  - HIS service migration to NAT transformation first, others (IPTV, VoIP, government and enterprise) remain unchanged for now
  - Assure the transformation is step-by-step with no impact on users.

IPv6 Transition @Wuxi Broadband Networks (for Illustration)



Deploy NAT44 to Slow Down Address Consumption

- **Current status：**
  - **Address usage ratio**=50%；**Address allocation ratio**=110%； **Address percentage on ME60 40%**；
  - **Number of subscribers=1M, NAT IPv4 address sharing ratio=1:16 (4K ports per subscriber)**
- **Step 1: Recoverable IPv4 addresses due to NAT deployment (estimate)**
  - **Total IPv4 addresses in use** = about 240,000 (956 /24)
  - Recoverable IPv4 addresses (NAT IP address sharing ratio 1:16) = **225,000（896 /24)**
  - **Total saving on IPv4 global address = 94%**
- **Step 2: Annual growth rate of Subscribers**
  - **Annual growth rate** =**15%**

	New Subscribers With Public Addresses	50% New Subscribers with Private Addresses	100% New Subscribers with Private Addresses
Addresses Consumed	82.5 K（325 /24)	**43.8 K（173 /24)**	5.2 K（21 /24)

- **Step 3: Saved IPv4 addresses available for re-distribution in growth**

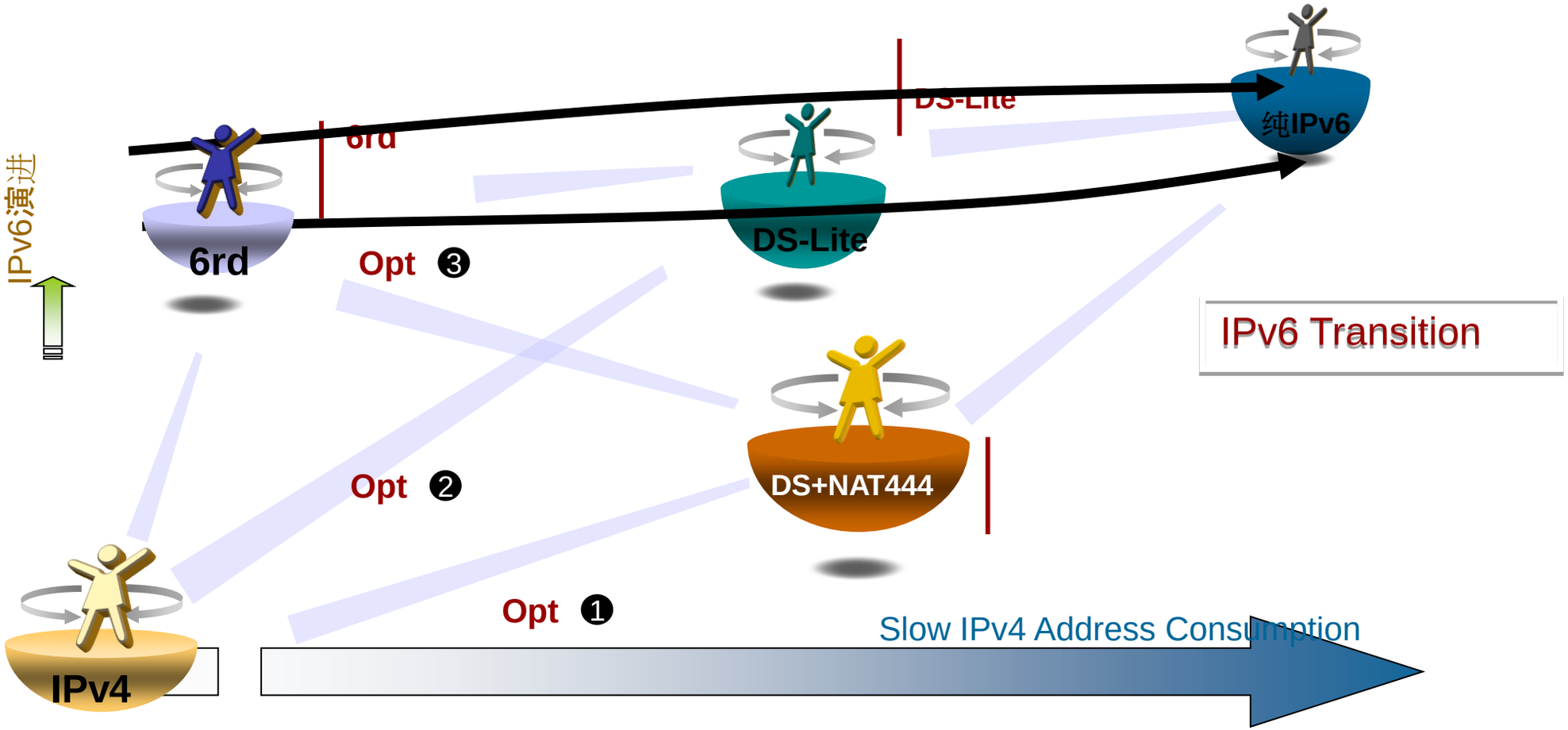
	New Subscribers with Public Addresses	50% New Subscribers with Private Addresses	100% New Subscribers with Private Addresses
Years to Grow	2.7 Year	**5.2 Year**	43.8 Year

