IPv6 Test Solution for Network Devices

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Agenda

- **Global IPv6 Test Organizations**
- **IPv6 Test mothdology for Vendors**
- **IPv6 Test methodology for Operators**

Global IPv6 Test Organization

- **JITC**
  - The Department of Defense (DoD) Internet Protocol version 6 (IPv6) product certification program began as a mandate from the DoD's Assistant Secretary of Defense for Networks & Information Integration (ASD-NII) in 2005. The program mandates the Joint Interoperability Test Command (JITC) to test and certify IT products for IPv6 capability according to the Request For Comments (RFCs) outlined in the DoD's IPv6 Standards Profiles for IPv6 Capable Products
  - As of February 2009, the DoD ceased the requirement for IPv6-only testing for certification and entry into the Unified Capabilities Approved Products List (UC APL). According to Kris Strance, DoD CIO IPv6 Lead, "The testing of IPv6 is a part of all product evaluations — it is much broader in scope now."
- **USGv6 in NIST**
  - the USGv6 profile is a recommended acquisition guide for IPv6 capabilities in common network products used by US government. It is meant as a strategic planning guide for USG IT acquisitions to help ensure the completeness, correctness, interoperability and security of early IPv6 product offerings so as to protect early USG investments in the technology, detailed explanation by http://www.antd.nist.gov/usgv6/usgv6-v1.pdf
  - The USGv6 consists Conformance Test , Interoperability Test , and Network Protection Test Methods. It classify devices on host, router and Network Protection device
- **IPv6 Logo Programme**
  - The international IPv6 Forum has established an IPv6 Ready Logo program for IPv6 conformance and interoperability testing. The IPv6 Ready Logo program has been operational since 2003 and has gone through two significant revisions (Phase-1 and Phase-2) and continues to add testing capabilities for service/protocol specific logos today. The program is managed by a committee of IPv6 Forum members (mainly vendors and test labs) from around the world that include the University of new Hampshire Interoperability Testing Lab (USA), members from the TAHI project (Japan), IRISA (France), ETSI IPv6 Plugtests (Europe), TTA (Korea), BII (China), and CHT-TL(Taiwan).
  - The Test suite and Specification can be acquired from http://www.ipv6ready.org/ ,and open source test tools and scripts can also be acquired such as TAHI , But certification organizations had their private scripts
  - NIST has established MOUs with IPv6 Forum members to adopt the IPv6 Ready Logo test specifications as the initial basis for the USGv6 test program

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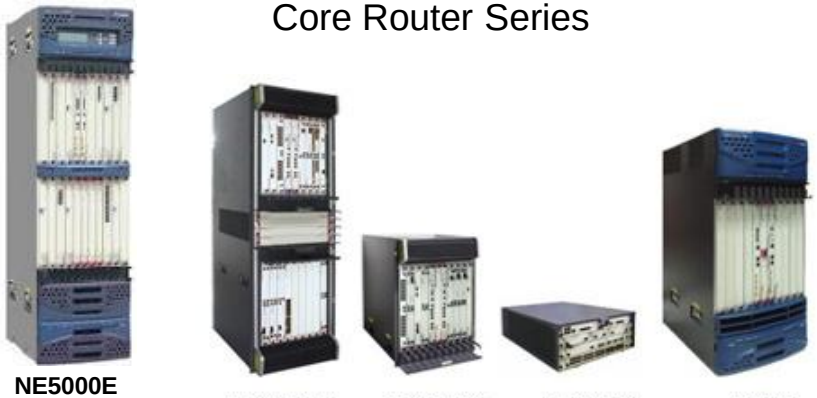
Huawei Network Products Passing IPv6 Ready Certification

- **Huawei router, switch and firewall products have already passed IPv6 Ready certification**
- **List of products passing IPv6 ReadyPhase2 certification is available at : http://www.ipv6ready.org/phase-2_approved_list**

