Comparing LDR on emu. env.

Adler Oliveira Silva Neves

Agenda

- Tools
- Topologies
- Testing
- Results
- Discussion
- Acknowledgements

Tools

- Ryu
- Mininet
- A lot of own code:
  - Topology generation
  - Ryu controller
  - Visualization
  - Automatic testing
  - Table generation
  - Chart generation

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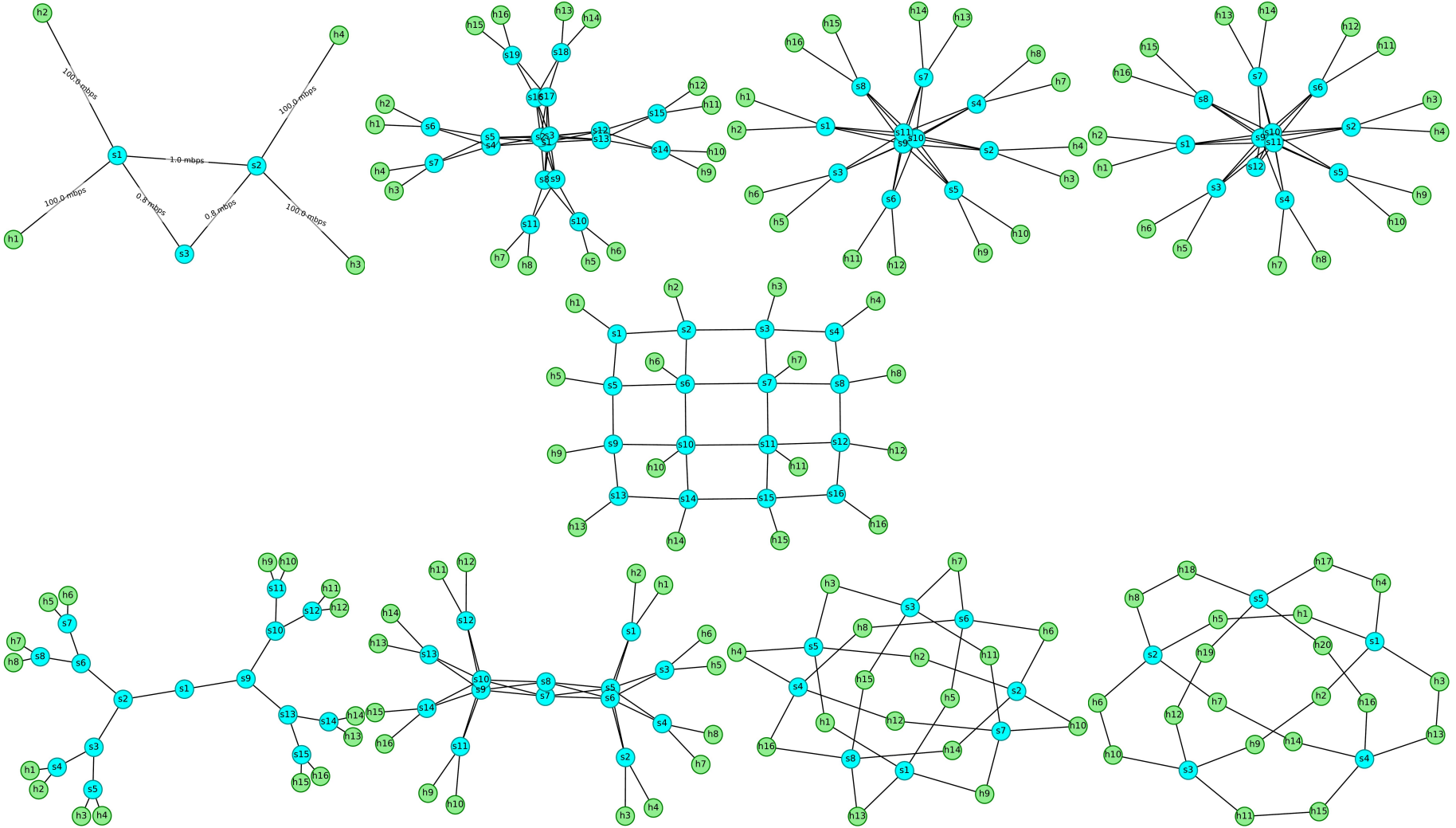
h2
100.0 mbps
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100.0 mbps
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s2
100.0 mbps
0.8 mbps
0.8 mbps
100.0 mbps
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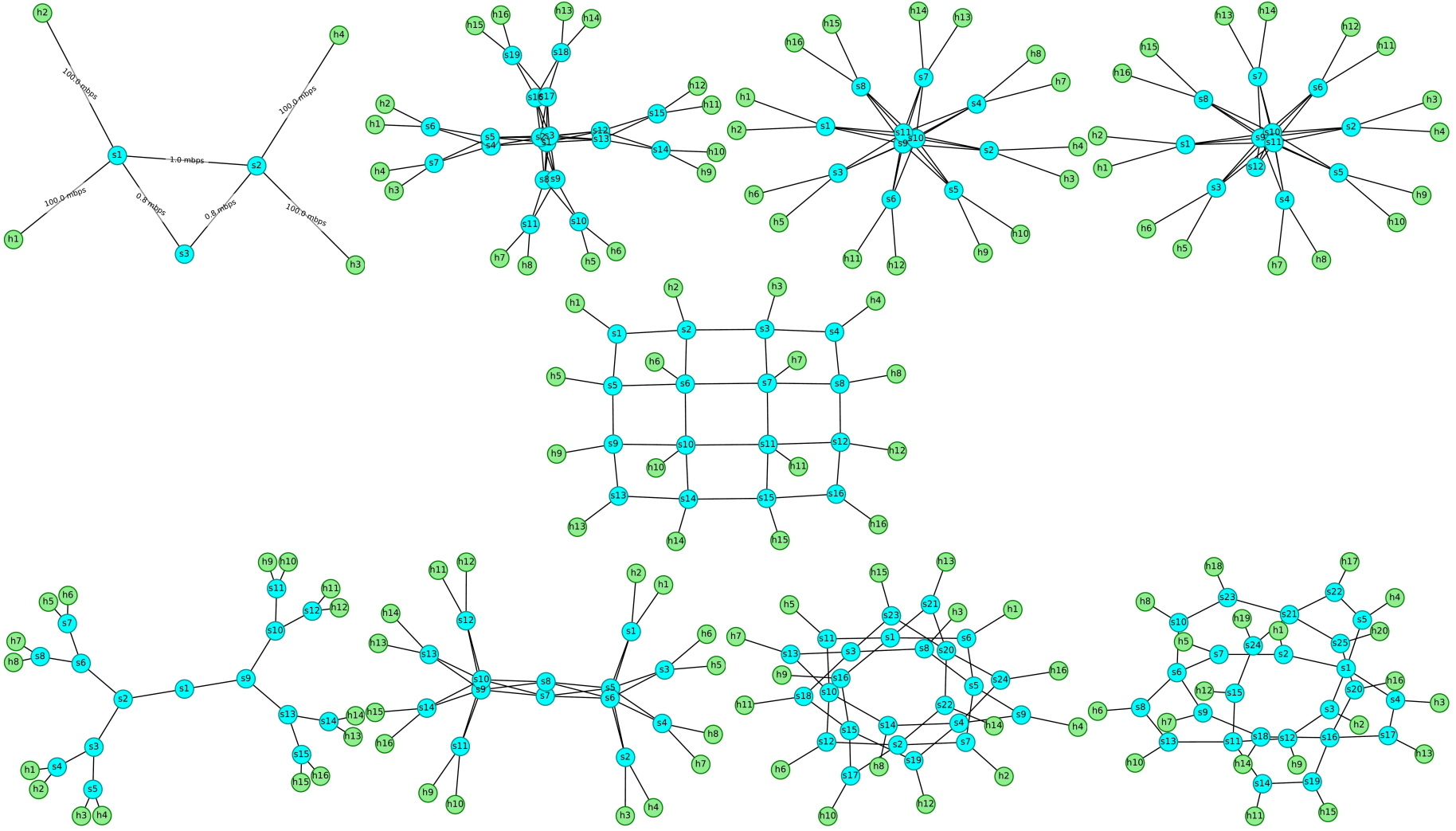
h9
h14
s4
s3
h11
h15


