



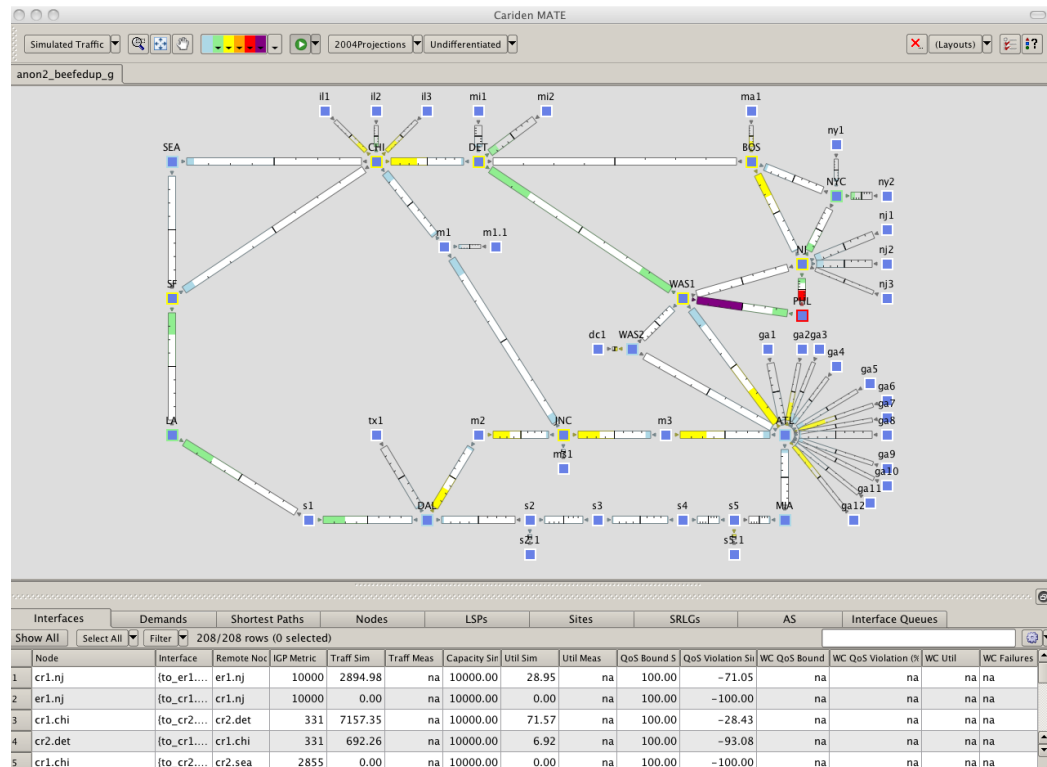
Cariden MATE *IPFRR LFA Simulation*



Arman Maghbouleh

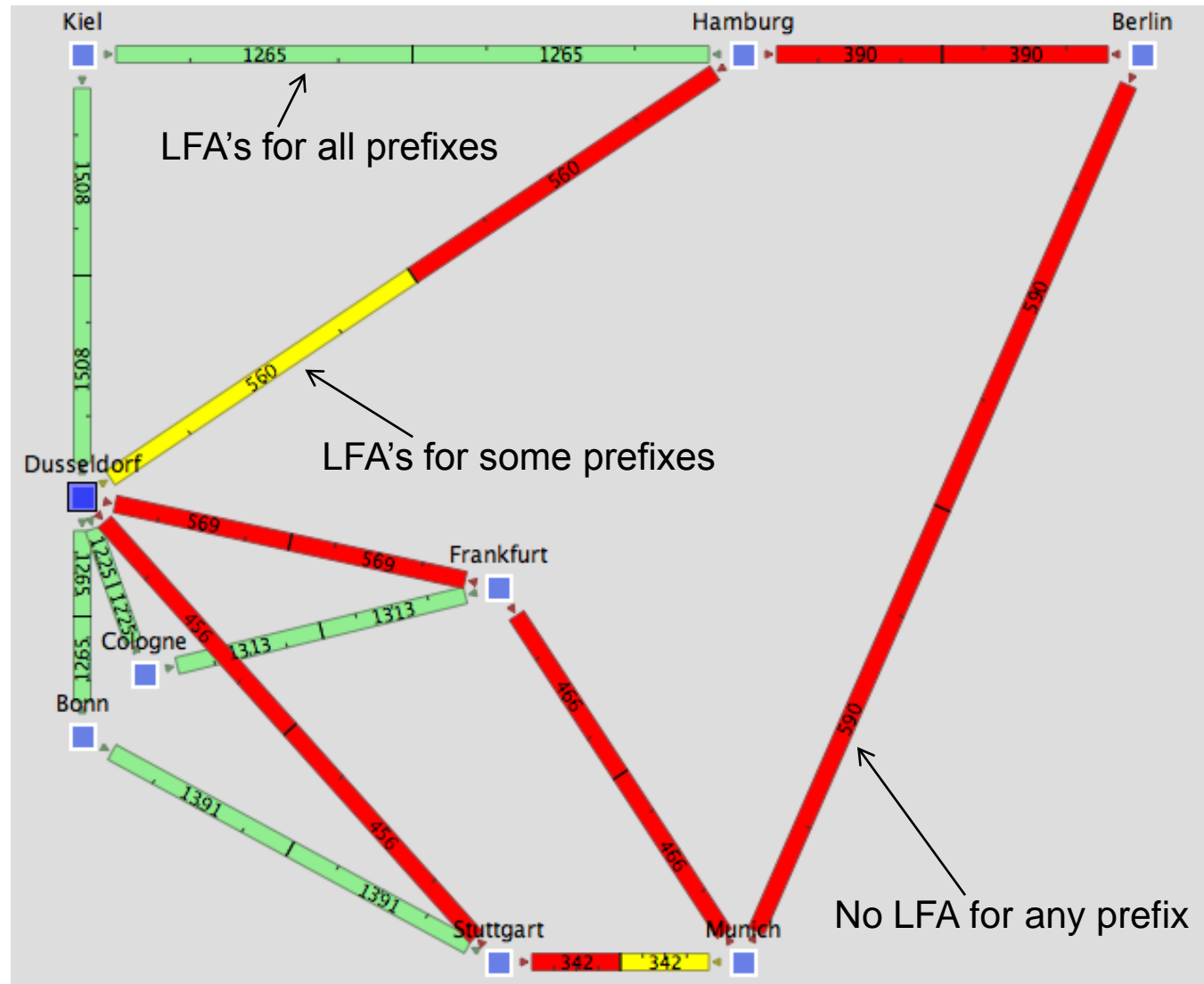
Cariden MATE

- IP/MPLS Traffic Management software
- Discovery & Visualization
- Planning & Design
- Traffic Engineering



