IPv6 Transition Technology and Solution

July 1st, 2010

Dean Cheng
Principal Engineer
Advanced Technology Department, U.S.A.
Huawei Technologies Ltd.

HUAWEI

Agenda

- Problems carriers face today
- Transition technology under development at IETF
- Transition technology under development at BBF
- Huawei's IPv6 Solution

What are the Drives for IPv6 at Carriers?

- IPv4 public address depletion
  - Daily report is recorded at:
    http://www.potaroo.net/tools/ipv4/index.html
  - Exhaustion prediction on June 29th, 2010:
    - IANA Unallocated Address Pool: 11-August-2011
    - RIR Unallocated Address Pool: 15-April-2012
- Compliance to governments' regulations
- Competitions with other carriers
- Required by new services and applications
  - Internet of Things
  - Cloud computing

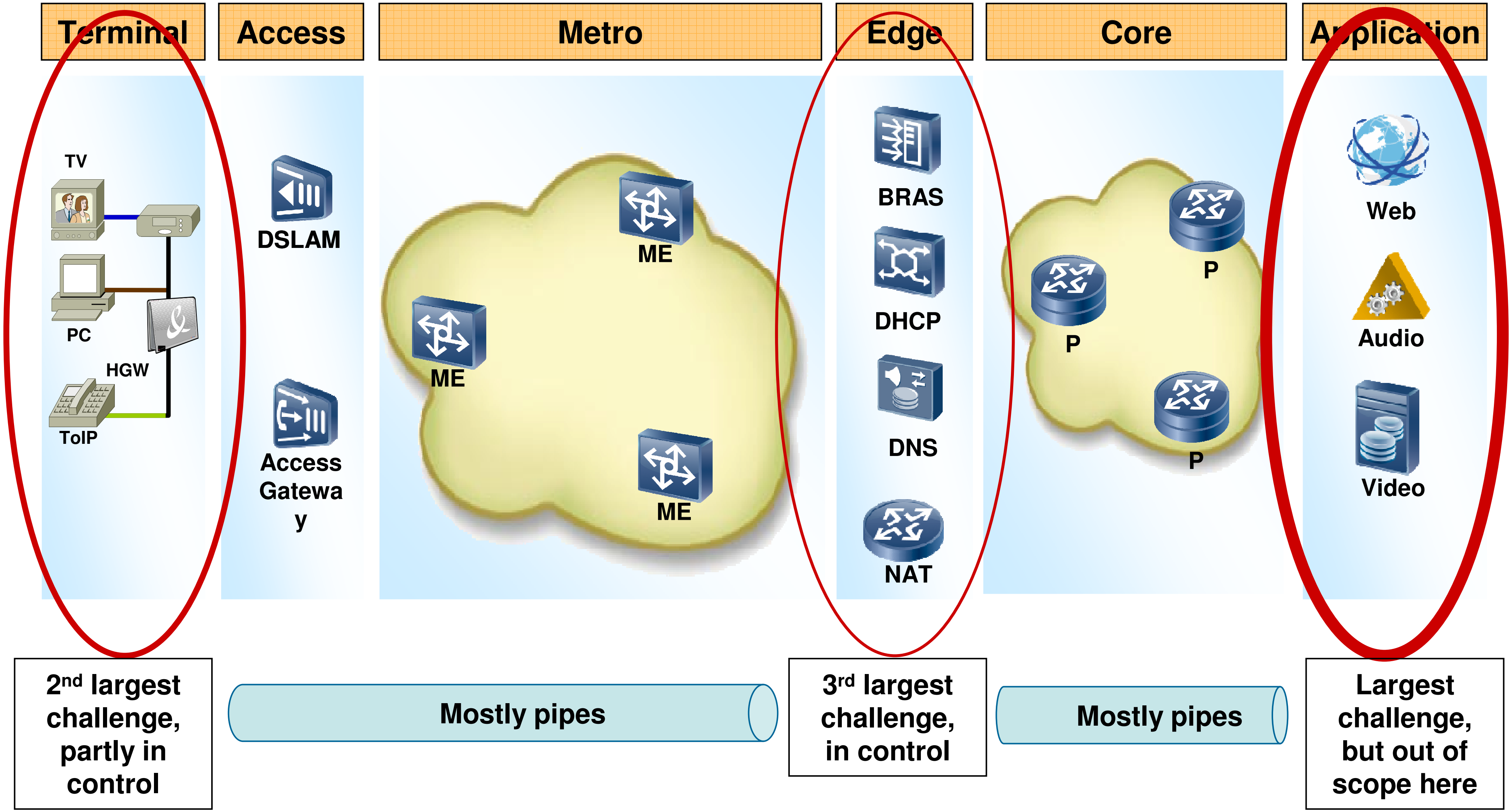
Why IPv6 Transition is a Big and Lasting Task?

- IPv4 and IPv6 are two non-interoperable protocols, and IPv4 and IPv6 network are two separate networks.
- Majority of applications today are IPv4 based and there are very little IPv6 based applications
- Therefore there requires:
  - IPv4->IPv6 transition
  - IPv4 and IPv6 co-existence
    - 6->4 for content access
    - 4->6 for content access
- The above need technologies, equipments, investments, planning, deployment, system/network upgrade, training, etc.