100.0 mbps
1.0 mbps
0.8 mbps
0.8 mbps
100.0 mbps
100.0 mbps
100.0 mbps

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Testing

h1	h2	h3	h4	h5	h5	h6	h7	h8	h9

h1	h2	h3	h4	h5
h6	h7	h8	h9	

h1	h2	h3	h4
h9	h8	h7	h6

Testing

h1	h2	h3	h4	h5	h5	h6	h7	h8	h9

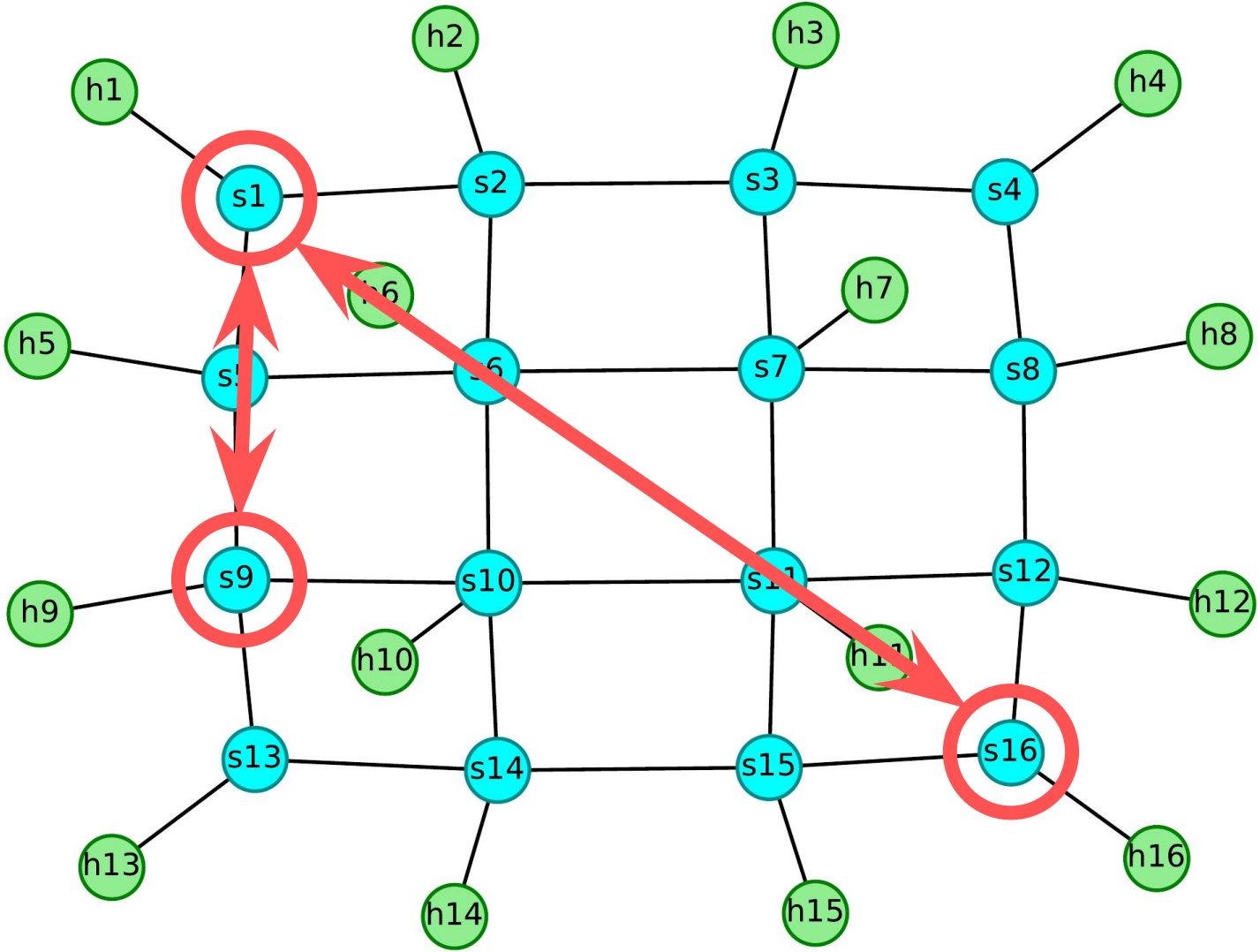
h1	h2	h3	h4	h5
h6	h7	h8	h9	

Latency & Jitter

h1	h2	h3	h4
h6	h7	h8	h9

Bandwidth

× 30


h1
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s12
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h10
h12
s13
s14
s15
s16
h13
h14
h15
h16