Cariden MATE: IPFRR LFA's

- Simulate IPFRR LFA coverage for a given topology
- Traffic aware
- This example: 75% of interface traffic has an LFA available



Presentation Overview

- LFA Analysis Workflow
- Three Cases
 - Prototypical Rings and Edges
 - Mesh (emphasis on backbone)
 - Dual-Plane

IPFRR LFA Analysis Workflow

MATE Plan

- Existing MATE Archive (if available)
(convenient, includes end-to-end traffic)
- **IGP Database (*covered here*)**
(quick and easy but may miss parallel links, no traffic)
- Config Parsing
(more complete than IGP DB)
- ...



IPFRR
Tool



Results

IPFRR LFA Analysis Workflow

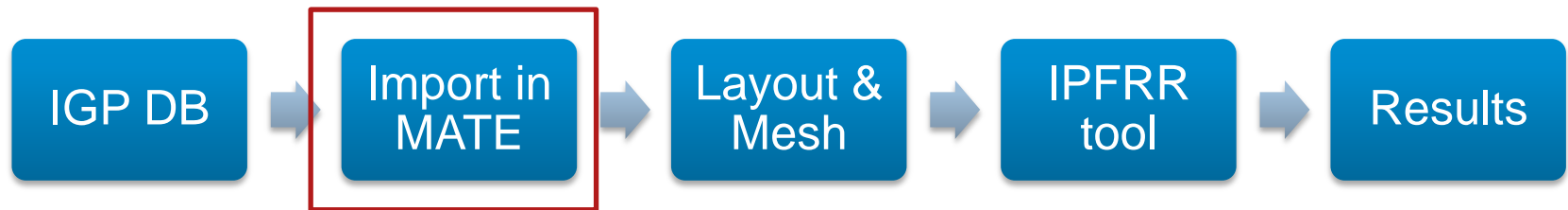


- Show IS-IS or OSPF link-state database from router

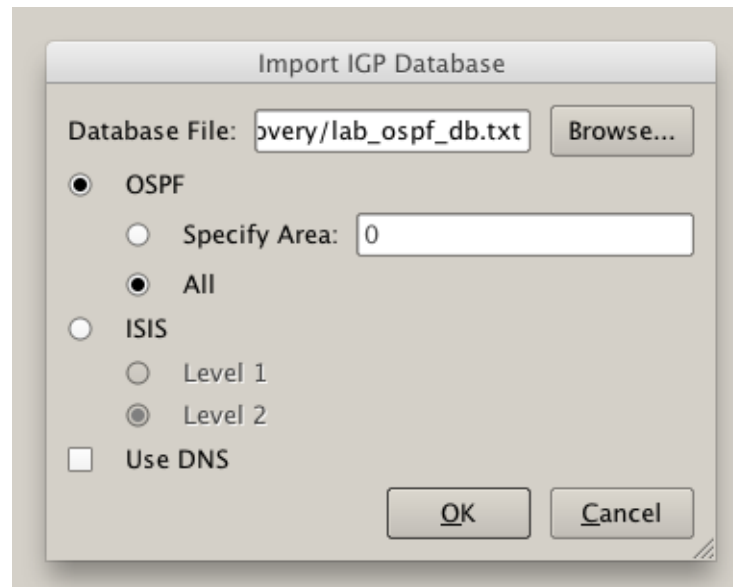
```
cr1.jfk1>show isis database verbose

IS-IS Level-2 Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
vr1.amstnl.00-00  0x0000024F  0xB253        23848         0/0/0
Area Address: 39.840f.8011.3824.0000.0528.0000
NLPID:         0xCC 0x8E
Router ID:     65.108.72.204
IP Address:    65.108.72.204
Hostname:      vr1.amstnl
Metric: 1      IS-Extended vr1.amstnl.02
Interface IP Address: 65.108.72.217
Global Pool BW Unreserved:
  [0]: 972800 kbits/sec, [1]: 972800 kbits/sec
  [2]: 972800 kbits/sec, [3]: 972800 kbits/sec
  [4]: 972800 kbits/sec, [5]: 972800 kbits/sec
  [6]: 972800 kbits/sec, [7]: 972800 kbits/sec
Reservable Global Pool BW: 1000000 kbits/sec
Physical BW: 1000000 kbits/sec
Affinity: 0x00000000
Metric: 2500   IS-Extended wr1.ams2.00
Interface IP Address: 65.108.72.210
Neighbor IP Address: 65.108.72.209
show-isis.txt (END)
```

