

Router for Academia Research Education

RARE/freeRtr in a nutshell 

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Control plane software

P4-(**not only P4**) **Programmable** data plane

Interface them and the result is ...

Feature rich routing platform

running at **various** hardware line rate

Flexible, DIY “hackable/extensible” router

Control plane independence

→ that suits R&E use case

One familiar platform



Multiple solutions



Each solution addresses



R&E

use case

Why RARE now ?

Starting from early 2010:

Several valuable Open Source control plane usage besides well know commercial vendor



Starting from 2020:

Dataplane solution reached maturity ready to implement production grade use case

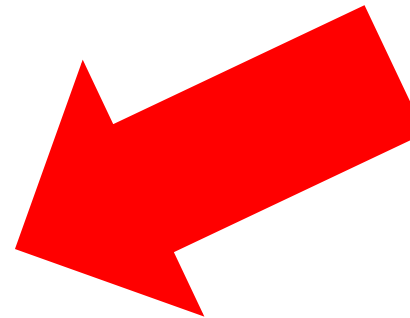


NOS emergence

ARISTA



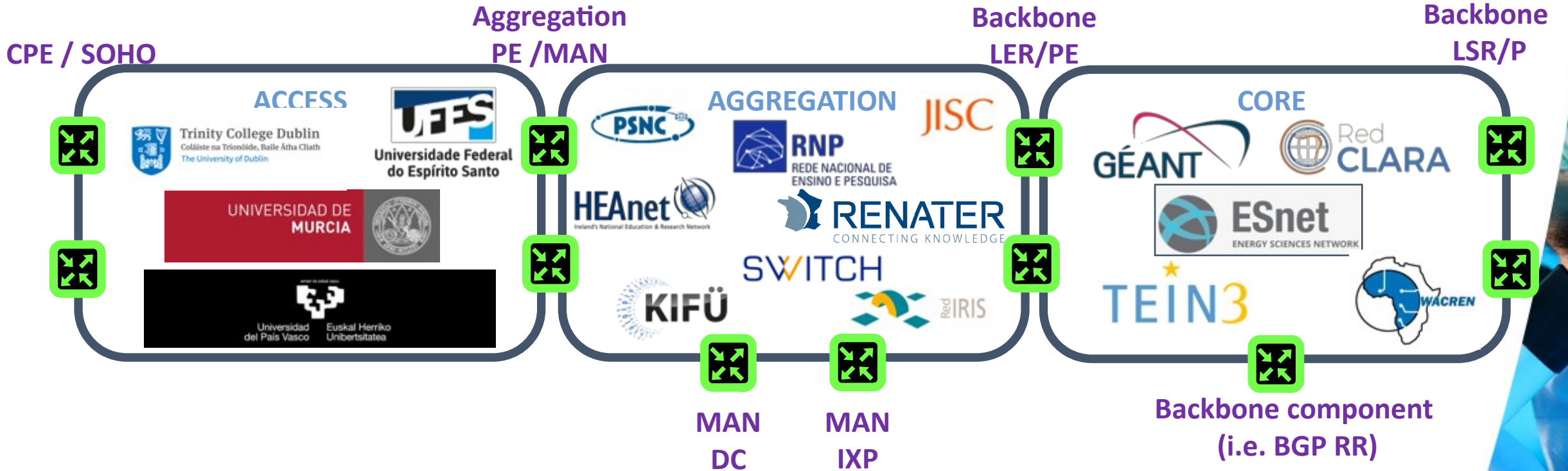
JUNIPER NETWORKS



Technology convergence (Hypervisor/VM, K8s/Container, kernel bypass ...)

It's a good time to tie Control Plane and Dataplane !

RARE use cases



IPv4 and IPv6 compliant !

RARE for everyone in R&E

Routing (CP+DP) platform solution for the R&E context

- Open Platform
- Programmable

RARE for Research and Education connectivity

- Emerging NREN
- Or not ...

RARE for R&E content provider

- IaaS owned by NREN
- IaaS owned by International Global Research project

RARE for R&E end user institution

- Primary/Secondary schools
- University campus
- MAN network for Regional network

RARE for International Global research project connectivity

- Network research
- Science research

Positive societal consequences !