Testing

h1	h2	h3	h4	h5	h5	h6	h7	h8	h9

h1	h2	h3	h4	h5
h6	h7	h8	h9	

Latency & Jitter

h1	h2	h3	h4
h6	h7	h8	h9

Bandwidth

× 30

Testing

h1	h2	h3	h4	h5	h5	h6	h7	h8	h9

h1	h2	h3	h4	h5
h6	h7	h8	h9	

Latency & Jitter

h1	h2	h3	h4
h9	h8	h7	h6

Bandwidth

× 30

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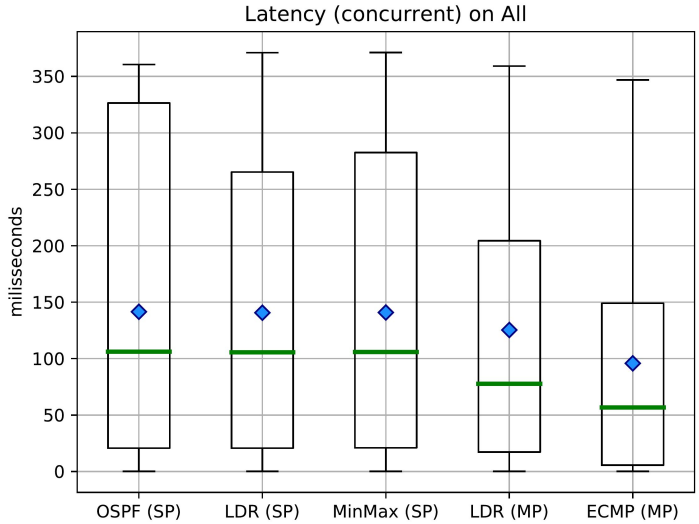
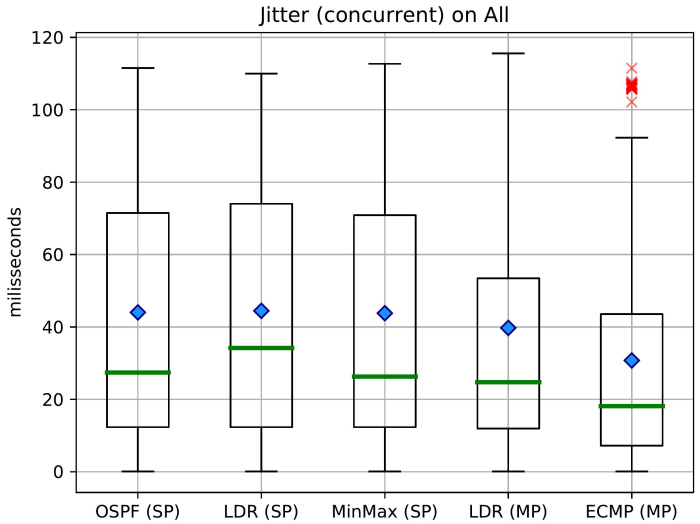
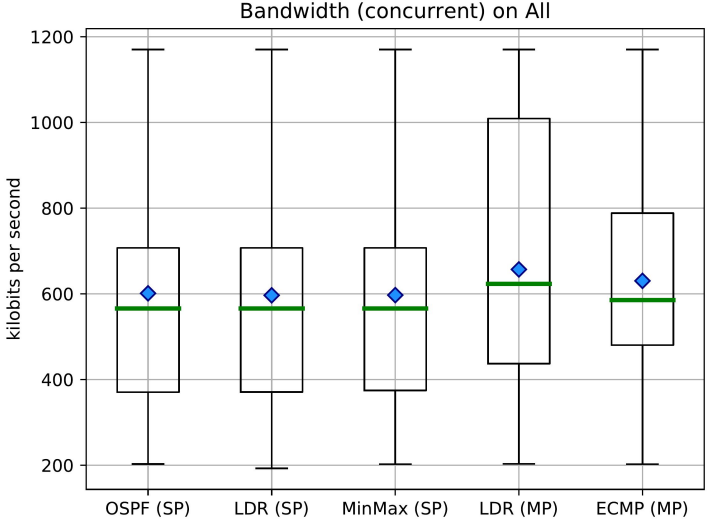
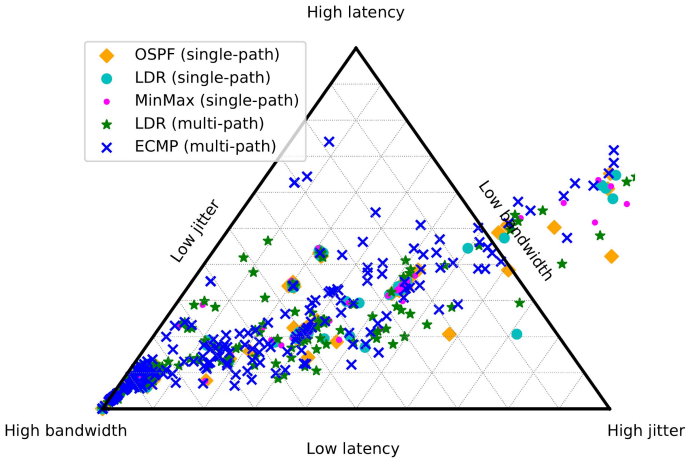

