

Router for Academia Research Education

RARE/freeRtr in a nutshell



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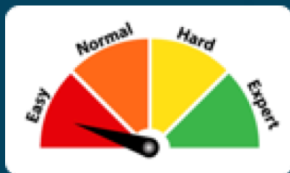
GÉANT/KIFU – RARE/freeRtr lead core developer

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Public

www.geant.org



GÉANT RARE project : Group focus



funded project

- Control plane software
 - **Programmable** dataplane
 - Interface them and the result is ...
-
- Feature rich routing platform
 - various hardware line rate
 - Flexible, DIY “hackable/extensible” router
 - Control plane independence

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



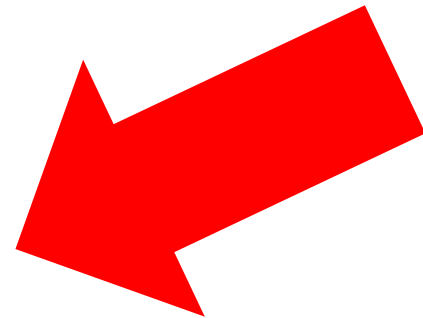
- Starting from 2020:
 - Dataplane solution reached maturity ready to implement production grade use case



- NOS emergence

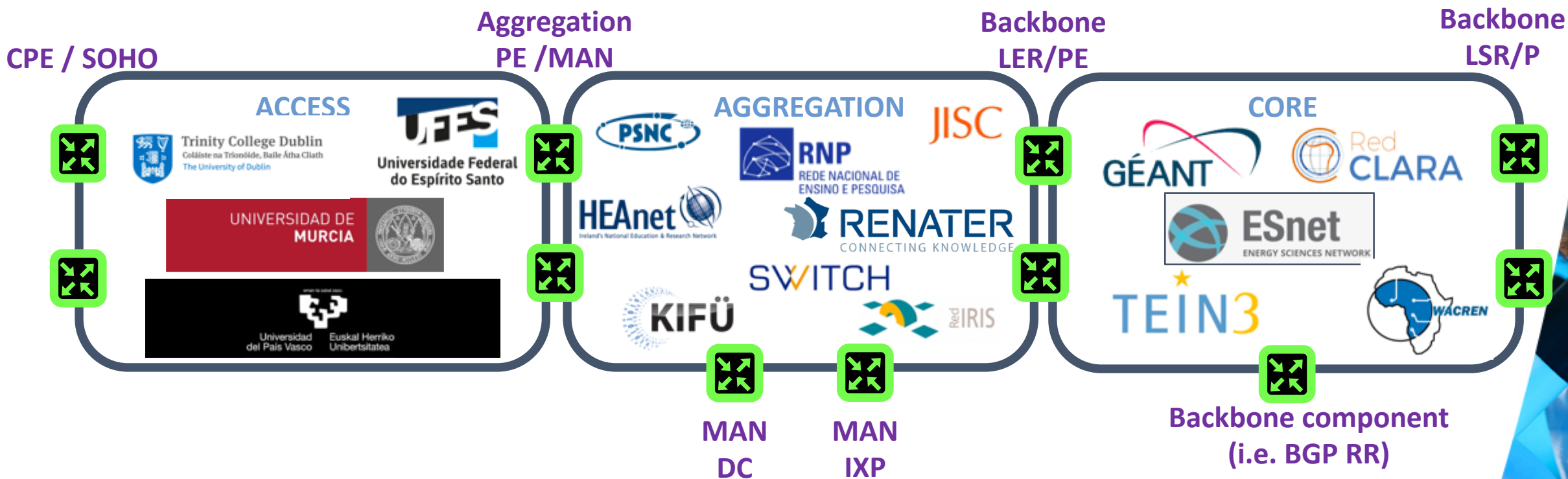


- Hypervisor Technology convergence
 - openstack.
 - kubernetes



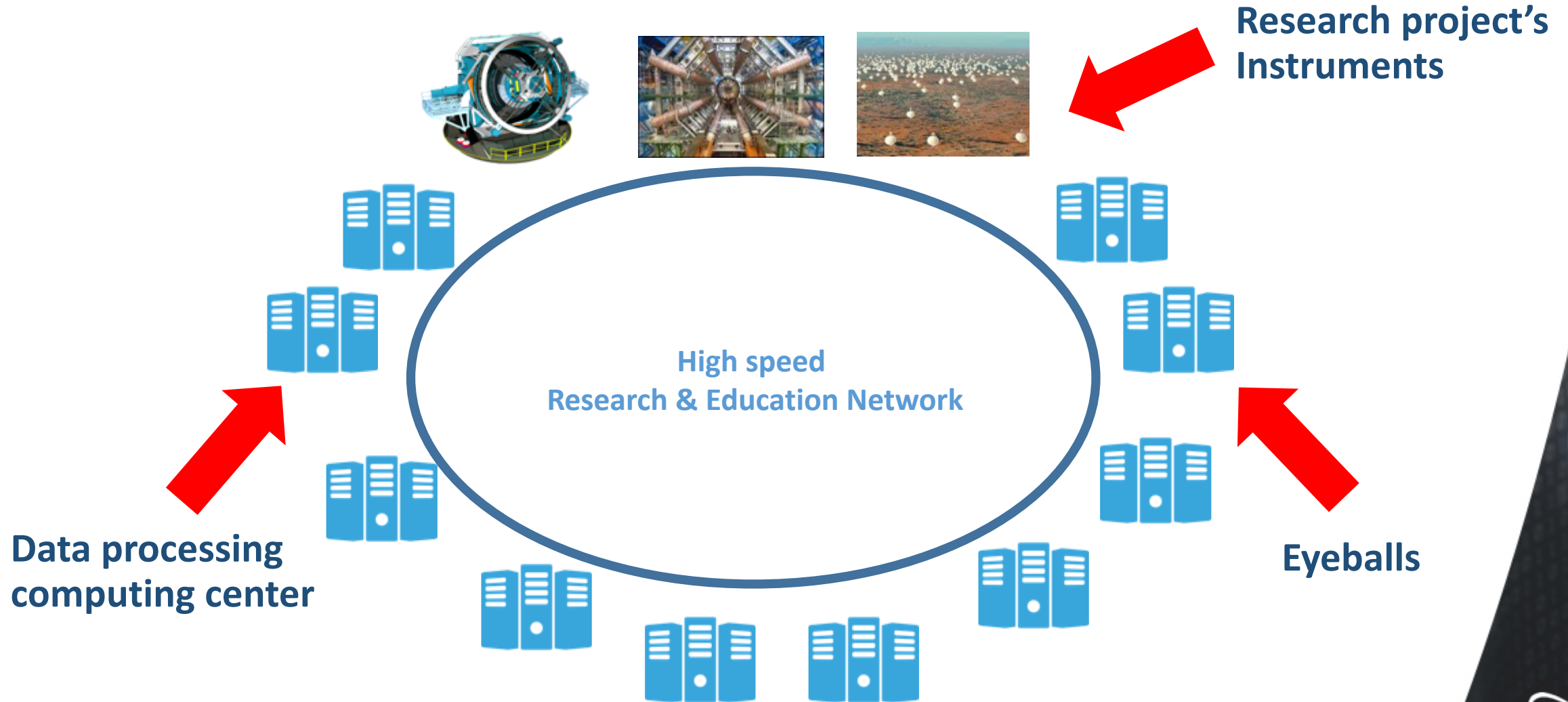
It's a good time to tie Control Plane and Dataplane!