A Laundry List of Carriers' Considerations

- When and why to start IPv6 transition?
- How much longer my IPv4 address pool can survive?
- What technology and transition path should I take?
- What is the existing equipment vendor's advice for my transition?
- What is the existing equipment vendor's product roadmap?
- What is the benchmark for IPv4 traffic and IPv6 traffic in my network in coming years?
- What is the performance impact on dual-stack operation?
- How should I manage a complete end-to-end transition including equipments, technologies, and operations?
- What would Capex and Opex look like for each transition strategy?
- Are the transitional technologies mature enough?
- How should I perform the transition without any impact on existing customers and services?

IPv6 Migration Challenges



HUAWEI

Agenda

- Problems carriers face today
- Transition technology under development at IETF
- Transition technology under development at BBF
- Huawei's IPv6 Solution

IPv6 Working Groups at a Glance

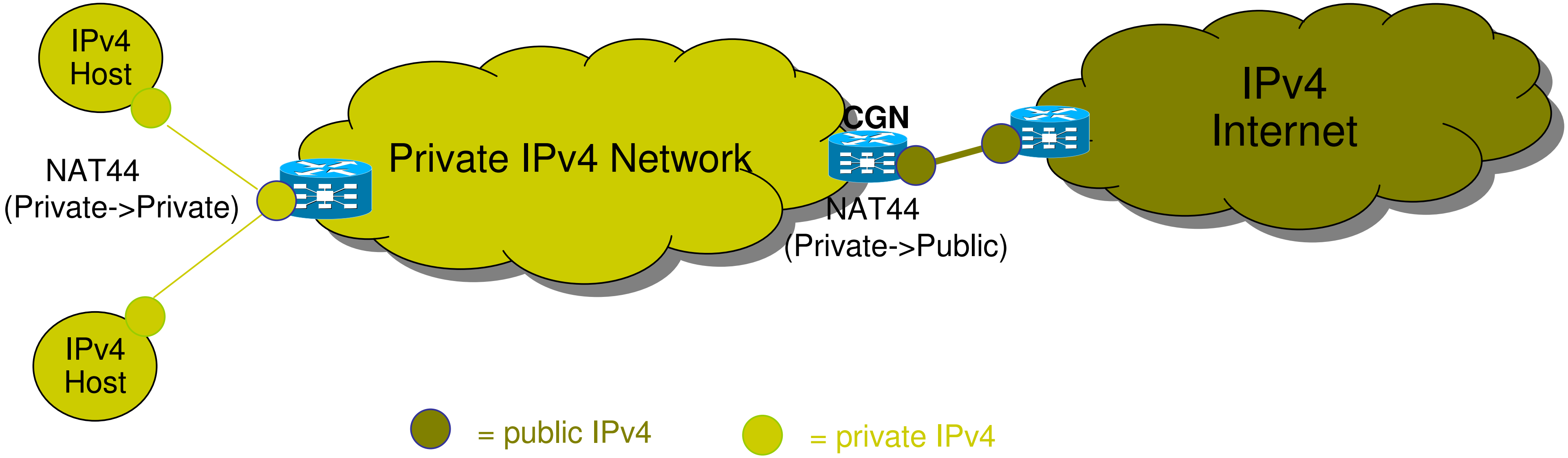
- behave - Behavior Engineering for Hindrance Avoidance
- softwire - Softwires
- v6ops – IPv6 Operations
- Dhc – Dynamic Host Configuration
- 6man – IPv6 Maintenance
- savi - Source Address Validation Improvements
- Mext - Mobility Extensions for IPv6

- Dnsext - DNS Extensions
- Dnsop - Domain Name System Operations
- 6lowpanIPv6 over Low power WPAN
- Roll - Routing Over Low power and Lossy networks
- Ancp- Access Node Control Protocol

Transition Technologies

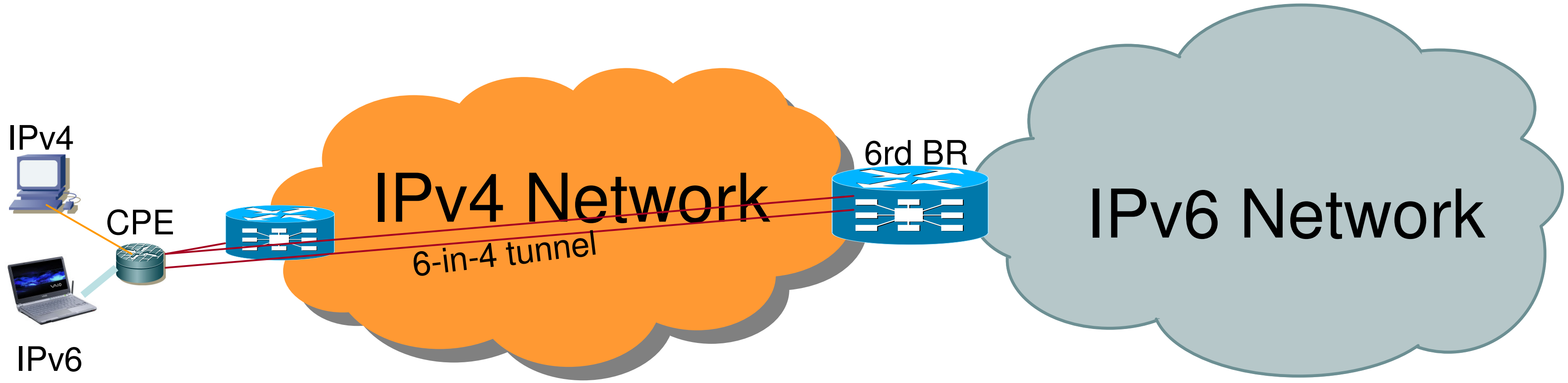
- Transition period is inevitable because IPv4 address space will run out at carriers before full IPv6 deployment.
- Transition technologies currently under development:
  - NAT444
  - 6rd
  - DS-Lite
  - NAT64
  - Dual stack
  - 6PE/6vPE
  - PNAT
  - IVI
  - Port range
  - NAT46
  - Etc.
- Not all of these are standards today, with some mature enough and deployment/trail appears to be imminent.

