Internet dove
gli altri non arrivano

Traffic Engineering
The EOLO way of life

The People

eolo Internet dove gli altri non arrivano

A. Spini, A. Milani, P. Biasoli, S. Ceccato, M. Citterio, D. Dellabianca, F. Alberti, D. Buzzi

A (very) distinguishing feature

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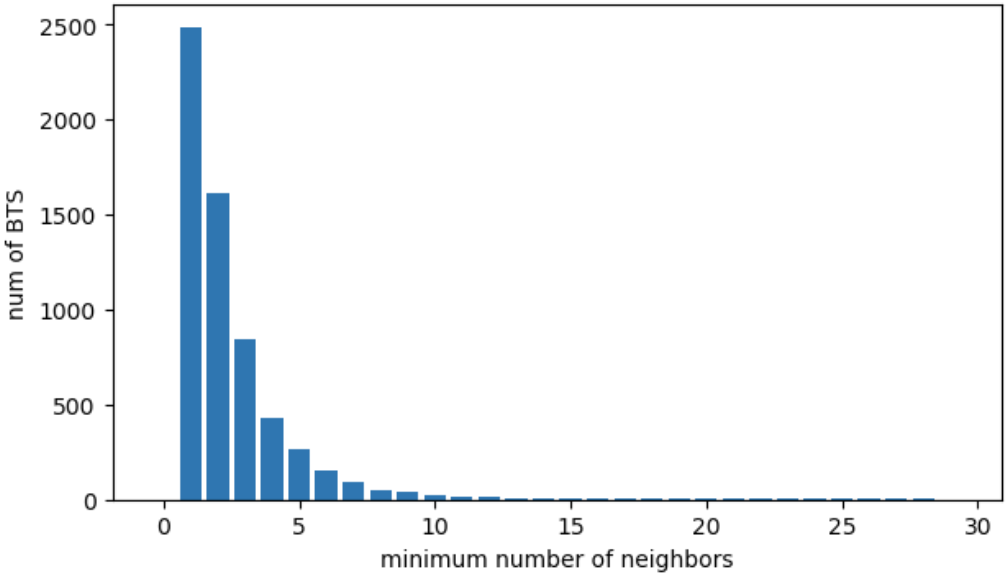
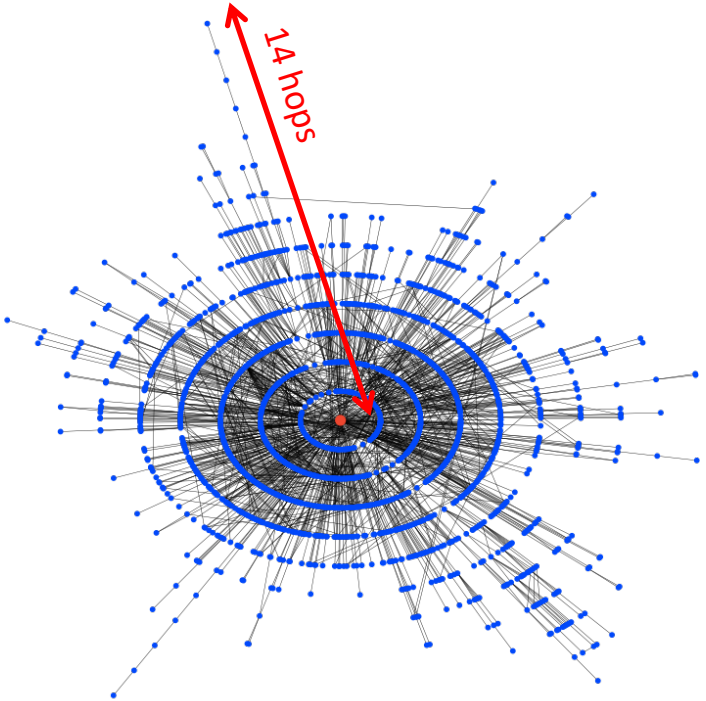
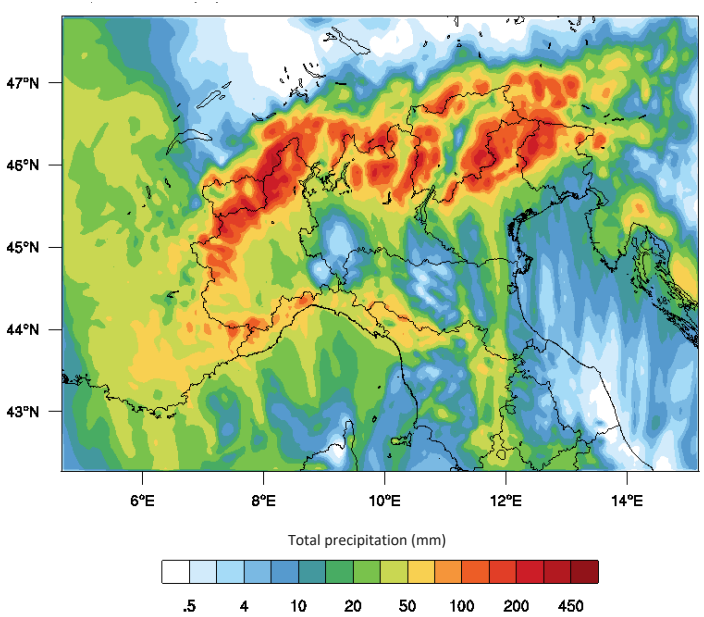




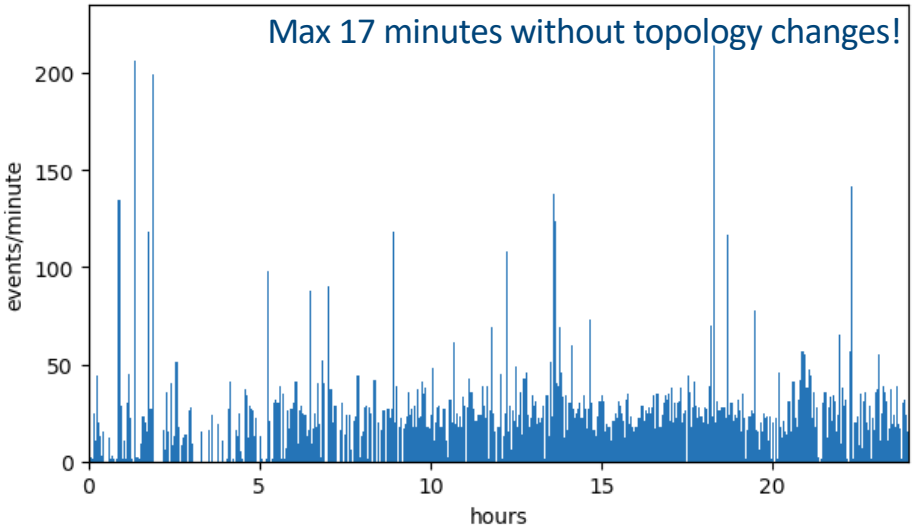
A (very) distinguishing feature

- Radio links in bad weather conditions

29/10/18 24h rainfall forecast over Italy



29/10/18 topology changes (30k events in 24h)