RARE use cases

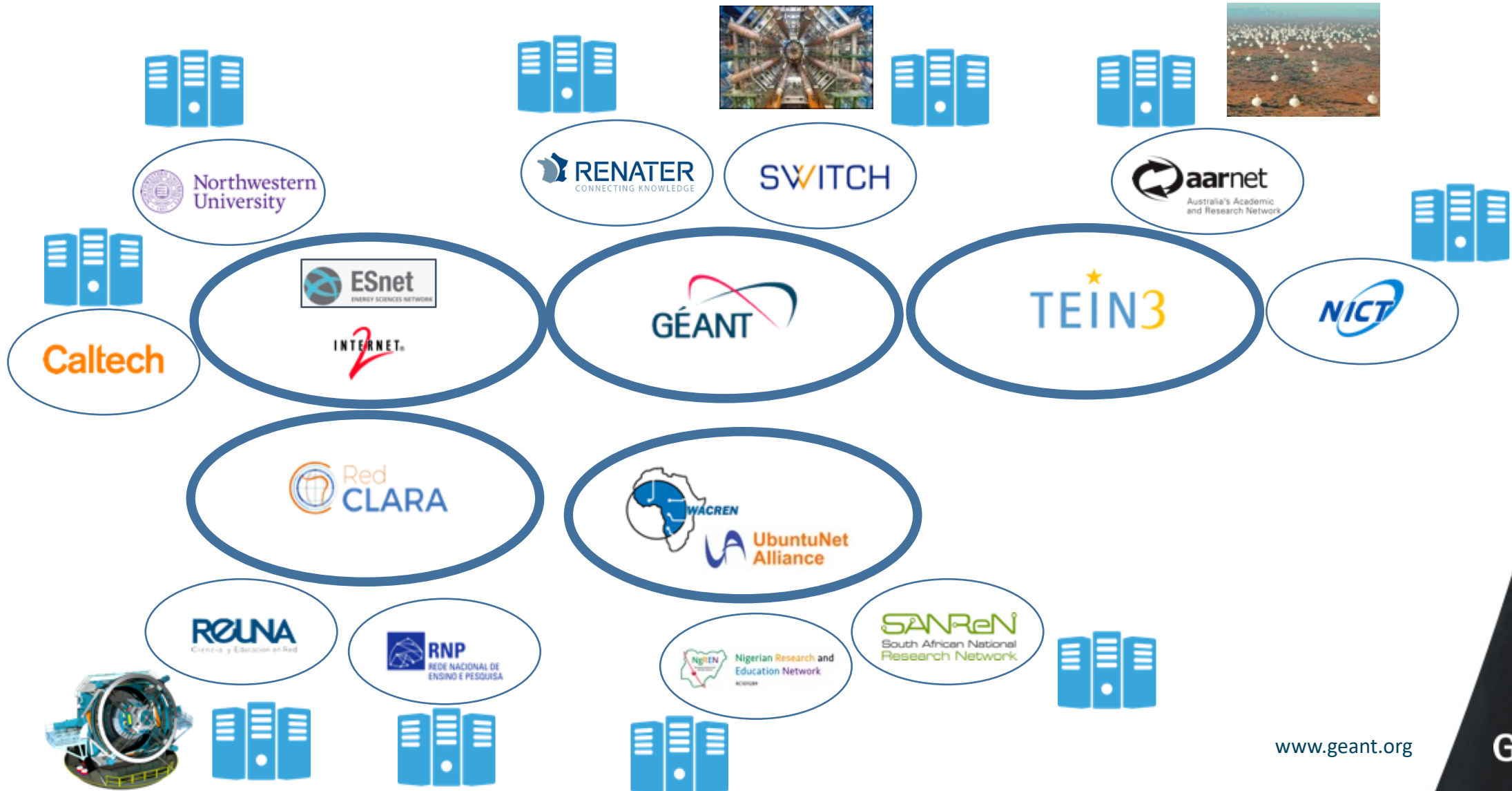


IPv4 and IPv6 compliant!

Anatomy of a typical R&E worldwide research project #1



Anatomy of a typical R&E worldwide research project #2



RARE is for everyone

- **Routing (CP+DP) platform solution**
 - Open Platform
 - Programmable
- **RARE for Research and Education connectivity**
 - Emerging NREN
 - Or not ...
- **RARE for content provider DCI**
 - IaaS owned by NREN
 - IaaS owned by International Global Research project
- **RARE for 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 latest news (Month 29 of 48)