RARE value proposition:
Implement a solution to each R&E use case

RARE for R&E connectivity (nx100GE, Tbps)

Core backbone node

Edge backbone node

RARE for R&E content provider (1,10,25,40,50,100GE)

ToR node

Spine node

Edge node

RARE for R&E organization end user

CPE for SOHO primary schools

MAN Router for regional network

RARE latest news (Month 27 of 48)

RARE p4 targets



bmv2 software switch



Programmable Ethernet ASIC on WEDGE-BF100-32X



under study

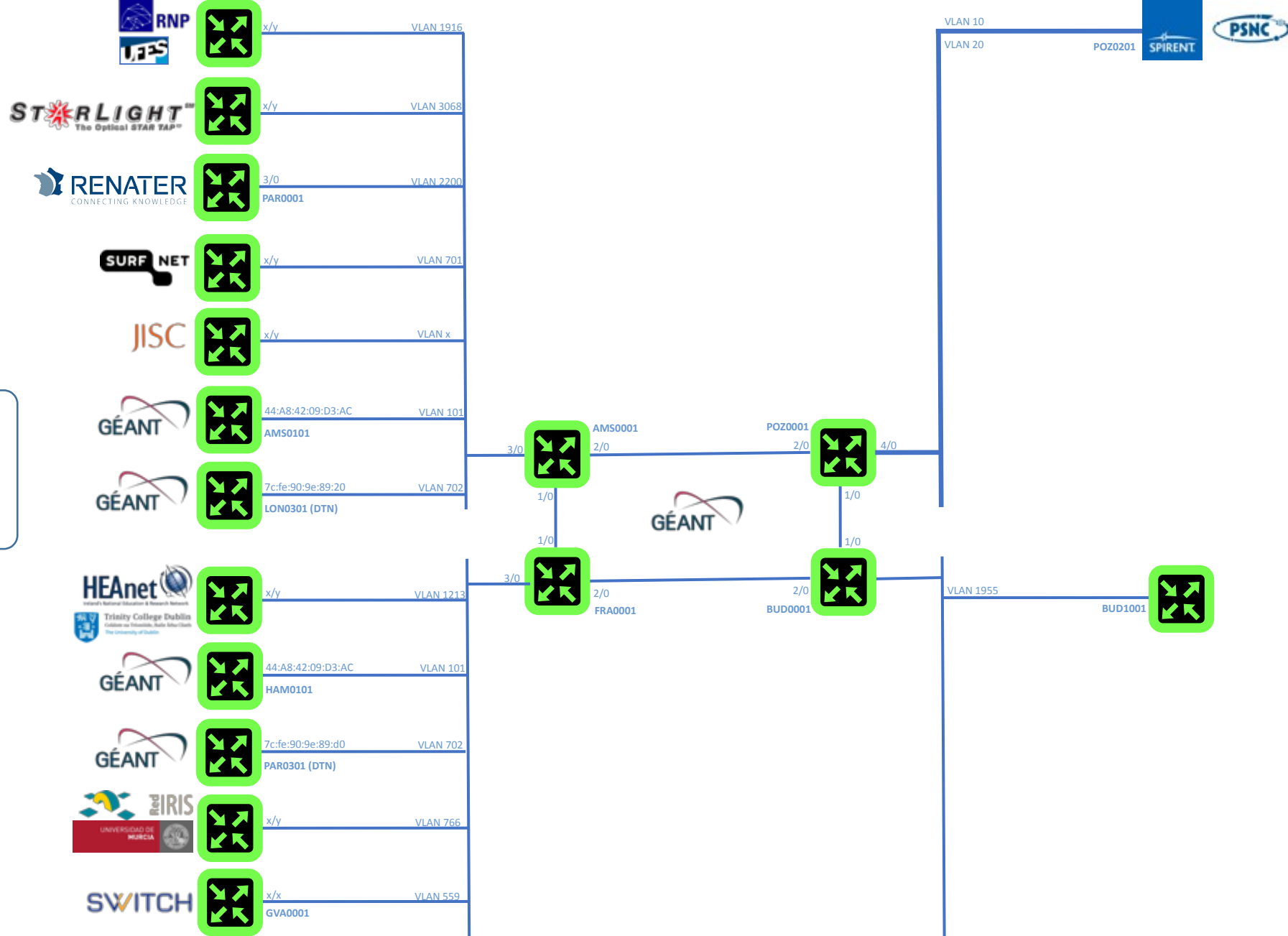
RARE p4 discussion emulation targets



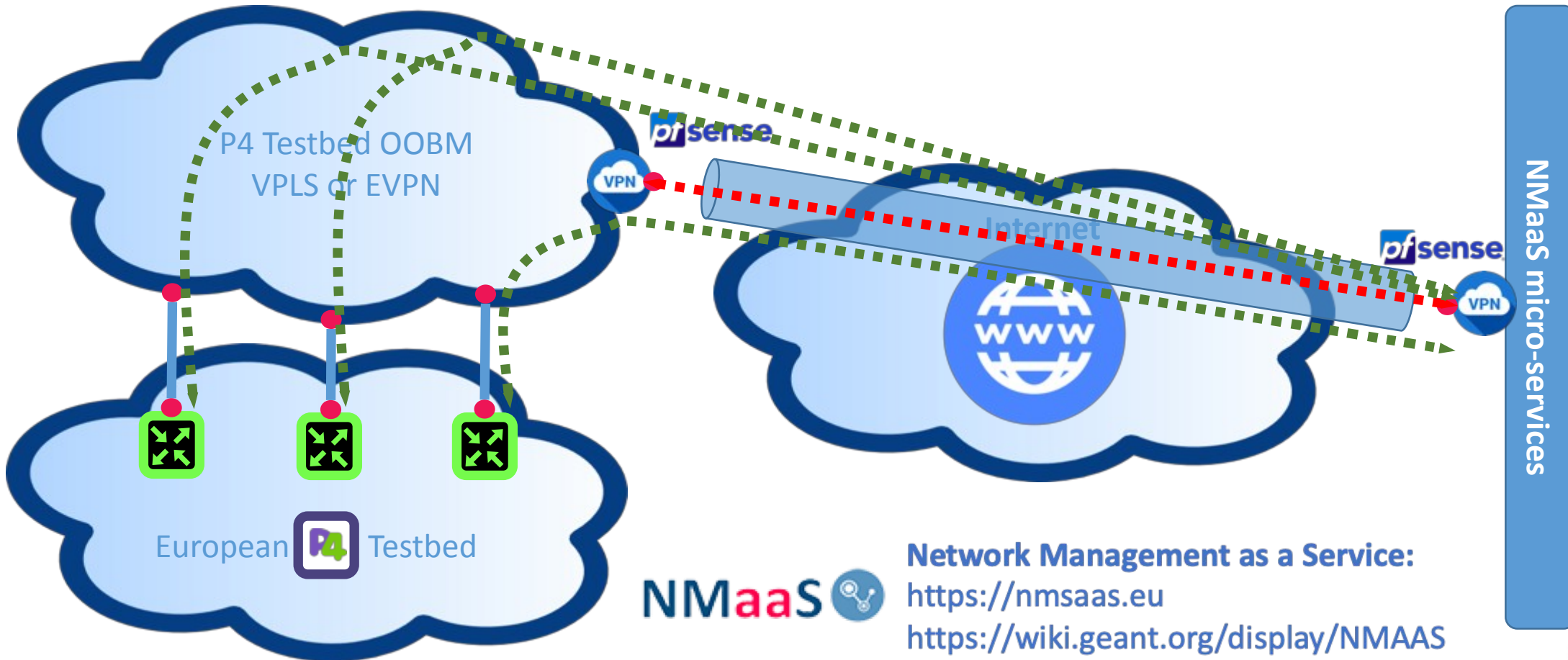
RARE Network Programmable targets



Broadcom **under study**



P4 LAB network management via NMaaS* !



NMaaS

Network Management as a Service:

<https://nmsaas.eu>

<https://wiki.geant.org/display/NMAAS>

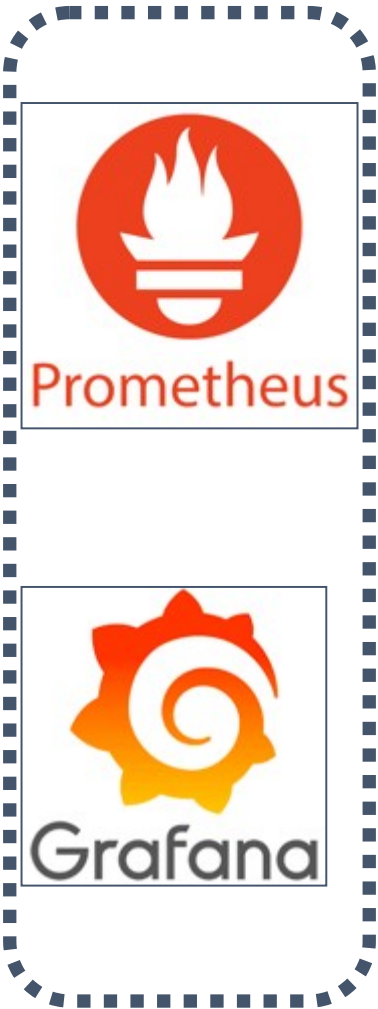
P4 LAB network management via NMaas* !

