

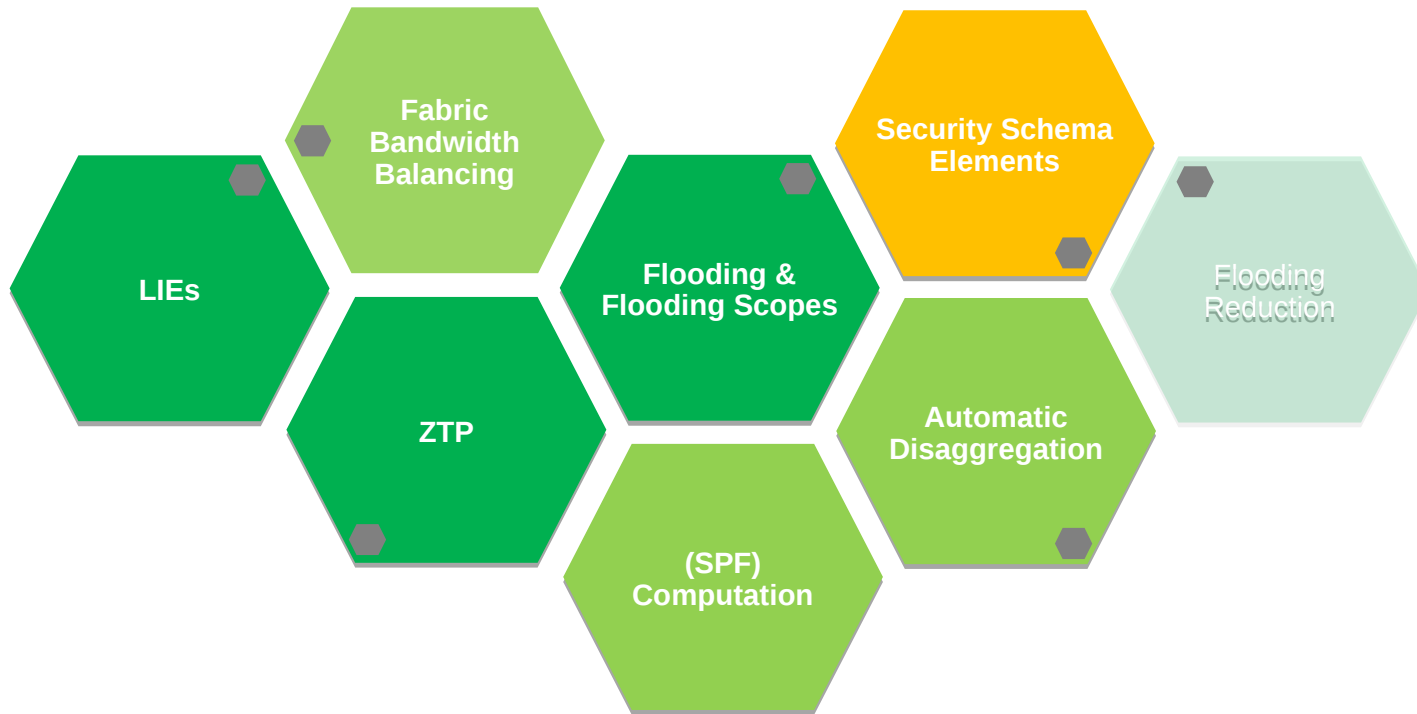


RIFT De'Mystified (a bit) ;-)

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

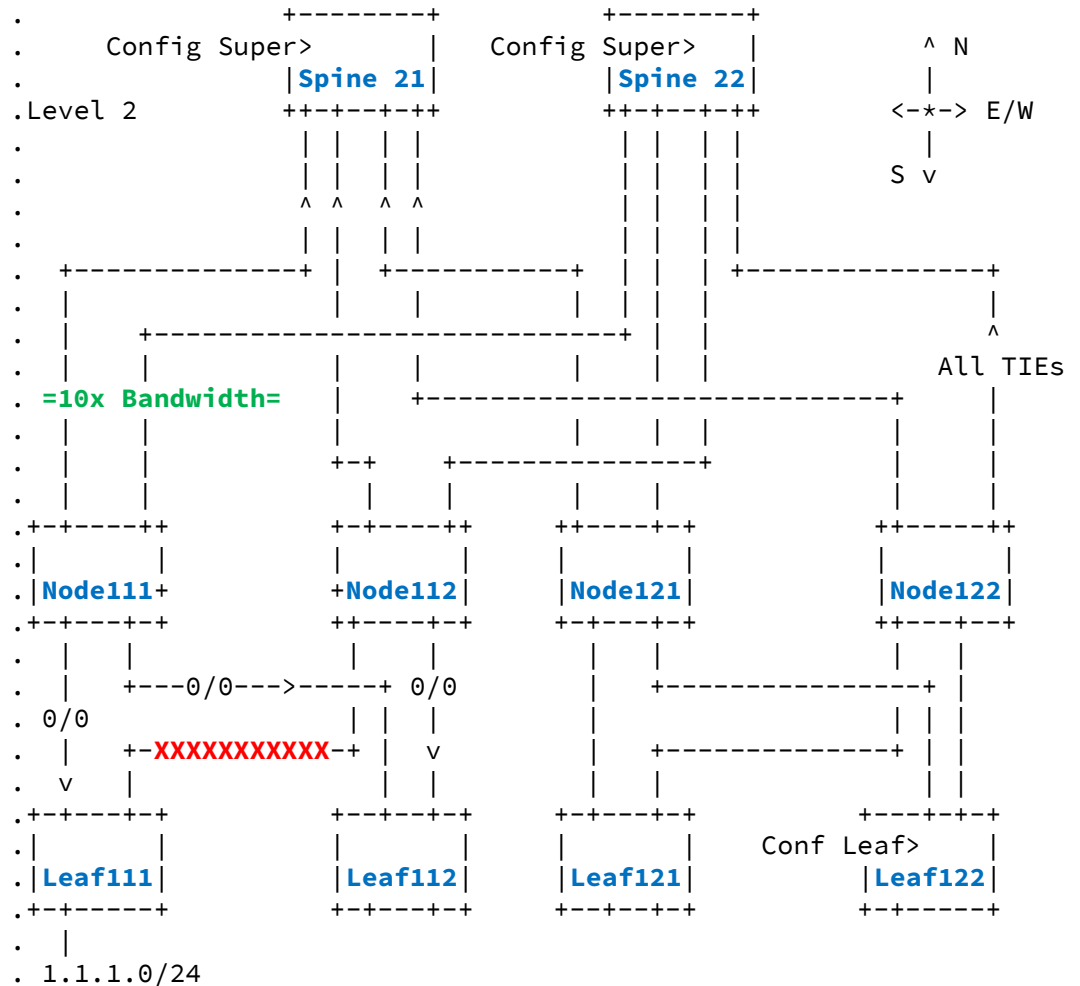
Tony Przygienda (Juniper)

