Native IPv6 Service across NAT44s (6a44)

draft-despres-softwire-6a44-01

Rémi Després – RD-IPtech
Brian Carpenter – Univ. of Oakland
Sheng Jiang – Huawei

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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
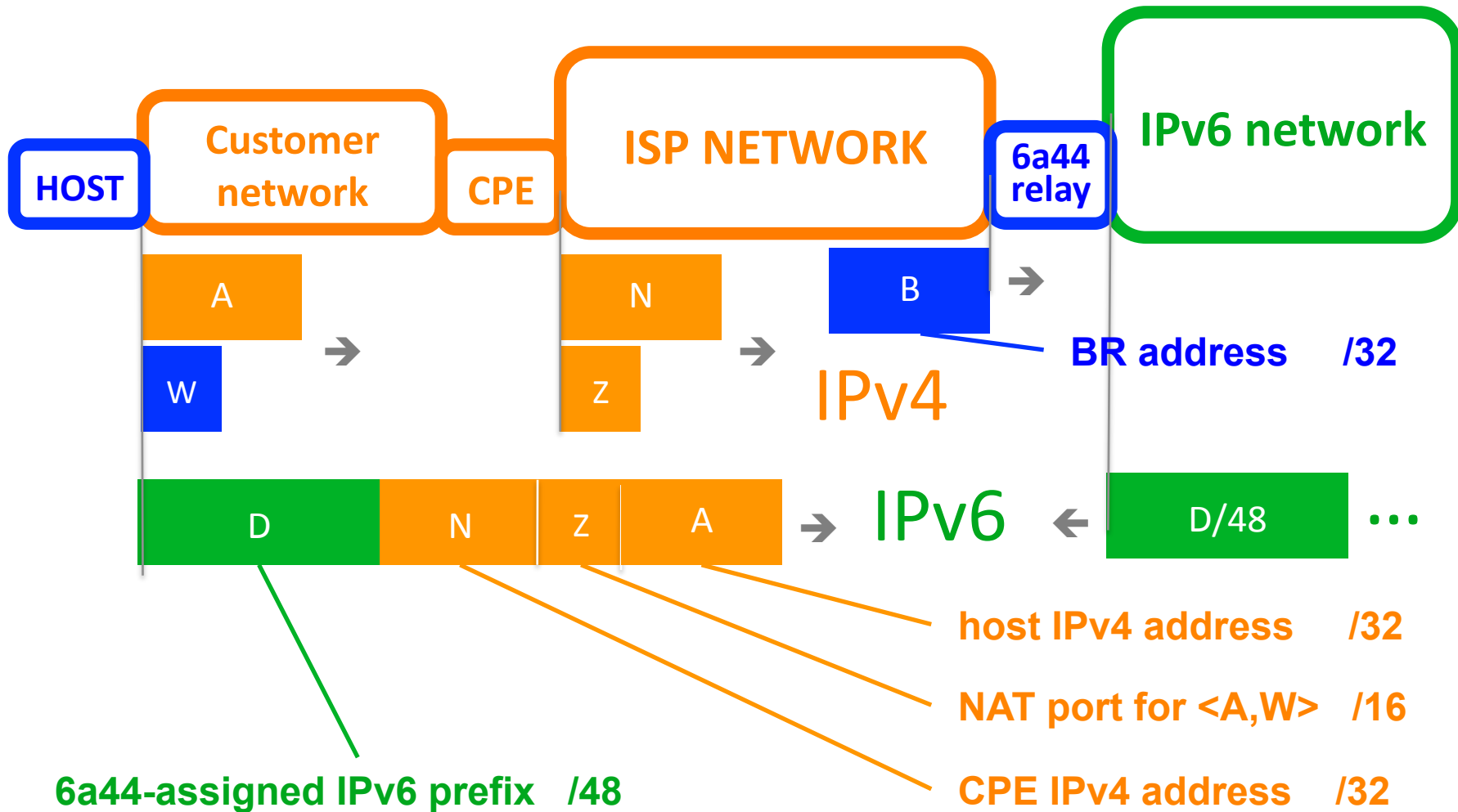 - **QoS** isn't controlled by local ISPs

