Hierarchical Routing Architecture
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HRA Motivation

- Solve the routing scalability issue
  - Split ID and locator

- Strengthen the security feature
  - Cryptographic hash identifier

- Solve the IPv4 address depletion issue
  - Allow multiple IPv4 address spaces to coexist
Hierarchical Identifier in HRA

- **128-bit identifier includes two parts:**
  - Administrative Domain (AD) ID with organizational affiliation embedded
    - Enforce organization-level access control policy
    - Economic&trust model in the id/locator mapping system
  - Hash value of the public key and the AD ID
    - Intrinsic proofs of ownership

- It’s similar to, but not the same with CGA
Hierarchical Locator in HRA

- **Global locator=LD ID(96 bits) + IPv4 address**
  - Allow multiple locator domains (LD) with independent IPv4 address space to coexist
    - Maximize the reuse of the existing IPv4 networks.
    - Site internal address portable.
  - Each LD has a globally unique ID
    - Topologically aggregatable, like provider-aggregatable address.
    - Geographical location awareness.

- It can be looked as a special IPv6 address
Hierarchical ID/locator Mapping System

Two options of the mapping system

- Hierarchical DHT
  - The former part (AD ID) of host ID used for routing on top-level DHT rings, the remaining part (hash value) used for routing on bottom-level DHT rings

- Integrating DNS with DHT
  - DNS for the former part, AD ID
  - DHT for the latter part, the hash value
Routing Mechanism

- **Two-level routing mechanism**
  - LD ID based routing for inter-LD routing
    - LD ID can be aggregated into LD prefix, like IPv6 prefix.
  - IPv4 address based routing for intra-LD routing
    - IPv4 address is now used as tunnel header among LDBRs

<table>
<thead>
<tr>
<th>Host A:10.1.1.2</th>
<th>10.2.1.1</th>
<th>20.2.1.1</th>
<th>30.1.1.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD 1</td>
<td>Payload</td>
<td>Payload</td>
<td>Payload</td>
</tr>
<tr>
<td>LD ID:1::1:0/96</td>
<td>HI(A)-&gt;HI(B)</td>
<td>HI(A)-&gt;HI(B)</td>
<td>HI(A)-&gt;HI(B)</td>
</tr>
<tr>
<td>10.1.1.2 -&gt;10.2.1.1</td>
<td>1::1:0:10.1.1.2-&gt;1::3:0:30.2.1.2</td>
<td>1::1:0:10.1.1.2-&gt;1::3:0:30.2.1.2</td>
<td>1::1:0:10.1.1.2-&gt;1::3:0:30.2.1.2</td>
</tr>
<tr>
<td>Host B:30.2.1.2</td>
<td>20.2.2.1</td>
<td>30.1.1.1</td>
<td>30.2.1.2</td>
</tr>
</tbody>
</table>
Multi-homing and Traffic-engineering

- **Multiple LD IDs allocated for the multi-homed LD**
  - One LD ID allocated from per ISP
  - These LD ID are Provider-Aggregatable

- **Site-controlled traffic-engineering**
  - Site border router rewrites the source LD ID and enforces source-based policy-route on outgoing packets.
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Conclusion

- Routing scalability and route stability improved
- IPv4 address depletion issue solved
- Built-in security in host identifier
- Geographic location awareness in LD ID
- Business and trust model in mapping system