NAT444 – A Quick Way to Resolve IPv4 Address Depletion Problem



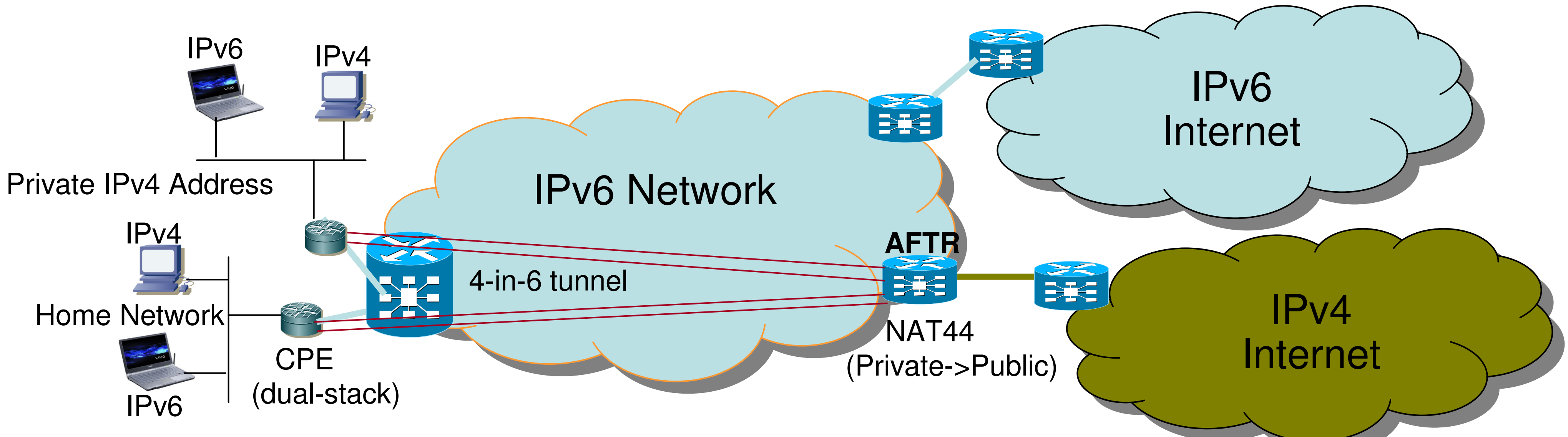
- **No change in existing CPEs or customer's networks.**
- **No change in existing IPv4 based access network except installation of CGN device, usually embedded with one or more routers, and its function is transparent to the existing access network and customers.**
- **http://www.ietf.org/internet-drafts/draft-nishitani-cgn-04.txt**
- **http://tools.ietf.org/html/draft-shirasaki-nat444-isp-shared-addr-03.txt**

IPv6 Rapid Deployment (6rd)



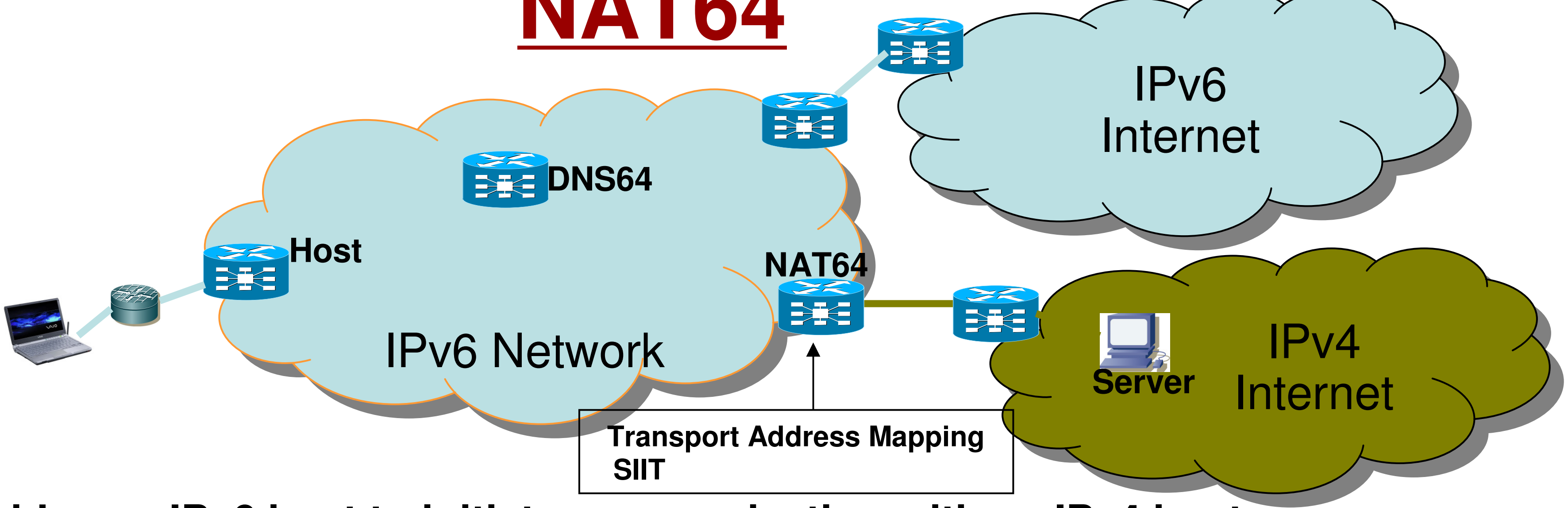
- Provide IPv6 connectivity to end user with existing IPv4 network infrastructure.
- CPE runs dual-stack facing home network but IPv4 only on WAN side.
- 6-over-4 (RFC3056), is used to encapsulate IPv6 packet in IPv4 packet.
- Virtual interface is required on CPE and Border Relay (BR).
- SP chooses an IPv6 prefix for 6rd deployment (6rd SP prefix). A 6rd delegated prefix is formed from the 6rd SP prefix and the normal IPv4 address assigned to the end user. This delegated prefix is equivalent to a DHCPv6 RFC3633 delegated prefix.
- 6rd BR operates stateless without limit on the number of subscribers. Multiple BRs may be deployed addressed via anycast for network resilience.
- http://tools.ietf.org/html/draft-ietf-softwire-ipv6-6rd-10.txt

