RIFT De’Mystified (a bit) ;-)  

Major RIFT Flows/Procedures on a Mini-Fabric & Partial Update RIFT-01 Draft (without Mobility)

Tony Przygienda (Juniper)
Simplest Fabric Flow

- Configuration
  - Only Superspines MUST be set
  - One Leaf Fixed
  - One Prefix
- LIE Flow
- ZTP Flow
- Flooding Flow
- SPF
three way LIE (without ZTP)

111

1-WAY

{no neighbor}

{no neighbor}

2-WAY

{21}

21

1-WAY

2-WAY

3-WAY
peer: if_111_21->0.0.0.0:20004
nodeid: node_111
subsystem: lies

extensive: fsm
12:49:51.991 DEBUG FSM if_111_21->0.0.0.0:20004 processing event LevelChanged/OneWay
12:49:51.991 DEBUG level changed: Some(21)
12:49:51.992 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.992 DEBUG FSM if_111_21->0.0.0.0:20004 processing event HALChanged/OneWay
12:49:51.992 DEBUG hal changed: Some(22)
12:49:51.992 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.992 DEBUG FSM if_111_21->0.0.0.0:20004 processing event HALSChanged/OneWay
12:49:51.992 DEBUG hal systems changed: (1112)
12:49:51.992 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.992 DEBUG FSM if_111_21->0.0.0.0:20004 processing event SendLie/OneWay
12:49:51.992 DEBUG rebuilding lie packet mylevel: Some(21) hals: (1112) not_an_offer: false

extensive: lies
12:49:51.992 DEBUG sending lie in OneWay

extensive: fsm
12:49:51.993 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.993 DEBUG FSM if_111_21->0.0.0.0:20004 processing event LevelChanged/OneWay
12:49:51.993 DEBUG level changed: Some(23)
12:49:51.993 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.993 DEBUG FSM if_111_21->0.0.0.0:20004 processing event HALChanged/OneWay
12:49:51.993 DEBUG hal changed: Some(24)
12:49:51.993 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.993 DEBUG FSM if_111_21->0.0.0.0:20004 processing event HALSChanged/OneWay
12:49:51.993 DEBUG hal systems changed: (22)
12:49:51.993 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.993 DEBUG FSM if_111_21->0.0.0.0:20004 processing event SendLie/OneWay
12:49:51.993 DEBUG rebuilding lie packet mylevel: Some(23) hals: (22) not_an_offer: false

extensive: lies
12:49:51.993 DEBUG sending lie in OneWay

extensive: fsm
12:49:51.994 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.994 DEBUG FSM if_111_21->0.0.0.0:20004 processing event LieRcvd/OneWay

extensive: lies
12:49:51.994 DEBUG rcvd lie

12:49:51.994 DEBUG change neighbor: new AsycnObjectRef { id: UniqueSystemId(2147484236), object: Mutex { data: Neighbor { id: UniqueSystemId(2147484236), systemid: 21, flood_address: V4(127.0.0.1:20003), name: None, level: Some(24), cost: 1, bandwidth: 100, holdtime: Duration { secs: 3, nanos: 0 }, remote_linkid: Some(4120), local_linkid: 4096, pod: None, nonce: None, capabilities: None, not_a_ztp_offer: false } } } vs. last seen None

extensive: fsm
12:49:51.994 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.994 DEBUG FSM if_111_21->0.0.0.0:20004 processing event UpdateZTPOffer/OneWay
12:49:51.994 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.994 DEBUG FSM if_111_21->0.0.0.0:20004 processing event NewNeighbor/OneWay
12:49:51.994 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to TwoWay
12:49:51.994 DEBUG FSM if_111_21->0.0.0.0:20004 processing event SendLie/TwoWay
12:49:51.994 DEBUG rebuilding lie packet mylevel: Some(23) hals: (22) not_an_offer: false

extensive: lies
12:49:51.994 DEBUG sending lie in TwoWay

extensive: fsm
12:49:51.995 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to TwoWay
12:49:51.995 DEBUG FSM if_111_21->0.0.0.0:20004 adding 2 events
12:49:51.995 DEBUG FSM if_111_21->0.0.0.0:20004 processing event HATChanged/TwoWay
12:49:51.995 DEBUG hal changed: Some(22)
12:49:51.995 DEBUG FSM if_111_21->0.0.0.0:20004 moving machine to TwoWay
12:49:51.995 DEBUG FSM if_111_21->0.0.0.0:20004 processing event HALSChanged/TwoWay

extensive: lies
12:49:51.995 DEBUG sending lie in TwoWay
Neighbors for Node 121

Neighbors for

```
[ 
  "if_121_2122->0.0.0.0:20055 at level Some(0)",
  "if_121_2121->0.0.0.0:20051 at level Some(22)",
  "if_121_21->0.0.0.0:20020 at level Some(24)",
  "if_121_22->0.0.0.0:20028 at level Some(24)"
]
```
Flooding Scopes/Architecture