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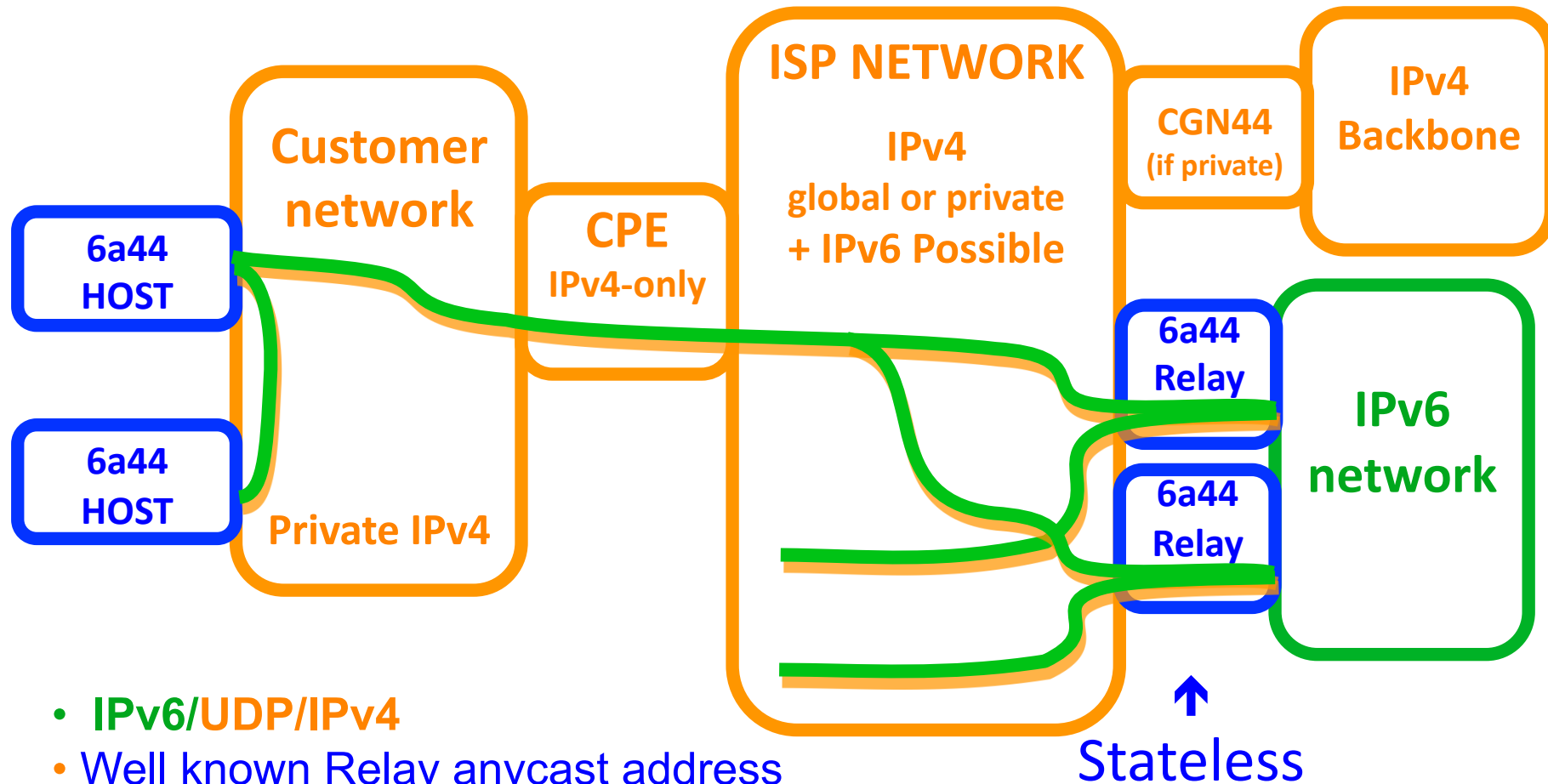
- **IPv6/UDP/IPv4**
- Well known Relay anycast address
- Well known 6a44 port
- Stateless Address Mapping

