IPv6 Transition Experience

IVI IPv4-IPv6 Translator Service

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IPv6 Transition

- Post IPv4 Completion
  - Need “IPv6 Transition”!
  - Coexistence IPv4 and IPv6
- Interoperate IPv4 clouds and IPv6 clouds
  - IPv6 network <-> IPv4 network
  - Translate Packets from IPv6(IPv4) to IPv4(IPv6)
A Short History of IPv6 Translator

- **2000**: NA(P)T-PT (RFC2776)
  - IPv4/IPv6 version's NAT
  - Cooperate with DNS-ALG
- **2007**: NAT-PT was deprecated to Histric Status
  - Deep depend DNS-ALG (need share state)
- **Now**: There is no standard...
What's IVI?

- IVI means IV(IPv4) <-> VI(IPv6)
- Designed by Xing Li @CERNET, et al.
  - draft-xli-behave-ivi-00, draft-baker-behave-ivi-01
- Based on SIIT(RFC2765) and NAT-PT(RFC2766)
  - But different address format
  - No shared state between NAT and DNS-ALG
- Support **Stateless** Address Translation (1:1)
  - IPv4 hosts can initiate to access a IPv6 host!
  - Also supports stateful address translation (1:N)
IVI Address Format

- LIR Prefix consists of two parts
  - ISP's prefix (/32) + IVI marker ('FF')
    - e.g. 2001:db8:ff00::/40
- Embedded 'IPv4 Addr'(ess)
  - IPv4 host address, or
  - IPv6 host's (mapped) IPv4 address
IVI Address Format (cont'd)

IPv6 Address (IVI6 address)

IPv4 address

Prefix

Embedded IPv4 part

IPv6 Address

2001:db8: ff

0a:0405:06

00:: (entirely 0)

10.4.5.6

0 32 40 64 72 127
How to translate packets

1) Query Y's AAAA RR?

2) Query Y's A RR?

3) Y's A RR is 10.4.5.6

4) Synthesize AAAA from Y's A RR

5) Y's AAAA is 2001:db8:ff01:405:600::

[IPv6 Packet]
DST=2001:db8:ff0a:405:600::
SRC=2001:db8:ff0a:102:300::

2001:db8:ff0a:102:300:: (mapped IPv4 address = 10.1.2.3)

[IPv4 Packet]
DST=10.4.5.6
SRC=10.1.2.3

6) IPv6<->IPv4 Translation!
Routing Topology

2001:db8:ff::/40

IVI GW

10.1.2.0/24

2001:db8:ff0a:102::/64

IVI(IPv6) Network

IPv4 Network
• IVI Demo was provided during the meeting period
• Only Stateless Translator (no stateful)
• IVI6 Client Network was separated from the generic wireless network (different SSID)
• Configurations for IVI6 Clients were set by participants manually
  - We passed a slip to each demo participants
    • IPv6(IVI6) address, DNS server's address, SSID
Spec/Topology @ARIN Demo

- **IVI GW**
  - Linux 2.6.12 + IVI patch, Debian
  - totd 1.4 + IVI AAAA synthesizing feature (DNS-ALG)
  - alternatives?
  - Pentium III 1GHz, RAM: 256MB

- **IVI6 clients**
  - Demo Participants Laptops
Measuring Result

- From 16th morning to 17th morning (one day)
- 6 IVI clients
- 1503 IPv4 addresses were translated
- More than 90% of communication were translated (IPv6<->IPv4)
  - 90.68% (packet-base), 92.66% (byte-base)
  - Native IPv6 communication < 10%
- CPU Load - no data, but very low
  - because of no need to manage states
# of Translated I/O
Packets, Bytes

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Protocol Breakdown

TCP Protocol Breakdown (packets)  TCP Protocol Breakdown (bytes)

(IVI6 clients' addresses <-> (almost)Mapped IPv6 Addresses)
Demo Issues

• Address Assignment
  - Stateless Address Auto Configuration (RA)
    • IPv6 prefixes are different on each clients
  - DHCPv6
    • Need to install DHCPv6 client software
  - Manual (used in the demo)
    • pass out a slip with an address, default gw and DNS server address for attendees. and set by user

• Name resolution (DNS)
  - Windows XP can't resolve DNS over IPv6
    • need some hacks, will be introduced in JTech's demo
Demo @JTechs

- **IVI GW**
  - Linux 2.6.12 + IVI patch, Debian
  - radvd (sends RA)
    - notify default GW (no prefix)
- **DNS-ALG**
  - totd 1.4 + IVI AAAA synthesizing feature (DNS-ALG)
- **DHCP Server**
  - DHCPv6 (dibbler)
  - DHCPv4 (ISC DHCP3), for XP
IETF Standardization Status

• Replace NAT-PT
  - Now a lot of candidates proposed in IETF
    • IVI, NAT64, NAT6, sNAT-PT...
    • discussing in IETF behave WG, etc
  - conclusion: Merge the various proposals
    • @interim meeting, Oct 2008
  - Support both stateless and stateful
    • draft-baker-behave-v4v6-framework-00
    • draft-baker-behave-v4v6-translation-00
Summary

• Address Assignment
  – RA can not distribute 1:1 mapping address
  – DHCPv6 is required
    • But need to install DHCPv6 client software
      – e.g., dibbler, WIDE-DHCPv6, ISC-DHCP-4 for *nix
      – Vista supports DHCPv6 (kicked if RA M&O flags is on)
    • There is no way to recognize the assigned address is as a 1:1 mapping address
Summary (cont'd)

- Protocols that are carrying IP addresses
  - Need ALG (SIP, some web applications, etc)
  - Same problem in IPv4-NAT
    - will be gone after IPv6 deployment

- Using DNSSEC
  - Validating resolver case
    - IVI6 client (stub resolver) CAN NOT validate the synthesized AAAA RR
  - Validating server case
    - IVI-DNS (DNS-ALG) CAN validate the original A RR
  - Other technique? => incremental signing
Summary (cont'd)

• Address selection
  - In IPv6 only network
    • IPv6 only host must select most similar addresses pair

  
  IPv4 host (10.4.5.6)
  
  2001:db8:ff0a:405:600::
  
  IVI GW
  
  2001:db8:ff0a:102:300::
  
  IVI host
  
  2001:db8:1234::5

  - In dual-stack network
    • Host must use/select IPv4 (address) if destination is a synthesized IPv6 address

  IPv4 host (10.4.5.6)
  
  2001:db8:ff0a:405:600::
  
  IVI GW
  
  2001:db8:ff0a:102:300::
  
  IVI host
  
  2001:db8:1234::5

  10.1.2.3
Appendix
IPv4 node

DNS

root DNS

com DNS

PROBLEM

can't generate RRSIG for mapped AAAA

node.example.com A

node.exapmle.com A

eample.com NS,
eample.com DS,RRSIG(DS)

node.example.com A

node.example.com A,RRSIG(A)

Map A to AAAA & return

node.example.com AAAA

validation

(1:1 Mapping)

cache server

IVI DNS

node.example.com AAAA?

node.example.com AAAA?

IVI node

node.example.com AAAA?
IVI Stateful Operation

- Use port multiplexing technique
  - IVI GW need to manage a lot of states

IPv4 host (10.4.5.6) -> IVI GW
src=10.1.2.3:8000

IVI GW
src=[2001:db8:ff0a:102:300:1]:8000

IVI host 1
src=10.1.2.3:8001

IVI host 2
src=[2001:db8:ff0a:102:300:2]:8000

dst port: need to be changed

Manage port multiplexing status