IPv4/IPv6 Translation: Framework

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Outcome from the Montreal Interim

• Basically, merging NAT64 and IVI to produce a common translation technology
  – Not to exclude other documents, but these form the basis

• Described in at least four documents:
  – Framework
    • draft-baker-behave-v4v6-framework
  – SIIT Update – basic translation behavior
    • draft-baker-behave-v4v6-translation
  – Extensions for stateful translation
    • draft-bagnulo-behave-nat64
  – DNS Translation gateway
    • draft-bagnulo-behave-dns64
  – Possible future documents
    • FTP ALG etc
The IPv4 packets arrived in the IP/ICMP translator will be translated to IPv6 packets.
- The translator translates the packet headers from IPv4 to IPv6 and translates the addresses in those headers from IPv4 addresses to IPv6 addresses.

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Terminology (1)

• **State**
  – Refers to dynamic per-flow or per-host state

• **Stateless translation**
  – The translation information is carried in the address itself, permitting both IPv4->IPv6 and IPv6->IPv4 sessions establishment.

• **Stateful translation**
  – Translation state is maintained between IPv4 address/port pairs and IPv6 address/port pairs, enabling IPv6 systems to open sessions with IPv4 systems.
Terminology (2)

- **IPv4-mapped IPv6 address**
  - The IPv4-mapped IPv6 addresses are the IPv6 addresses which have unique relationship to specific IPv4 addresses.
  - This relationship is self described by embedding IPv4 address in the IPv6 address.

- **Unmapped IPv6 address**
  - The unmapped IPv6 addresses are general IPv6 addresses.
  - There may exist relationship to the IPv4 addresses, but this relationship is maintained as the states (mapping table between IPv4 address/port and IPv6 address/port) in the translator.
  - The states are either manually configured or session initiated.
Terminology (3)

- IPv4 address pool
  - In the stateful mode, a certain amount of IPv4 addresses are maintained in the translator as the IPv4 address pool.
  - In the stateless mode, there is no IPv4 address pool in the translator. A special block of IPv4 addresses are reserved, embedded in the IPv6 addresses and represented by the IPv6 end systems.
IPv4/IPv6 Translation: temporary tool to help coexistence/transition

- IPv4 addresses
  - Embedded in an IPv6 prefix in the IPv6 domain
  - Stateless and stateful translation

- Connectivity provided:
  - IPv4 <-> IPv4
  - IPv6 <-> IPv6
  - 1:N IPv6 -> IPv4 (unmapped)
  - 1:1 IPv6 <-> IPv4 (mapped)

- Attributes:
  - Enables services in both domains
  - Stateless translation works in multiple providers, multiple translators

- Experience:
  - IVI 2 years in CERNET
  - NAT-PT/SIIT commercially deployed
The address format chosen

• Basic format:
  – IPv4 address embedded in IPv6 address

• Prefix: provided by the network administration
  – 0::0/3 format has routing issues with multiple translators and with multiple IPv4 domains
  – 0::0/3 format partially deprecated in RFC 4291

• Placement of IPv4 address:
  – Cook’s choice: IPv4 bit 0 in IPv6 bit 33..63 or 96
  – Prefix64::/96 format appropriate for CPE and for stub IPv4 networks
  – Putting upper part of prefix in routing locator appropriate for ISP usage
ISP usage #1

• Carrier Grade NAT, if you will
  – Designed to facilitate carrier transition with customers in various phases of transition

• Enables service:
  – IPv6 /48 or longer general prefix to customer
  – Equivalent of IPv4 /24 or longer to customer in IPv6 form for access by remote IPv4-only hosts with 1:1 stateless translation
    – Requires advertisement of /64 by edge network for IPv4-mapped IPv6 addresses
  – IPv6-only service with
    • remote IPv4 hosts accessing local mapped IPv6-only servers and
    • local IPv6 hosts accessing remote IPv4-only servers
ISP usage #2 (residential/SOHO/SMB)

- Dual stack customers around IPv6-only network
- /64..48 to customer results in
  - One /64 translated to IPv4
  - $2^n-1$ /64 IPv6 subnets
  - No IPv4-accessible servers

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<tr>
<th>ISP provided /96 prefix</th>
<th>IPv4 Address</th>
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IPv6-only Network Domain
Or host
Stub network usage:
Access to legacy equipment

- IPv6-only network, IPv4-only equipment (could be dual stack but network chooses not to)
- /64 prefix to RFC 1918 space with 1:1 stateless translation
Routing advertisements by translator

- In the IPv4 network
  - Translator advertises an IPv4 prefix for stateless translation in ISP#1 case
  - Translator advertises an IPv4 prefix for the stateful translation address pool
  - Attracts traffic destined for translation to IPv6
- In the IPv6 network
  - Translator advertises an IPv6 prefix for entire IPv4 address space
  - Attracts traffic destined for translation to IPv4
Usage of 1:n translation

• Primarily to let IPv6-only hosts with general format addresses access IPv4-only servers/peers
• IPv4 access to general IPv6 hosts excluded due to complexity
Usage of DNS translator

• Client/Server and Peer/Peer
  – Enable IPv6 hosts with mapped addresses to be accessible to IPv4 clients/peers
  – Enable IPv4 hosts to be accessed by IPv6 clients/peers
• Designed for simplicity and maintainability
  – Simplest case is static configuration of records
  – Capable of dynamic translation A<->AAAA
  – Capable of multiple DNS servers with predictable results and no state other than DNS caches