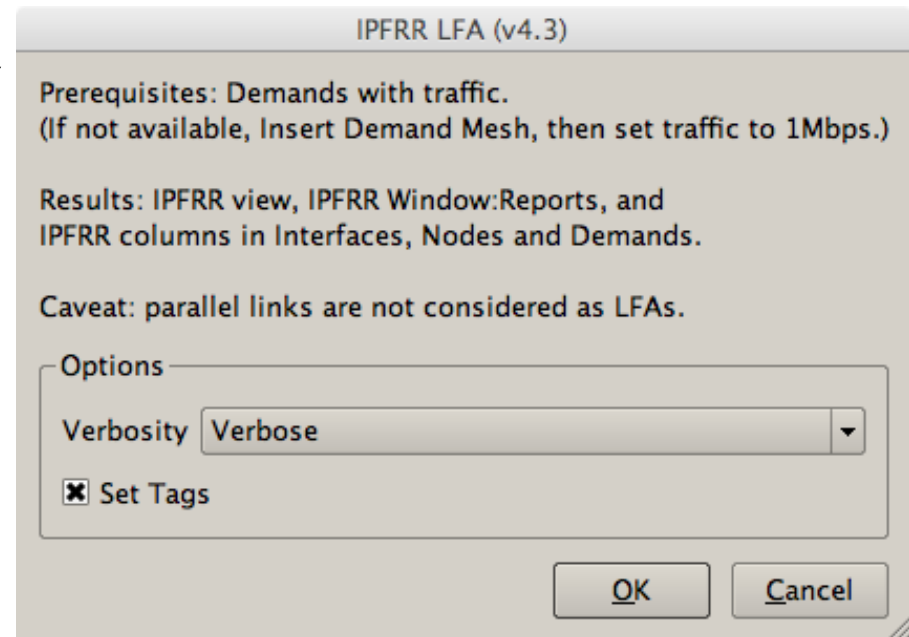
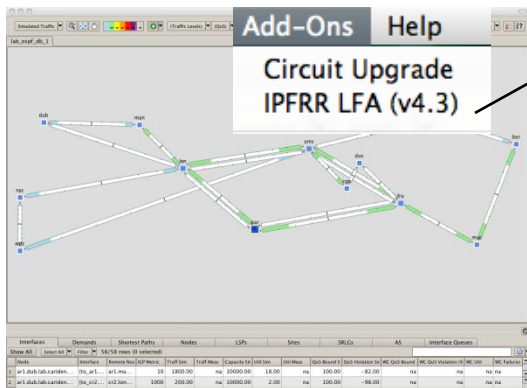
IPFRR LFA Analysis Workflow



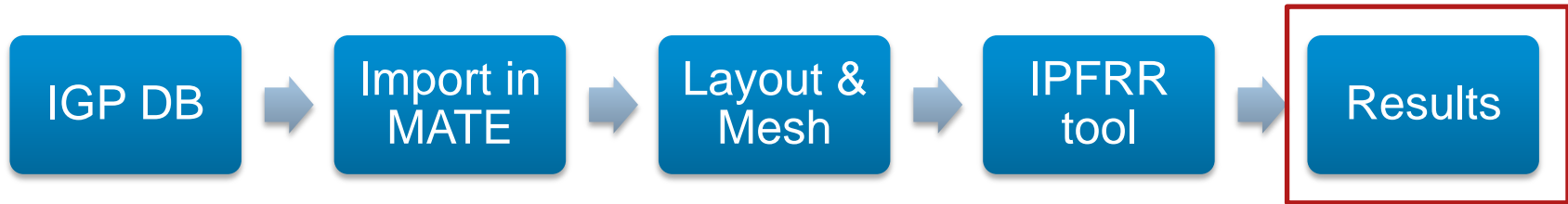
- Import IGP database in MATE



IPFRR LFA Analysis Workflow



IPFRR LFA Analysis Workflow



Cariden MATE

lab_ospf_db_1 lab_ospf_db_1-ipfrr

Interfaces	Demands	Shortest Paths	Nodes	LSPs	Sites	SRLGs	AS	Interface Queues						
Show All	Select All	Filter	58/58 rows (0 selected)											
Node	Interface	Remote Node	IGP Metric	Traffic Sim	Traffic Meas	Capacity Sim	Util Sim	Util Meas	QoS Bound S	QoS Violation S	WC QoS Bound	WC QoS Violation %	WC Util	WC Failures
1	ar1.dub.lab.cariden.com	(to_ar1....)	ar1.ma...	10	1800.00	na	10000.00	18.00	na	100.00	-82.00	na	na	na
2	ar1.dub.lab.cariden.com	(to_cr2....)	cr2.lon....	1000	200.00	na	10000.00	2.00	na	100.00	-98.00	na	na	na