1. Topological Sort
2. Link-state Flooding North
3. Distance Vector Down
4. One Layer "Bounce"
• TIDEs Describe Content (CSNP)
• TIREs Request OR Confirm (PSNP)
• TIEs Is Content (LSPs)
Flooding (Part 1)

peer: if_111_21->0.0.0.0:20004
nodeid: node_111
subsystem: flood
May 01 13:48:04.073 DEBG if_111_21->0.0.0.0:20004 create flood FSM on V4(127.0.0.1:20003)

DEBG: io
May 01 13:48:04.075 DEBG sent tie Key+Life: South/22/InternalTIETYPEType(NODETIETYPE)/0/2/600/0.000
May 01 13:48:04.075 DEBG tire: same acked Key+Life: South/22/InternalTIETYPEType(NODETIETYPE)/0/2/600/0.000 vs. Key+Life: South/22/InternalTIETYPEType(NODETIETYPE)/0/2/600/0.000
May 01 13:48:04.075 DEBG tire: processed acks 1 older 0 newer 0
May 01 13:48:04.157 DEBG tide generation starting
May 01 13:48:04.157 DEBG: sending 5 headers from TIEID { originator: 18446744073709551615, tienr: 4294967295, tietype: InternalTIETYPEType(TIETYPEMAXVALUE), direction: North } to TIEID { direction: NORTH, originator: -1, tietype: TIETYPENUMBER, tie nr: -1 } to V4(127.0.0.1:20003)

May 01 13:48:04.158 DEBG tire: rcvd Key+Life: South/21/InternalTIETYPEType(NODETIETYPE)/0/2/600/0.000
May 01 13:48:04.158 DEBG tire: rcvd unknown Key+Life: South/21/InternalTIETYPEType(NODETIETYPE)/0/2/600/0.000
May 01 13:48:04.158 DEBG tire: after rcvd Key+Life: South/21/InternalTIETYPEType(NODETIETYPE)/0/2/600/0.000 ack: Some(Key+Life: South/21/InternalTIETYPEType(NODETIETYPE)/0/2/600/0.000) tx: None
May 01 13:48:04.158 DEBG tire: transmit our newer Key+Life: South/111/InternalTIETYPEType(NODETIETYPE)/0/0/0.000 vs. Key+Life: South/111/InternalTIETYPEType(NODETIETYPE)/0/0/0.084
May 01 13:48:04.158 DEBG tire: transmit our newer Key+Life: North/111/InternalTIETYPEType(NODETIETYPE)/0/0/0.000 vs. Key+Life: North/111/InternalTIETYPEType(NODETIETYPE)/0/0/0.084
May 01 13:48:04.158 DEBG tire: transmit our newer Key+Life: North/111/InternalTIETYPEType(PREFIXTIETYPE)/268435457/0/0/0.000 vs. Key+Life: North/111/InternalTIETYPEType(PREFIXTIETYPE)/268435457/0/0/0.000

May 01 13:48:04.158 DEBG tire: processed acks 0 older 3 newer 0
May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 111, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South } to 21

May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 111, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South } to 21

May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South } to 21

May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South } to 21

May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETYPEType(PREFIXTIETYPE), direction: South } to 21

May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETYPEType(PREFIXTIETYPE), direction: South } to 21

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May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South } to 21

May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETYPEType(PREFIXTIETYPE), direction: South } to 21

May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South } to 21

May 01 13:48:04.158 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South } to 21
Flooding (Part 2)