Latency (concurrent) on All
milisseconds
0
50
100
150
200
250
300
350
OSPF (SP)
LDR (SP)
MinMax (SP)
LDR (MP)
ECMP (MP)


Jitter (concurrent) on All
milisseconds
0
20
40
60
80
100
120
OSPF (SP)
LDR (SP)
MinMax (SP)
LDR (MP)
ECMP (MP)


Bandwidth (concurrent) on All
kilobits per second
200
400
600
800
1000
1200
OSPF (SP)
LDR (SP)
MinMax (SP)
LDR (MP)
ECMP (MP)


High latency
OSPF (single-path)
LDR (single-path)
MinMax (single-path)
LDR (multi-path)
ECMP (multi-path)
Low jitter
Low bandwidth
High bandwidth
Low latency
High jitter

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All paths are 1mbps ➔ Ideal for ECMP

Most topologies are overloaded

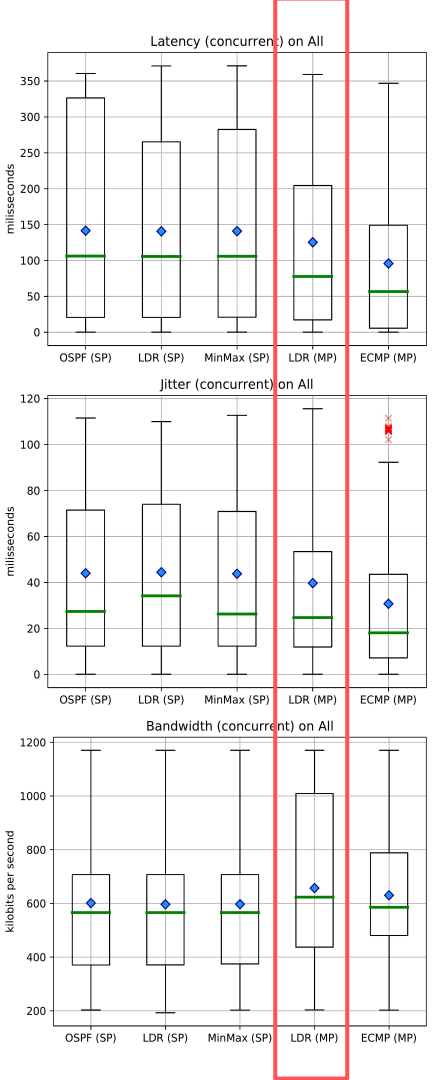
Compared to ECMP: ⬆ bandwidth ⬆ latency ⬆ jitter

LDR doesn't pursue low latency

Low latency is achieved indirectly

If an application increases latency-sensitive traffic on latency… Thrashing!

"We hope our work can be a first step toward enabling the deployment of ISP topologies that are better than today's for the provision of low-latency service" - Gvozdiev et. al. (2018)



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Acknowledgements

We thank...

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Magnos Martinello for pointing me towards CLOS topologies,

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Wildan Maulana Syahidillah for the explanatory multi-path routing tutorial using Ryu.

Questions?