De'Mystification Landscape

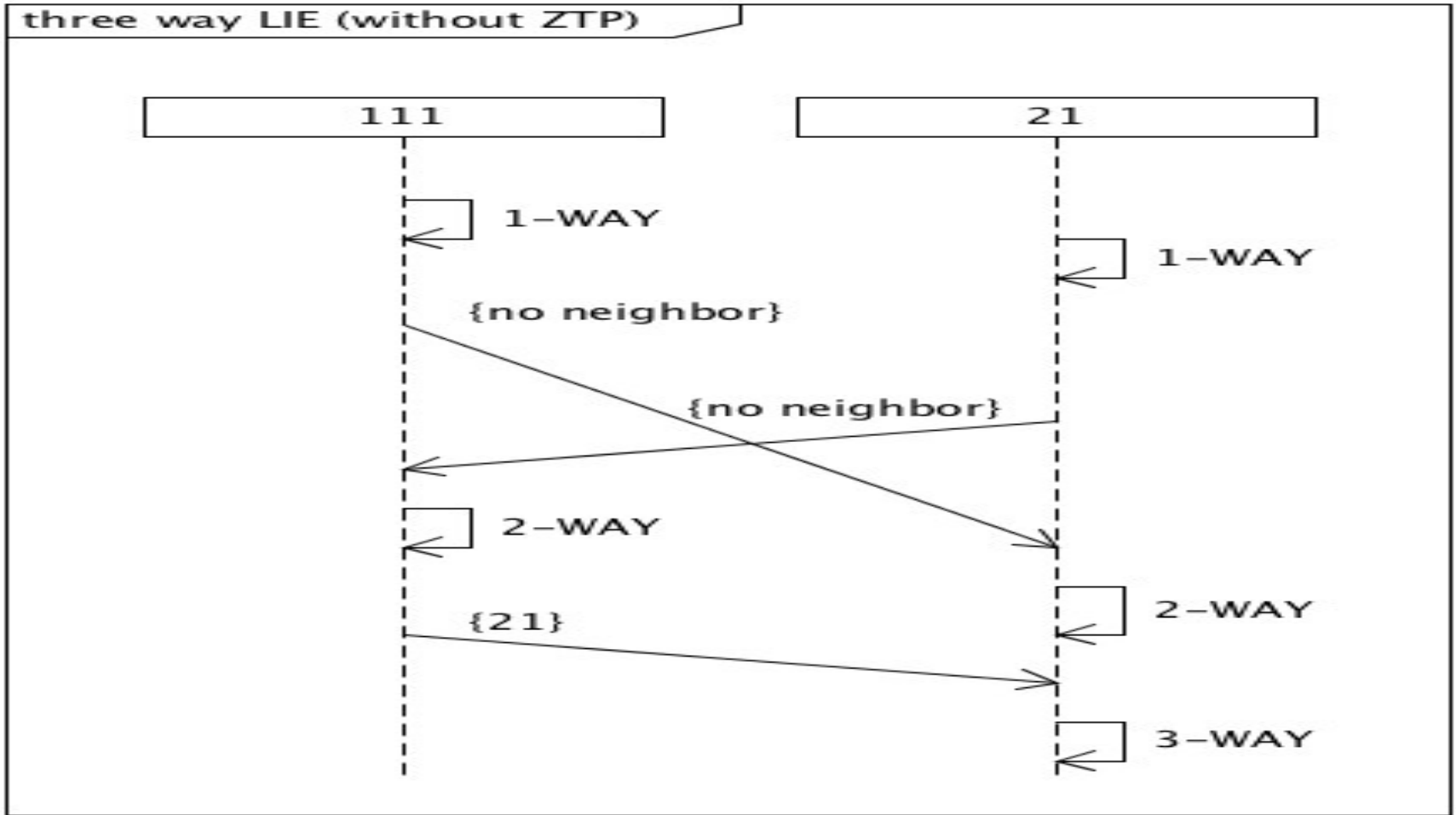


Simplest Fabric Flow

- Configuration
 - Only Superspines MUST be set
 - One Leaf Fixed
 - One Prefix
- LIE Flow
- ZTP Flow
- Flooding Flow
- SPF