DS-Lite



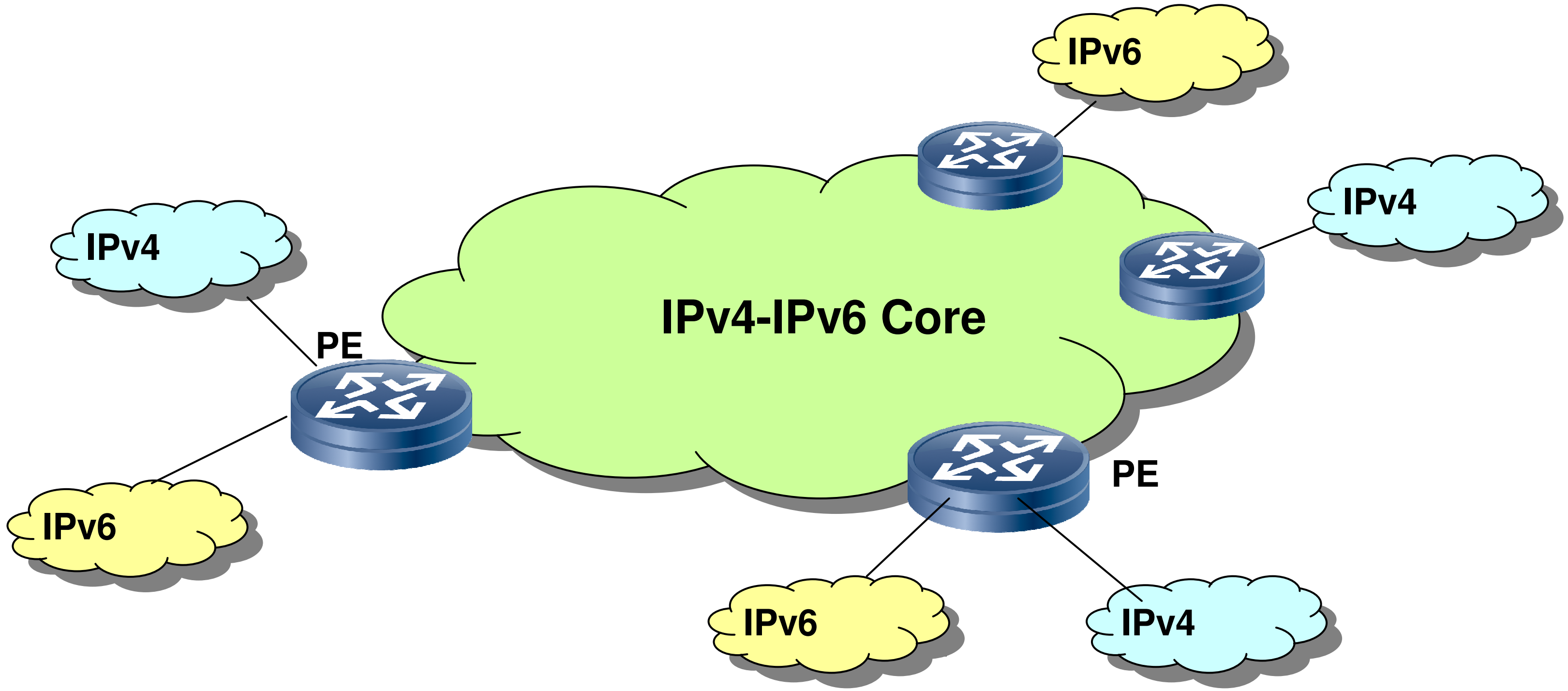
- **Home network and CPE is dual-stack but ISP is IPv6-only access network.**
- **IPv6 traffic is forwarded in native mode.**
- **IPv4 connectivity is through IPv4-in-IPv6 softwire in ISP network**
  - **The softwire is between CPE (initiator) and AFTR (concentrator)**
  - **CPE does not perform NAT function.**
  - **Multiple private IPv4 addresses (overlapping allowed) mapping to a single public IPv4 address at AFTR disambiguated by tunnel endpoints.**
  - **Encapsulation is IPv4-in-IPv6, but may also be L2TPv2/v3, GRE, MPLS, etc.**
  - **How IPv4 multicast is handled not currently defined.**
- **http://tools.ietf.org/html/draft-ietf-softwire-dual-stack-lite-04.txt**