Conclusion: Recover and save IPv4 addresses by deploying NAT44 along with a good plan, the current IPv4 addresses in hand can satisfy 5+ years business growth need.

Wuxi Telecom Deployment Notes

- Transition from public to private addressing must be smooth with no impact on users
- No impact on applications on Instant Messaging, P2P, IPTV, etc.
- Hot stand-by deployment of CGN with load balancing
- IPv4 address sharing ratio: 1:12 to 1:16 with 4,000 ports per user
- 3-6 months trial period – service reversible if required
- Automatic configuration (port assignment, address & port mapping, etc.) via RADIUS
- Source tracing capability using RADIUS (optionally Syslog)

Chengdu Telecom Migration Thoughts



- **Choice for move forward is the Option 1**
- **Deploy NAT44 to reduce IPv4 address shortage pressure**
- **Deploy IPv4-IPv6 dual-stack incrementally**
- **May transit from dual-stack to DS-Lite in the future**

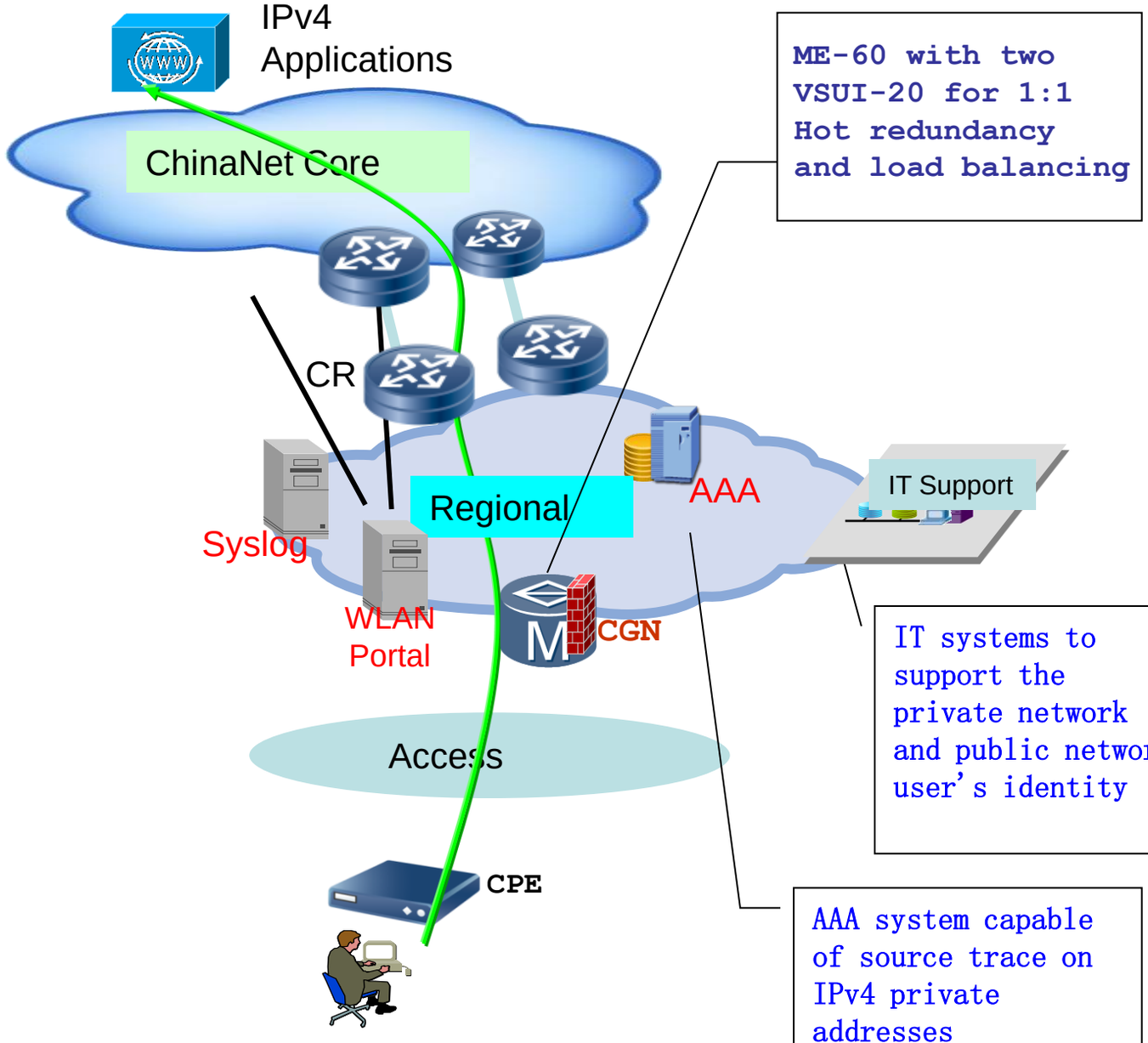
Deployment of Distributed CGN-NAT44
Chengdu Telecom, China