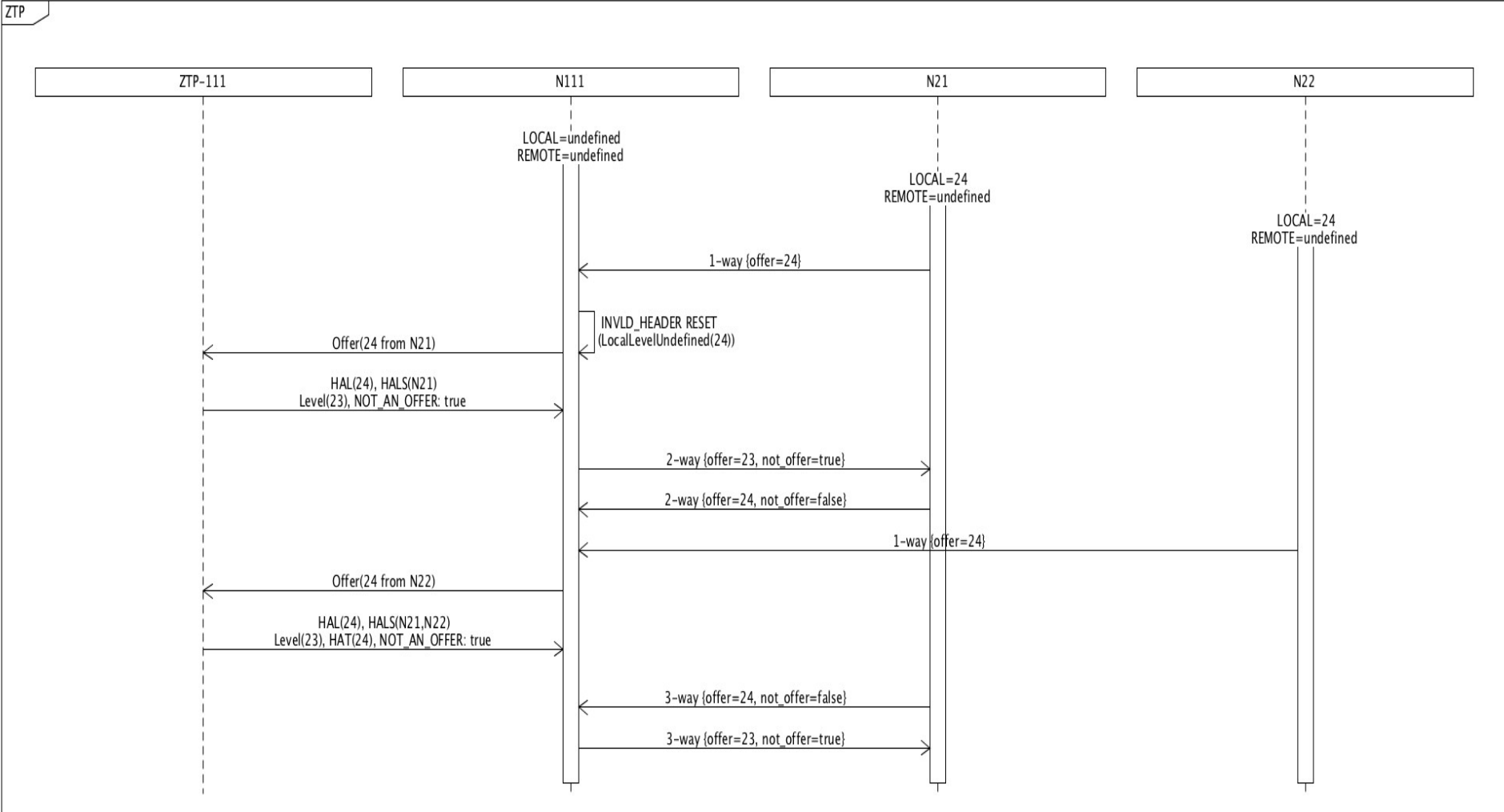
LIE Flow Leaf111-Node111



LIE Flow Leaf111-Node111

```
#!/bin/rift-envirn -c -vvv -Clies -Elies,io -Nnode_111 -P"if_111_21->0.0.0.0:20004" -R 2 topology -DD topology/interim-rfc-2x2x2-example.yaml
>/tmp/interim.dump
peer: if_111_21->0.0.0.0:20004
nodeid: node_111
subsystem: lies
  11:58:33.382 DEBG rebuilding lie packet mylevel: None Hals: {} not_an_offer: false
extensive: lies
  11:58:33.382 DEBG sending lie in OneWay
  11:58:33.388 DEBG neighbor LIE resets adjacency: RemoteUndefinedLevel
  11:58:33.388 DEBG neighbor LIE resets adjacency: LocalLevelUndefined(24)
  11:58:33.389 DEBG level changed: Some(23)
  11:58:33.389 DEBG hal changed: Some(24)
  11:58:33.389 DEBG hal systems changed: {21}
  11:58:33.390 DEBG rebuilding lie packet mylevel: Some(23) Hals: {21} not_an_offer: false
  11:58:33.390 DEBG sending lie in OneWay
  11:58:33.390 DEBG rcvd LIE
  11:58:33.392 DEBG change neighbor: new AsyncObjectRef { id: UniqueSystemID(2147484221), object: Mutex { data: Neighbor { id: UniqueSystemID(2147484221),
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
  11:58:33.392 DEBG rebuilding lie packet mylevel: Some(23) Hals: {21} not_an_offer: true
  11:58:33.392 DEBG sending lie in TwoWay
  11:58:33.394 DEBG hat changed: Some(22)
  11:58:33.394 DEBG hal systems changed: {22, 21}
peer: if_111_21->0.0.0.0:20004
nodeid: node_111
subsystem: lies
  11:58:33.482 DEBG rebuilding lie packet mylevel: Some(23) Hals: {22, 21} not_an_offer: true
extensive: lies
  11:58:33.482 DEBG sending lie in TwoWay
  11:58:33.487 DEBG rcvd LIE
  11:58:33.487 DEBG received reflection first time, rebuild packet
  11:58:33.487 DEBG addjacency 3-way up
  11:58:33.487 DEBG hat changed: Some(24)
  11:58:34.517 DEBG rebuilding lie packet mylevel: Some(23) Hals: {22, 21} not_an_offer: true
  11:58:34.517 DEBG sending lie in ThreeWay
  11:58:34.518 DEBG rcvd LIE
```