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

HOST — Customer network — CPE — ISP NETWORK — 6a44 relay — IPv6 network

A / W → N / Z → B → IPv4

BR address /32

D | N | Z | A → IPv6 ← D/48 ...

host IPv4 address /32

NAT port for <A,W> /16

CPE IPv4 address /32

6a44-assigned IPv6 prefix /48

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
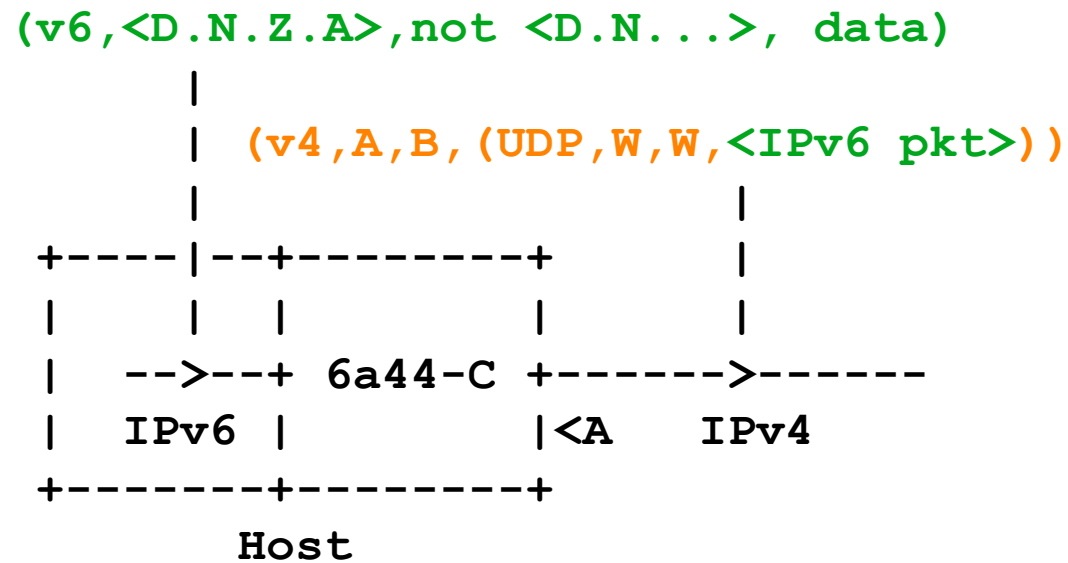- Is there a place in IETF to pursue the work

Technical Complement

Detailed Mappings
and Encapsulations/Decapsulations
of *draft-despres-softwire-6a44-01*

(for reference)