May 01 13:48:04.199 DEBG: tire: processed acks 1 older 0 newer 0
May 01 13:48:04.199 DEBG: tire: same added Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/5/600/0.000 vs. Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/5/600/0.000
May 01 13:48:04.199 DEBG: tire: processed acks 1 older 0 newer 0
May 01 13:48:04.205 DEBG: filtered out transmission TIEID (originator: 22, tienr: 268435456, tietype: InternalTIETYPEType(PREFIXTIETYPE), direction: South) to 21
May 01 13:48:04.206 DEBG: tire: rcvd Key+Life: South/21/InternalTIETYPEType(PREFIXTIETYPE)/268435456/1/600/0.000
May 01 13:48:04.206 DEBG: tietype: InternalTIETYPEType(PREFIXTIETYPE), direction: North
May 01 13:48:05.077 DEBG: tire: processed acks 1 older 0 newer 0
May 01 13:48:05.079 DEBG: tire: same added Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/6/599/0.000 vs. Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/6/599/0.000
May 01 13:48:05.080 DEBG: tire: processed acks 1 older 0 newer 0
May 01 13:48:05.080 DEBG: filtered out transmission TIEID (originator: 111, tienr: 268435456, tietype: InternalTIETYPEType(PREFIXTIETYPE), direction: South) to 21
May 01 13:48:05.089 DEBG: tire: same added Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/7/599/0.000 vs. Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/7/599/0.000
May 01 13:48:05.090 DEBG: tire: processed acks 1 older 0 newer 0
May 01 13:48:05.090 DEBG: tire: same added Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/7/599/0.000 vs. Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/7/599/0.000
May 01 13:48:05.092 DEBG: tire: same added Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/7/599/0.000 vs. Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/7/599/0.000
May 01 13:48:05.093 DEBG: tire: processed acks 1 older 0 newer 0
May 01 13:48:06.119 DEBG: tide len 14 rcvd: start TIEID (originator: 21, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South) end TIEID (originator: 18446744073709551615, tienr: 4294967295, tietype: InternalTIETYPEType(TIETYPEMAXVALUE), direction: North)
May 01 13:48:06.119 DEBG: tide: unknown requested Key+Life: North/21/InternalTIETYPEType(NODETIETYPE)/0/3/598/0.000
May 01 13:48:06.120 DEBG: tide: newer requested Key+Life: North/112/InternalTIETYPEType(NODETIETYPE)/0/9/599/0.000 vs. Key+Life: North/112/InternalTIETYPEType(NODETIETYPE)/0/2/599/1.959
May 01 13:48:06.120 DEBG: tide: unknown requested Key+Life: North/121/InternalTIETYPEType(NODETIETYPE)/0/4/599/0.000
May 01 13:48:06.120 DEBG: tide: unknown requested Key+Life: North/122/InternalTIETYPEType(NODETIETYPE)/0/5/599/0.000
May 01 13:48:06.120 DEBG: tide: unknown requested Key+Life: North/2121/InternalTIETYPEType(NODETIETYPE)/0/3/599/0.000
May 01 13:48:06.120 DEBG: tide: unknown requested Key+Life: North/2122/InternalTIETYPEType(NODETIETYPE)/0/2/598/0.000
May 01 13:48:06.120 DEBG: tide: gap to end TIEID (originator: 2122, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: North) to TIEID (originator: 18446744073709551615, tienr: 4294967295, tietype: InternalTIETYPEType(TIETYPEMAXVALUE), direction: North)
May 01 13:48:06.120 DEBG: tide: processed new-tx 0 new-req 6
May 01 13:48:06.120 DEBG: filtered request out TIEID (originator: 21, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: North) to 21
May 01 13:48:06.120 DEBG: filtered request out TIEID (originator: 112, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: North) to 21
May 01 13:48:06.121 DEBG: filtered request out TIEID (originator: 121, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: North) to 21
May 01 13:48:06.121 DEBG: filtered request out TIEID (originator: 122, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: North) to 21
May 01 13:48:06.121 DEBG: filtered request out TIEID (originator: 2121, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: North) to 21
May 01 13:48:06.121 DEBG: filtered request out TIEID (originator: 2122, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: North) to 21
May 01 13:48:07.024 DEBG: tire tics left None
May 01 13:48:07.125 DEBG: tide generation starting
May 01 13:48:07.125 DEBG: tide: sending 13 headers from TIEID (originator: 18446744073709551615, tienr: 4294967295, tietype: InternalTIETYPEType(TIETYPEMAXVALUE), direction: North) to TIEID (direction: NORTH, originator: -1, tietype: TIETYPEMAXVALUE, tie_nr: -1) to V4(127.0.0.1:20003)
May 01 13:48:07.126 DEBG: tire: transmit our new Key+Life: South/111/InternalTIETYPEType(NODETIETYPE)/0/0/0.000 vs. Key+Life: South/111/InternalTIETYPEType(NODETIETYPE)/0/4/597/3.052
May 01 13:48:07.126 DEBG: tire: transmit our new Key+Life: South/112/InternalTIETYPEType(NODETIETYPE)/0/0/0.000 vs. Key+Life: South/112/InternalTIETYPEType(NODETIETYPE)/0/7/597/2.045
May 01 13:48:07.126 DEBG: tire: processed acks 0 older 2 newer 0
May 01 13:48:07.126 DEBG: filtered out transmission TIEID (originator: 111, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South) to 21
May 01 13:48:07.126 DEBG: filtered out transmission TIEID (originator: 112, tienr: 0, tietype: InternalTIETYPEType(NODETIETYPE), direction: South) to 21