ZTP Flow Leaf111-Node111



ZTP Flow Leaf111-Node111

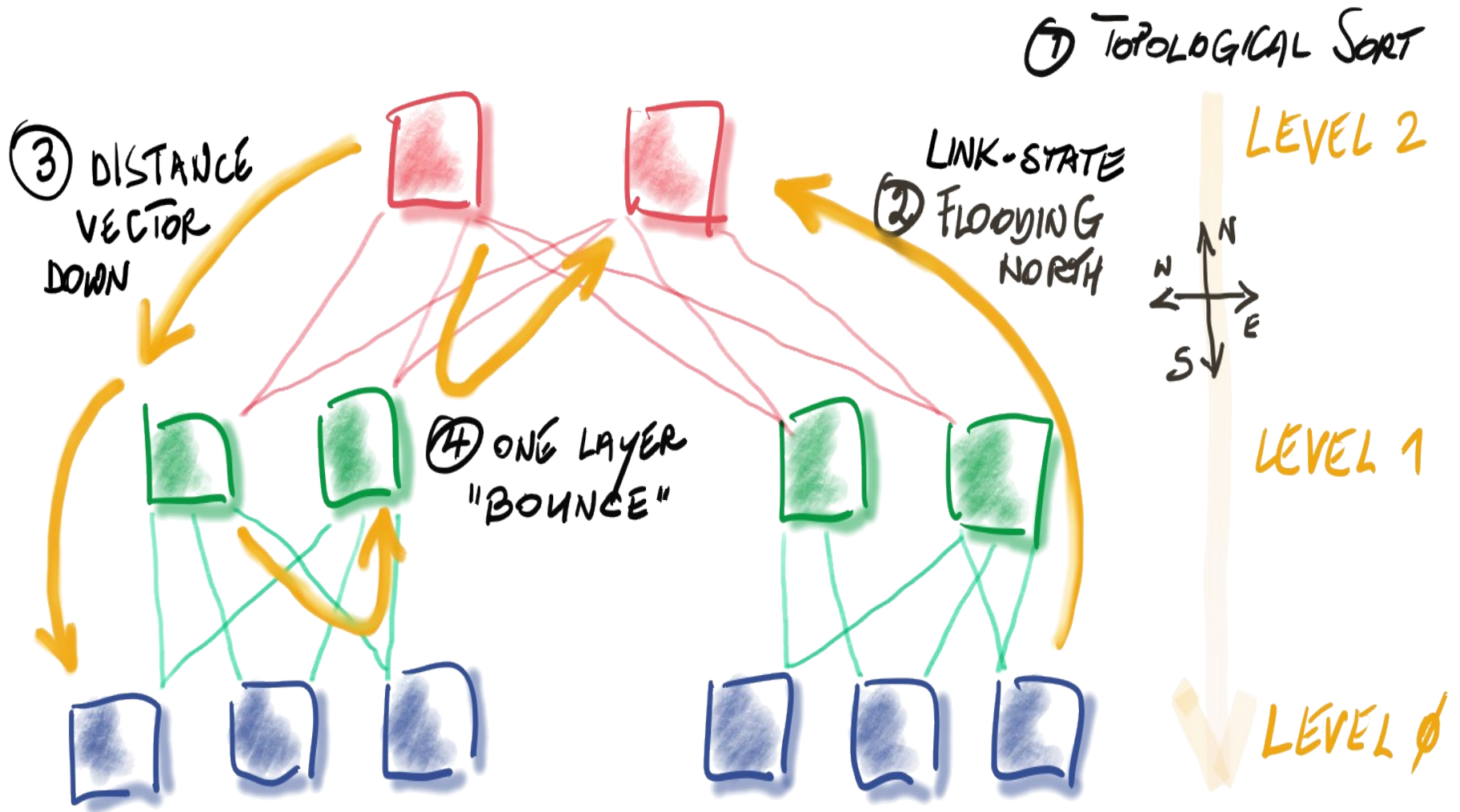
```
peer: if_111_21->0.0.0.0:20004
nodeid: node_111
subsystem: lies
extensive: fsm
12:49:51.591 DEBG FSM if_111_21->0.0.0.0:20004 processing event LevelChanged/OneWay
12:49:51.591 DEBG level changed: Some(21)
12:49:51.592 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.592 DEBG FSM if_111_21->0.0.0.0:20004 processing event HALChanged/OneWay
12:49:51.592 DEBG hal changed: Some(22)
12:49:51.592 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.592 DEBG FSM if_111_21->0.0.0.0:20004 processing event HALSChanged/OneWay
12:49:51.592 DEBG hal systems changed: {1112}
12:49:51.592 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.592 DEBG FSM if_111_21->0.0.0.0:20004 processing event SendLie/OneWay
12:49:51.592 DEBG rebuilding lie packet mylevel: Some(21) hals: {1112} not_an_offer: false
extensive: lies
12:49:51.592 DEBG sending lie in OneWay
extensive: fsm
12:49:51.593 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.593 DEBG FSM if_111_21->0.0.0.0:20004 processing event LevelChanged/OneWay
12:49:51.593 DEBG level changed: Some(23)
12:49:51.593 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.593 DEBG FSM if_111_21->0.0.0.0:20004 processing event HALChanged/OneWay
12:49:51.593 DEBG hal changed: Some(24)
12:49:51.593 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.593 DEBG FSM if_111_21->0.0.0.0:20004 processing event HALSChanged/OneWay
12:49:51.593 DEBG hal systems changed: {22}
12:49:51.593 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.593 DEBG FSM if_111_21->0.0.0.0:20004 processing event SendLie/OneWay
12:49:51.593 DEBG rebuilding lie packet mylevel: Some(23) hals: {22} not_an_offer: false
extensive: lies
12:49:51.593 DEBG sending lie in OneWay
extensive: fsm
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 processing event LieRcvd/OneWay
extensive: lies
12:49:51.594 DEBG rcvd LIE
12:49:51.594 DEBG change neighbor: new AsyncObjectRef { 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
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 processing event UpdateZTPOffer/OneWay
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to OneWay
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 processing event NewNeighbor/OneWay
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to TwoWay
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 processing event SendLie/TwoWay
12:49:51.594 DEBG rebuilding lie packet mylevel: Some(23) hals: {22} not_an_offer: false
extensive: lies
12:49:51.594 DEBG sending lie in TwoWay
extensive: fsm
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to TwoWay
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 adding 2 events
12:49:51.594 DEBG FSM if_111_21->0.0.0.0:20004 processing event HATChanged/TwoWay
12:49:51.595 DEBG hat changed: Some(22)
12:49:51.595 DEBG FSM if_111_21->0.0.0.0:20004 moving machine to TwoWay
12:49:51.595 DEBG FSM if_111_21->0.0.0.0:20004 processing event HALSChanged/TwoWay
```