Mappings and Encapsulations Rules
Host to Relay

```
(v6,<D.N.Z.A>,not <D.N...>, data)
        |
        |   (v4,A,B,(UDP,W,W,<IPv6 pkt>))
        |                       |
+----|--+--------+             |
|       |   |            |     |
|   -->--+ 6a44-C +------>------
|  IPv6 |            |<A   IPv4
+-------+--------+
        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
```
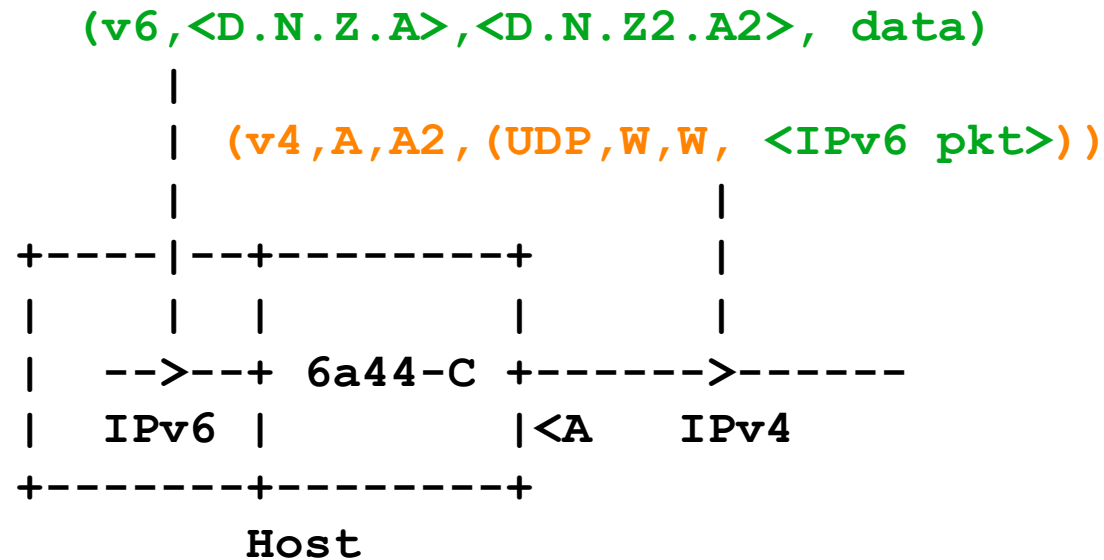
Mappings and Encapsulations Rules
Relay Traversal

```
(v4,<N=not B>,B,(UDP,Z,W,(v6,<D.N.Z...>,not <D...>, data)))
      |
      |                     <IPv6 pkt>
      |                          |
      |         +--------+--|------+
      |   B>|   |        |  |       |<D
---->-----|  6a44-C |-->>------+---->
    IPv4    |        |         |  IPv6
            +--------+---------+