NAT64



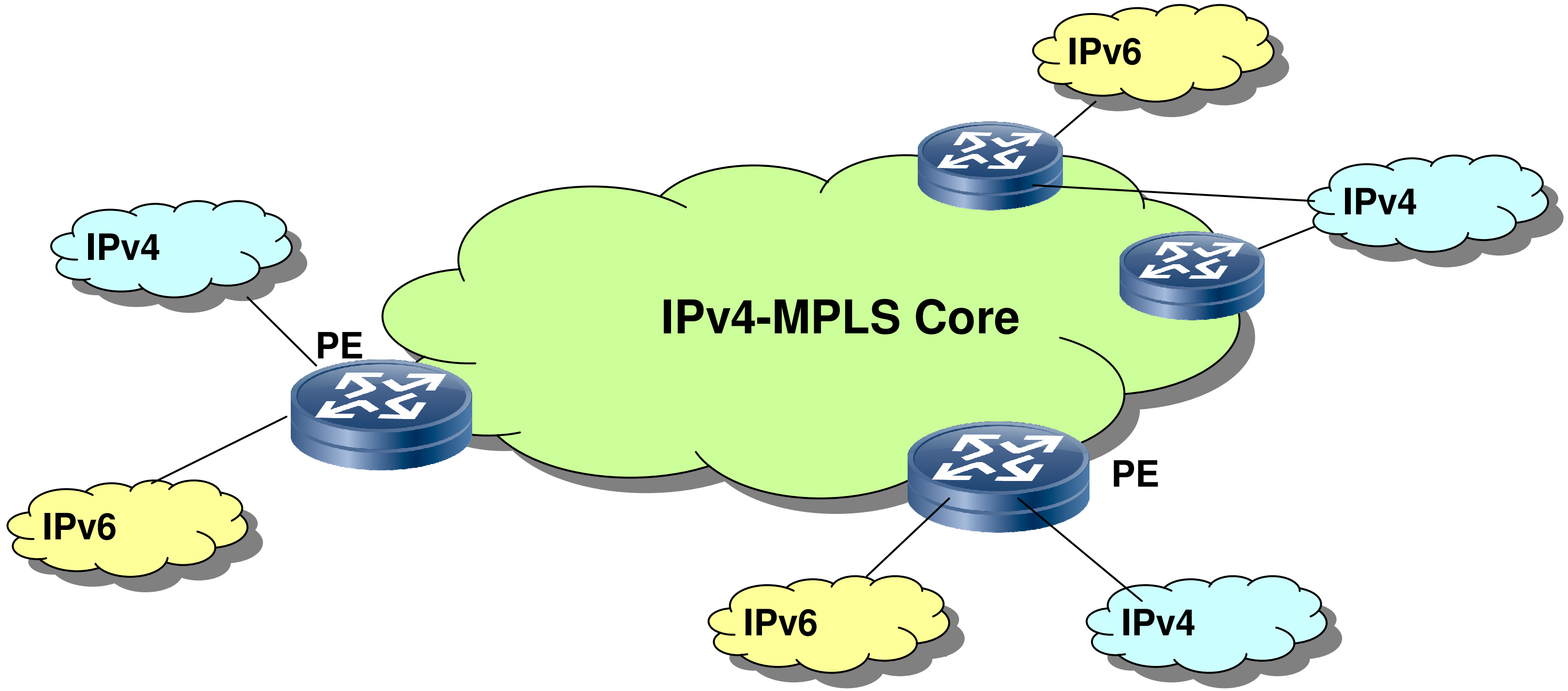
- Enables an IPv6 host to initiate communication with an IPv4 host or server.
- Translation details:
  - ➢The host performs a DNS query for the server and gets an AAAA record that contains the IPV6 with a prefix Pref64::/96 that associated with the NAT64 device and the server's IPv4 address in the lowest 32 bits.
  - ➢The host sends an IPv6 packet destined to the server via the NAT64 device that does the mapping:
    - •Source IPv4 address and transport number are from the address and port number pool maintained by the NAT64 device, respectively.
    - •Destination IPv4 address is extracted from the lowest 32 bits of the destination IPv6 address. The destination port number is extracted from the destination IPv6 port number.
  - ➢Translating the packet headers according to SIIT RFC2765
  - ➢Requires the NAT64 device to maintain translate state
- http://www.ietf.org/internet-drafts/draft-ietf-behave-v6v4-xlate-20.txt
- http://www.ietf.org/internet-drafts/draft-ietf-behave-dns64-09.txt

IPv4-IPv6 Dual Stack Core



- IPv4-IPv6 dual-stack core
  - Core runs both IPv4 and IPv6 with native forwarding for both.
  - In general it requires two separate control planes running in SIN mode
    - One optimization is to run a single IS-IS for both IPv4 and IPv6 unicast
  - Expecting IPv4 traffic to decline eventually becoming IPv6 only.