1. IPv4 Internet & applications
2. ChinaNet remains IPv4 only

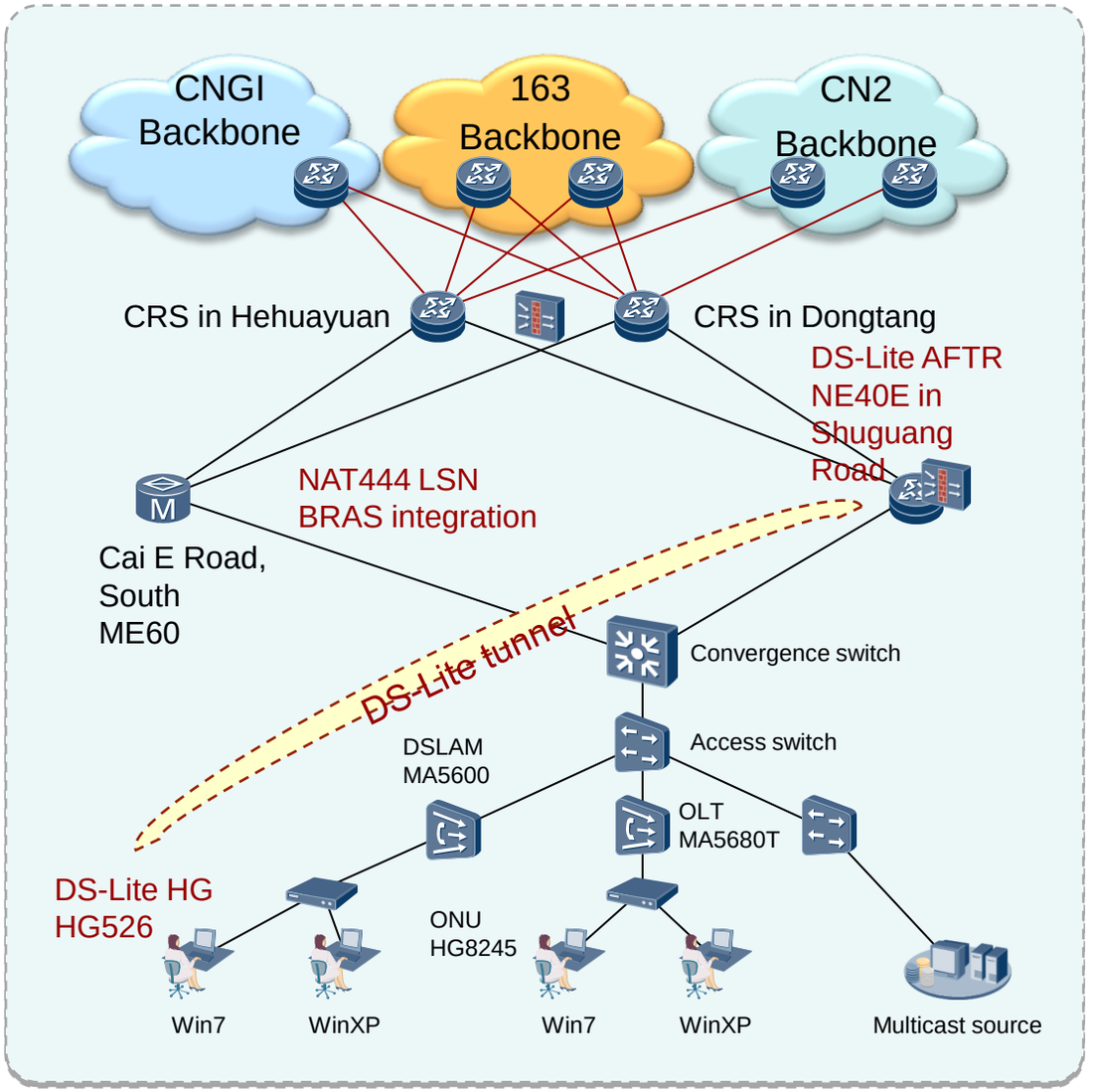
1. Regional & aggregation core, routers and BRAS remain IPv4 only.
2. At Dujiangyan and Sichuan Jincheng College, CGN card is inserted into existing BRAS(ME-60). All users use IPv4 private addresses with a few public addresses reserved for special customers.
3. IPv4 private addresses are not advertised in the regional network.