RIFT WG Interim May-2018
## Flooding Scopes

<table>
<thead>
<tr>
<th>Packet Type</th>
<th>South</th>
<th>North</th>
</tr>
</thead>
<tbody>
<tr>
<td>vs. Peer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>node S-TIE</th>
<th>flood self-originated only</th>
<th>flood if TIE originator’s level is higher than own level</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-node</td>
<td>flood self-originated only</td>
<td>flood only if TIE originator is equal peer</td>
</tr>
<tr>
<td>all N-TIEs</td>
<td>never flood</td>
<td>flood always</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TIDE</th>
<th>include TIEs in flooding</th>
<th>include TIEs in flooding scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIRE</td>
<td>include all N-TIEs and all peer’s self-originated</td>
<td>include only if TIE originator is equal peer</td>
</tr>
<tr>
<td></td>
<td>TIEs and all node S-TIEs</td>
<td>peer</td>
</tr>
</tbody>
</table>
[{
  "South",
  [
    "Key+Life: South/112/InternalTIETYPEType(PREFIXTIETYPE)/268435456/1/597/3.984",
    "Key+Life: South/112/InternalTIETYPEType(NODETIETYPE)/0/3/597/2.005",
    "Key+Life: South/22/InternalTIETYPEType(NODETIETYPE)/0/4/597/3.894",
    "Key+Life: South/21/InternalTIETYPEType(NODETIETYPE)/0/2/597/3.806",
    "Key+Life: South/22/InternalTIETYPEType(PREFIXTIETYPE)/268435456/1/597/3.759",
    "Key+Life: South/111/InternalTIETYPEType(NODETIETYPE)/0/3/597/3.790",
    "Key+Life: South/21/InternalTIETYPEType(PREFIXTIETYPE)/268435456/1/597/3.747"
  ]
},
{
  "North",
  [
    "Key+Life: North/1111/InternalTIETYPEType(NODETIETYPE)/0/3/597/3.783",
    "Key+Life: North/112/InternalTIETYPEType(NODETIETYPE)/0/5/597/2.005",
    "Key+Life: North/1111/InternalTIETYPEType(PREFIXTIETYPE)/268435457/1/597/3.895",
    "Key+Life: North/1112/InternalTIETYPEType(NODETIETYPE)/0/3/598/2.996"
  ]
}]}
### Reachability Computation

<table>
<thead>
<tr>
<th>N-(SPF), It’s Really Any Feasible Path</th>
<th>S-(SPF)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Use Own N-SPF to Find Neighbors</strong></td>
<td><strong>Use S-SPF to Find Neighbors</strong></td>
</tr>
<tr>
<td><strong>Use Neighbor S-TIE to Validate Connectivity</strong></td>
<td><strong>Use Candidate’s N-TIE to Validate Connectivity</strong></td>
</tr>
<tr>
<td><strong>One Hop</strong></td>
<td><strong>All the Way Down</strong></td>
</tr>
</tbody>
</table>
subsystem: spf
May 01 18:32:47.057 DEBG existing holddown N/S SPF pending: false/false
May 01 18:32:47.079 DEBG computing SPF South