IPv4-MPLS Core with 6PE/6vPE



- **IPv4-MPLS core with 6PE/6vPE**
  - Core runs IPv4 only with MPLS.
  - PE runs IPv4-IPv6 customer facing and IPv4 only network facing.
  - IPv4 traffic forwarded through the core natively.
  - IPv6 traffic forwarded through MPLS LSP through the core.
  - A transitional approach

Drafts submitted by Huawei

- 1) Submission to behave Working Group
- 1a) http://www.ietf.org/internet-drafts/draft-xu-behave-stateful-nat-standby-03.txt
- 1b) http://www.ietf.org/internet-drafts/draft-xu-behave-nat-state-sync-01.txt
- 1c) http://www.ietf.org/internet-drafts/draft-xu-behave-hybrid-type-prefix-00.txt
- 1d) http://www.ietf.org/internet-drafts/draft-jiang-behave-v4v6mc-proxy-00.txt
- 2) Submission to softwire Working Group
- 2a) http://www.ietf.org/internet-drafts/draft-boucadair-dslite-interco-v4v6-03.txt
- 2b) http://www.ietf.org/internet-drafts/draft-guo-softwire-sc-discovery-03.txt
- 2c) http://www.ietf.org/internet-drafts/draft-guo-softwire-auto-gre-00.txt
- 3) Submission to v6ops Working Group
- 3a) http://www.ietf.org/internet-drafts/draft-ietf-v6ops-incremental-cgn-00.txt
- 3b)http://www.ietf.org/internet-drafts/draft-ietf-v6ops-isp-scenarios-00.txt
- 3c) http://www.ietf.org/internet-drafts/draft-jiang-v6ops-nc-protection-01.txt
- 3d) http://www.ietf.org/internet-drafts/draft-sarikaya-v6ops-prefix-delegation-00.txt
- 4) Submission to dhc Working Group
- 4a) http://www.ietf.org/internet-drafts/draft-ietf-dhc-secure-dhcpv6-00.txt
- 4b) http://www.ietf.org/internet-drafts/draft-xu-ipv6-ra-dhcp-server-option-00.txt
- 4c) http://www.ietf.org/internet-drafts/draft-jiang-csi-cga-config-dhcpv6-01.txt
- 4d) http://www.ietf.org/internet-drafts/draft-xia-dhc-host-gen-id-02.txt
- 5) Submission to 6man Working Group
- 5a) http://www.ietf.org/internet-drafts/draft-carpenter-6man-flow-update-02.txt
- 6) Submission to ospf Working Group
- 6a) http://www.ietf.org/internet-drafts/draft-boucadair-ospf-v4v6-ospfv3-mt-02.txt
- 7) Submission to isis Working Group
- 7a) http://www.ietf.org/internet-drafts/draft-boucadair-isis-v4v6-mt-02.txt
- 8 Submission to savi Working Group
- 8a) http://www.ietf.org/internet-drafts/draft-kaippallimalil-savi-dhcp-pd-01.txt

Not a complete list!

Agenda

- Problems carriers face today
- Transition technology under development at IETF
- Transition technology under development at BBF
- Huawei's IPv6 Solution

