Babel Routing Protocol for OMNeT++

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EIGRP

CISCO

Babel
**Babel**

def is a routing protocol
- multi-address family support (IPv4, IPv6)
- hybrid distance-vector
- open-source alternative to EIGRP
- policy-based metric calculation
- codified in RFC 6126

**Implementations**
- babeld
- Pybabel
- Sbabeld

**Unavailable in any other major simulator NS-2/3, OPNET, etc.**
- We need Babel in order to compare it with our EIGRP
- We want to use it in frame if PRISTINE project
The best known metric \( m_A \) (lower means better) together with a sequence number \( s_A \) (higher means more current) to a destination network \( N \) from a router \( A \) denotes its feasible distance \( FD_A(N) \):

\[
D_B(N) = (s_B, m_B), \quad FD_A(N) = (s_A, m_A):
D_B(N) < FD_A(N) \iff (s_B = s_A \land m_B < m_A) \lor s_B > s_A
\]

**Metric**

- is a sum of link costs: \( m_A = m_B + c \)
- Programmable link cost calculation
  - k-out-of-j
  - ETX
**MESSAGES**

- **Communication**
  - Multicast addresses 224.0.0.111 and ff02::1:6
  - UDP on port 6696

- **Babel messages employs TLV protocol extensions**
  - *Hello* – neighbor discovery
  - *AckReq* and *Ack* – solicited ack request and confirmation response
  - *IHU* – I Hear You confirms mutual reachbility of neighbors
  - *Router-id* – unique router identifier
  - *NextHop* – nexthop IP address
  - *Update* – advertises or withdraws routes
  - *RouteReq* – request for specific route
  - *SeqNoReq* – request for route with specific sequence number
  - *Pad1, PadN* – padding
IMPLEMENTATION
SCENARIO

- Comparing real and simulated network

a) Establishing neighborship
b) Routing table convergence
c) Link failure and subsequent routing information propagation
### A) Establishing Neighborhood

<table>
<thead>
<tr>
<th>Ord.</th>
<th>TLVs</th>
<th>S → R</th>
<th>Simul.[s]</th>
<th>Real [s]</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Hello, RouteReq</td>
<td>R1→R2</td>
<td>0.092</td>
<td>0.006</td>
</tr>
<tr>
<td>#2</td>
<td>Hello, IHU, Update</td>
<td>R2→R1</td>
<td>0.292</td>
<td>0.007</td>
</tr>
<tr>
<td>#3</td>
<td>Hello, IHU</td>
<td>R1→R2</td>
<td>0.492</td>
<td>0.040</td>
</tr>
<tr>
<td>#4</td>
<td>Hello, IHU</td>
<td>R2→R1</td>
<td>0.692</td>
<td>0.134</td>
</tr>
<tr>
<td>#5</td>
<td>RouteReq</td>
<td>R2→R1</td>
<td>0.692</td>
<td>0.903</td>
</tr>
<tr>
<td>#6</td>
<td>Hello, IHU, Update</td>
<td>R1→R2</td>
<td>0.892</td>
<td>1.084</td>
</tr>
<tr>
<td>#7</td>
<td>RouteReq</td>
<td>R1→R2</td>
<td>0.892</td>
<td>1.085</td>
</tr>
<tr>
<td>#8</td>
<td>Update, IHU</td>
<td>R2→R1</td>
<td>1.902</td>
<td>1.744</td>
</tr>
<tr>
<td>#9</td>
<td>Hello, IHU</td>
<td>R2→R1</td>
<td>5.632</td>
<td>5.111</td>
</tr>
</tbody>
</table>
### B) Routing Table Convergence

<table>
<thead>
<tr>
<th>Flag Prefix</th>
<th>Met</th>
<th>RD</th>
<th>Router-Id</th>
<th>Next-Hop</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 2001:db8:a::/64</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 2001:db8:12::/64</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 2001:db8:13::/64</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 2001:db8:b::/64</td>
<td>96</td>
<td>0</td>
<td>2222:2222:2222:2222</td>
<td>fe80:12::2</td>
</tr>
<tr>
<td>&gt; 2001:db8:c::/64</td>
<td>96</td>
<td>0</td>
<td>3333:3333:3333:3333</td>
<td>fe80:13::3</td>
</tr>
<tr>
<td>&gt; 2001:db8:d::/64</td>
<td>192</td>
<td>96</td>
<td>4444:4444:4444:4444</td>
<td>fe80:12::2</td>
</tr>
<tr>
<td>2001:db8:12::/64</td>
<td>96</td>
<td>0</td>
<td>2222:2222:2222:2222</td>
<td>fe80:12::2</td>
</tr>
<tr>
<td>2001:db8:13::/64</td>
<td>96</td>
<td>0</td>
<td>3333:3333:3333:3333</td>
<td>fe80:12::2</td>
</tr>
<tr>
<td>2001:db8:12::/64</td>
<td>192</td>
<td>96</td>
<td>2222:2222:2222:2222</td>
<td>fe80:13::3</td>
</tr>
<tr>
<td>2001:db8:13::/64</td>
<td>96</td>
<td>0</td>
<td>3333:3333:3333:3333</td>
<td>fe80:12::2</td>
</tr>
<tr>
<td>&gt; 2001:db8:23::/64</td>
<td>96</td>
<td>0</td>
<td>2222:2222:2222:2222</td>
<td>fe80:12::2</td>
</tr>
<tr>
<td>2001:db8:23::/64</td>
<td>96</td>
<td>0</td>
<td>3333:3333:3333:3333</td>
<td>fe80:13::3</td>
</tr>
<tr>
<td>&gt; 2001:db8:24::/64</td>
<td>96</td>
<td>0</td>
<td>2222:2222:2222:2222</td>
<td>fe80:12::2</td>
</tr>
</tbody>
</table>
### C) Link-Failure

#### Diagram

```plaintext
bt->getRoutes() (BabelRoute *)
  elements[15] (inet::BabelRoute *)
```

```plaintext
bt->getRoutes() (BabelRoute *>)
  elements[14] (inet::BabelRoute *)
```

```plaintext
bt->getRoutes() (BabelRoute *>)
  elements[14] (inet::BabelRoute *)
```

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<tr>
<td>#1</td>
<td>SeqNoReq</td>
<td>R2 → R3</td>
<td>0.187</td>
<td>0.208</td>
</tr>
<tr>
<td>#2</td>
<td>SeqNoReq</td>
<td>R3 → R1</td>
<td>0.347</td>
<td>1.079</td>
</tr>
<tr>
<td>#3</td>
<td>Update</td>
<td>R1 → R3</td>
<td>0.595</td>
<td>1.152</td>
</tr>
<tr>
<td>#4</td>
<td>Update</td>
<td>R3 → R2</td>
<td>0.673</td>
<td>1.275</td>
</tr>
</tbody>
</table>
The End

- ANSAINET extends INET with new simulation modules
  - IS-IS, TRILL
  - EIGRP, OSPFv3
  - LISP
  - CDP, LLDP
  - HSRP, VRRP, GLBP

- Please do not go anywhere 😊

Thank you for your attention! Questions?