The BLU project

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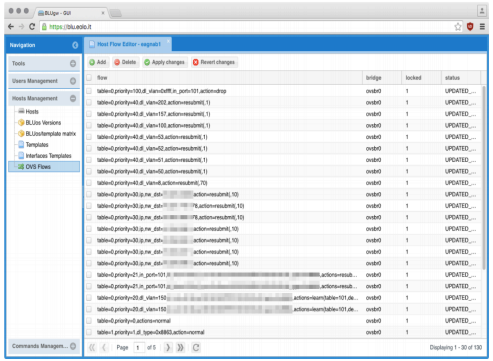

BLU routers

BLUos

BLUgw

The BLU router

BLU «model 1»

- TILEgx architecture
- 72 cores
- 24x 1G ports
- 2x 10G ports
- 16 GB RAM
- 128 GB SSD
- **90 Watt (average)**
- 1800 hosts deployed since 1Q 2016

BLU «model 2 POP»

- x86 architecture
- 32 cores Intel based CPU
- 8x 1G ports
- 16x 10G ports
- 48 GB RAM
- 256 GB SSD
- 210 Watt (average)
- 30 hosts deployed since 1Q 2019

BLU «model 2 BTS»

- x86 architecture
- 24 cores Intel based CPU
- 24x 1G ports
- 8x 10G ports
- 24 GB RAM
- 256 GB SSD
- 180 Watt (average)
- 250 hosts deployed. since 1Q 2019

IEEE 1613 compliant:

- Electromagnetic compatibility
- Error-free operation in -15°C / +75°C environment
- EMI fields of up to 180V/m

BLUos

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BLUos

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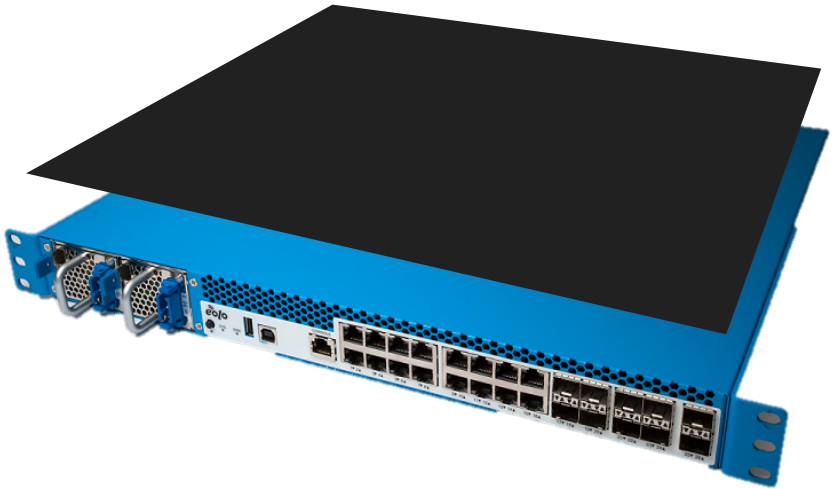

Linux kernel

BLUos

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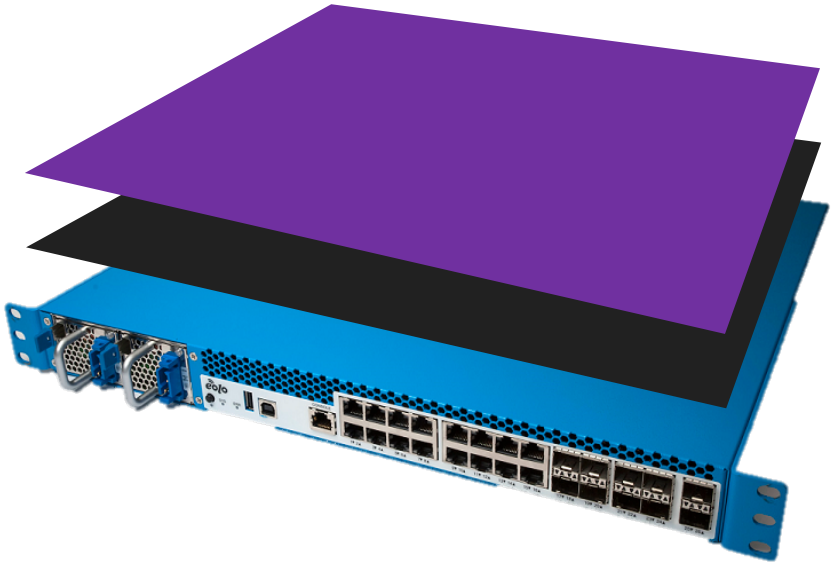

DPDK*
DATA PLANE DEVELOPMENT

Linux kernel

* 6wind customized version

BLUos

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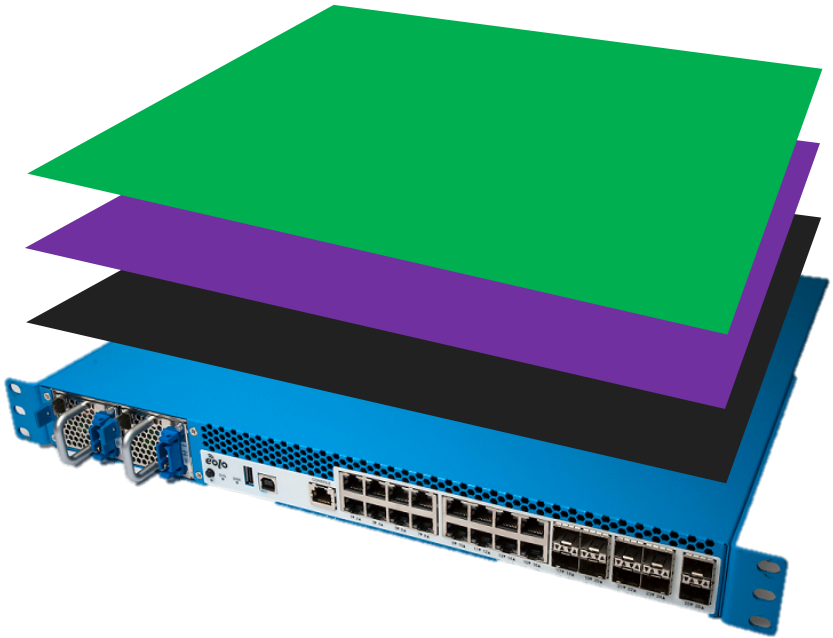

