Native IPv6 Service across NAT44s (6a44)

draft-despres-softwire-6a44-01

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Problem Statement

- Host behind IPv4-only CPEs must be supported
- More and more ISPs assign private IPv4 addresses to customer sites
- Some applications need outgoing AND incoming connectivities
- Local traffic must remain "local"
- Operation must be Plug-and-Play
- QoS must be controlled by local ISPs
Limitations of other solutions

- IPv6 Tunnel Brokers
  - Local communication is via the ISP network!
  - Not completely plug-and-play
- Teredo (as is)
  - With some NAT-types, incoming and outgoing connectivity can break
  - QoS isn't controlled by local ISPs
Feasibility with 6a44

- **IPv6/UDP/IPv4**
- Well known Relay anycast address
- Well known 6a44 port
- Stateless Address Mapping

**ISP NETWORK**
- IPv4 global or private + IPv6 Possible

**ISP Backbone**
- CGN44 (if private)

**IPv6 network**

**CPE**
- IPv4-only

**Customer network**
- Private IPv4

**6a44 HOST**
- Private IPv4
Address construction

• 6a44 address = D.N.Z.A/128, where:
  • **D/48** is the IPv6 prefix assigned by the ISP to NAT44 customer sites
  • **N/32** is the IPv4 Address of the site (public or private)
  • **Z/16** is the external UDP port of the tunnel maintained by the host across the NAT to reach 6a44 Relays
  • **A/32** is the IPv4 local address of the host
6a44 Address Format

Customer network

CPE

ISP NETWORK

6a44 relay

IPv6 network

HOST

A

W

N

Z

B

BR address /32

IPv4

IPv6

D

N

Z

A

D/48 ...

6a44-assigned IPv6 prefix /48

host IPv4 address /32

NAT port for <A,W> /16

CPE IPv4 address /32
Parameter Acquisition by a Host

- A **Host** sends **Parameter Requests** to Relays:
  - Periodically in the absence of host to relay traffic (NAT binding refresh)
  - With its local IPv4 address as data
- A **Relay** transmits a **Parameter Indications** to a host:
  - When it receives a parameter request
  - With the host IPv6 address (and a lifetime?)
  - Also if it receives from the host a packet with incompatible IPv6 IPv6 and IPv4+port that are inconsistent (CPE reset)
Incremental Deployment

• An ISP can start with just a few relays
• If more are needed: sign of real user service (intense IPv6 traffic from and to hosts behind NAT44 CPEs)
• If a host supports 6a44
  ➔ Where the local ISP supports 6a44:
    • Native IPv6 addresses are usable
    • Local traffic remains local
  ➔ Where other native IPv6 addresses are available
    => no harm
  ➔ Where ISPs don't support 6a44 => no harm
Open questions

• Can it be treated as a Teredo option
  • Possibly autonomous (Teredo-lite variant)
  • Possibly added to existing Teredo supports
• Is there a place in IETF to pursue the work
Technical Complement

Detailed Mappings and Encapsulations/Decapsulations of \textit{draft-despres-softwire-6a44-01}

(for reference)
Mappings and Encapsulations Rules

Host to Relay

\[(v6, <D.N.Z.A>, not <D.N...>, data)\]

\[\rightarrow \]

\[(v4, A, B, (UDP, W, W, <IPv6 pkt>))\]

\[\rightarrow \]

\[\rightarrow \] 6a44-C

\[IPv6 \rightarrow IPv4\]

\[\rightarrow \] Host
Mappings and Encapsulations Rules
Host to Host (intra-site)

(v6,<D.N.Z.A>,<D.N.Z2.A2>, data)

| (v4,A,A2,(UDP,W,W, <IPv6 pkt>)) |

+-----|-----------------+
|     |                |
|     |                |
+--->-- 6a44-C +------>------
| IPv6 |        |<A IPv4
|-------|--------|
  Host

2010-11-11
Mappings and Encapsulations Rules

Relay Traversal

\[
(v4, \langle N=\text{not } B \rangle, B, (UDP, Z, W, (v6, \langle D.N.Z... \rangle, \text{not } <D...>, \text{data})))
\]

\[
\langle \text{IPv6 pkt} \rangle
\]

\[
\begin{align*}
\text{IPv4} & \quad \text{-----} \quad 6a44-C \quad \text{---} \quad \text{-----} \\
6a44-C & \quad \text{-----} \quad \text{-----} \quad \text{-----} \quad \text{-----} \\
\text{IPv6} & \quad \text{-----} \quad \text{-----} \quad \text{-----} \quad \text{-----} \\
\end{align*}
\]

6a44 Relay
Mapping and Encapsulation Rules

Relay Hairpinning

\[
(v4, \langle N_1 = \text{not } B \rangle, B, (UDP, Z_1, W, (v6, \langle D \cdot N_1 \cdot Z_1 \ldots \rangle, \langle D \cdot N_2 \cdot Z_2 \ldots \rangle, \text{data})))
\]

\[\begin{align*}
\text{IPv4} & \quad \text{+----------------+} \\
\text{B} & \quad | \quad 6a44-C \\
\text{IPv6} & \quad | \quad \text{IPv6} \\
\end{align*}\]

\[\begin{align*}
\text{6a44 Relay} & \quad \text{HAIRPINNING CASE} \\
\end{align*}\]

\[
(v4, B, N_2, (UDP, B, Z_2, <IPv6 \text{ pkt}>))
\]
Parameter Acquisition by Hosts
Message Processing in 6a44 Relays

\[(v4,N,B,(UDP,Z,W,(6a44,A)))\]

OR

\[(v4,N,B,(UDP,Z,W,(IPv6,not<D.N.Z.A>,...)))\]

| +------------------+
|        |         |<D
| IPv4   B>       | 6a44-C   |------
|        |         | IPv6
| +------------------+

\[(v4,B,N,(UDP,B,Z,(6a44,<D.N.Z.A>,lifetime)))\]