Neighbors for Node 121

Neighbors for

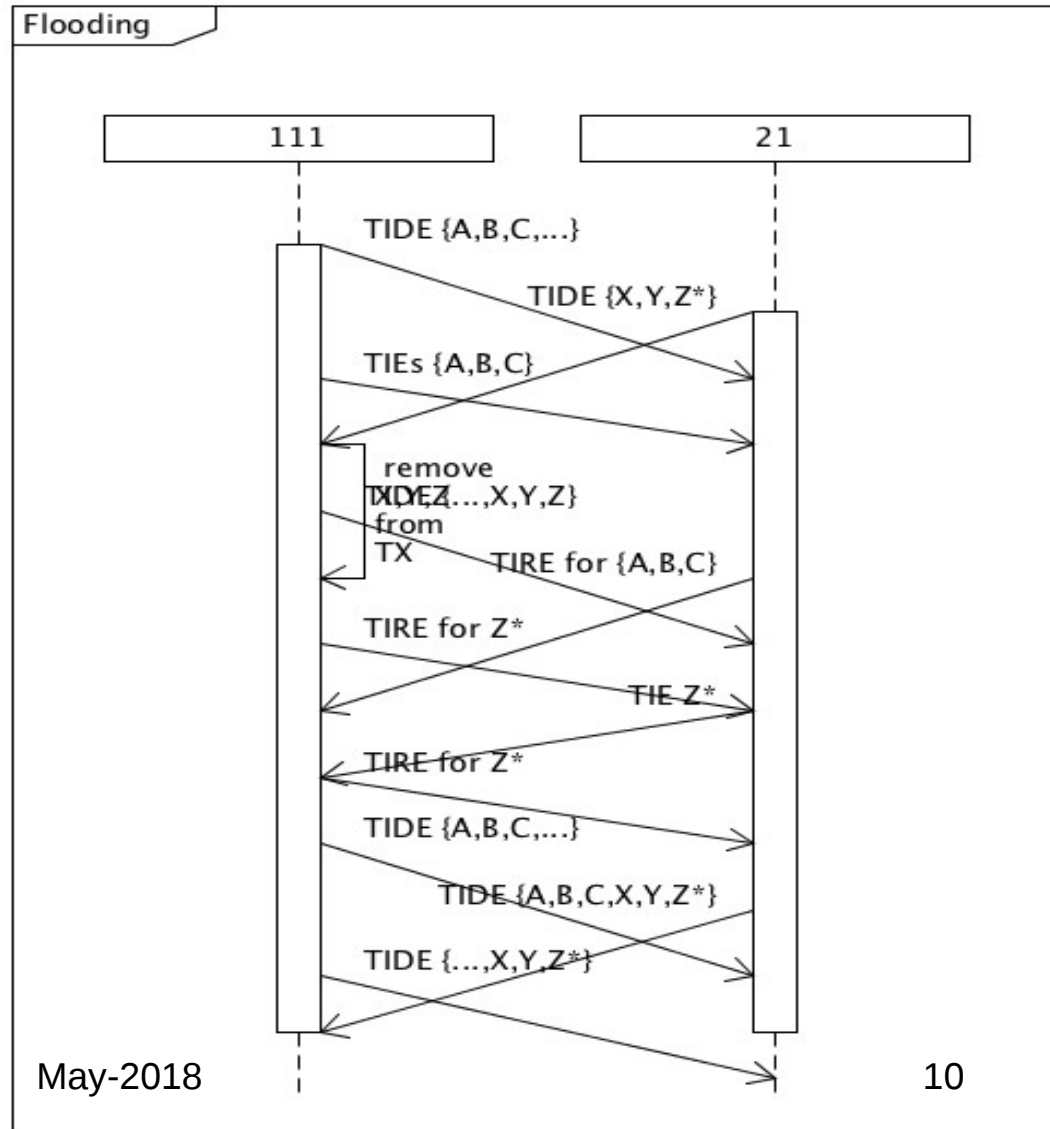
```
[  
  "if_121_2122->0.0.0.0:20055 at level Some(0)",  
  "if_121_2121->0.0.0.0:20051 at level Some(22)",  
  "if_121_21->0.0.0.0:20020 at level Some(24)",  
  "if_121_22->0.0.0.0:20028 at level Some(24)"  
]
```