The screenshot shows the NMaas application interface. At the top, there is a navigation bar with 'Applications', 'Subscriptions', and 'Instances' tabs. The domain is set to 'GEANT' and the user is 'frederic.loui'. Below the navigation bar, there is a search bar, a 'Tags' dropdown set to 'all', and a 'Sort' dropdown set to 'None'. The main content area displays a grid of application cards, each with a logo, name, star rating, and a brief description. The visible cards include:

- NAV**: Network Administration Visualized - network management system (5 stars)
- LibreNMS**: Autodiscovering SNMP based network monitoring tool (5 stars)
- Oxidized**: Network device configuration backup tool (5 stars)
- Booked**: Web-based calendar and schedule (5 stars)
- Bastion**: Bastion server based on Ubuntu OS (5 stars)
- Victoria Metrics**: Scalable monitoring solution and time series database (0 stars)
- perfSONAR Central Management**: perfSONAR Central Management (0 stars)
- esmond**: Central Measurement Archive (0 stars)
- ELK Stack**: Elasticsearch, Logstash and Kibana (0 stars)
- Synapse**: Secured instant messaging for teams (0 stars)
- MaDDash**: Monitoring and Debugging Dashboard (0 stars)
- pSConfig Web Admir**: Web-based UI for perfSONAR administrators (0 stars)
- WiFiMon**: Wireless Crowdsourced Performance Monitoring and... (0 stars)
- Jenkins**: Leading open-source automation server (0 stars)
- InfluxDB**: Time series database (0 stars)
- GEANT SPA Inventory**: Topology database with TMF-compliant API (0 stars)

Network Management as a Service:
<https://nmsaas.eu>
<https://wiki.geant.org/display/NMAAS>

Monitoring at Network Element Level ! (Prometheus agent)



Monitoring at EML ! (Grafana dashboard)

The screenshot shows the Grafana Labs website interface. At the top, there is a navigation bar with links for "Grafana Labs", "Grafana", "Products", "Open Source", "Learn", "Downloads", "My Account", and "Contact us". Below this is a secondary navigation bar with "Features", "Contribute", "Dashboards", "Plugins", and "Download". The main heading is "Dashboards" with the subtitle "Official & community built dashboards". On the right, there is a "Product updates" section with a sign-up form. On the left, there is a filter sidebar with sections for "Filter by:", "Name / Description" (with a search input containing "freeRouter"), "Data Source" (set to "All"), "Panel Type" (set to "All"), "Category" (set to "All"), "Collector" (set to "All"), and "Sort By" (set to "Name"). The main content area displays a list of search results for "freeRouter" dashboards, each with a small icon, title, description, and download/review statistics.

Name / Description	Downloads	Reviews
RARE/freeRouter - Link State IGP peers / reachability & neighbor count summary by fredericloui Display link state IGP peer reachability and neighbor count metrics	2	0
RARE/freeRouter - Routing / Computed - Redistributed by fredericloui	5	0
RARE/freeRouter - Routing / Interfaces by fredericloui	4	0
RARE/freeRouter - Routing / Neighbors by fredericloui	4	0
RARE/freeRouter - BFD states by fredericloui Display BFP state metrics	2	0

<https://grafana.com/grafana/dashboards?search=freeRouter>



Key take-way – We are ready to roll into production

Automated testing

3rd party testing via Spirent usage
(thanks PSNC@WB team)

P4 profile calibration

DPDK currently in operation SOHO

Production deployment



Work in progress production deployment





And what about ISP and commercial network use cases ?