Core Router Series



Edge and Enterprise Router Series

Metro Router and MSCG Series

Carrier class switch Series

Methodology of IPv6 test for network devices

- **IPv6 Ready certification test is a basic requirement in Huawei's internal test. Other considerations including:**
  - IPv6 Ready provides the certification of basic IPv6 capabilities – mainly interoperability
  - Must keep the IPv4 features and performance
  - Tests related to software/hardware platform of products, i.e. reliability and fault recovery
  - Vendors should support IPv6 deployment and operations, and products must meet the requirements of performance, specifications, deployment, compability, maintenance and mangement, etc.
- **IPv6 basic test is similar to IPv4 test, mainly including forwarding performance test, protocol functionality and compliance test, routing performance test, QoS and safety test, service provvisioning test, interoperability test. Transitional solution test is a unique IPv6 test. Network management, service management and user management should also be tested.**
  - Different deployment positions in the network may have different test emphasis
- **Protocol compliance test is a basic requirement, tools used for the test would include:**
  - compliance test solution provided by instrument vendor
  - Open source compliance test solution
  - Self-develop compliance test solution
- **Operators must validate and test IPv6 network solution at whole-network level before transition to IPv6. As a vendor, Huawei should also perform the related tests.**

IPv6 test for core routers

- **Network device in the backbone must have freatures of high speed interfaces, line-rate forwarding, big routing table, supporting QoS. The test includes:**
  - Forwarding performance of interfaces, usually with mixed IPv4 and IPv6 traffic
  - IPv6 routing performance test, mainly including routing table capacity, number of neighbours, routing convergence, and other specifications.
    - ISISv6: RFC5308, RFC5120 for Multi Topology and RFC4444 for MIB
    - OSPFv3: RFC5340 and RFC5643 forMIB
    - BGP4 + : RFC4271, RFC1772, RFC2545, RFC4760, RFC4659, RFC4798, RFC5549
      - Routers supporting BGP RR need to support a big routing table and a large number of neighbours, need to provide high performance for routing table distribution and routing table calculation
    - Multicast routing protocol PIM SM/SSM: RFC4601, RFC4609, RFC3956
  - MPLS
  - Reliability test, including GR, NSR, fault recovery, etc. Usually this is done in a test comprising multiple devices
  - IPSECv6 or MD5, enabling encryption should not degrade the performance. IPsecv3: RFC4301
  - Load balancing is a common test scenario
  - QoS, mainly diff-serv, reference: RFC2474, RFC2475, RFC3260, RFC2983, RFC3140, RFC2597, RFC3246, etc
  - MIB and network management system test, reference: RFC3411, RFC3412, RFC3413, RFC3414, RFC4292, RFC4293, RFC4087, RFC3289, etc
- **In case of coexistance of IPv4 and IPv6, usually IPv4 is used to support network management protocol and network management system**
  - Some devices provide IPv6 applications, i.e. IPv6 SSH, IPv6 SNMP, IPv6 MPLS RSVP; the services provided to the user are same as IPv4, the test methods the same.

IPv6 test for service routers

- **Service routers provide more functionalities than core routers; all the features available on core routers are also available on service routers; and more service functionalities are required. Requirements to forwarding performance, supporting different kind of interfaces and other specifications would be decided based on the application scenario.**
  - Most vendors, including Huawei, use the same software and hardware platform for different routers
- **Features to be tested for service routers**
  - All the features on core routers
  - DHCPv6, reference: RFC3315, RFC3633, RFC3736
  - MPLS VPN, Both L2 and L3 VPN
  - Multicast, besides PIM supported on core routers, reference: RFC3810, RFC3306, RFC3307, RFC4607, RFC4604
  - Tunneling technology in IPv6 transition
  - QoS features, including priority mapping between different technologies: ehternet, VLAN/QinQ, IP, MPLS, etc, scheduling and queueing, congestion avoidance, etc
  - MIPv6, referrence: RFC3775
  - Others, ie.e DNS, CGA, SeND, etc