extensive: computations
COMPUTATION_ID: 8368
May 01 18:32:47.079 DEBG running South SPF graph closure on 5 nodes originating in 111
May 01 18:32:47.079 DEBG ++ Entering node 111 @ 0
May 01 18:32:47.079 DEBG ++++ Entering node 111 dist 0 with 4 neighbors
May 01 18:32:47.079 DEBG ---- node 21 in level 24 is opposite DAG closure direction
May 01 18:32:47.079 DEBG ---- node 22 in level 24 is opposite DAG closure direction
May 01 18:32:47.080 DEBG ++ Link to node 1111 @ hndl 3 checking backlinks South
May 01 18:32:47.080 DEBG +++++ found backlink in South
May 01 18:32:47.080 DEBG +++++ added 1111 @ 1 nhops ComputationNextHopsType((NeighborNextHopType { distance: 1, interface: 4126, neighborid: 1111 }))
May 01 18:32:47.080 DEBG ++ Link to node 1112 @ hndl 4 checking backlinks South
May 01 18:32:47.080 DEBG +++++ found backlink in South
May 01 18:32:47.080 DEBG +++++ added 1112 @ 1 nhops ComputationNextHopsType((NeighborNextHopType { distance: 1, interface: 4129, neighborid: 1112 })),
May 01 18:32:47.080 DEBG ++ Entering node 1111 @ 1
May 01 18:32:47.080 DEBG ++++ Entering node 1111 dist 1 with 2 neighbors
May 01 18:32:47.080 DEBG ---- node 112 in level 23 is opposite DAG closure direction
May 01 18:32:47.081 DEBG ++ Entering node 1112 @ 1
May 01 18:32:47.081 DEBG ++++ Entering node 1112 dist 1 with 2 neighbors
May 01 18:32:47.081 DEBG ---- node 112 in level 23 is opposite DAG closure direction
May 01 18:32:47.082 DEBG 3 SPF reachable systems expanded to North 2 prefixes
May 01 18:32:47.082 DEBG direction North 2 prefixes attached with diffsize 1

subsystem: rib
extensive: prefixes
May 01 18:32:47.082 DEBG prefix changes:
DeltaCompareVec()
{
  ipv4prefix(
    IPv4PrefixType {
      address: 1.1.1.0,
      prefixlen: 24
    }
  ): DeltaCompareEntry {
    DeltaCompareElement {deltatype: ElementAdded, value: Some(
      CompositeNextHopsWithTotalMetrics(
        
      }
    }
  }
}
COMPUTATION_ID: 8456
May 01 20:09:51.107 DEBUG running North SPF graph closure on 6 nodes originating in 111
May 01 20:09:51.107 DEBUG ++ Entering node 111 @ 0
May 01 20:09:51.107 DEBUG ++++ Entering node 111 dist 0 with 4 neighbors
May 01 20:09:51.107 DEBUG ++ Link to node 21 @ hndl 0 checking backlinks North
May 01 20:09:51.107 DEBUG ++++ found backlink in North
May 01 20:09:51.107 DEBUG +++++ added 21 @ 1 nhops ComputationNextHopsType((NeighborNextHopType { distance: 1, interface: 4120, neighborid: 21 }))
May 01 20:09:51.107 DEBUG ++ Link to node 22 @ hndl 1 checking backlinks North
May 01 20:09:51.107 DEBUG ++++ found backlink in North
May 01 20:09:51.107 DEBUG +++++ added 22 @ 1 nhops ComputationNextHopsType((NeighborNextHopType { distance: 1, interface: 4123, neighborid: 22 }))
May 01 20:09:51.107 DEBUG ---- node 111 in level 22 is opposite DAG closure direction
May 01 20:09:51.107 DEBUG ---- node 112 in level 23 is opposite DAG closure direction
May 01 20:09:51.107 DEBUG ---- node 121 in level 23 is opposite DAG closure direction
May 01 20:09:51.107 DEBUG ---- node 122 in level 23 is opposite DAG closure direction
May 01 20:09:51.107 DEBUG ++ Entering node 21 @ 1
May 01 20:09:51.107 DEBUG ++++ Entering node 21 dist 1 with 4 neighbors
May 01 20:09:51.107 DEBUG ---- node 112 in level 23 is opposite DAG closure direction
May 01 20:09:51.107 DEBUG ---- node 121 in level 23 is opposite DAG closure direction
May 01 20:09:51.107 DEBUG ---- node 122 in level 23 is opposite DAG closure direction
May 01 20:09:51.108 DEBUG ++ Entering node 22 @ 1
May 01 20:09:51.108 DEBUG ++++ Entering node 22 dist 1 with 4 neighbors
May 01 20:09:51.108 DEBUG ---- node 112 in level 23 is opposite DAG closure direction
May 01 20:09:51.108 DEBUG ---- node 121 in level 23 is opposite DAG closure direction
May 01 20:09:51.108 DEBUG ---- node 122 in level 23 is opposite DAG closure direction