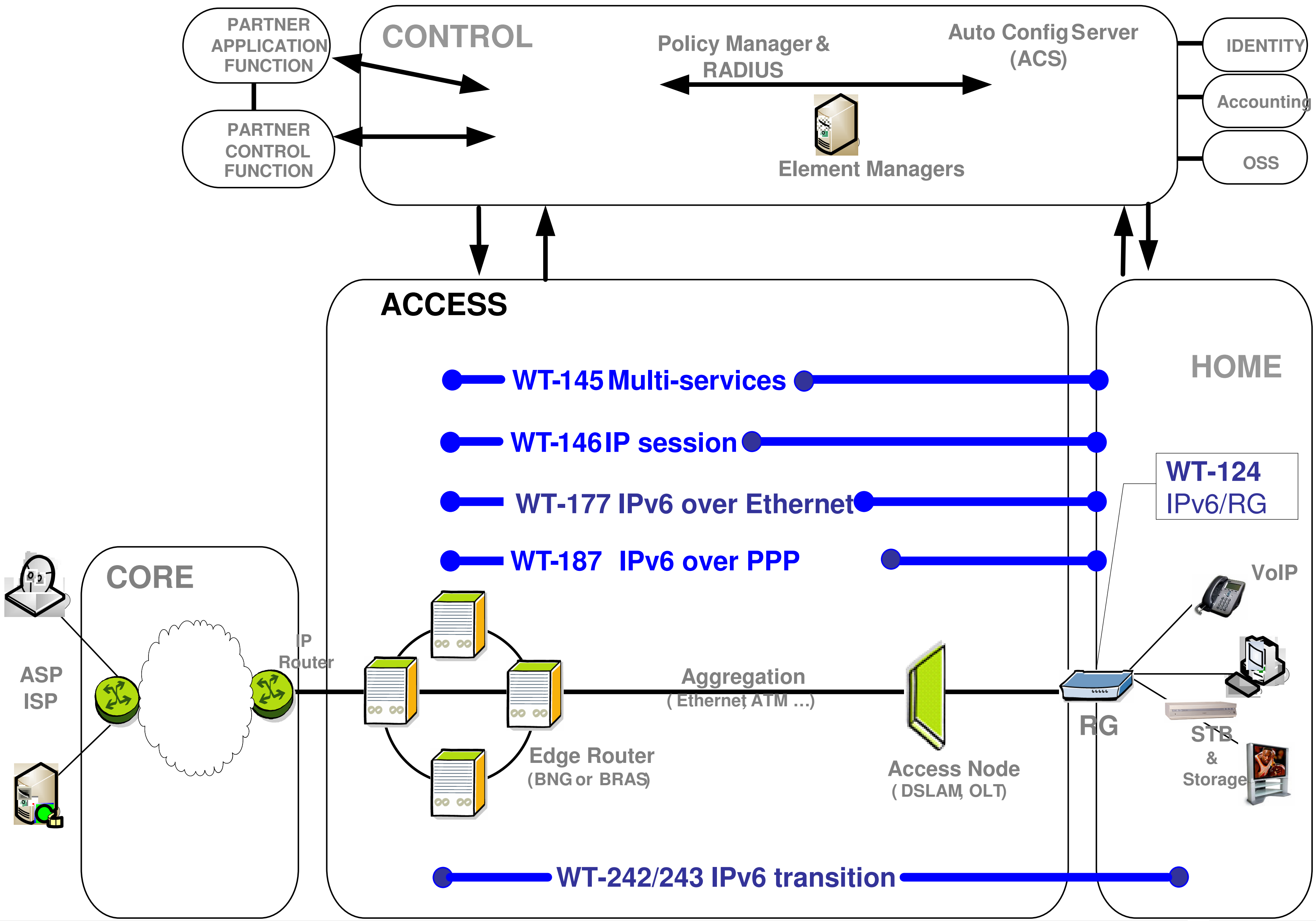
IPv6 Work at Broadband Forum

- **WT-187 – IPv6 over PPP**
  - Under "Architecture & Transport" Working Group
  - Updates to TR-59 (Architecture Requirements for the Support of QoS-Enabled IP Services)
  - Updates to TR-101 (Migration to Ethernet-based DSL Aggregation)
  - Status - letter ballot
- **WT-177 – IPv6 over Ethernet**
  - Under "Architecture & Transport" Working Group
  - Migration to IPv6 in the context of TR-101
  - TR-101: Migration to Ethernet-based DSL Aggregation
  - Status - straw ballot due Q3/2010
- **WT-124 – Residential Gateway (RG) Requirements**
  - Under " BroadbandHome" Working Group
  - Updates to TR-124 – Requirements to Broadband Residential Gateway
  - Status – final ballot with new revision (WT-124i3) just started on QoS, performance, FMC, IMS)
- **WT-146 – IP Session**
  - Under "Architecture & Transport" Working Group
  - IPv4/IPv6 subscriber session, IP flow classifiers, session authentication, etc.
  - Status - draft

IPv6 Work at Broadband Forum (cont)

- **WT-145**
  - Under "Architecture & Transport" Working Group
  - Multi-service Broadband Network Functional Modules and Architecture
  - Extends TR-101 to meet requirements in TR144 (Broadband Multi-Service Requirements and Framework)
  - Status - draft
- **WT-178**
  - Under "Architecture & Transport" Working Group
  - Nodal requirements for WT-145
  - Status – no draft yet
- **WT-242/243**
  - Under "Architecture & Transport" Working Group
  - A new project – IPv6 transition technologies
    - Softwire based, DS-Lite, 6rd, etc.
    - IPv4 sunsetting technologies, NAT44, Release Control, etc.

Scope of BBF IPv6-related Work



Agenda

- Problems carriers face today
- Transition technology under development at IETF
- Transition technology under development at BBF
- Huawei's IPv6 Solution

Agenda

- Problems carriers face today
- Transition technology under development at IETF
- Transition technology under development at BBF
- Huawei's IPv6 Solution

Huawei E2E IPv6 Solution

E2E Dual Stack solution for multi-play and VPN
Ready for commercial deployment

DS-Lite solution for France Telecom, Telecom Italia pre-commercial, First to launch!