- RARE p4 targets



bmv2 software switch



Programmable Ethernet ASIC on WEDGE-BF100-32X

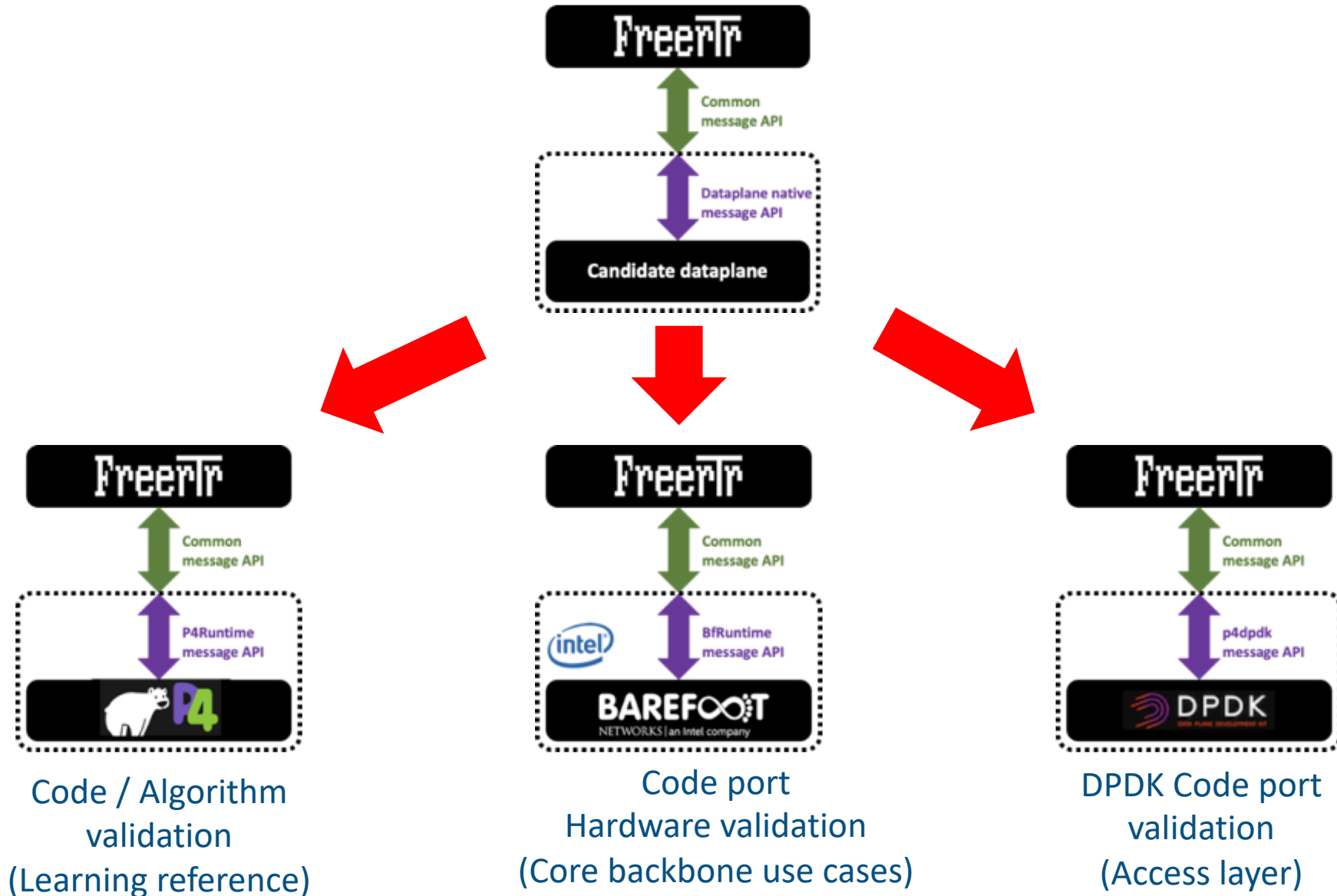


under study

- RARE p4 discussion emulation targets



RARE “target” development



RARE testing framework : ~ 2300 features = 2300 tests

crypt-skip12.tst	success	skip with sha1
crypt-skip13.tst	success	skip with sha256
crypt-skip14.tst	success	skip with sha512
crypt-ssh.tst	success	ssh test
crypt-swipe01.tst	success	swipe over ipv4
crypt-swipe02.tst	success	swipe over ipv6
crypt-swipe03.tst	success	swipe over swipe
crypt-swipe04.tst	success	swipe over loopback
crypt-swipe05.tst	success	swipe with des
crypt-swipe06.tst	success	swipe with blowfish
crypt-swipe07.tst	success	swipe with 3des
crypt-swipe08.tst	success	swipe with aes128
crypt-swipe09.tst	success	swipe with aes192
crypt-swipe10.tst	success	swipe with aes256
crypt-swipe11.tst	success	swipe with md5
crypt-swipe12.tst	success	swipe with sha1
crypt-swipe13.tst	success	swipe with sha256
crypt-swipe14.tst	success	swipe with sha512
crypt-tls.tst	success	tls test
crypt-wireguard01.tst	success	wireguard over ipv4
crypt-wireguard02.tst	success	wireguard over ipv6
crypt-wireguard03.tst	success	wireguard over wireguard
crypt-wireguard04.tst	success	wireguard over loopback
crypt-wireguard05.tst	success	wireguard over asymmetric ports
demo01.tst	success	empty demo network
demo02.tst	success	addressed demo network
intop1-bgp01.tst	success	interop1: ebgp
intop1-bgp02.tst	success	interop1: ibgp
intop1-bgp03.tst	success	interop1: bgp locpref
intop1-bgp04.tst	success	interop1: bgp origin