OvS Open vSwitch

DPDK* DATA PLANE DEVELOPMENT

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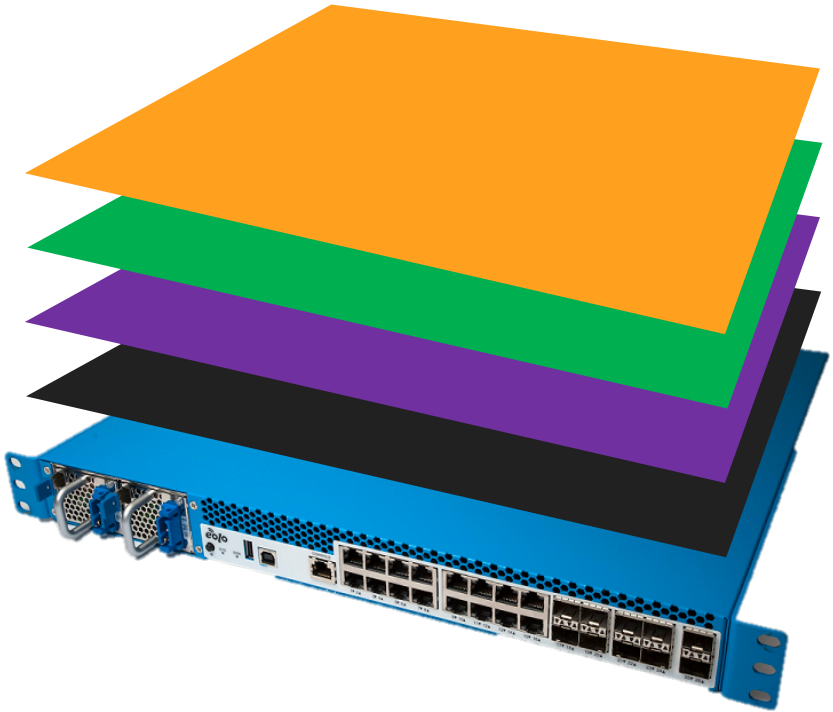

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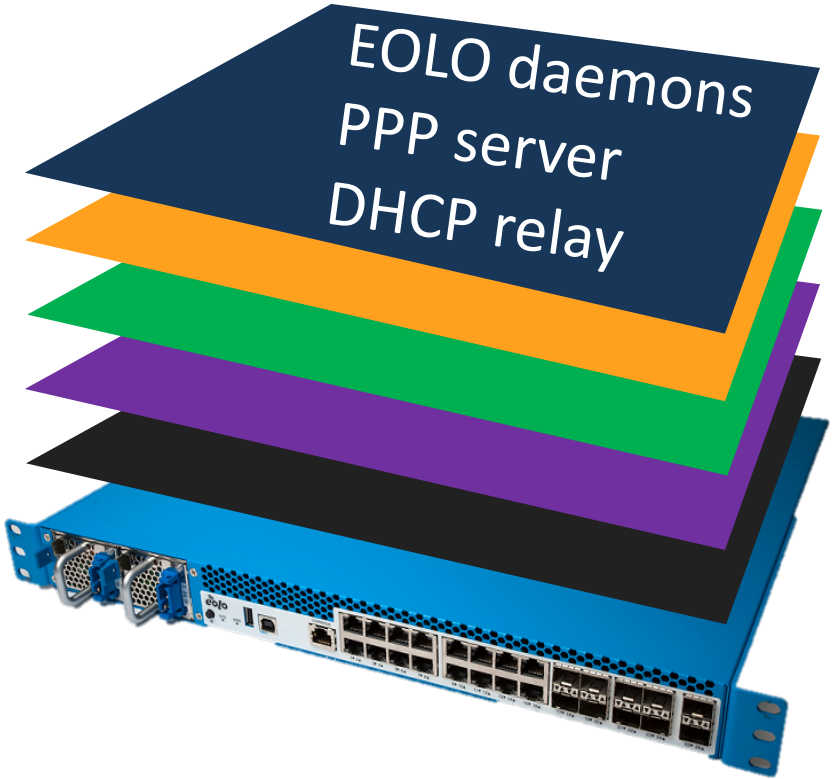

OvS
Open vSwitch

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BLUos – a lot of (fun) hacking!
A more efficient mac-learning implementation

Internet dove
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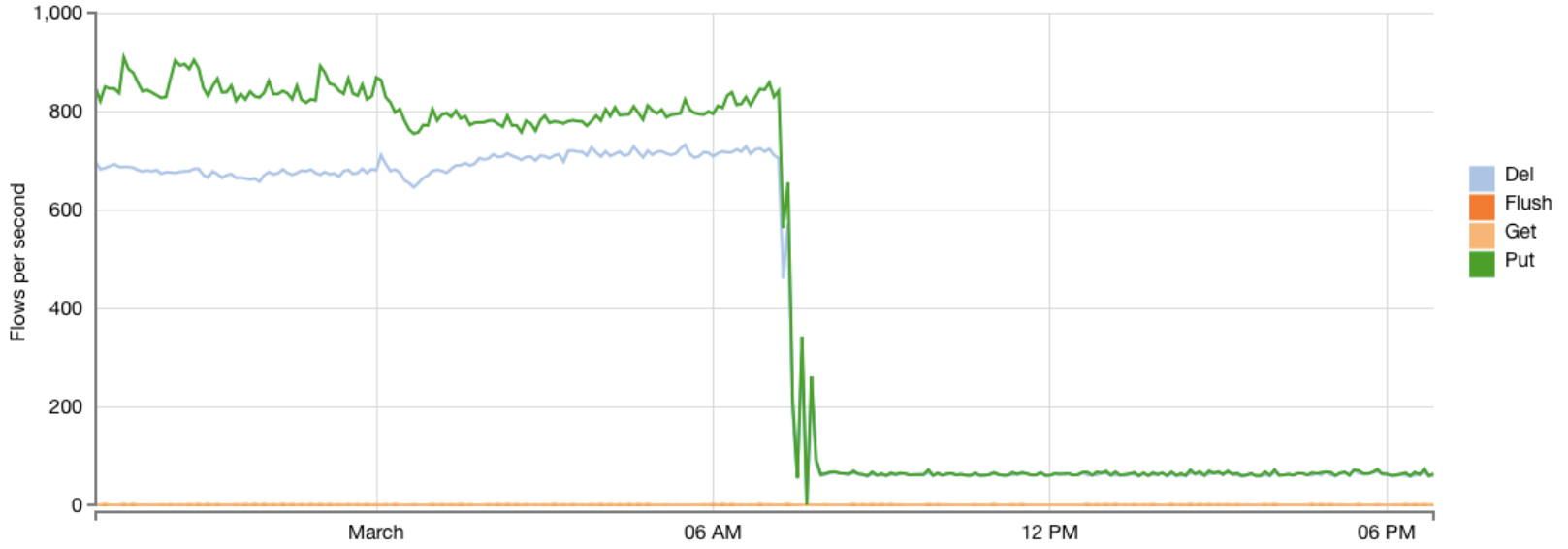