subsystem: spf
May 01 20:09:51.109 DEBUG 3 SPF reachable systems expanded to South 2 prefixes
May 01 20:09:51.109 DEBUG direction South 2 prefixes attached with diffsize 2

subsystem: rib extensive: prefixes
May 01 20:09:51.109 DEBUG prefix changes:
DeltaCompareVec(
  { IPv4Prefix( IPv4PrefixType { address: 0.0.0.0, prefixlen: 0 } ): DeltaCompareEntry( deltype: ElementAdded, value: Some( CompositeNextHopsWithTotalMetrics( { 2147484256: 2 } ) ) ) })

IPv6Prefix( IPv6PrefixType { address: 0000::0000, prefixlen: 0 } ): DeltaCompareEntry( deltype: ElementAdded, value: Some( CompositeNextHopsWithTotalMetrics( { 2147484256: 2 } ) ) )

RIFT WG Interim May-2018
Resulting RIB on N111

RIB routing table for
<
s 000.000.000.000/00 CompositeNextHopsWithTotalMetrics({2147484256: 2})
n 001.001.001.000/24 CompositeNextHopsWithTotalMetrics({2147484254: 2})
>
RIB nexthops for
<
2147484256 {21: LinkIDSet { links: {4120} }, 22: LinkIDSet { links: {4123} }}
2147484254 {1111: LinkIDSet { links: {4126} }}
2147484111 {111: LinkIDSet { links: {} }}
>

RIFT WG Interim May-2018
**Update: Northbound Bandwidth Balancing**

RIFT calculates the amount of northbound bandwidth available towards a node compared to other nodes at the same level and adjusts the default route distance accordingly to allow for the lower level to have different weights on load balancing.

**BAD_N**: Bandwidth Adjusted Metric to N

\[ L_{N_u} : \text{as sum of the bandwidth available from L to N} \]
\[ N_u : \text{as sum of the uplink bandwidth available on N} \]
\[ T_{N_u} : L_{N_u} + N_u \]
\[ M_{N_u} : \log_2(\text{next_power_2}(T_{N_u})) \]

**BAD_N**: \( D \times (1 + \text{maximum_of_all}(M_{N_u}) - M_{N_u}) \)

---

<table>
<thead>
<tr>
<th>Node</th>
<th>N</th>
<th>T_{N_u}</th>
<th>M_{N_u}</th>
<th>BAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf111</td>
<td>Node111</td>
<td>110</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Leaf111</td>
<td>Node112</td>
<td>220</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Leaf112</td>
<td>Node111</td>
<td>120</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Leaf112</td>
<td>Node112</td>
<td>220</td>
<td>8</td>
<td>1</td>
</tr>
</tbody>
</table>
nodeid: leaf_1111  
subsystem: spf
May 01 20:50:59.340 DEBG own bandwidth closure: {111: Some(100), 112: Some(100)}
May 01 20:50:59.340 DEBG north neighbors bandwidth closure: [(111, Some(2000)), (112, Some(200))]
May 01 20:50:59.340 DEBG adding own Some(100) bw to Some(2000) by node 111
May 01 20:50:59.340 DEBG adding own Some(100) bw to Some(200) by node 112
May 01 20:50:59.340 DEBG own+north bandwidth closure: {111: Some(2100), 112: Some(300)}
May 01 20:50:59.340 DEBG bwmax max power2 remap: [SystemWith2PowerBandwidthPow2(111, 13),  
SystemWith2PowerBandwidthPow2(112, 10)] max: Some(SystemWith2PowerBandwidthPow2(111, 13))
May 01 20:50:59.340 DEBG bwmax, bw multipliers remapped: 13 / Some({111: 1, 112: 4})

RIB routing table for leaf_1111
<
  s 000.000.000.000/00 CompositeNextHopsWithTotalMetrics({2147484257: 5, 2147484246: 2})
  i 001.001.001.000/24 CompositeNextHopsWithTotalMetrics({2147483918: 1})
>
RIB nexthops for leaf_1111
<
  2147483918 {111: LinkIDSet { links: {} }}
  2147484257 {112: LinkIDSet { links: {4171} }}
>