lab_ospf_db_1-ipfrr plan info

Reports

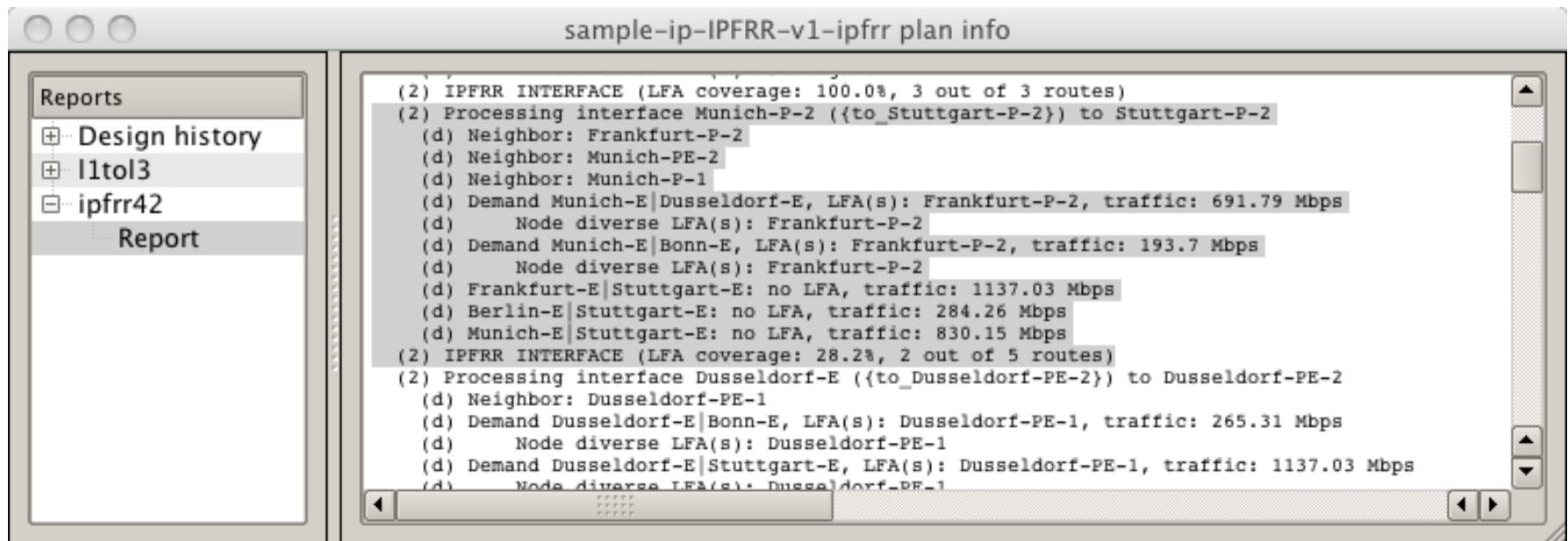
- Design history
- ipfrr42
- Report

```

(1) Id: ipfrr-prefix42.pl 21731 2010-08-24 10:37:30 telkamp
(1) Processing /private/var/folders/zb/zbxo6K50H9EKUWBRV0IS0++++TI/-Tmp-/runscript_input_36
Using Traffic Level: Default
(1) Calculating routing table
(1) Processing routing table
(2) Processing interface cr2.ams.lab.cariden.com ((to_cr1.ams.lab.cariden.com)) to cr1.ams.lab.cariden.com
(d) Neighbor: cr2.fra.lab.cariden.com
(d) Neighbor: cr2.lon.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|er1.par.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com, cr2.lon.lab.cariden.com, ar1.ham.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr1.ams.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com, cr2.lon.lab.cariden.com, ar1.ham.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|ar1.cgn.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|ar1.dub.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.lon.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr1.fra.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com, ar1.ham.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr2.par.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com, cr2.lon.lab.cariden.com, ar1.ham.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr1.nyc.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.lon.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr1.wdc.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com, ar1.cgn.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr1.par.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com, cr2.lon.lab.cariden.com, ar1.ham.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|ar1.man.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.lon.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr1.lon.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|ar1.dus.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|er2.par.lab.cariden.com, LFA(s): cr2.fra.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com, cr2.lon.lab.cariden.com, ar1.ham.lab.cariden.com
(2) IPFRR INTERFACE (LFA coverage: 100.0%, 13 out of 13 routes)
(2) Processing interface cr1.ams.lab.cariden.com ((to_cr1.fra.lab.cariden.com)) to cr1.fra.lab.cariden.com
(d) Neighbor: cr2.ams.lab.cariden.com
(d) Neighbor: ar1.cgn.lab.cariden.com
(d) Neighbor: cr1.lon.lab.cariden.com
(d) Neighbor: cr1.wdc.lab.cariden.com
(d) Demand cr1.lon.lab.cariden.com|cr2.fra.lab.cariden.com, LFA(s): cr2.ams.lab.cariden.com
(d) Node diverse LFA(s): cr2.ams.lab.cariden.com, ar1.cgn.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr2.par.lab.cariden.com, LFA(s): cr1.lon.lab.cariden.com
(d) Node diverse LFA(s): cr1.lon.lab.cariden.com
(d) Demand cr1.cgn.lab.cariden.com|ar1.man.lab.cariden.com, LFA(s): cr2.ams.lab.cariden.com
(d) Node diverse LFA(s): cr2.ams.lab.cariden.com
(d) Demand cr1.nyc.lab.cariden.com|cr2.fra.lab.cariden.com, LFA(s): cr2.ams.lab.cariden.com
(d) Node diverse LFA(s): cr2.ams.lab.cariden.com, ar1.cgn.lab.cariden.com
(d) Demand ar1.cgn.lab.cariden.com|er2.par.lab.cariden.com, LFA(s): cr1.lon.lab.cariden.com
(d) Node diverse LFA(s): cr1.lon.lab.cariden.com
(d) Demand cr2.ams.lab.cariden.com|cr1.fra.lab.cariden.com, LFA(s): cr1.lon.lab.cariden.com
(d) Node diverse LFA(s): cr1.lon.lab.cariden.com
(d) Demand cr1.lon.lab.cariden.com|cr1.fra.lab.cariden.com, LFA(s): cr2.ams.lab.cariden.com
(d) Node diverse LFA(s): cr2.ams.lab.cariden.com, no LFA, traffic: 100.0 Mbps
(d) Demand cr1.lon.lab.cariden.com|ar1.ham.lab.cariden.com, LFA(s): cr2.ams.lab.cariden.com
(d) Node diverse LFA(s): cr2.fra.lab.cariden.com
(d) Demand cr1.lon.lab.cariden.com|ar1.ber.lab.cariden.com, LFA(s): cr2.ams.lab.cariden.com
(d) Node diverse LFA(s): cr2.ams.lab.cariden.com
(d) Demand ar1.cgn.lab.cariden.com|ar1.ber.lab.cariden.com, LFA(s): cr2.ams.lab.cariden.com
    
```