BLUos – a lot of (fun) hacking!
Hacking FRR for a new routing schema

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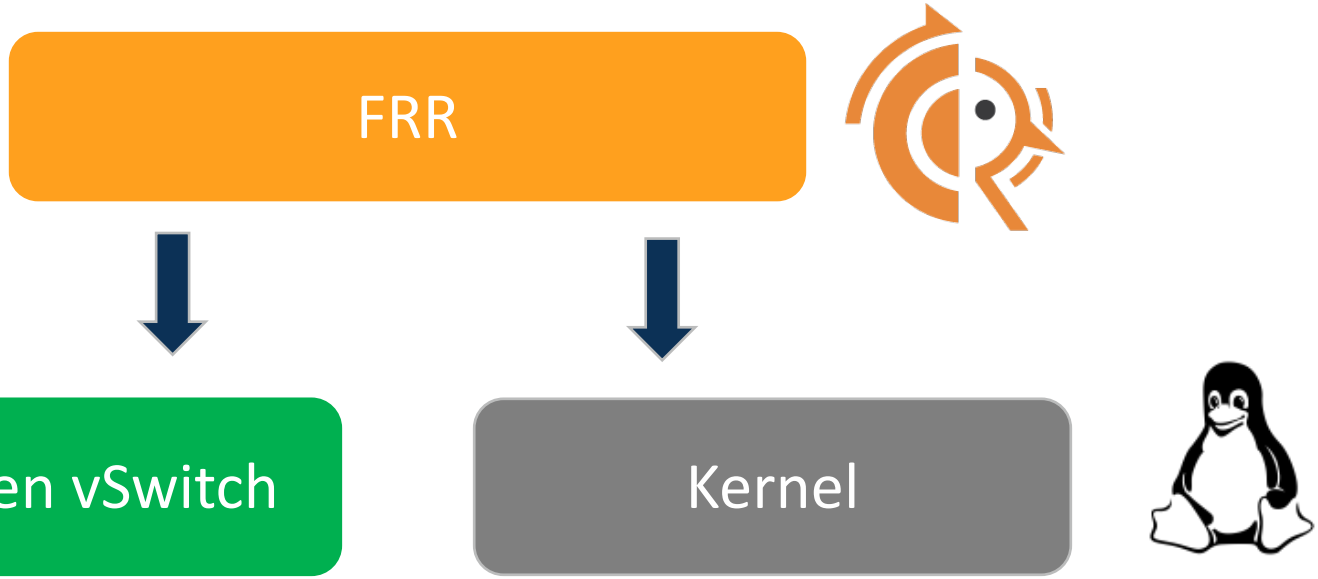
Linux kernel does not have to be the (only) FIB



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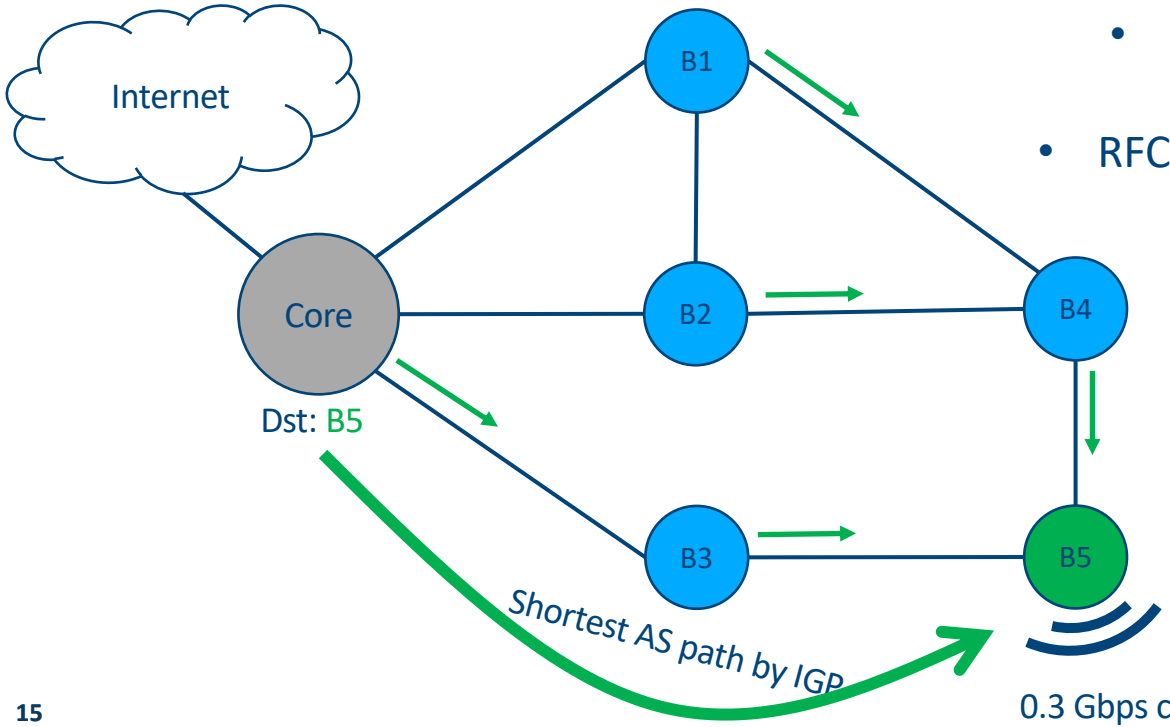

- eBGP governs Open vSwitch
  - active routes determine label-switching flows
- RFC3107 for downlink traffic labeling

0.3 Gbps customers request

BLUgw

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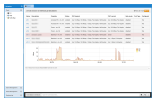
Full management framework for BLU routers