Practical use case #001 SOHO router

DPDK flavor ideal for CPE

nx1GE

nx10GE small MAN ideal for small campus

Couple of 100GE (Depending on server generation)



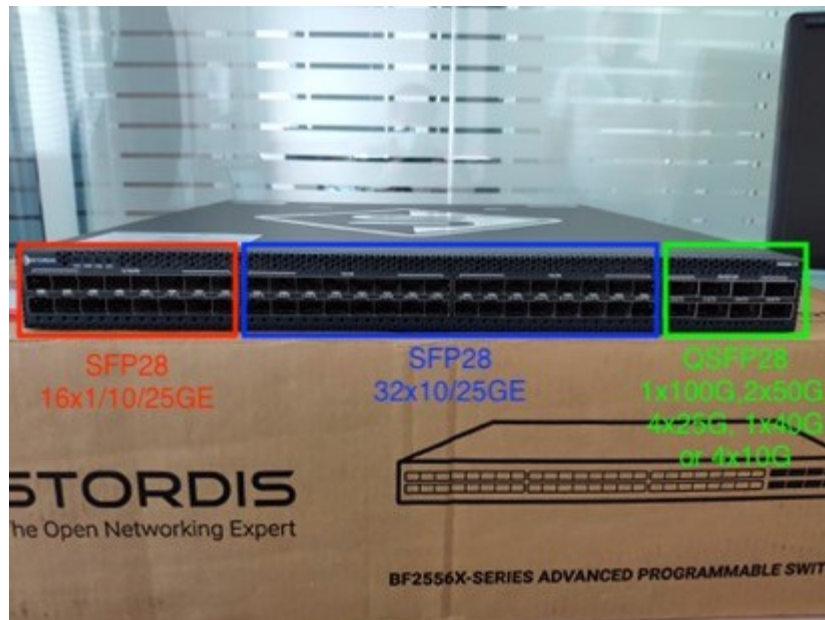


Practical use case #002 BRAS router

DPDK and P4 dataplane

→ suitable for CAMPUS / EDGE BACKBONE router

nx1GE, nx10GE, nx100GE





Practical use case #003 LSR router

P4 dataplane fits perfectly pure **LSR** core router

NNI: 4 directions with (8x100GE) bundle





Practical use case #004 LER router

P4 dataplane fits perfectly pure **LER** use case
NNI: EST/WEST direction @ (8x100GE) bundle
UNI: 16x100GE left for end user connection !





Practical use case #005 high performance BGP RR

Recycling old server ?

Ideal for **K8s** cluster using **BGP** as **CNI** network plugin

Taking advantage of server « huge » amount of RAM

No need specific high performance dataplane



Practical use case #006 « small » PE

Ideal for aggregation

- 2x10GE or 2x100GE NIC server side
- 2x10g+48x1g or 1x100g+48x1/10g switch





Practical use case #xxx **The sky is the limit**

Automation integration

IXP with MPLS core

ToR router combined to BGP aware network plugin

Spine/Leaf DC router

Global BGP monitoring for your entire BGP domain

Global IGP guard for your entire IGP domain

BGP flowspec aware anti DDOS

AAA servers (TACACS, RADIUS)

...

We need YOUR creativity !





Key take-way – Room for improvement

Network Management

Node monitoring

Flow Monitoring

New Network Management Paradigm

Streaming Telemetry

INT

→ **It is a good opportunity to rethink how Network Management is handled**

« Closing the dots » with **automation existing project**



Key take-way – Final words – RARE vision

Open Network programming opportunity

R&E small institution

R&E global project (100GE is real, 400GE just landed)

Opportunity to define NGN NMS

Scaling new NMS (horizontal scaling with K8s)

Streaming Telemetry

INT

➔ **It is a good opportunity to rethink how Network Management is handled**

Opportunity to integrate existing automation initiatives

Instantaneous & Flexible

Network Services for the users !

