Asymmetric IPv6

draft-jiang-asymmetric-ipv6-02

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Motivation and Approach

- In edge IoT deployments, physical MTU and bit rate may be very low, so packet size needs to be minimized
- Also, the edge routers may be constrained
  - compression/decompression algorithms use resources
  - 128 bit addresses consume memory
- The proposed approach is
  - Shorten addresses inside IPv6 packets
  - Route on shortened addresses
  - Don’t transmit unnecessary bytes
  - Avoid compression/decompression algorithms

The device in LAN uses short addresses internally, directly communicate with devices in external address space (long addresses)
Method

• Define an address length N within a domain
• All addresses inside the domain are assumed to have a common prefix of (128-N) bits
• RIB/FIB can use short addresses for intra-domain forwarding, full addresses outside
• Unnecessary header bytes are elided
• Use a “flexible header encoding”
How to determine address length within a domain

• Each node must be configured with address length
  – By manufacturers
  – By network operators
  – By endpoint users

• Get address length as a parameter from gateway when attaching

• Negotiate address length with neighbors
  ✓ Use function $f$ to determine the address length
RA Message with modified prefix option

- Reuse RA message
- But define new flag bit for short address mode

**Router Advertisement Message**

<table>
<thead>
<tr>
<th>Field</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>8 bits</td>
</tr>
<tr>
<td>Code</td>
<td>8 bits</td>
</tr>
<tr>
<td>Checksum</td>
<td>16 bits</td>
</tr>
<tr>
<td>Cur Hop Limit</td>
<td>16 bits</td>
</tr>
<tr>
<td>M (0)</td>
<td>O (1)</td>
</tr>
<tr>
<td>Router Lifetime</td>
<td>32 bits</td>
</tr>
<tr>
<td>Reachable Time</td>
<td>32 bits</td>
</tr>
<tr>
<td>Retrans Timer</td>
<td>32 bits</td>
</tr>
<tr>
<td>Options</td>
<td>Variable</td>
</tr>
</tbody>
</table>

**Modified Prefix Information Option**

<table>
<thead>
<tr>
<th>Field</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>8 bits</td>
</tr>
<tr>
<td>Length</td>
<td>8 bits</td>
</tr>
<tr>
<td>Prefix Length</td>
<td>16 bits</td>
</tr>
<tr>
<td>Reserved1</td>
<td>8 bits</td>
</tr>
<tr>
<td>Valid Lifetime</td>
<td>32 bits</td>
</tr>
<tr>
<td>Preferred Lifetime</td>
<td>32 bits</td>
</tr>
<tr>
<td>Reserved2</td>
<td>8 bits</td>
</tr>
<tr>
<td>Prefix</td>
<td>Variable</td>
</tr>
</tbody>
</table>

ICMP type = 134
Src = router link-local address
Dst = all-nodes multicast address(FF02::1)
Data = Router lifetime, Cur hop limit, Autoconfig flag,
Options(prefix(Prefix Length、S) 、MTU)
Stateless short address configuration

- Device get SRA（Short Router Address）from RA message
- Generate a short address according to SRA
- Validate the address with revised DAD(Duplicate Address Detection)
Encapsulation of Asymmetric IPv6

• Use adaption layer like 6lowpan, new dispatch should be assigned.

```
| 0 1 | Dispatch | type-specific header |
```

e.g. 000011  Asymmetric IPv6 header

• Use a “flexible header encoding”

```
| Modified Version |
|------------------|------------------|
|                  |                  |
|                  |                  |
|                  |                  |
|                  |                  |
|                  |                  |
|                  |                  |
```

• Modified version field
  • 0b0000: The source address (if exist) has pre-determined length inside the domain and the destination address (if exist) uses standard 128-bit IPv6 address. (Outward traffic)
  • 0b0001: The source address (if exist) uses standard 128-bit IPv6 address and the destination address (if exist) has pre-determined length inside the domain. (Inward traffic)
  • 0b0010: The source address and destination address have the same length inside the domain. The address length will be pre-determined.

  • 0b0110: Reserved for IPv6 compatible case.
  • 0b0100: Reserved for IPv4 compatible case.
  • 0b0011~0b1111(except 0b0110, 0b0100): Reserved.
Communication with short address

- From inner node to outer node (outward)
  - Gateway must add prefix to form standard IPv6 address

- Intra-domain communication uses short address only
Delegation of outer nodes’ address

- Use short address as delegation of the IPv6 address inside domain.
- Use RS/RA message to run delegation process

**Device A**

**Asymmetric IP**

**Router**

**IPv6**

**IPv6 Server**

2001::25de::cade

- ICMP type = 133
- Src = Self interface address
- Dst = all-router multicast address(FF02::2)
- Data = options(Dst proxy req(2001::25de::cade))

- ICMP type = 134
- Src = router unique local address
- Dst = all-nodes multicast address(FF02::1)
- Data = Router lifetime, Cur hop limit, Autoconfig flag, Options(Dst proxy rsp)

**Dst proxy req格式**

<table>
<thead>
<tr>
<th>Type (8)</th>
<th>Length (8)</th>
<th>Dst address list (128 * n)</th>
<th>Padding</th>
</tr>
</thead>
</table>

**Dst proxy rsp格式**

<table>
<thead>
<tr>
<th>Type (8)</th>
<th>Length (8)</th>
<th>Dst address (128)</th>
<th>Domain Address</th>
<th>Other address pairs</th>
<th>Padding</th>
</tr>
</thead>
</table>

Address Pair List
Discussion

• Comments? Questions?