IP/ICMP Translation Algorithm

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Abstract

- This document specifies an update to the Stateless IP/ICMP Translation Algorithm described in RFC 2765. The algorithm translates between IPv4 and IPv6 packet headers (including ICMP headers).

- The specification addresses both a stateful and a stateless mode.

  - In the stateless mode, translation information is carried in the address itself, permitting both IPv4->IPv6 and IPv6->IPv4 session establishment.

  - In the stateful mode, translation state is maintained between IPv4 address/port pairs and IPv6 address/port pairs, enabling IPv6 systems to open sessions with IPv4 systems.

- The choice of operational mode is made by the operator deploying the network. This document confines itself to the actual translation.

Document structure

- Introduction and Motivation
  - Translation Model
  - Applicability and Limitations
  - Stateless vs Stateful Mode
  - IPv4-embedded IPv6 addresses and IPv4-related IPv6 addresses
- Translating from IPv4 to IPv6
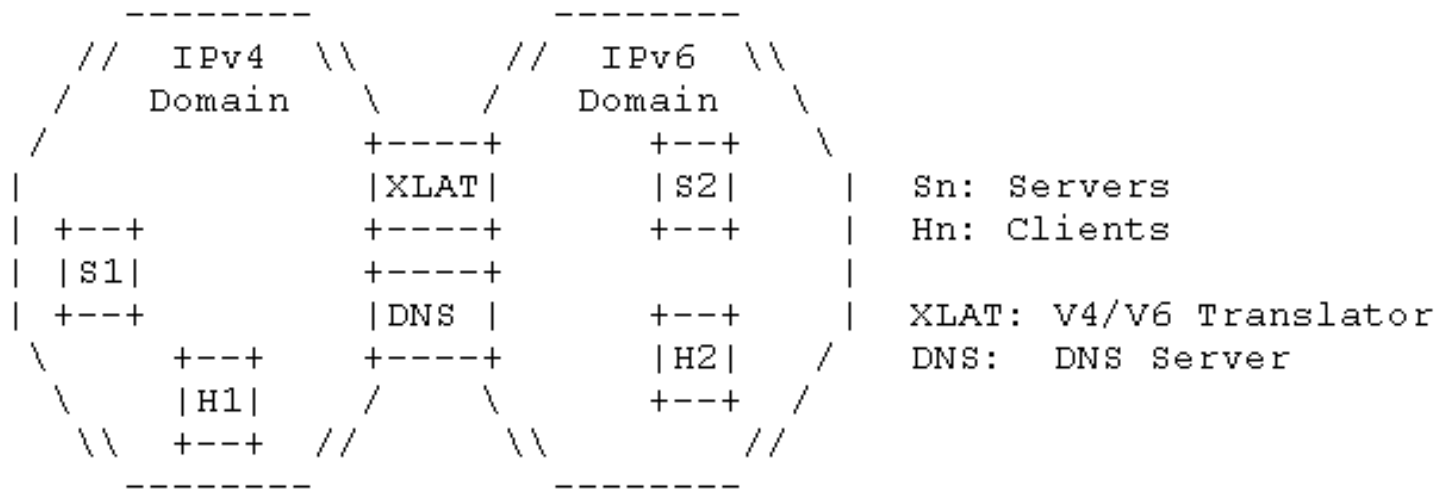- Translating from IPv6 to IPv4

Translation Model

```
         --------              --------
      //   IPv4   \\        //   IPv6   \\
     /   Domain    \      /   Domain     \
    /            +----+        +--+       \
    |            |XLAT|        |S2|    |    Sn: Servers
    | +--+       +----+        +--+    |    Hn: Clients
    | |S1|       +----+                |
    | +--+       |DNS |        +--+    |    XLAT: V4/V6 Translator
     \    +--+   +----+        |H2|   /     DNS:  DNS Server
      \   |H1|     /    \      +--+  /
       \\ +--+  //        \\        //
         --------              --------

         Figure 1:  Translation Model
```

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Stateless vs Stateful Mode

- In the stateless mode, one system has an IPv4 address and one has an address of the form specified in [FRAMEWORK], which is explicitly mapped to an IPv4 address. In this mode, there is no need to concern oneself with port translation or translation tables, as the IPv4 and IPv6 counterparts are algorithmically related.