www.geant.org





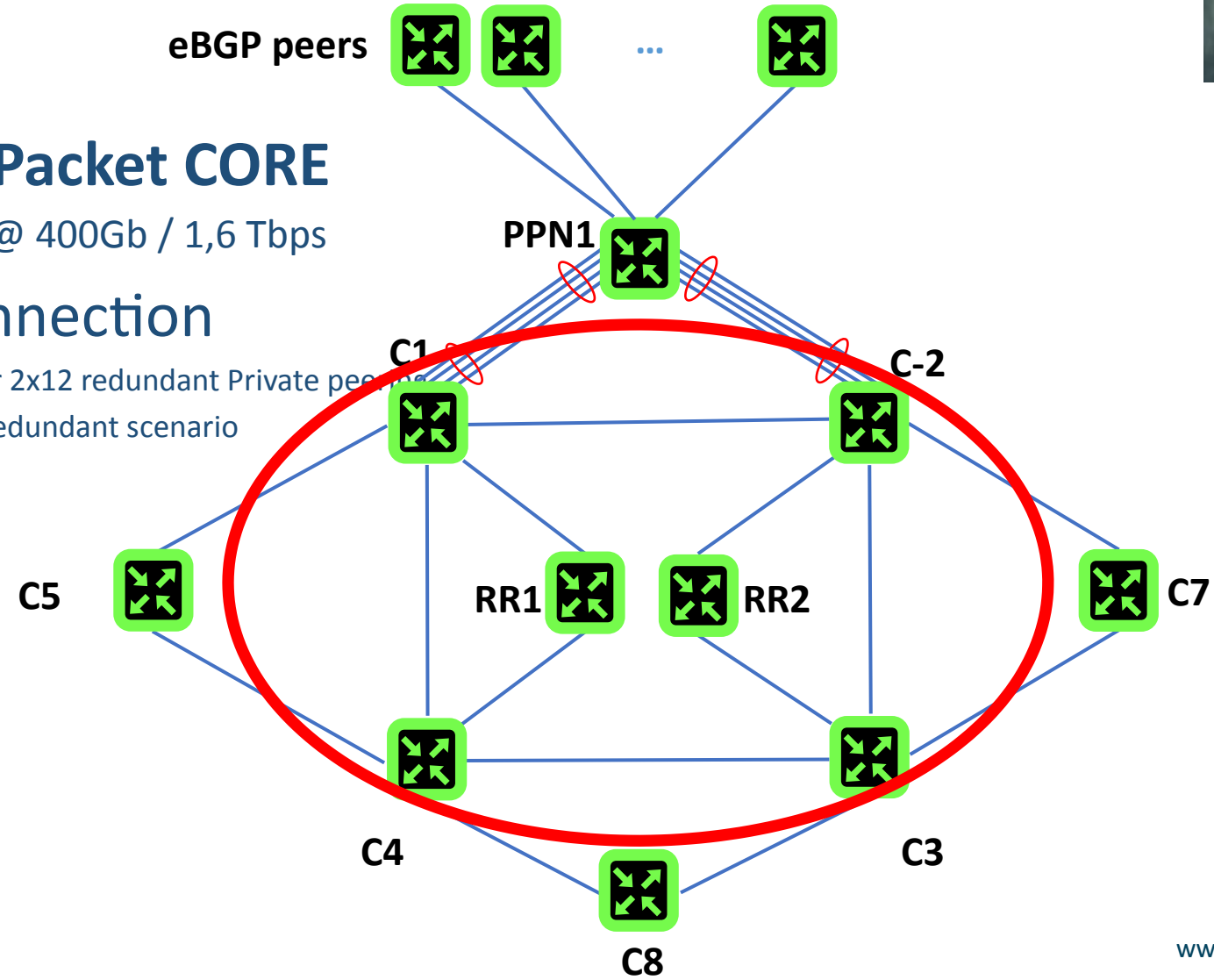
Key take-way – Private Peering Node

High resilient Packet CORE

2 direction @ 400Gb / 1,6 Tbps

User ports connection

24 ports left for 2x12 redundant Private peering
1:3 ratio with redundant scenario



Useful links

Project

freeRtr control plane's home: freertr.net

more information on dataplanes: rare.freertr.net

Project members' journey: blog.freertr.net

FreeRtr configuration guide: docs.freertr.net

Contact

For daring RARE/freeRtr users: rare-users@lists.geant.org

For RARE/freeRtr JEDI developer wanabee: rare-dev@lists.geant.org

For RARE/freeRtr supporters !  https://twitter.com/rare_freerouter

**We are interested to work with industry and ISPs !
Please get in touch if you are interested (contact above)**

Useful links

Source code !!!!



freeRtr core: sources.nop.hu/src/



TOFINO ASIC: sources.nop.hu/misc/p4bf/



P4Lang bmv2: sources.nop.hu/misc/p4lang/



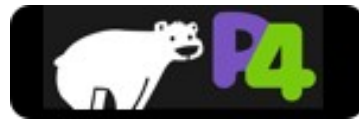
p4emu: sources.nop.hu/misc/native/p4*



p4dpk: sources.nop.hu/misc/native/p4*



Special thanks ...



And others ...
Who make this possible !

Thank you

Any questions?

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