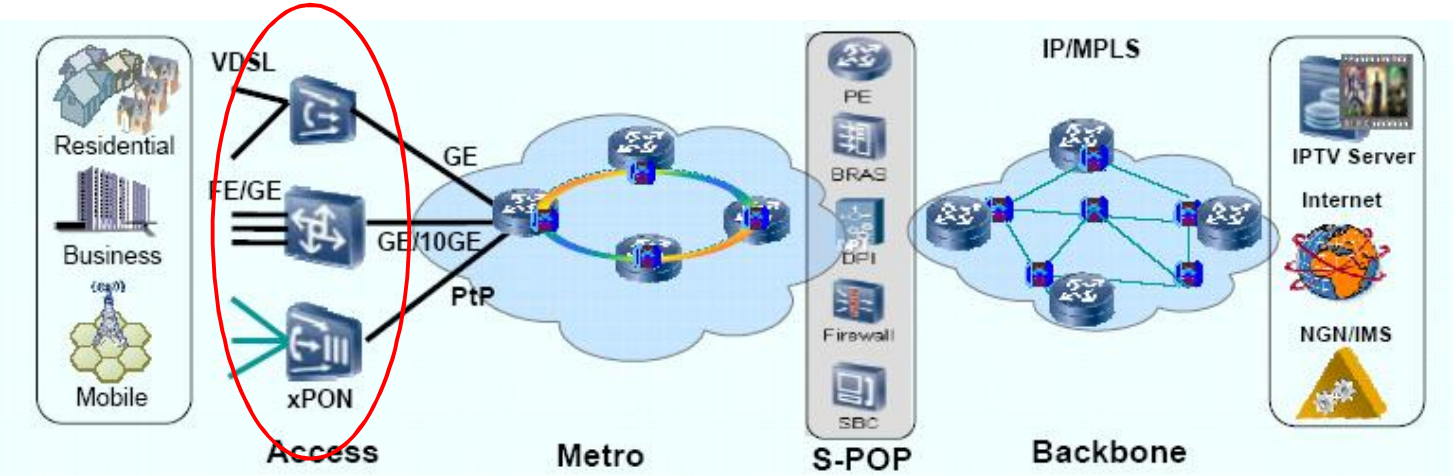
IPv6 performance test for routers

- **Long (128bit) IPv6 address may affect performance of routers and switches**
  - Routing calculation and forwarding table install need higher calculation performance and channel bandwidth
  - Forwarding engine need to match more bits in routing table lookup (modern high-end router could reach line-rate forwarding with the help of dedicated hardware)
- **Modern routers usually have ACL/QoS capabilities, which is commonly used in commercial networks. RFC5180 require the forwarding performance test should be carried out with ACL/QoS functions enabled.**
  - A key index would be ACL capacity and its effect to forwarding performance when maximum number of ACL is configured
- **Test methomodology for IPv4 routing performance is also valid to IPv6. Reference: OSPF/BGP/FIB/multicast (RFC2432, RFC3222, RFC3918, RFC4061, RFC4063, RFC4098, etc) at IETF bwmg WG (http://www.ietf.org/dyn/wg/charter/bmwg-charter.html)**
- **IPv6 specific performance test also includes tunneling performance; tunneling technology may exist for a long time in IPv6 network. Forwarding in tunnels needs more resource, and some functions may be implemented by software which would cause a performance bottleneck and make it difficult to deploy in a large scale.**
- **Impact of coexistance of IPv6 and IPv4 to IPv4 performance should be considered in IPv6 performance test**

IPv6 test for BRAS

- **Trend of flat network structure has become obvious. In order to realize network service control and network managemnet in a simpler network, BRAS and service router have been converging. In the early stage of IPv6 deployment, to save the cost of management and operations, PPPoE would be the perfered access technology.**
- **Beside the features of a service router, BRAS need to perform authentication, authorization and accounting for individual users and enterprise users. So the test should include:**
  - All the feature available on a service router
  - Access authorization for dual stack users. Vendors may use different access technics (DHCP/PPPoE) and different authorization technics, i.e. RADIUS, web protal, 802.1x
  - Access type: ethernet, VLAN and QinQ mode should be tested respectively
  - QoS features: beside requirements for service routers, HQoS, which is necessary for multiply, should also be considered
  - Performance and specification are the focus of the test