IPFRR LFA Analysis Results

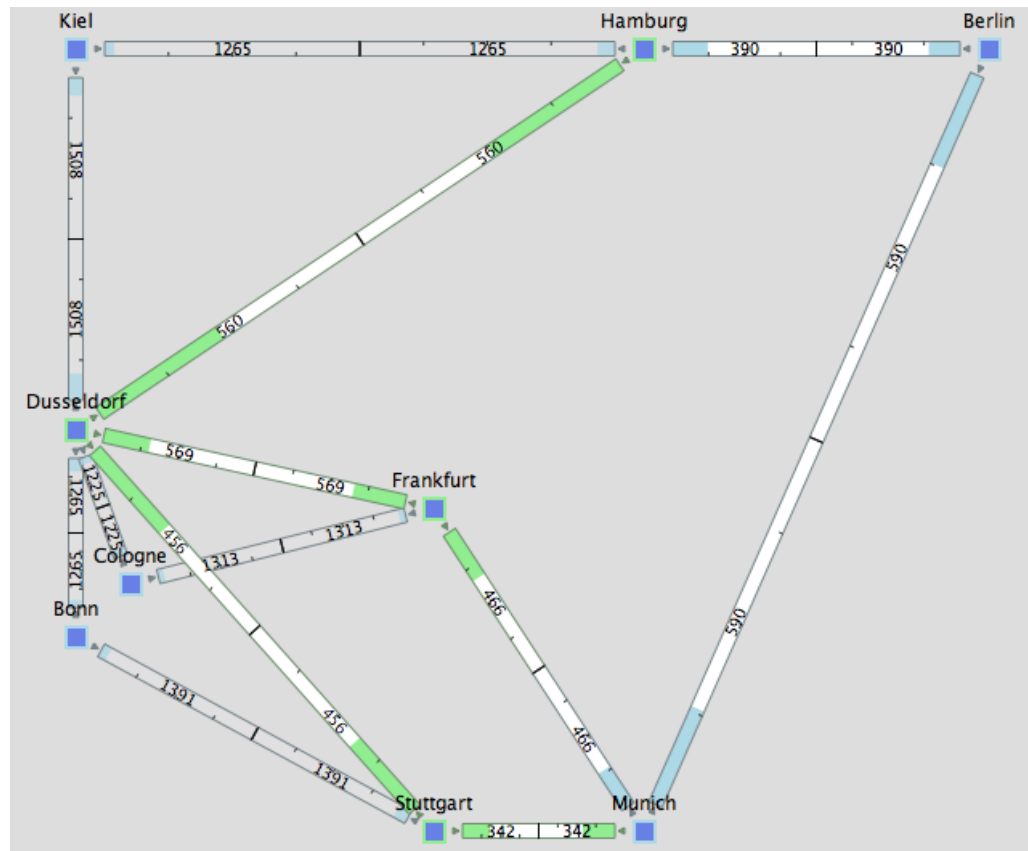
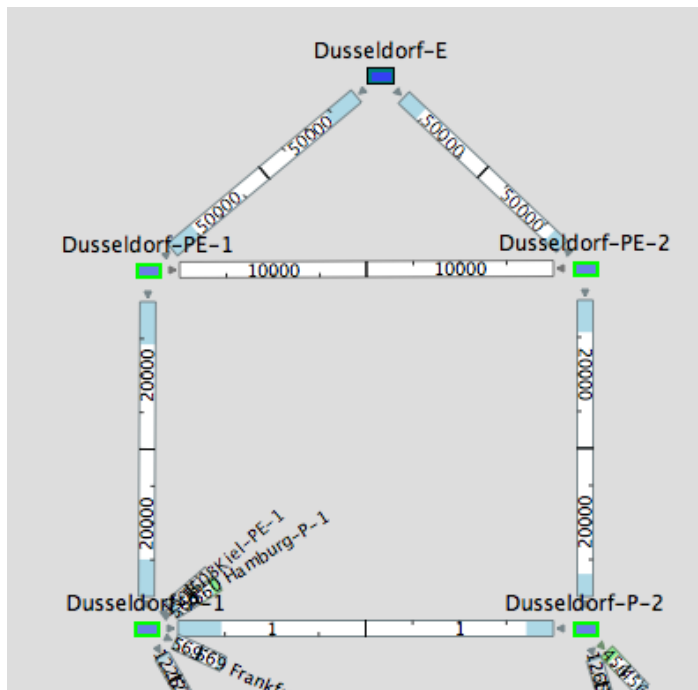
- Results in detail
- Per Interface per Demand (=prefix):
 - All LFA's
 - Node protecting LFA's



The screenshot shows a window titled "sample-ip-IPFRR-v1-ipfrr plan info". On the left is a sidebar with a "Reports" section containing "Design history", "I1tol3", "ipfrr42", and "Report". The main area displays a text-based report of IPFRR LFA analysis results.

```
(2) IPFRR INTERFACE (LFA coverage: 100.0%, 3 out of 3 routes)
(2) Processing interface Munich-P-2 ({to_Stuttgart-P-2}) to Stuttgart-P-2
(d) Neighbor: Frankfurt-P-2
(d) Neighbor: Munich-PE-2
(d) Neighbor: Munich-P-1
(d) Demand Munich-E|Dusseldorf-E, LFA(s): Frankfurt-P-2, traffic: 691.79 Mbps
(d)   Node diverse LFA(s): Frankfurt-P-2
(d) Demand Munich-E|Bonn-E, LFA(s): Frankfurt-P-2, traffic: 193.7 Mbps
(d)   Node diverse LFA(s): Frankfurt-P-2
(d) Frankfurt-E|Stuttgart-E: no LFA, traffic: 1137.03 Mbps
(d) Berlin-E|Stuttgart-E: no LFA, traffic: 284.26 Mbps
(d) Munich-E|Stuttgart-E: no LFA, traffic: 830.15 Mbps
(2) IPFRR INTERFACE (LFA coverage: 28.2%, 2 out of 5 routes)
(2) Processing interface Dusseldorf-E ({to_Dusseldorf-PE-2}) to Dusseldorf-PE-2
(d) Neighbor: Dusseldorf-PE-1
(d) Demand Dusseldorf-E|Bonn-E, LFA(s): Dusseldorf-PE-1, traffic: 265.31 Mbps
(d)   Node diverse LFA(s): Dusseldorf-PE-1
(d) Demand Dusseldorf-E|Stuttgart-E, LFA(s): Dusseldorf-PE-1, traffic: 1137.03 Mbps
(d)   Node diverse LFA(s): Dusseldorf-PE-1
```