Device provisioning in the warehouse



Web interface for users operations

Scripting for automatic checks and analysis

Scheduler for command execution and upgrades

Telemetry and statistics collection and visualization

Traffic Engineering

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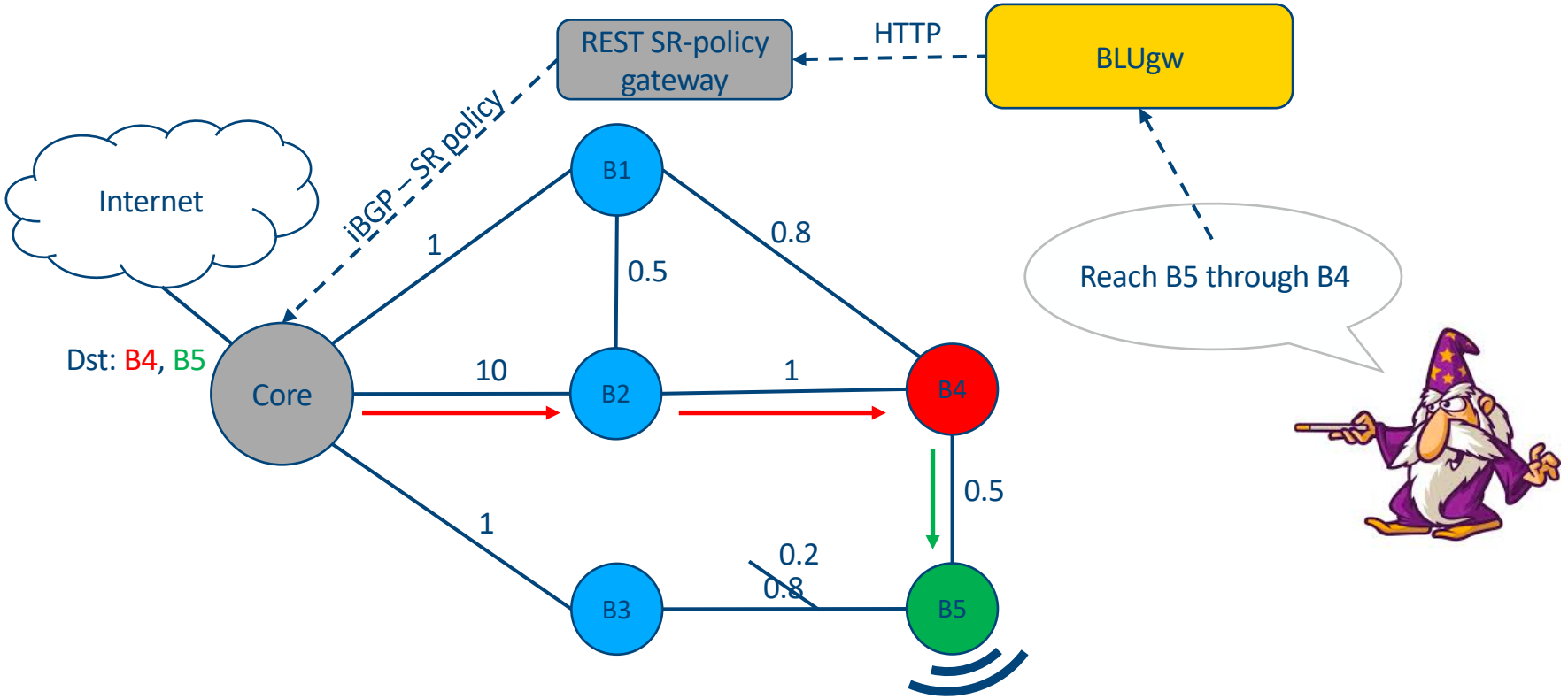
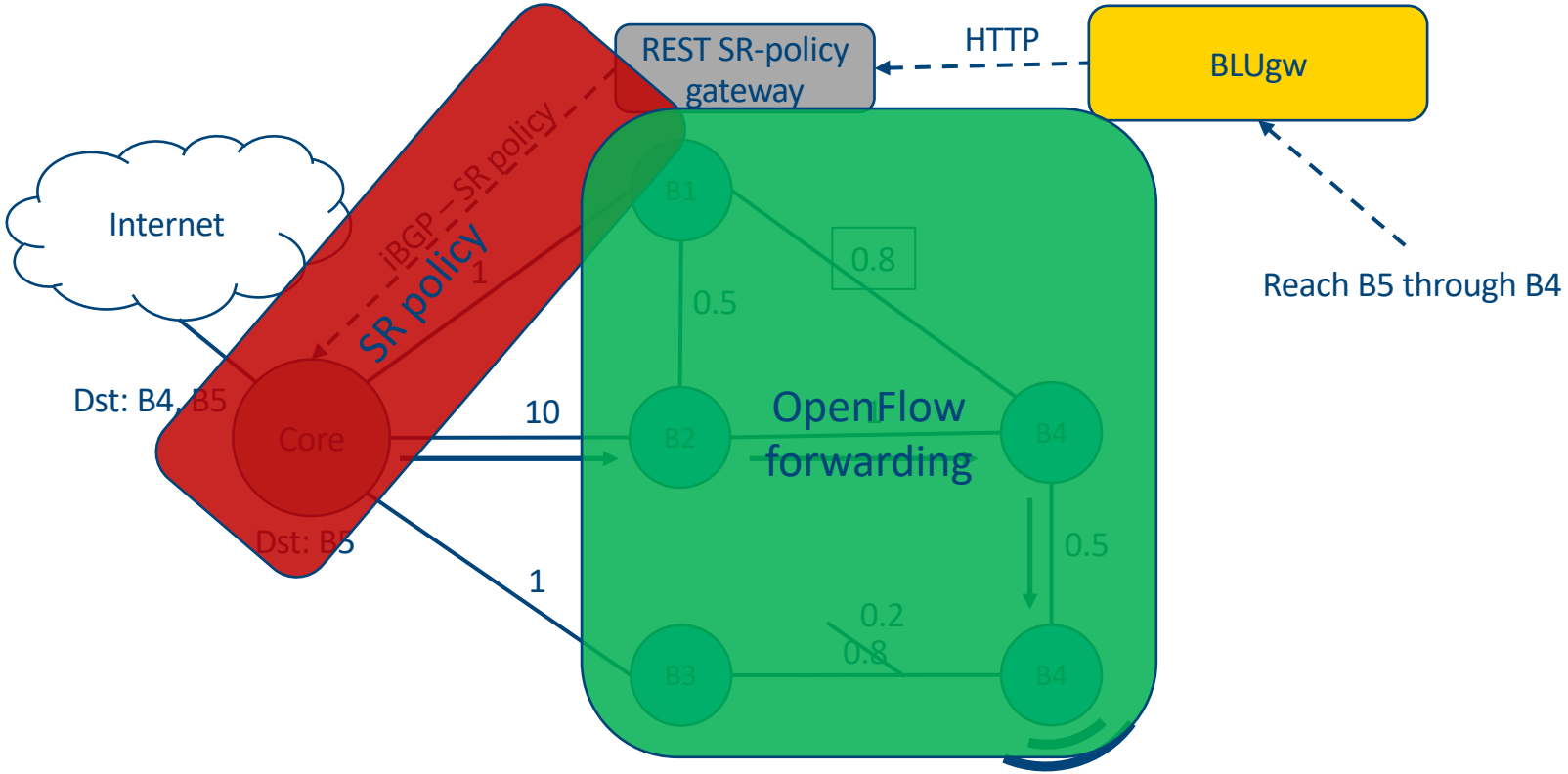
- Segment Routing philosophy
- IGP running on the BLU routers
  - eBGP, RFC3107
- RFC 3107 + SR policy for downlink traffic labeling
- Label switching (OVS)
  - eBGP governs Open vSwitch: active routes determine label switching flows