IPv6 test for access network devices

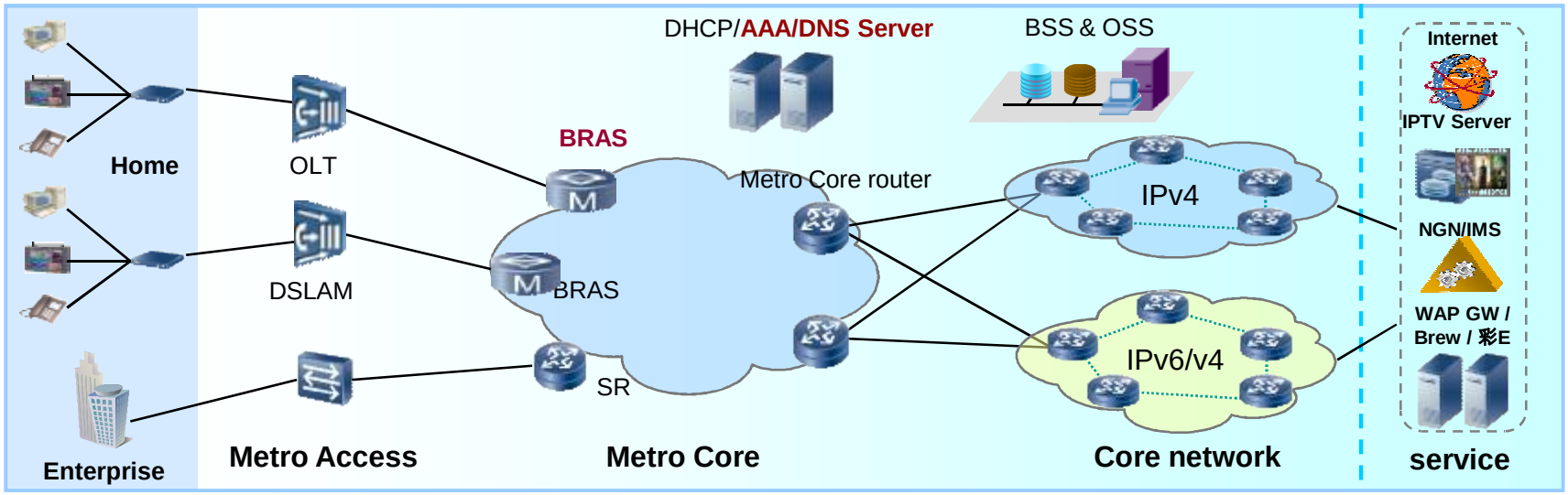


- **In the early stage of IPv6 deployment, layer2 forwarding could be used in the access network to achieve rapid business provisioning. In such a case, IPv6 features are not required.**
- **Access network should be IPv6 aware so as to support service management, including:**
  - MLD snooping
  - MVLAN
  - DHCPv6 snooping
  - DHCPv6 option, could insert and process user location and other information, i.e. Option18, Option37，Option23-24(DNS Server, DNS suffix), etc
  - RA Guard, draft-ietf-v6ops-ra-guard
- **Focus of the test would be on functional test and specification test, which is to find out whether the functionalities have been implemented and whether specified number of users could be supported.**
- **Do we need layer2 access and BRAS in future network?**