Case 1: Square Edge, Ring Backbone

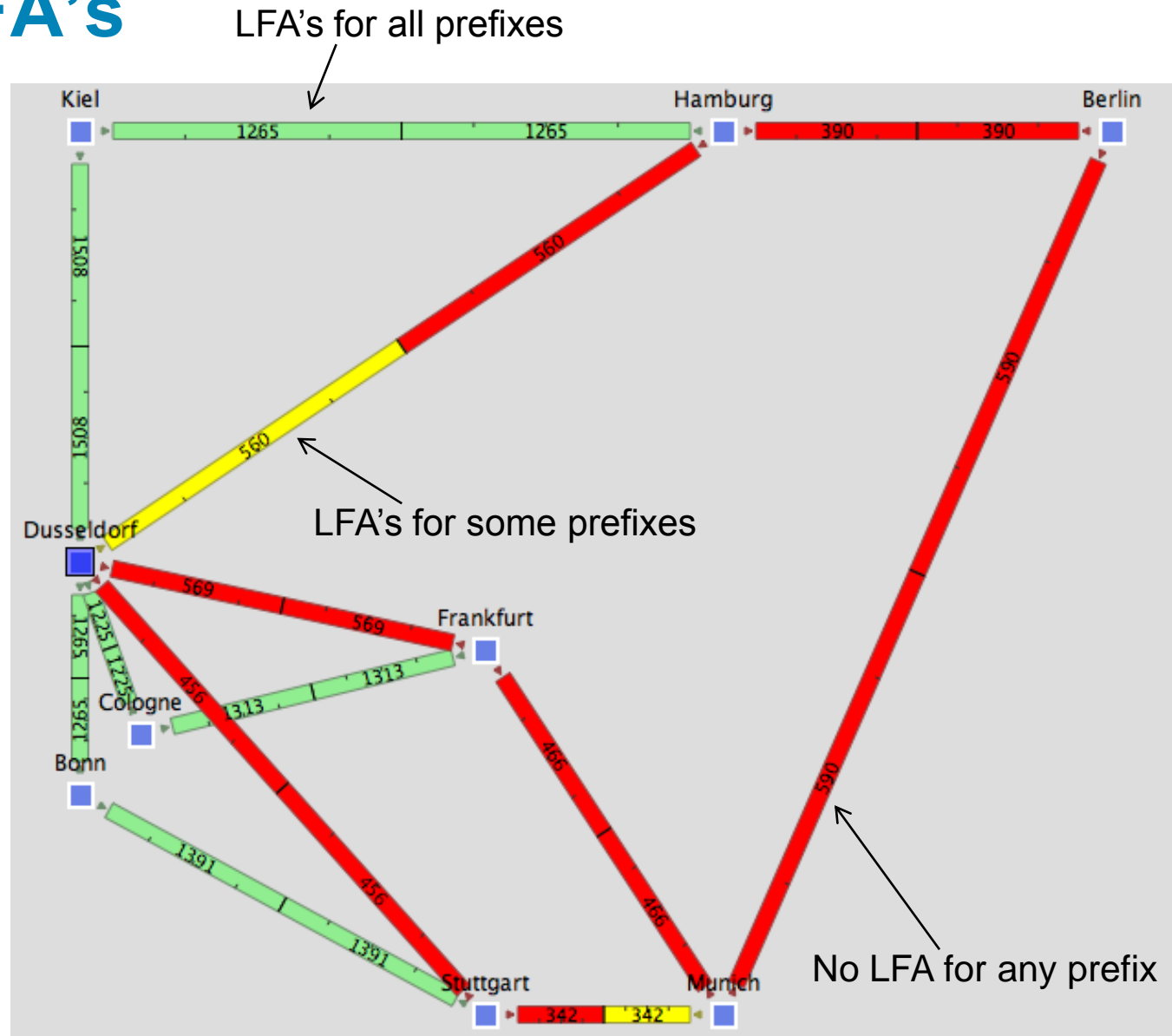


- Follows LFA applicability draft section 3.3: Square
- MATE will verify

- Delay-based Metrics.
- MATE will evaluate coverage, allow re-design to expand coverage

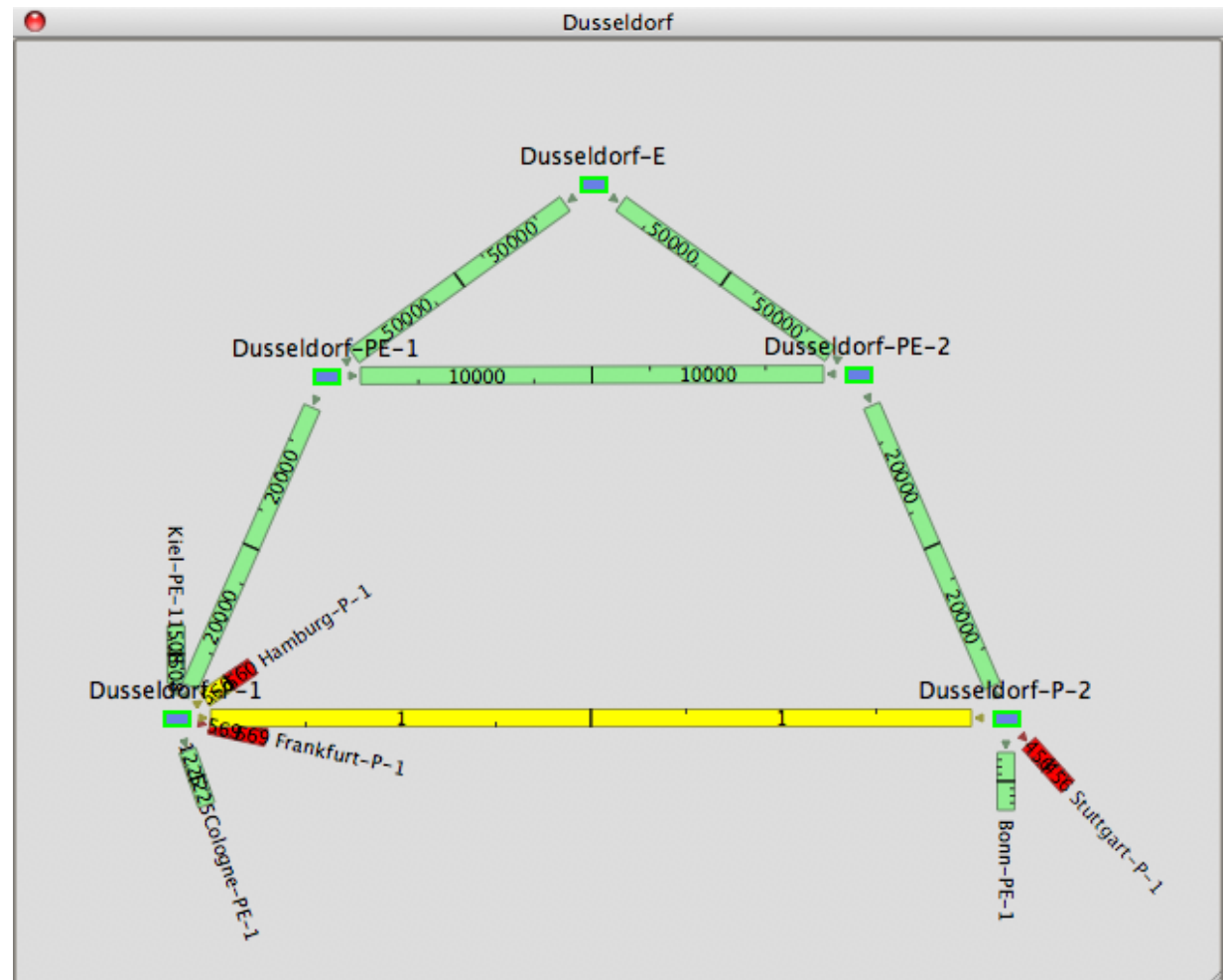
IPFRR LFA's

- 75% of interface traffic has an LFA available
- Some inter-site links are not protected due to ring topology