Flooding Scopes/Architecture



Flooding, TIDEs & TIREs

- 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)
extensive: io
May 01 13:48:04.075 DEBG sent tie Key+Life: South/22/InternalTIETTypeType(NODETIETType)/0/2/600/0.000
May 01 13:48:04.075 DEBG tire: same acked Key+Life: South/22/InternalTIETTypeType(NODETIETType)/0/2/600/0.000 vs. Key+Life: South/22/InternalTIETTypeType(NODETIETType)/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 tide: sending 5 headers from TIEID { originator: 18446744073709551615, tienr: 4294967295, tietype: InternalTIETTypeType(TIETPEMAXVALUE), direction: North } to TIEID { direction:
NORTH, originator: -1, tietype: TIETPEMAXVALUE, tie_nr: -1 } to V4(127.0.0.1:20003)
May 01 13:48:04.158 DEBG tie: rcvd Key+Life: South/21/InternalTIETTypeType(NODETIETType)/0/2/600/0.000
May 01 13:48:04.158 DEBG tie: rcvd unknown Key+Life: South/21/InternalTIETTypeType(NODETIETType)/0/2/600/0.000
May 01 13:48:04.158 DEBG tie: after rcvd Key+Life: South/21/InternalTIETTypeType(NODETIETType)/0/2/600/0.000 ack: Some(Key+Life: South/21/InternalTIETTypeType(NODETIETType)/0/2/600/0.000) tx: None
May 01 13:48:04.158 DEBG tire: transmit our newer Key+Life: South/111/InternalTIETTypeType(NODETIETType)/0/0/0/0.000 vs. Key+Life: South/111/InternalTIETTypeType(NODETIETType)/0/4/600/0.084
May 01 13:48:04.158 DEBG tire: transmit our newer Key+Life: North/111/InternalTIETTypeType(NODETIETType)/0/0/0/0.000 vs. Key+Life: North/111/InternalTIETTypeType(NODETIETType)/0/4/600/0.084
May 01 13:48:04.158 DEBG tire: transmit our newer Key+Life: North/111/InternalTIETTypeType(PREFIXTIETType)/268435457/0/0/0.000 vs. Key+Life:
North/111/InternalTIETTypeType(PREFIXTIETType)/268435457/1/600/0.084
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: InternalTIETTypeType(NODETIETType), direction: South } to 21
May 01 13:48:04.158 DEBG sent tie Key+Life: North/111/InternalTIETTypeType(PREFIXTIETType)/268435457/1/600/0.000
May 01 13:48:04.158 DEBG sent tie Key+Life: North/111/InternalTIETTypeType(NODETIETType)/0/4/600/0.000
May 01 13:48:04.159 DEBG sent tie Key+Life: North/111/InternalTIETTypeType(NODETIETType)/0/5/600/0.000
May 01 13:48:04.159 DEBG tire: same acked Key+Life: North/111/InternalTIETTypeType(PREFIXTIETType)/268435457/1/600/0.000 vs. Key+Life:
North/111/InternalTIETTypeType(PREFIXTIETType)/268435457/1/600/0.085
May 01 13:48:04.159 DEBG tire: processed acks 1 older 0 newer 0
May 01 13:48:04.159 DEBG tire: same acked Key+Life: North/111/InternalTIETTypeType(NODETIETType)/0/5/600/0.000 vs. Key+Life: North/111/InternalTIETTypeType(NODETIETType)/0/5/600/0.000
May 01 13:48:04.159 DEBG tire: processed acks 1 older 0 newer 0
May 01 13:48:04.160 DEBG sent tie Key+Life: North/1112/InternalTIETTypeType(NODETIETType)/0/4/600/0.000
May 01 13:48:04.160 DEBG tire: same acked Key+Life: North/1112/InternalTIETTypeType(NODETIETType)/0/4/600/0.000 vs. Key+Life: North/1112/InternalTIETTypeType(NODETIETType)/0/4/600/0.000
May 01 13:48:04.160 DEBG tire: processed acks 1 older 0 newer 0
May 01 13:48:04.160 DEBG sent tie Key+Life: North/112/InternalTIETTypeType(NODETIETType)/0/2/600/0.000
May 01 13:48:04.161 DEBG tire: same acked Key+Life: North/112/InternalTIETTypeType(NODETIETType)/0/2/600/0.000 vs. Key+Life: North/112/InternalTIETTypeType(NODETIETType)/0/2/600/0.001
May 01 13:48:04.161 DEBG tire: processed acks 1 older 0 newer 0
May 01 13:48:04.173 DEBG filtered out transmission TIEID { originator: 112, tienr: 0, tietype: InternalTIETTypeType(NODETIETType), direction: South } to 21
May 01 13:48:04.173 DEBG sent tie Key+Life: North/1111/InternalTIETTypeType(NODETIETType)/0/5/600/0.000
May 01 13:48:04.174 DEBG tire: same acked Key+Life: North/1111/InternalTIETTypeType(NODETIETType)/0/5/600/0.000 vs. Key+Life: North/1111/InternalTIETTypeType(NODETIETType)/0/5/600/0.000
May 01 13:48:04.174 DEBG tire: processed acks 1 older 0 newer 0
May 01 13:48:04.174 DEBG sent tie Key+Life: North/1111/InternalTIETTypeType(PREFIXTIETType)/279183361/1/600/0.000
May 01 13:48:04.174 DEBG sent tie Key+Life: North/1111/InternalTIETTypeType(NODETIETType)/0/6/600/0.000
May 01 13:48:04.174 DEBG tire: same acked Key+Life: North/1111/InternalTIETTypeType(PREFIXTIETType)/279183361/1/600/0.000 vs. Key+Life:
North/1111/InternalTIETTypeType(PREFIXTIETType)/279183361/1/600/0.001
May 01 13:48:04.174 DEBG tire: processed acks 1 older 0 newer 0
May 01 13:48:04.198 DEBG sent tie Key+Life: North/1112/InternalTIETTypeType(NODETIETType)/0/5/600/0.000
May 01 13:48:04.199 DEBG filtered out transmission TIEID { originator: 111, tienr: 268435456, tietype: InternalTIETTypeType(PREFIXTIETType), direction: South } to 21
May 01 13:48:04.199 DEBG tire: same acked Key+Life: North/1111/InternalTIETTypeType(NODETIETType)/0/6/600/0.000 vs. Key+Life: North/1111/InternalTIETTypeType(NODETIETType)/0/6/600/0.024
```

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 acked 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** tie: rcvd Key+Life: South/21/InternalTIETypeType(PREFIXTIETYPE)/268435456/1/600/0.000
May 01 13:48:04.206 **DEBG** tie: rcvd unknown Key+Life: South/21/InternalTIETypeType(PREFIXTIETYPE)/268435456/1/600/0.000
May 01 13:48:04.206 **DEBG** tie: after rcvd Key+Life: South/21/InternalTIETypeType(PREFIXTIETYPE)/268435456/1/600/0.000 ack: Some(Key+Life:
South/21/InternalTIETypeType(PREFIXTIETYPE)/268435456/1/600/0.000 tx: None
May 01 13:48:04.701 **DEBG** filtered out transmission TIEID { originator: 111, tienr: 268435456, tietype: InternalTIETypeType(PREFIXTIETYPE), direction: South } to 21
May 01 13:48:05.077 **DEBG** tide tics left Some(1)
May 01 13:48:05.079 **DEBG** sent tie Key+Life: North/1112/InternalTIETypeType(NODETIETYPE)/0/6/599/0.000
May 01 13:48:05.080 **DEBG** tire: same acked 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: 112, tienr: 0, tietype: InternalTIETypeType(NODETIETYPE), direction: South } to 21
May 01 13:48:05.691 **DEBG** sent tie Key+Life: North/1112/InternalTIETypeType(NODETIETYPE)/0/7/599/0.000
May 01 13:48:05.692 **DEBG** tire: same acked 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 13:48:05.692 **DEBG** tire: processed acks 1 older 0 newer 0
May 01 13:48:06.100 **DEBG** tide tics left Some(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 13:48:06.121 **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** tide 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 newer Key+Life: South/111/InternalTIETypeType(NODETIETYPE)/0/0/0/0.000 vs. Key+Life: South/111/InternalTIETypeType(NODETIETYPE)/0/4/597/3.052
May 01 13:48:07.126 **DEBG** tire: transmit our newer Key+Life: South/112/InternalTIETypeType(NODETIETYPE)/0/0/0/0.000 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

Flooding Scopes

Packet Type	South	North
vs. Peer		
Direction		
node S-TIE	flood self-originated only	flood if TIE
		originator's level is
		higher than own level
non-node S-TIE	flood self-originated only	flood only if TIE
		originator is equal
		peer
all N-TIEs	never flood	flood always
TIDE	include TIEs in flooding	include TIEs in
	scope	flooding scope
TIRE	include all N-TIEs and all	include only if TIE
	peer's self-originated	originator is equal
	TIEs and all node S-TIEs	peer

Link State Database on N112