1. No change in access network

1. Router-mode RG - IPv4 only
2. Bridge-mode RG, hosts IPv4 only



CGN & DS-Lite Deployment Changsha Telecom, China



Broadband Internet access

Online game

IM

Video

VOIP

VPN

Address source tracing

Single Sign On

Deployment Experiences

- CGN remains an effective mechanism to prolong IPv4 based network infrastructure, business, growth.
- DS-Lite is a solution that invests for the future, but also protect the existing IPv4 based business
- Operators must balance the effort in handling IPv4 address space pressure and IPv6-based applications
- The transition plan must serve the best for the current business, its growth with no or less impact.

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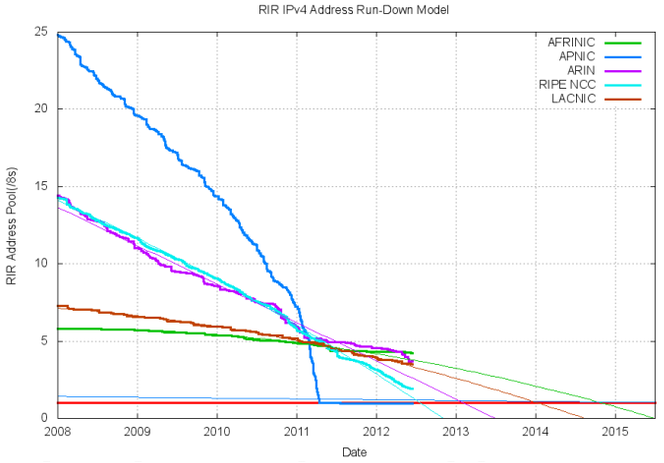
Conclusion

- IPv4 Address Report
- IANA address pool exhaustion occurred at February 3, 2011
- RIR unallocated address pool exhaustion is happening (report on 7/28/2012)