CGN solution based on PNAT,NAT64,NAT44,6RD transition technologies

Most IPv6 deployment

NOW

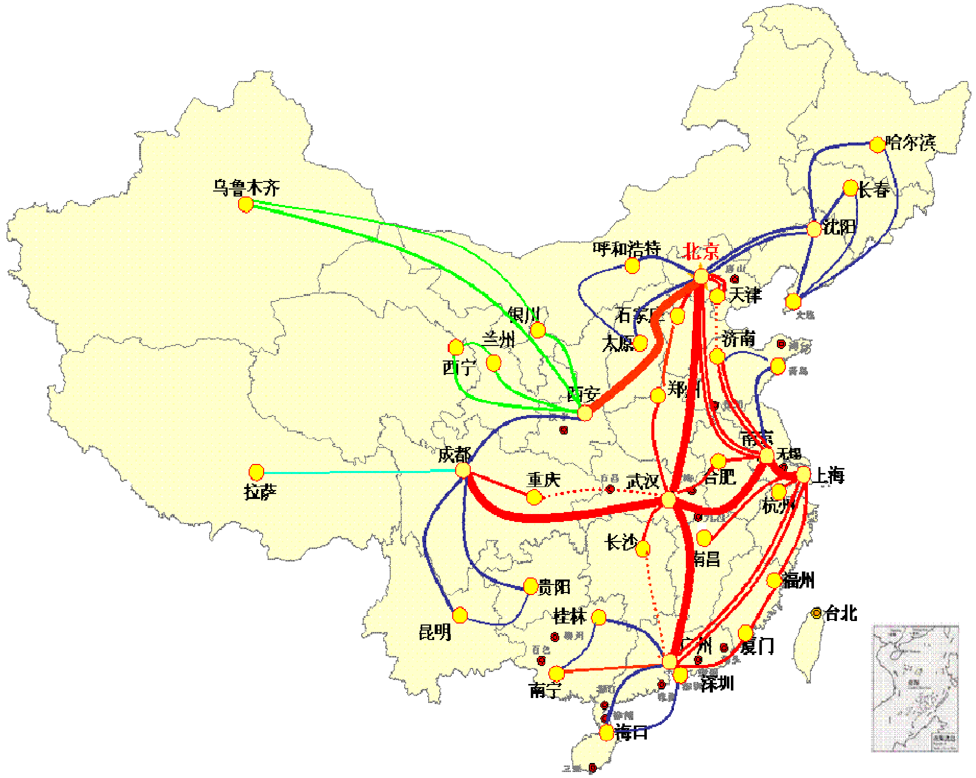
Industry's first DS-Lite CGN

2010 -2011

Industry-leading E2E Competitiveness, E2E Transition Solution Ready

Huawei's Successful IPv6 deployments in China

	Total Equipment number	Huawei	Juniper	Cisco	Other
China Telecom	20	86%	14%		
China Netcom	18	66.7%	22.2%	11.1%	
China Unicom	10	20%	80%		
China Mobile	19	85%	5%		10%
China Railcom	10	60%	40%		
CERNET	50	40%	10%		50%



Latif Ladid, President, IPv6 Forum "Huawei has become a leader in the IPv6 sector. "

北京2008年奥运会合作伙伴
Official Partner of the Beijing 2008 Olympic Games

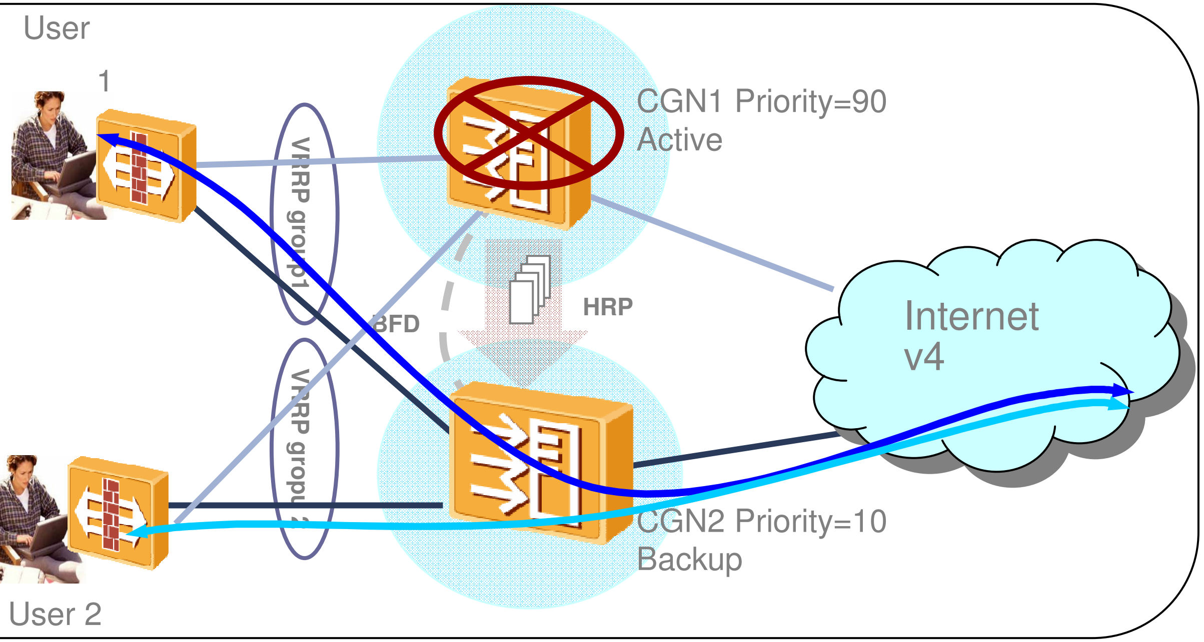
Huawei's highlights for v6 BNG and CGN solution

IPv6 BNG highlights

- Includes Industry leading features like BNG pool, 5-level QoS, PPP/IPoE hot standby, 40G/100G interfaces, value added services like DPI, SBC, firewall, etc
- Mature commercial deployment of v6 BNG in China

CGN solution highlights

- Pluggable single slot card in the CX600/NE40E/NE80E/ME60 routers
- Flexible solution for both centralized and distributed deployment models
- **Industry leading solution for CGN load balancing, hot standby and reliability**



HUAWEI

Summary

- **IPv6 transition is a high priority project among many operators this year.**
- **BNG, CGN and CPE are key components in end-to-end IPv6 solution**
- **Huawei has rich deployment experience and end-to-end solutions to meet operators requirement.**

Thank You

www.huawei.com