IPv6 test for transitional solutions

- **IPv6 is not backward-compatible with IPv4, it is expected that the coexist of IPv4 and IPv6 could last 10 years or even longer. Test of compatibility with IPv4 is very important.**
- **In transition area, IETF have developed a lot of technologies. None but dual stack technology has been deployed large scale network by operators. Main IETF working groups includes:**
  - v6ops:The IPv6 Operations Working Group (v6ops) develops guidelines for the operation of a shared IPv4/IPv6 Internet and provides operational guidance on how to deploy IPv6 into existing IPv4-only networks。The main focus of the v6ops WG is to look at the immediate deployment issues; more advanced stages of deployment and transition are a lower priority。 http://www.ietf.org/dyn/wg/charter/v6ops-charter.html
  - behave: focus on NAT technics. http://www.ietf.org/dyn/wg/charter/behave-charter.html
  - softwire:focus on IPv4 connection across IPv6 network and IPv4 connection across IPv6 network http://www.ietf.org/dyn/wg/charter/softwire-charter.html
  - Reference: rfc 4213 4038 4891 2473 2784
- **Test for solutions like DS-lite, tunnel, 6to4 translation should consider the following factors:**
  - MTU and fragmentation
  - ICMPv4 and ICMPv6 translation
  - Non TCP/UDP/ICMP payload, i.e. IPSEC, GRE
  - IPv6 header options
  - Multicast
  - Compability with existing NAT
  - DNS and other ALG solutions（not only packets transfer）
  - Others, i.e. security problem in a specific implementation

Test for network solution



- **When operators want to deploy IPv6 in the network, it is necessary to validate that the whole network solution could support the services. Vendors also need to validate the transition solution in a E2E manner to make sure the products and solution could meet the operators requirements.**
- **Network solution test should be performed in a E2E network environment, which includes:**
  - Upgrading and transition test
  - Service provisioning and erpericence test
  - Network performance and capacity test
  - Reliability test
  - Security test
  - Other considerations such as MIB, Network Management, service layer interoperation, etc

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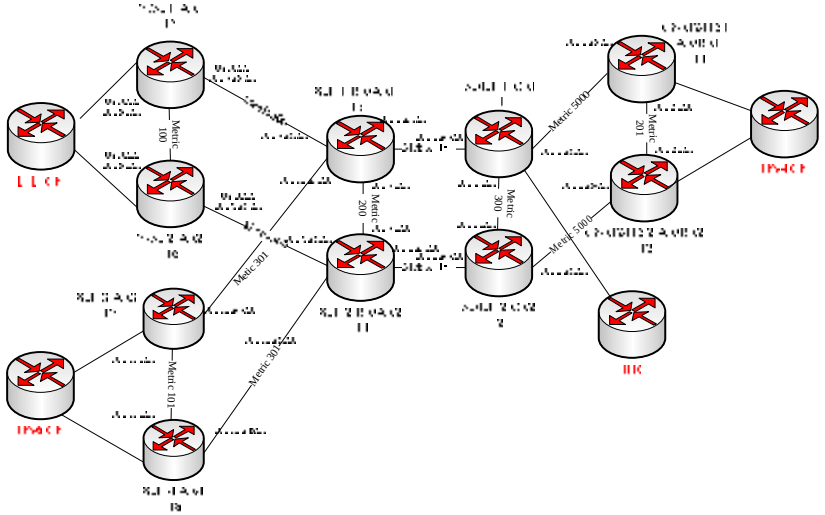
IPv6 test for operators

- **Before IPv6 deployment, operators need to do a series of IPv6 tests; it is not just for network device selection, but also a training course. IPv6 trial is a extension of test.**
- **The test would include two parts: network device test and network solution test.**
- **From a operator's point of view, the focus of the test would be:**
  - Performance
    number of users, forwarding performance, size of routing table; the performance under the stress; performance when introducing IPv6 (dual stack, tunnel, etc) into existing network
  - Reliability
    in case of huge traffic and large number of routing table items, the network devices should work reliably, network exceptions should be handled correctly
  - Interoperability
    interoperability at all layers in a multi-vendor scenario; compatible with exisit network devices.
  - Operations and maintenance
    easy to deploy, maintenance features, service booking and cancellation, performance of response, security, etc