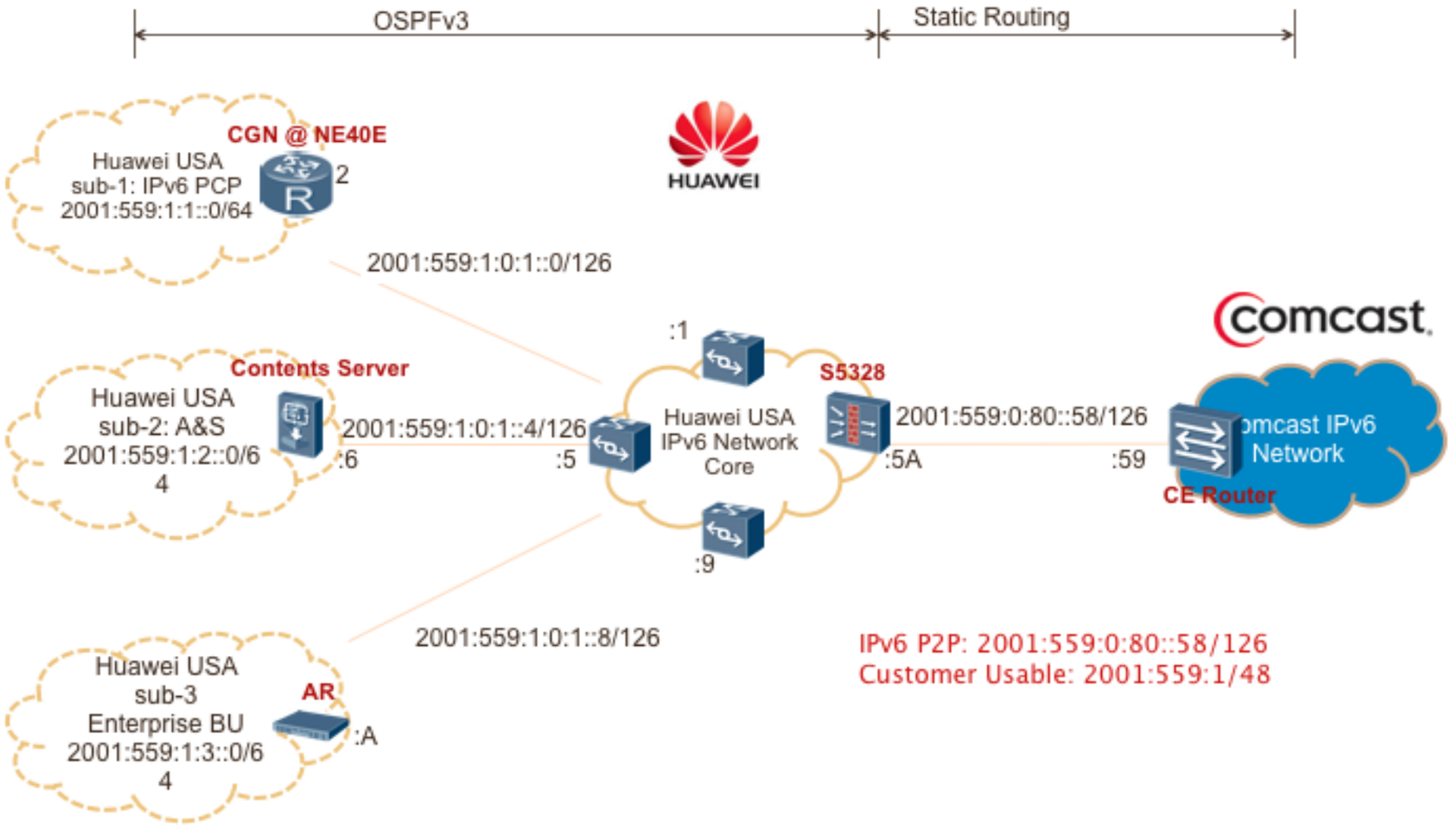
RIR	Projected Exhaustion Date	Remaining Addresses in RIR Pool (/8s)
APNIC:	19-Apr-2011	0.9208
RIPENCC:	03-Oct-2012	1.5342
ARIN:	26-Jul-2013	3.4733
LACNIC:	08-Jul-2015	3.4170
AFRINIC:	14-Oct-2019	4.1675



- IPv4 address exhaustion is the primary reason for IPv6 adoption and transition.
- The lack of IPv6 based applications, services, etc. is the primary reason for the delay of IPv6 transition.
- IPv4 and IPv6 will co-exist for many years to come, during which, the ability for end users to access both IPv4 and IPv6 (dual-stack) is mandatory.
- There are different technologies and options for transitioning to IPv6 or sharing IPv4 addresses, or both, and the actual migration path is determined by carriers and enterprises based on several factors including business requirements.

IPv6 Layout at Huawei U.S. R&D Center

An example - IPv6 Deployment at Enterprise



Every enterprise does its own part,

and together, we all go with IPv6!

Thank You

www.huawei.com