                6a44 Relay
```
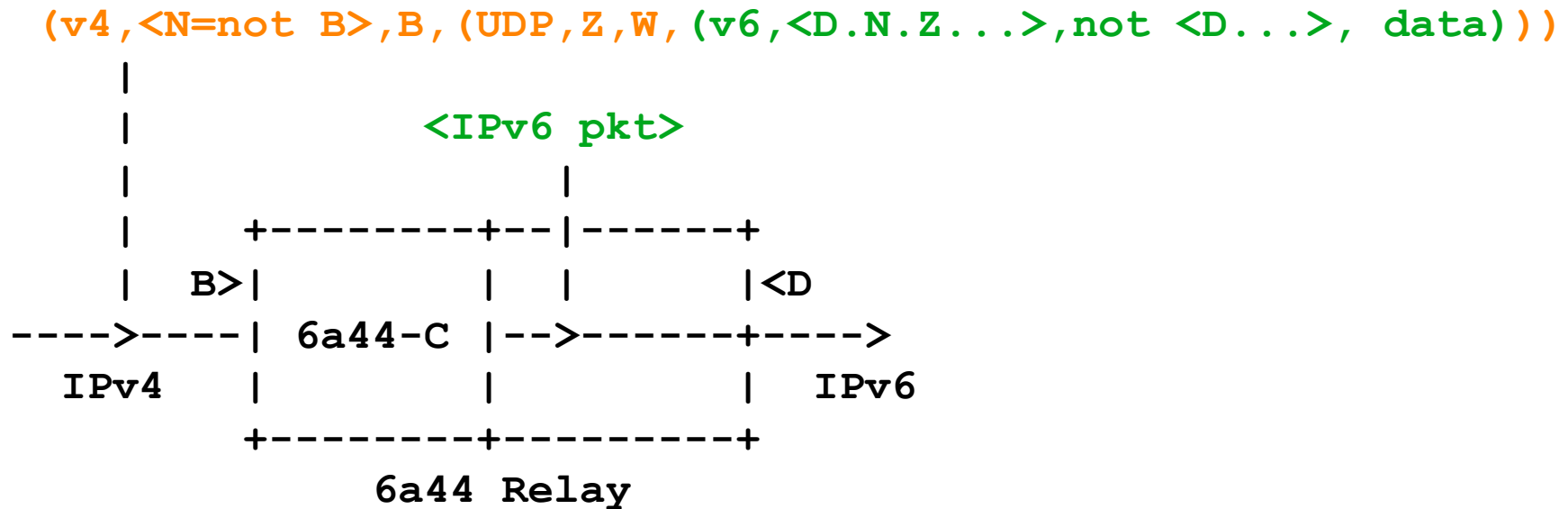
Mapping and Encapsulation Rules
Relay Hairpinning
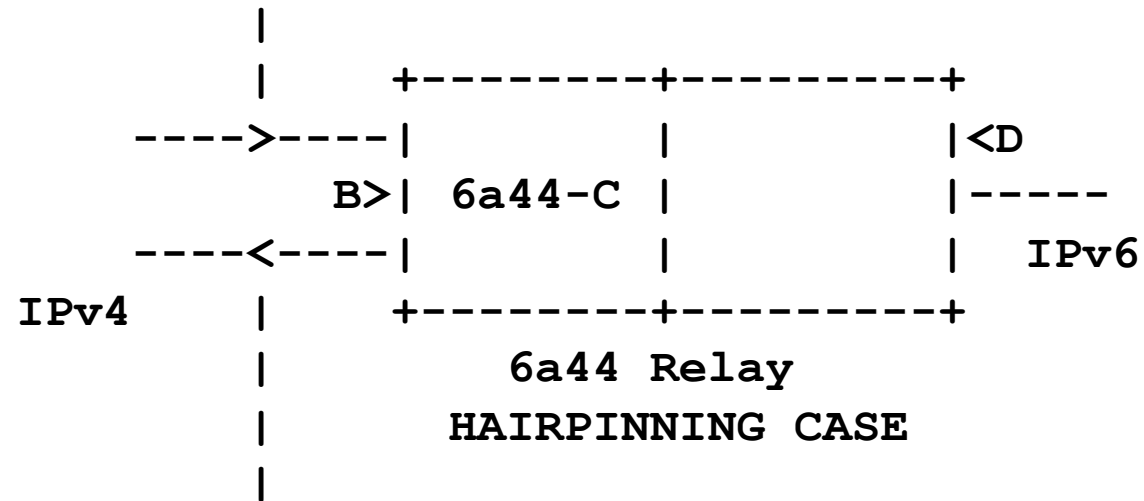
```
(v4,<N1=not B>,B,(UDP,Z1,W,(v6,<D.N1.Z1...>,<D.N2.Z2...>, data)))
                        |
                        |       +--------+--------+
              ---->----|        |        |        |<D
                     B>| 6a44-C |        |        |-----
              ----<----|        |        |        | IPv6
      IPv4      |       +--------+--------+
                |           6a44 Relay
                |         HAIRPINNING CASE
                |
     (v4,B,N2,(UDP,B,Z2, <IPv6 pkt>))
```
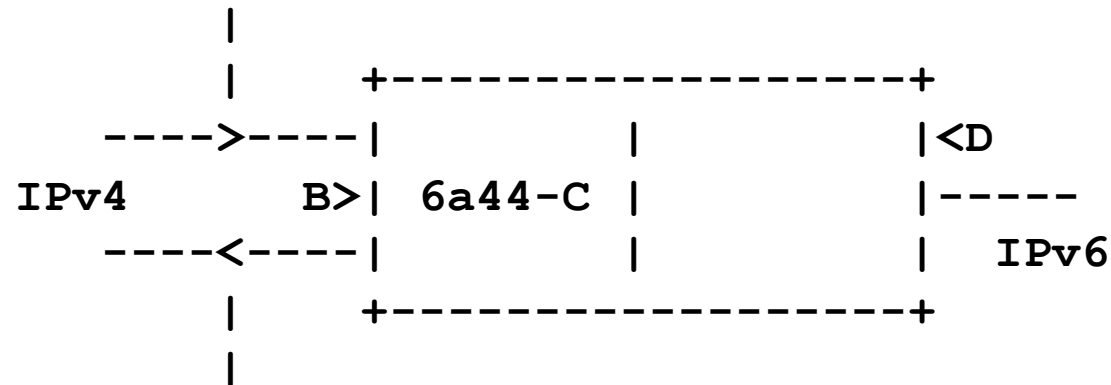
Parameter Acquisition by Hosts
Message Processing in 6a44 Relays

```
(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)))
```