Traffic Engineering



0.3 Gbps customers request

Traffic Engineering



Traffic Engineering

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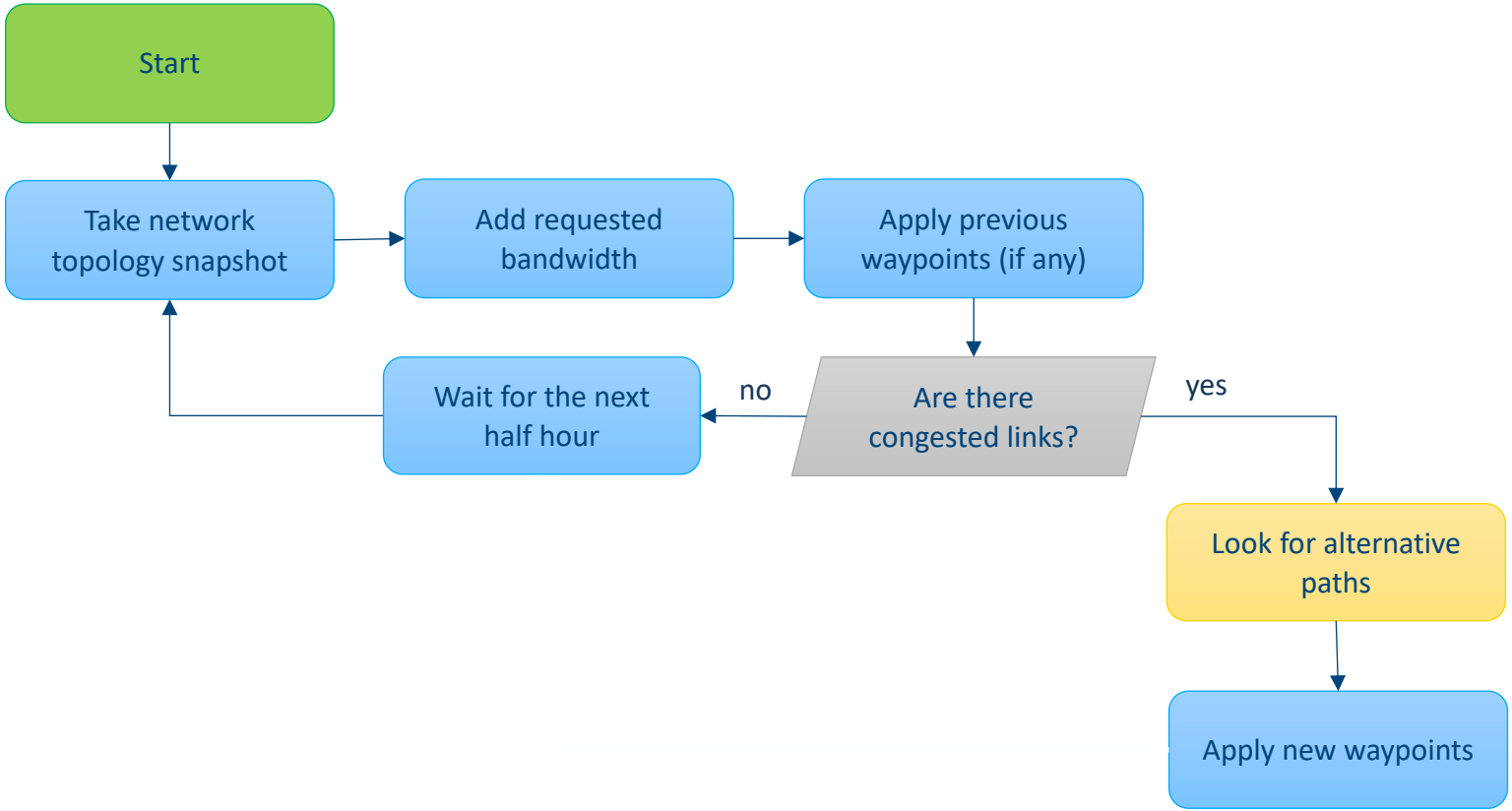
- No need to re-program the BLUs from BLUGW
  - They automatically learn how to forward MPLS labels based on IGP routes

- Optimizer:
  - Comes into play only in case of congestion
  - Many tools to tackle the optimization problem
    - Operations research, LP, SMT, etc. + a lot of heuristics

- We do have a “Big Red Button” !
  - In case of troubles, turning off the optimizer reverts to shortest path forwarding

Traffic Engineering



Waypoint discovery

jww A. Carzaniga, D. Rogora (USI)

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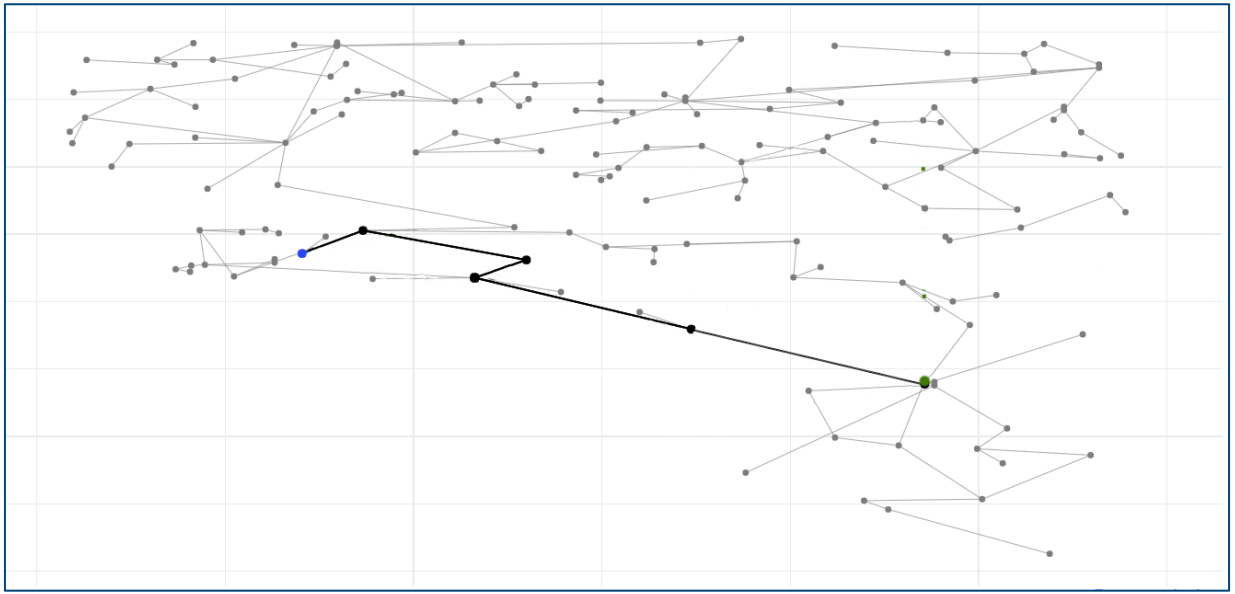
Build and solve a **linear program** to get feasible waypoints for each traffic flow



Use geographical informations to simplify the problem

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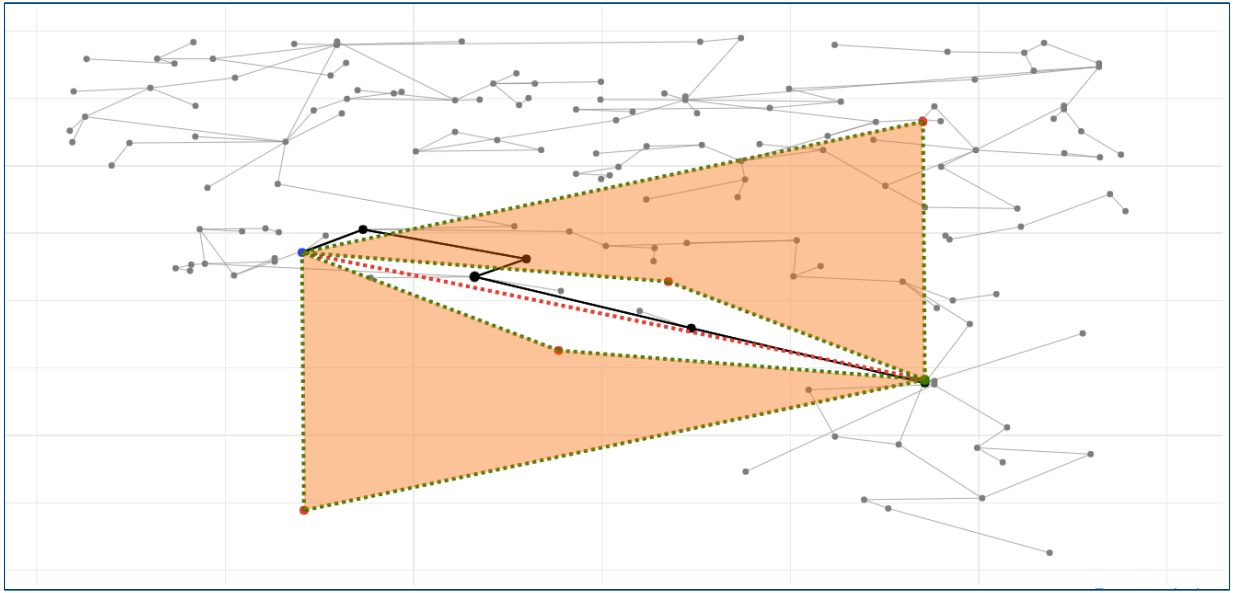