```
[
  (
    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

N-(SPF), It's Really Any Feasible Path	S-(SPF)
Use Own N-SPF to Find Neighbors	Use S-SPF to Find Neighbors
Use Neighbor S-TIE to Validate Connectivity	Use Candidate's N-TIE to Validate Connectivity
One Hop	All the Way Down

South Computation N111

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** {

deltaType: **Interim** Added,

value: **Some**(

CompositeNextHopsWithTotalMetrics(

 {

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North Computation N111

COMPUTATION_ID: 8456

```
May 01 20:09:51.107 DEBG running North SPF graph closure on 6 nodes originating in 111
May 01 20:09:51.107 DEBG ++ Entering node 111 @ 0
May 01 20:09:51.107 DEBG ++++ Entering node 111 dist 0 with 4 neighbors
May 01 20:09:51.107 DEBG ++ Link to node 21 @ hndl 0 checking backlinks North
May 01 20:09:51.107 DEBG +++++ found backlink in North
May 01 20:09:51.107 DEBG +++++ added 21 @ 1 nhops ComputationNextHopsType({NeighborNextHopType { distance: 1, interface: 4120, neighborid: 21 }})
May 01 20:09:51.107 DEBG ++ Link to node 22 @ hndl 1 checking backlinks North
May 01 20:09:51.107 DEBG +++++ found backlink in North
May 01 20:09:51.107 DEBG +++++ added 22 @ 1 nhops ComputationNextHopsType({NeighborNextHopType { distance: 1, interface: 4123, neighborid: 22 }})
May 01 20:09:51.108 DEBG ---- node 1111 in level 22 is opposite DAG closure direction
May 01 20:09:51.108 DEBG ---- node 1112 in level 22 is opposite DAG closure direction
May 01 20:09:51.108 DEBG ++ Entering node 21 @ 1
May 01 20:09:51.108 DEBG ++++ Entering node 21 dist 1 with 4 neighbors
May 01 20:09:51.108 DEBG ---- node 112 in level 23 is opposite DAG closure direction
May 01 20:09:51.108 DEBG ---- node 121 in level 23 is opposite DAG closure direction
May 01 20:09:51.108 DEBG ---- node 122 in level 23 is opposite DAG closure direction
May 01 20:09:51.108 DEBG ++ Entering node 22 @ 1
May 01 20:09:51.108 DEBG ++++ Entering node 22 dist 1 with 4 neighbors
May 01 20:09:51.108 DEBG ---- node 112 in level 23 is opposite DAG closure direction
May 01 20:09:51.108 DEBG ---- node 121 in level 23 is opposite DAG closure direction
May 01 20:09:51.108 DEBG ---- node 122 in level 23 is opposite DAG closure direction
```

subsystem: spf

```
May 01 20:09:51.109 DEBG 3 SPF reachable systems expanded to South 2 prefixes
May 01 20:09:51.109 DEBG direction South 2 prefixes attached with diffsize 2
```

subsystem: rib

extensive: prefixes

```
May 01 20:09:51.109 DEBG prefix changes:
```

DeltaCompareVec(
{

 Ipv4prefix(
 IPv4PrefixType {

 address: 0.0.0.0,
 prefixlen: 0
 }

): DeltaCompareEntry {

 deltatype: ElementAdded,
 value: Some(
 CompositeNextHopsWithTotalMetrics(
 {
 2147484256: 2
 }
)
)

 },
 Ipv6prefix(
 IPv6PrefixType {

 address: 0.0.0.0,
 prefixlen: 0
 }

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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

<

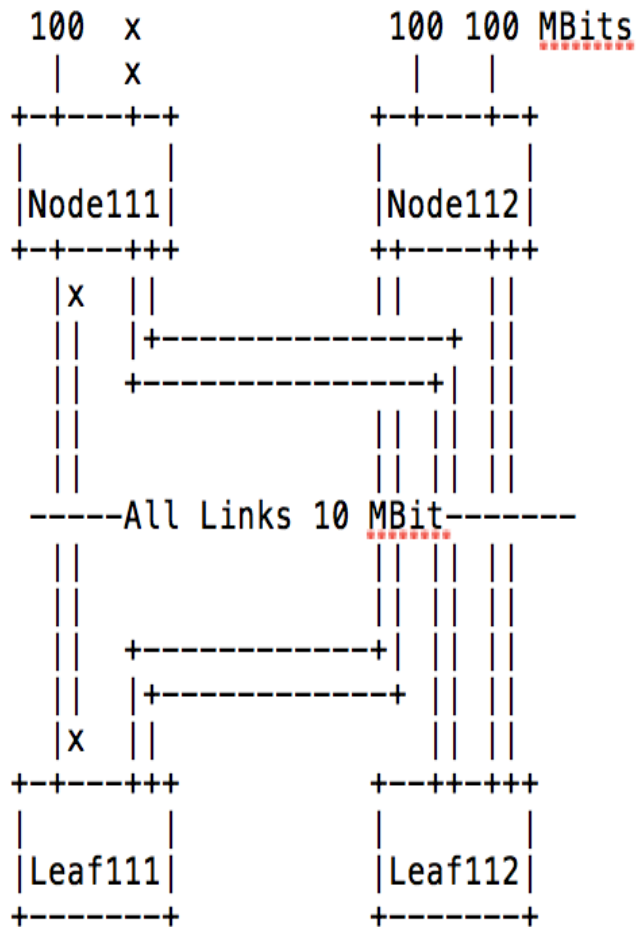
2147484256 {21: LinkIDSet { links: {4120} }, 22: LinkIDSet { links: {4123} }}

2147484254 {1111: LinkIDSet { links: {4126} }}

2147484111 {111: LinkIDSet { links: {} }}

>

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: as sum of the bandwidth available from L to N

N_u: 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: $D * (1 + \text{maximum_of_all}(M_N_u) - M_N_u)$

