Asymmetric IPv6

draft-jiang-asymmetric-ipv6

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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
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

- RFC 4861 defines RA message and prefix information option
- Define one more flag S to indicate that asymmetric IPv6 can be used.
  - (128-Prefix) length will be short address length

**Router Advertisement Message**

- 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

• When S is set to 1:
  1. Device get unique local address of router’s interface.
  2. If length of unique local address is not equal to (128-prefix length), calculate unique local address according to source address and prefix length.
  3. If not exceed retry times, generate new address according to router’s address. Many algorithms can be used, e.g. random.
  4. Execute DAD, if succeed, bind the address to interface, or back to step 3.

Duplicate Address Detection:

- NS: ICMP type = 135
  Src = ::
  Dst = solicited-nodes multicast address (FF02::1:FF + target(lower 24 bit))
  Target = domain address

- NA: ICMP type = 136
  Src = domain address
  Dst = all-nodes multicast address (FF02::1)
  Target = domain address
Encapsulation of Asymmetric IPv6

- Use adaptation layer like 6lowpan, new dispatch should be assigned.

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

- Use a “flexible header encoding”

```
<table>
<thead>
<tr>
<th>Modified Version</th>
<th>FHE octet</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 1</td>
<td>1 0 0 1 1 1 0 1</td>
</tr>
<tr>
<td>Payload Length</td>
<td>Next Header</td>
</tr>
<tr>
<td>Limit</td>
<td>Truncated Destination Address</td>
</tr>
</tbody>
</table>
+----------------------------------+
```

- Modified version field

0000: The length of source address is domain-specified and the destination address is normal (128 bit)
0001: The source address is normal (128 bit) and the length of destination address is domain-specified
0010: The length of both source and destination address is domain-specified
0011 ~ 1111: Reserved
Communication with short address

- From inner node to outer node and vice versa
  - Gateway must add prefix to form standard IPv6 address

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

- Define new options of destination proxy request and response.
- Use RS/RA message to run delegation process

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?
• Side meeting discussion:

  Wednesday 08:30-09:45 in Notre Dame
  (also draft-jiang-service-oriented-ip)