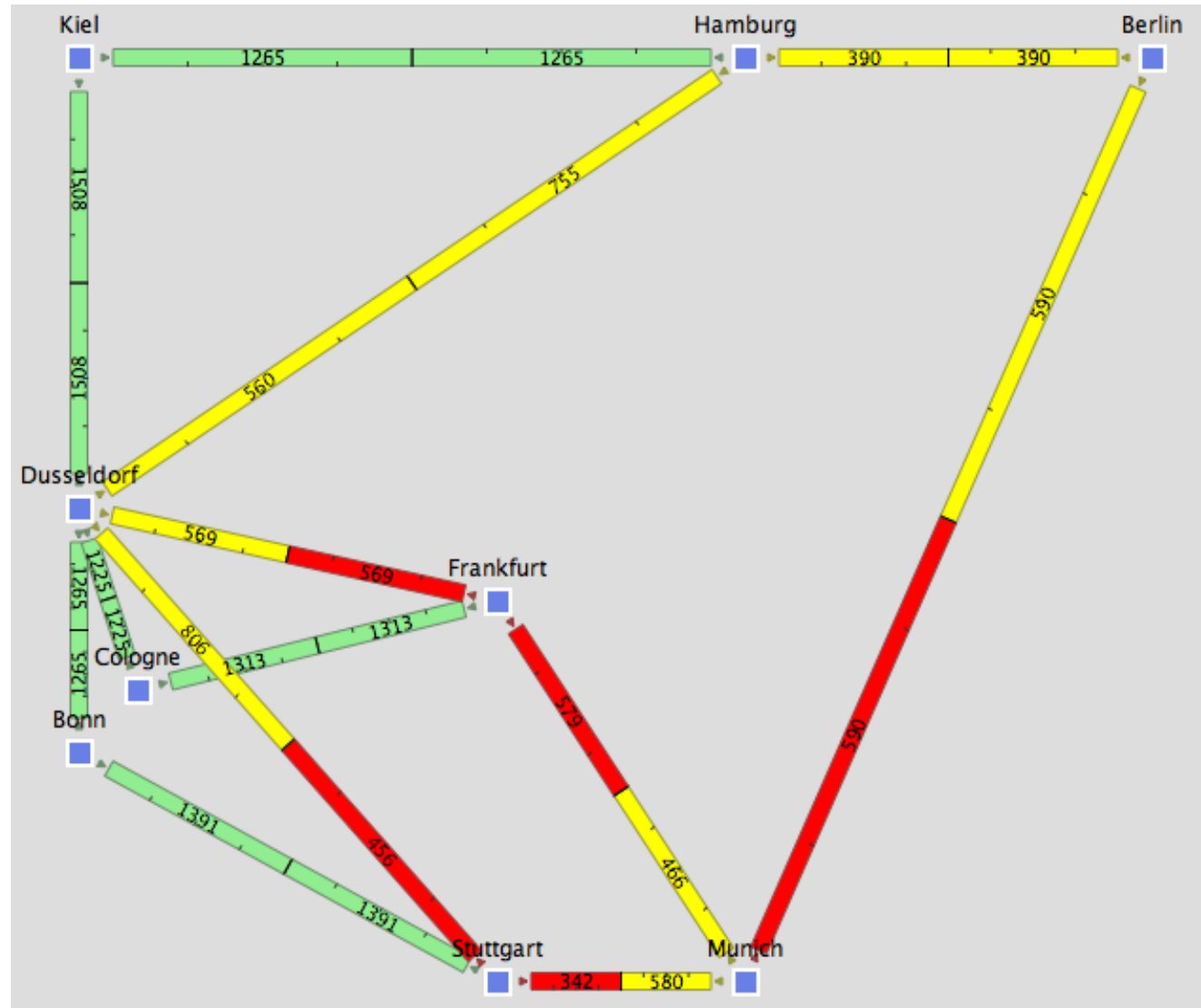
IPFRR LFA's: site view

- Following guidelines did result in edge IPFRR coverage



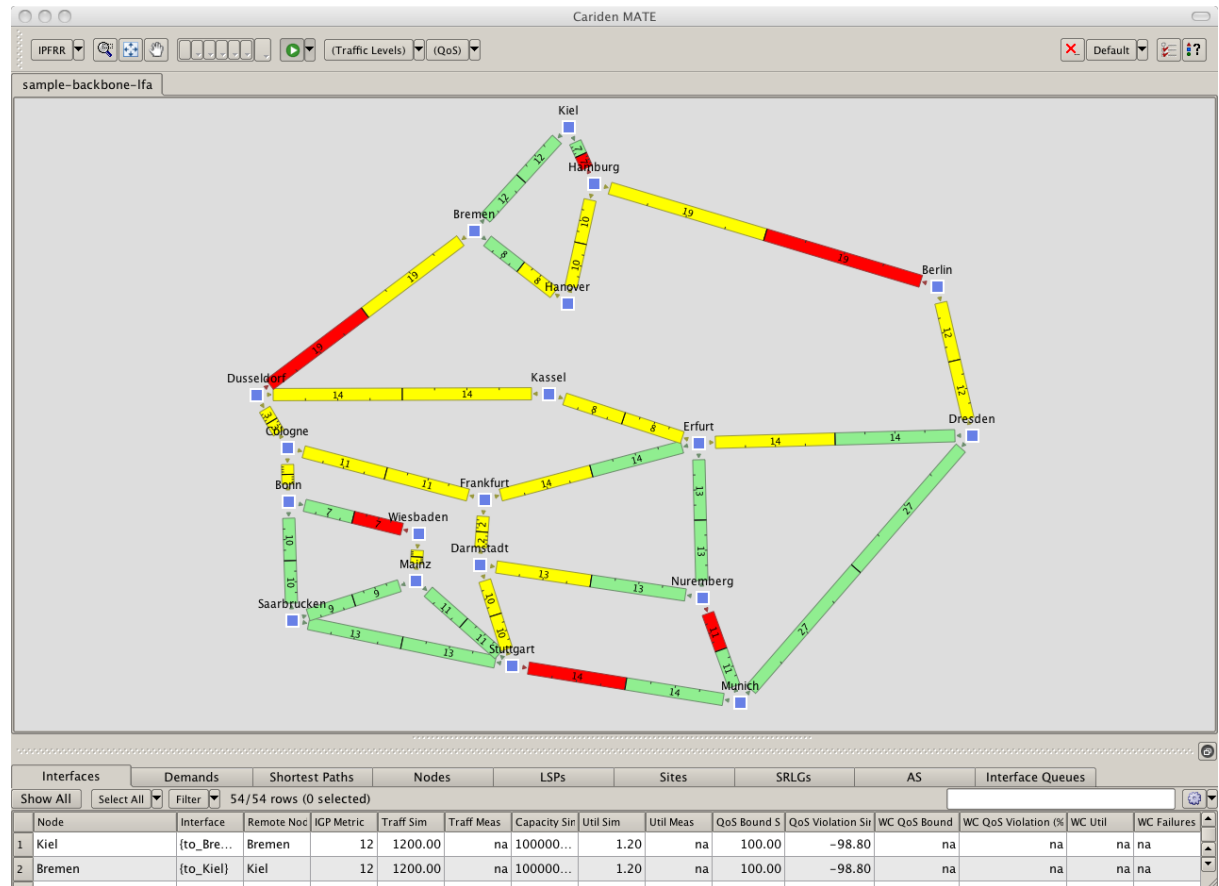
IPFRR LFA's: metric optimization

- IPFRR coverage on core links has improved
 - Metric optimization introduces more ECMP
- Average delay went up with 0.2 ms



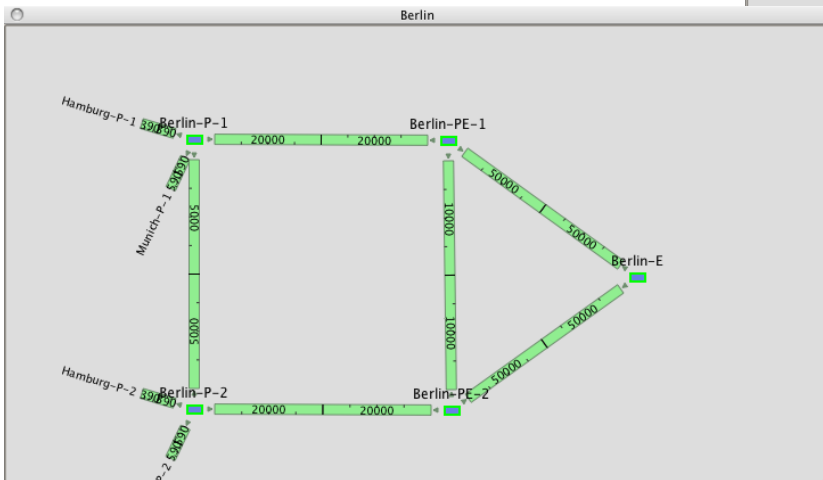
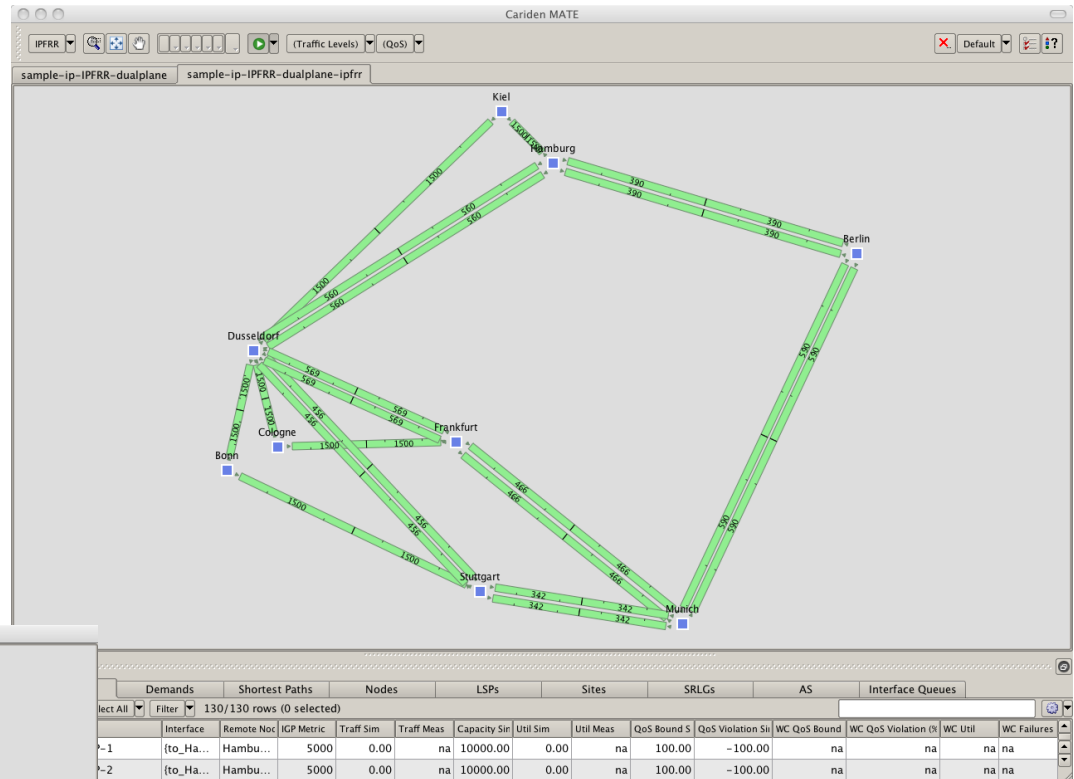
Case 2: Meshed backbone

- Backbone only (no edge)
- Delay-based Metrics
- 45% coverage (uniform traffic matrix between sites)



Dual-plane design: IPFRR LFA

- 100% IPFRR LFA coverage
- Link to other plane is always an LFA!



- Edge protected per guidelines

Summary

- Complete LFA coverage for standard designs (draft-filsfils-rtgwg-lfa-applicability)
- Need tool to evaluate real-world topologies
- Cariden MATE provides simple evaluation method
 - Easy to import current topology and IGP metrics
 - Per-prefix IPFRR LFA coverage
 - Analysis based on demand mesh (e.g. edge to edge), and possibly real (or projected) traffic (weighted results)

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IP-FRR Add-On

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