RIFT WG Interim May-2018
Basic Disaggregation

May 01 21:35:52.784 DEBG running SPO computation

**COMPUTATION_ID**: 8415

May 01 21:35:52.785 DEBG running South SPF_OTHER_NODE_IN_LAYER graph closure on 6 nodes originating in 112
May 01 21:35:52.785 DEBG ++ Entering node 112 @ 0
May 01 21:35:52.785 DEBG ++++ Entering node 112 dist 0 with 2 neighbors
May 01 21:35:52.785 DEBG ---- node 22 in level 24 is opposite DAG closure direction
May 01 21:35:52.785 DEBG ++ Link to node 1112 @ hndl 5 checking backlinks South
May 01 21:35:52.785 DEBG ++++ found backlink in South
May 01 21:35:52.785 DEBG ++++ added 1112 @ 1 nhops ComputationNextHopsType({NeighborNextHopType { distance: 1, interface: 4141, neighborid: 1112 }})

**COMPUTATION_ID**: 8416

May 01 21:35:52.786 DEBG running South SPF graph closure on 6 nodes originating in 111
May 01 21:35:52.786 DEBG ++ Entering node 111 @ 0
May 01 21:35:52.786 DEBG ++++ Entering node 111 dist 0 with 4 neighbors
May 01 21:35:52.786 DEBG ---- node 21 in level 24 is opposite DAG closure direction
May 01 21:35:52.786 DEBG ---- node 22 in level 24 is opposite DAG closure direction
May 01 21:35:52.786 DEBG ++ Link to node 1111 @ hndl 4 checking backlinks South
May 01 21:35:52.786 DEBG ++++ found backlink in South
May 01 21:35:52.786 DEBG ++++ added 1111 @ 1 nhops ComputationNextHopsType({NeighborNextHopType { distance: 1, interface: 4126, neighborid: 1111 }})
May 01 21:35:52.786 DEBG ++++ added 1112 @ 1 nhops ComputationNextHopsType({NeighborNextHopType { distance: 1, interface: 4141, neighborid: 1112 }})
May 01 21:35:52.786 DEBG ++++ added 1112 @ 1 nhops ComputationNextHopsType({NeighborNextHopType { distance: 1, interface: 4129, neighborid: 1112 }})

May 01 21:35:52.788 DEBG system IDs visible to all {1112}
May 01 21:35:52.787 DEBG system IDs needing disaggregation {1111, 111}
May 01 21:35:52.787 DEBG system IDs at same level without N-neighbors false
May 01 21:35:52.789 DEBG originate default metric: Some(1) based on #own south adjacencies: 2, all others have no north: false, can compute some north default: true
May 01 21:35:52.789 DEBG expanded IDs (1111, 111) into 3 NORTH disaggregated prefixes

**keyset:**

IPv4prefix(
 IPv4PrefixType {
 address: 0,
 prefixlen: 0
}),
IPv4prefix(
 IPv4PrefixType {
 address: 0,
 prefixlen: 0
})
Basic Disaggregation on 1112

> RIB routing table for leaf_1112
<
  s 000.000.000.000/00 CompositeNextHopsWithTotalMetrics({2147484243: 5, 2147484242: 2})
  s 001.001.001.000/24 CompositeNextHopsWithTotalMetrics({2147484242: 3})
>
RIB nexthops for leaf_1112
<
  2147484242 {111: LinkIDSet { links: {4171} }}
  2147484243 {112: LinkIDSet { links: {4174} }}
>
Secure, Optimized RIFT Information Element Envelope Suggestion

<table>
<thead>
<tr>
<th>UDP Header</th>
<th>Security Fingerprint Length</th>
<th>TIE Lifetime</th>
<th>Security Fingerprint (e.g. SHA)</th>
<th>LIE Nonce</th>
<th>Serialized RIFT Object</th>
</tr>
</thead>
</table>

- Maximizes Flooding Speed (No Re-Serialization)
- Provides Optimal Security (Lifetime Attacks Are Solved By RFC7987)

- Security Fingerprint Does Not Get Affected by TIE LifeTime Changes
- Serialized Object Keeps Its Fingerprint and Does Not Need Re-Serialization on LifeTime Field Change by Every Node
- Lie Nonces Are Protected by Fingerprint Against Replays
- Only Node with Private Key Can Generate the Fingerprint (Either for LIEs One-Hop or for TIEs Providing Origin Validation and Integrity)