Node	N	T_N_u	M_N_u	BAD
Leaf111	Node111	110	7	2
Leaf111	Node112	220	8	1
Leaf112	Node111	120	7	2
Leaf112	Node112	220	8	1

Bandwidth Calculation in 1111

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 {1111: LinkIDSet { links: {} }}

2147484257 {112: LinkIDSet { links: {4171} }}

>

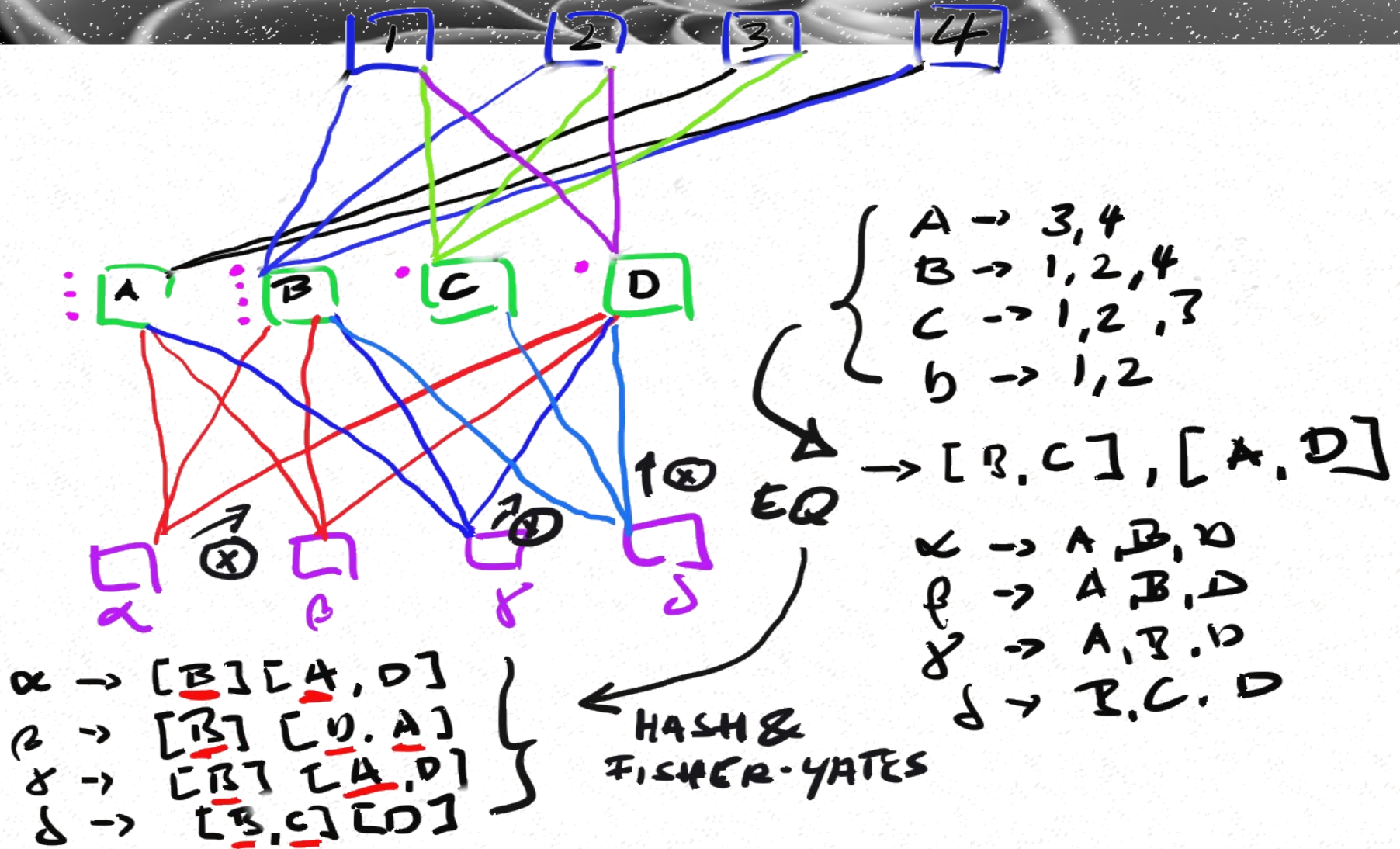
Basic Disaggregation

```
May 01 21:35:52.784 DEBG running SPO computation
extensive: computations
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 }})
  May 01 21:35:52.785 DEBG ++ Entering node 1112 @ 1
  May 01 21:35:52.785 DEBG ++++ Entering node 1112 dist 1 with 2 neighbors
  May 01 21:35:52.785 DEBG ---- node 111 in level 23 is opposite DAG closure direction
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 ++ Link to node 1112 @ hndl 5 checking backlinks South
  May 01 21:35:52.787 DEBG ++++++ found backlink in South
  May 01 21:35:52.787 DEBG ++++++ added 1112 @ 1 nhops ComputationNextHopsType({NeighborNextHopType { distance: 1, interface: 4129, neighborid: 1112 }})
  May 01 21:35:52.787 DEBG ++ Entering node 1111 @ 1
  May 01 21:35:52.787 DEBG ++++ Entering node 1111 dist 1 with 1 neighbors
  May 01 21:35:52.787 DEBG ++ Entering node 1112 @ 1
  May 01 21:35:52.787 DEBG ++++ Entering node 1112 dist 1 with 2 neighbors
  May 01 21:35:52.787 DEBG ---- node 112 in level 23 is opposite DAG closure direction
May 01 21:35:52.787 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
extensive: prefixes
May 01 21:35:52.789 DEBG expanded disaggregated NORTH prefixes: DeltaComparableHashMap {
keyset: {
  ipv4prefix(
    IPv4PrefixType {
      address: 0,
      prefixlen: 0
    }
  ),
  ipv4prefix(
    IPv4PrefixType {
```

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} }}
>
```

Northbound Flood Reduction and Balancing RIFT-01



Secure, Optimized RIFT Information Element Envelope Suggestion

UDP Header	Security Fingerprint Length	TIE Lifetime	Security Fingerprint (e.g. SHA)	LIE Nonce	Serialized RIFT Object
---------------	-----------------------------------	-----------------	---------------------------------------	--------------	------------------------------	------

- 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)