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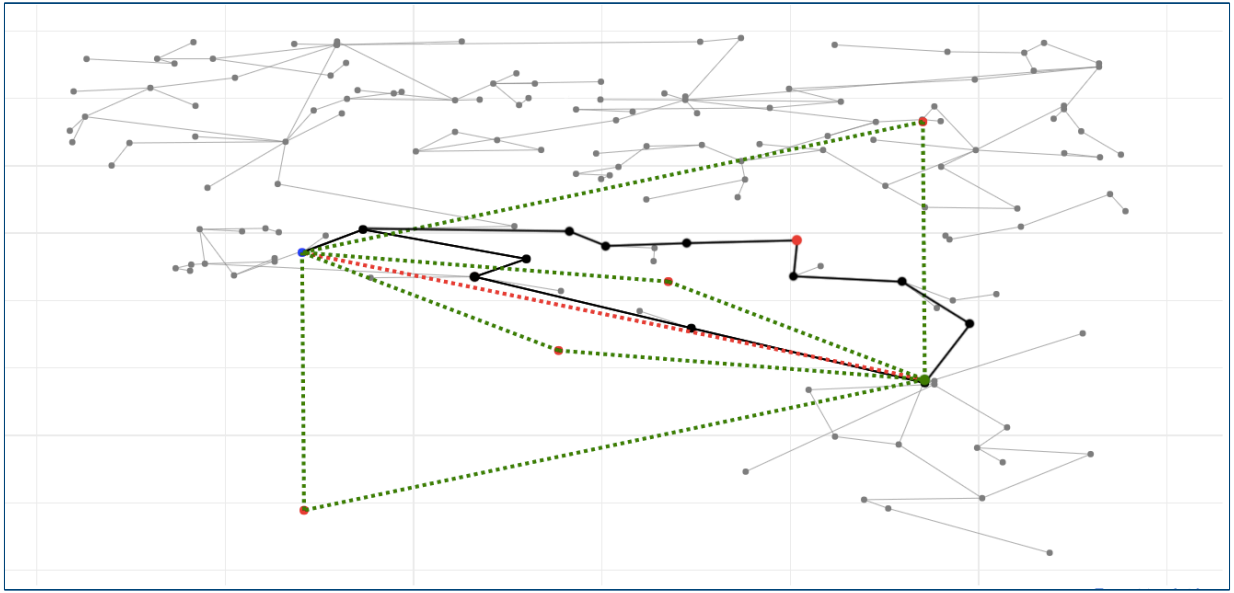
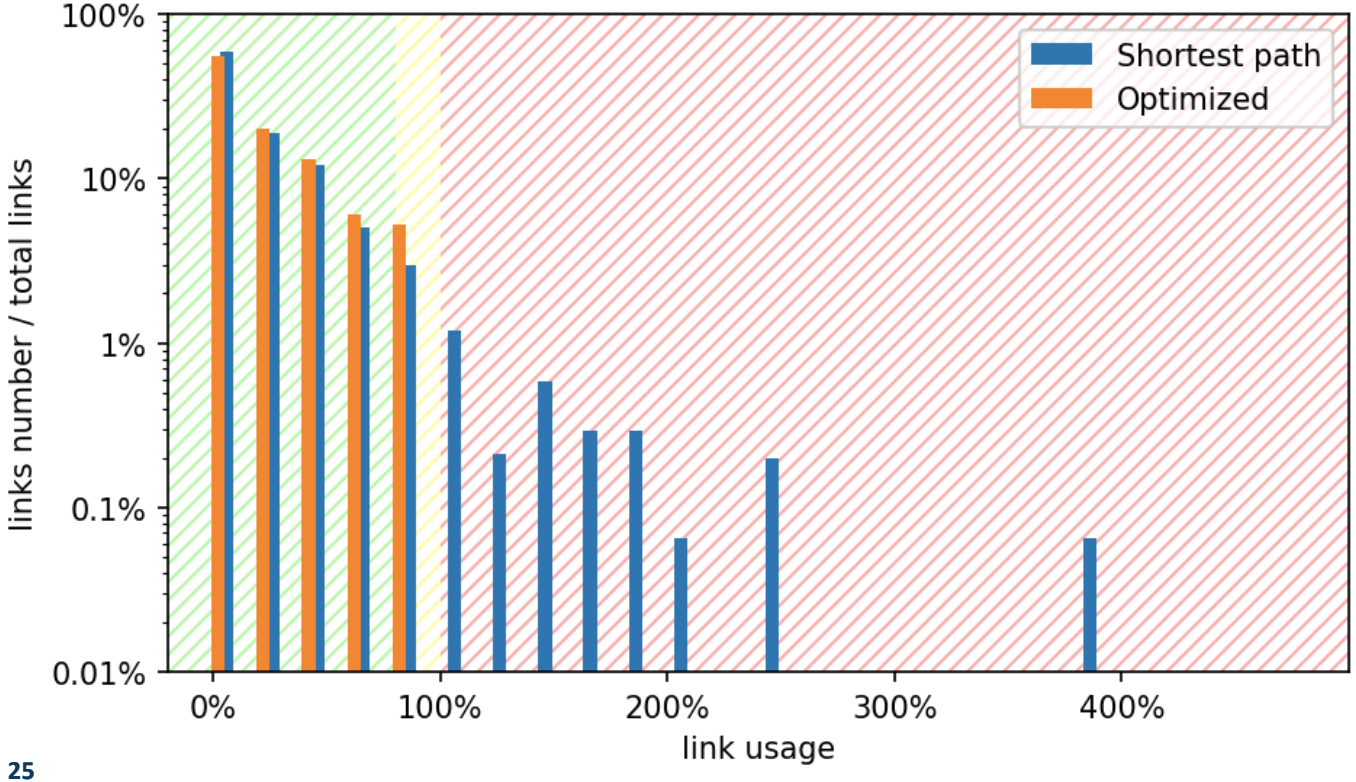


Use geographical informations to simplify the problem

Simulation

jww A. Carzaniga, D. Rogora (USI)



Network snapshot of
8th April 2018 at 22:30:

- 1510 nodes
- 1712 links (50 congested)

150 alternative paths:

- 85% with 1 waypoint
- 9% with 2 waypoints
- 6% with 3 waypoints

How do we get there?

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How do we get there?