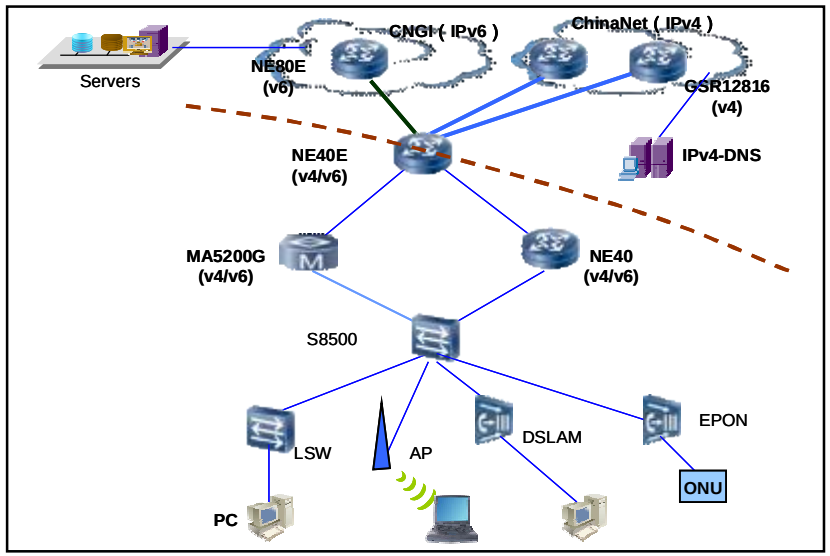
Example: multi-vendor interoperability test by China Mobile

- **China Mobile multi-vendor interoperability test adopts carrier-grade routers from HUAWEI, CISCO, JUNIPER, ALCALTE-LUCENT**
- **Test case**
  - QoS, routing protocol, MPLS and VPN interoperability
  - Four network mode: Native IPv6, 6PE, 6VPE, Dual Stack. Performance of E2E fault convergence is tested in each mode
  - interoperability and forwarding performance test for transitional solutions in E2E manner
  - quite some background traffic and routing table items are introduced in the test

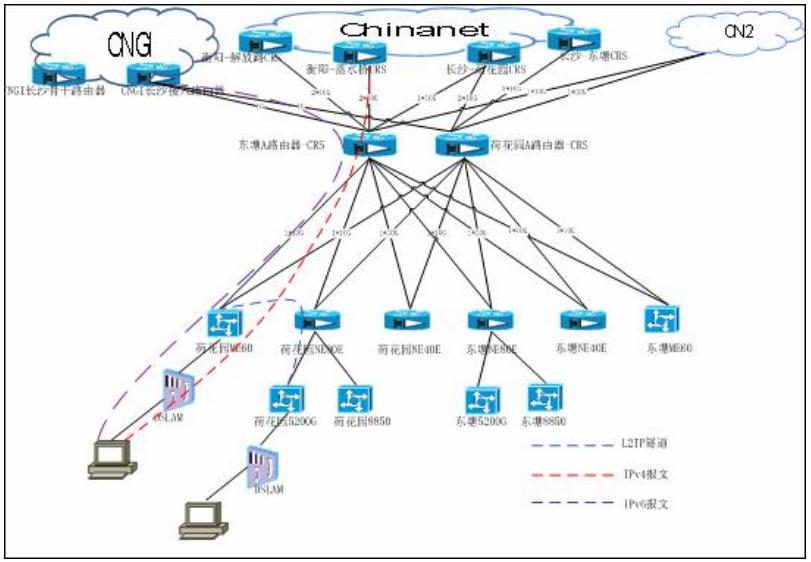


Network Topology for
China Moble Interoperability Test

Example: China Telecom IPv6 commercial trial metro network



China Telecom commmercial trial test environment



China Telecom commercial trial metro network
In Changsha City

- **In Changsha commercial trial metro network, BRASs and routers are all in dual-stack mode; access network is adopt layer2 forwarding; the trial network is connected to IPv6 backbone CNGI, and IPv4 backbone Chinanet and CN2**
- **Before the trial is started, two round of tests are done, lasting 6 months, to make sure routers, BRAS, network management system and OSS system can support IPv6 services.**

IPv6 test instruments

- **IPv6 test instruments used in the test include Ixia Optixia series and Spirent TestCenter series**
  - All support IPv6 protocol compliance test, fowarding test, routing test, performance test, etc
  - Test instruments can provide test solution for protocol compliance test

Test Center

N2X

Optixia

Thank you

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