- In the stateful mode, the system with the IPv4 address will be represented by that same address type, but the IPv6 system may use any [RFC4291] address except one in that range. In this case, a translation table is required.
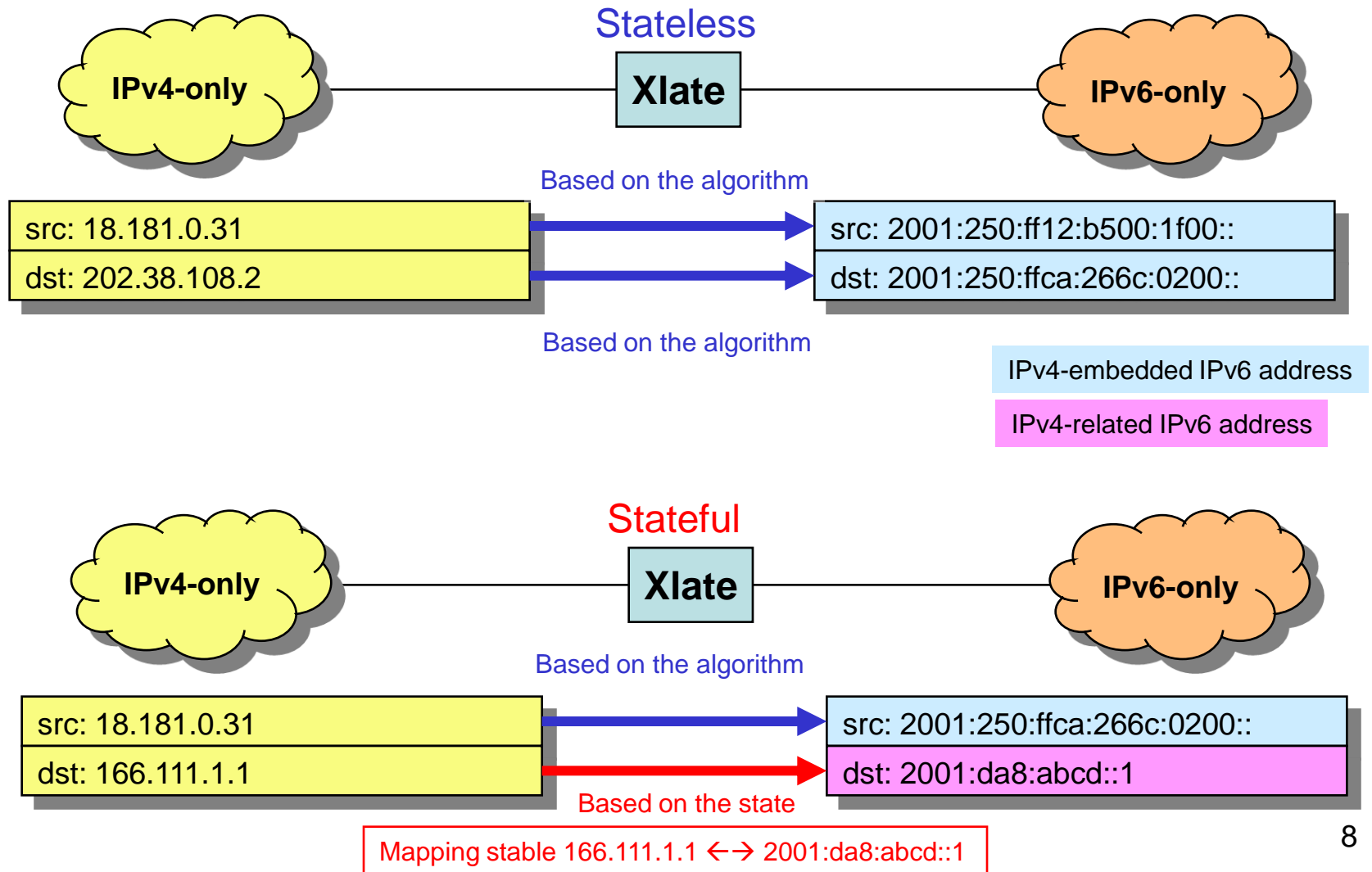
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IPv4-embedded IPv6 addresses and IPv4-related IPv6 addresses

- The IPv4-embedded 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. The IPv4-embedded IPv6 addresses are used for both the statesless and the stateful modes.

- The IPv4-related IPv6 addresses are the IPv6 addresses which have unique relationship to specific IPv4 addresses. This relationship is maintained as the states (mapping table between IPv4 address/ transport_port and IPv6 address/transport_port) in the IP/ICMP translator. The states are session initiated. The IPv4-related IPv6 addresses are used fo the stateful mode only.

Translation specifications

- Translating from IPv4 to IPv6
  - Translating IPv4 Headers into IPv6 Headers
  - Translating UDP over IPv4
  - Translating ICMPv4 Headers into ICMPv6 Headers
  - Translating ICMPv4 Error Messages into ICMPv6
  - Transport-layer Header Translation
  - Knowing when to Translate
- Translating from IPv6 to IPv4
  - Translating IPv6 Headers into IPv4 Headers
  - Translating ICMPv6 Headers into ICMPv4 Headers
  - Translating ICMPv6 Error Messages into ICMPv4
  - Transport-layer Header Translation
  - Knowing when to Translate

4→6 Address translation examples

Stateless

IPv4-only — **Xlate** — **IPv6-only**

Based on the algorithm

| src: 18.181.0.31 | → | src: 2001:250:ff12:b500:1f00:: |
| dst: 202.38.108.2 | → | dst: 2001:250:ffca:266c:0200:: |

Based on the algorithm

IPv4-embedded IPv6 address

IPv4-related IPv6 address

Stateful

IPv4-only — **Xlate** — **IPv6-only**

Based on the algorithm

| src: 18.181.0.31 | → | src: 2001:250:ffca:266c:0200:: |
| dst: 166.111.1.1 | → | dst: 2001:da8:abcd::1 |

Based on the state

Mapping stable 166.111.1.1 ←→ 2001:da8:abcd::1

6→4 Address translation examples

Stateless

IPv4-only —— **Xlate** —— **IPv6-only**

Based on the algorithm

| src: 202.38.108.2 | ←— | src: 2001:250:ffca:266c:0200:: |
| dst: 18.181.0.31 | ←— | dst: 2001:250:ff12:b500:1f00:: |

Based on the algorithm

IPv4-embedded IPv6 address

IPv4-related IPv6 address

Stateful

IPv4-only —— **Xlate** —— **IPv6-only**

Mapping stable 166.111.1.1 ←→ 2001:da8:abcd::1

Based on the state

| src: 166.111.1.1 | ←— | src: 2001:da8:abcd::1 |
| dst: 18.181.0.31 | ←— | dst: 2001:250:ffca:266c:0200:: |

Based on the algorithm

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