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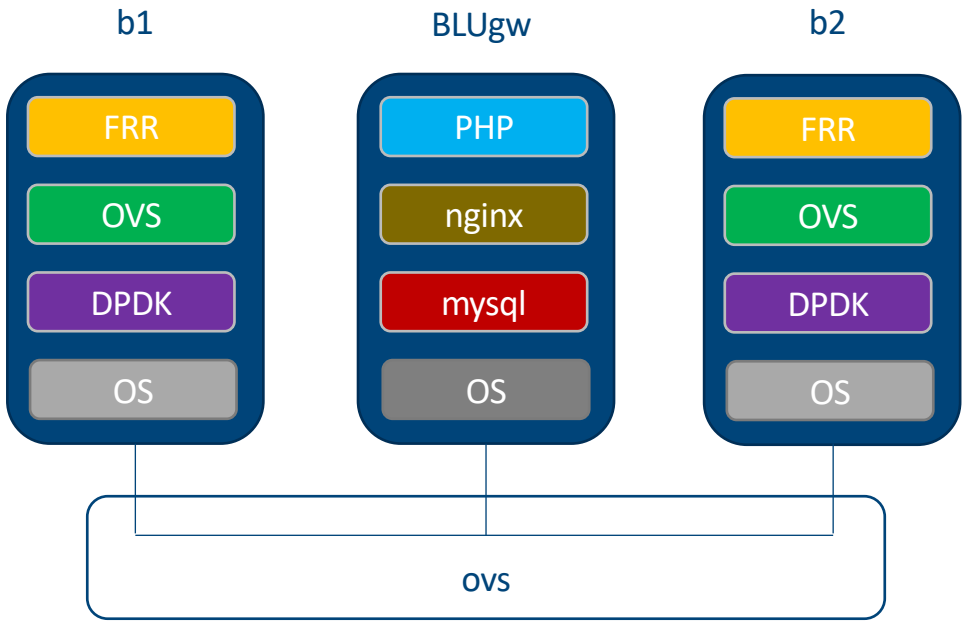
Python-ic interface to-and-from the virtual BLU world

```
import pyeolo

b1 = pyeolo.BLU()
b2 = pyeolo.BLU()

blugw = pyeolo.BLUgw()

blugw.congfigure(b1, "conf_B1")
blugw.configure(b2, "conf_B2")

net = pyeolo.Network()

net.link(b1, b2)

assert(b1.lo.ping(b2.lo))
```



Tools

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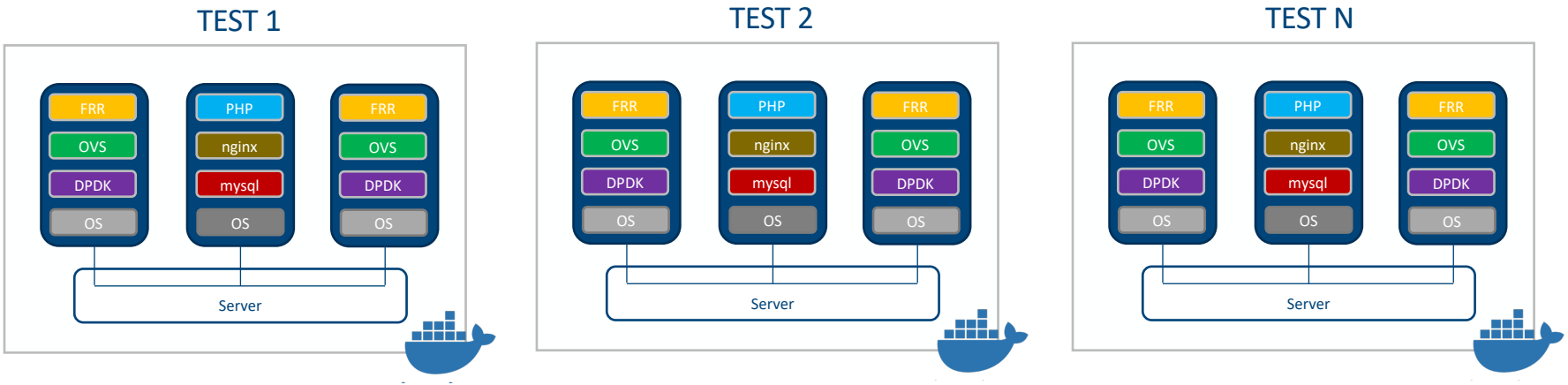

Server1 Server2 ... ServerN

Automate everything
so you can focus on interesting stuff

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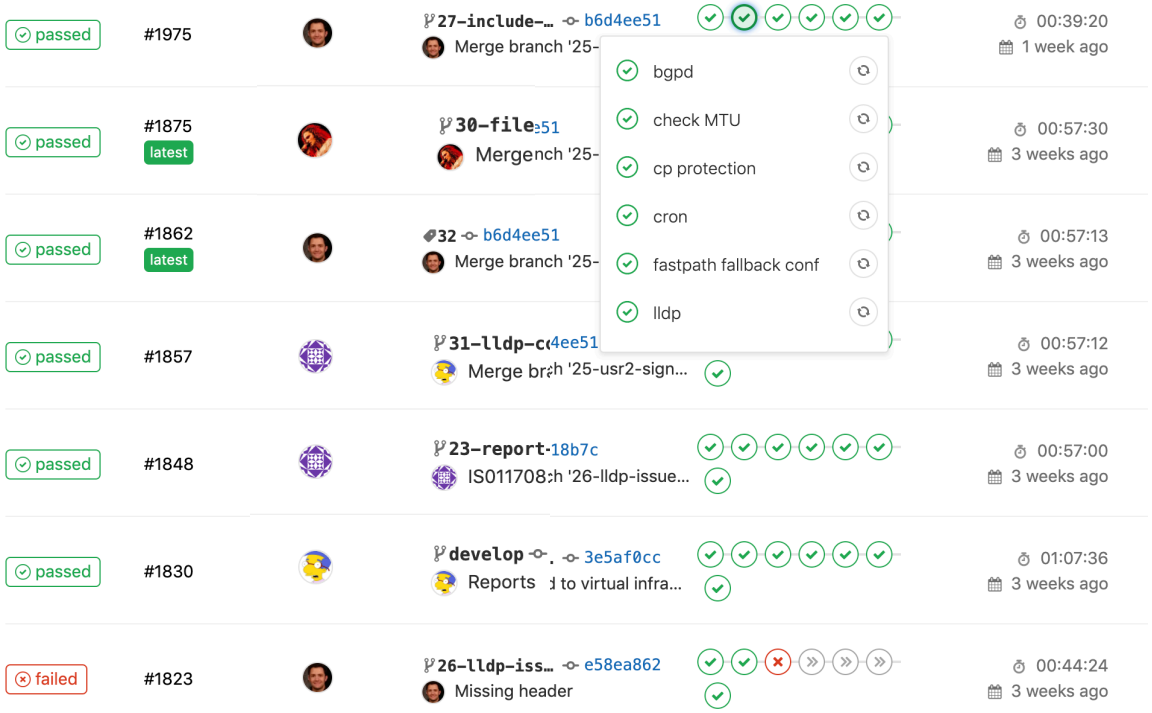

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Thank you!

If you are interested in our projects,
(we are hiring!!!!)
do not hesitate to contact us!

rnd@eolo.it