intop1-bgp05.tst	success	interop1: bgp metric
intop1-bgp06.tst	success	interop1: bgp community
intop1-bgp07.tst	success	interop1: bgp aspath
intop1-bgp08.tst	success	interop1: bgp with labels
intop1-bgp09.tst	success	interop1: bgp addpath
intop1-bgp10.tst	success	interop1: bgp prefix withdraw
intop1-bgp11.tst	success	interop1: bgp vpnv4
intop1-bgp12.tst	success	interop1: bgp authentication
intop1-bgp13.tst	success	interop1: bgp vpnv6

description wireguard over ipv6

```

addrouter r1
int ser1 ser - $1a$ $1b$
!
vrf def v1
rd 1:1
exit
int ser1
vrf for v1
ipv4 addr 1.1.1.1 255.255.255.0
ipv6 addr 1234::1 ffff::
exit
crypto ipsec ips
key EFw2rJEdqFGDgC80um3fwMmAafwqXno+PsbMHP20umM=M6vDV8QdiWDQppVKjKf8xjoKtyGAeRK/Ue48kwKI5Ss=
exit
int tun1
tunnel vrf v1
tunnel prot ips
tunnel mode wireguard
tunnel source ser1
tunnel destination 1234::2
vrf for v1
ipv4 addr 2.2.2.1 255.255.255.0
ipv6 addr 4321::1 ffff::
exit
!




addrouter r2
int ser1 ser - $1b$ $1a$
!
vrf def v1
rd 1:1
exit
int ser1
vrf for v1
ipv4 addr 1.1.1.2 255.255.255.0
ipv6 addr 1234::2 ffff::
exit
crypto ipsec ips
key 6JhyvKPuTQ9DNLuPmDnQLRWtUWlUjI6PTJ/I291lw=bQMmpCaGVyq9f+v48XGmfH5DMLytkqziID+rBH+qQic=
exit
int tun1
tunnel vrf v1
tunnel prot ips
tunnel mode wireguard
tunnel source ser1
tunnel destination 1234::1
vrf for v1
ipv4 addr 2.2.2.2 255.255.255.0
ipv6 addr 4321::2 ffff::
exit
!

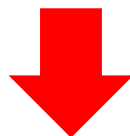
r1 tping 100 5 2.2.2.2 /vrf v1
r2 tping 100 5 2.2.2.1 /vrf v1
r1 tping 100 5 4321::2 /vrf v1
r2 tping 100 5 4321::1 /vrf v1
    
```



RARE testing framework: Dataplane tests ~300 tests

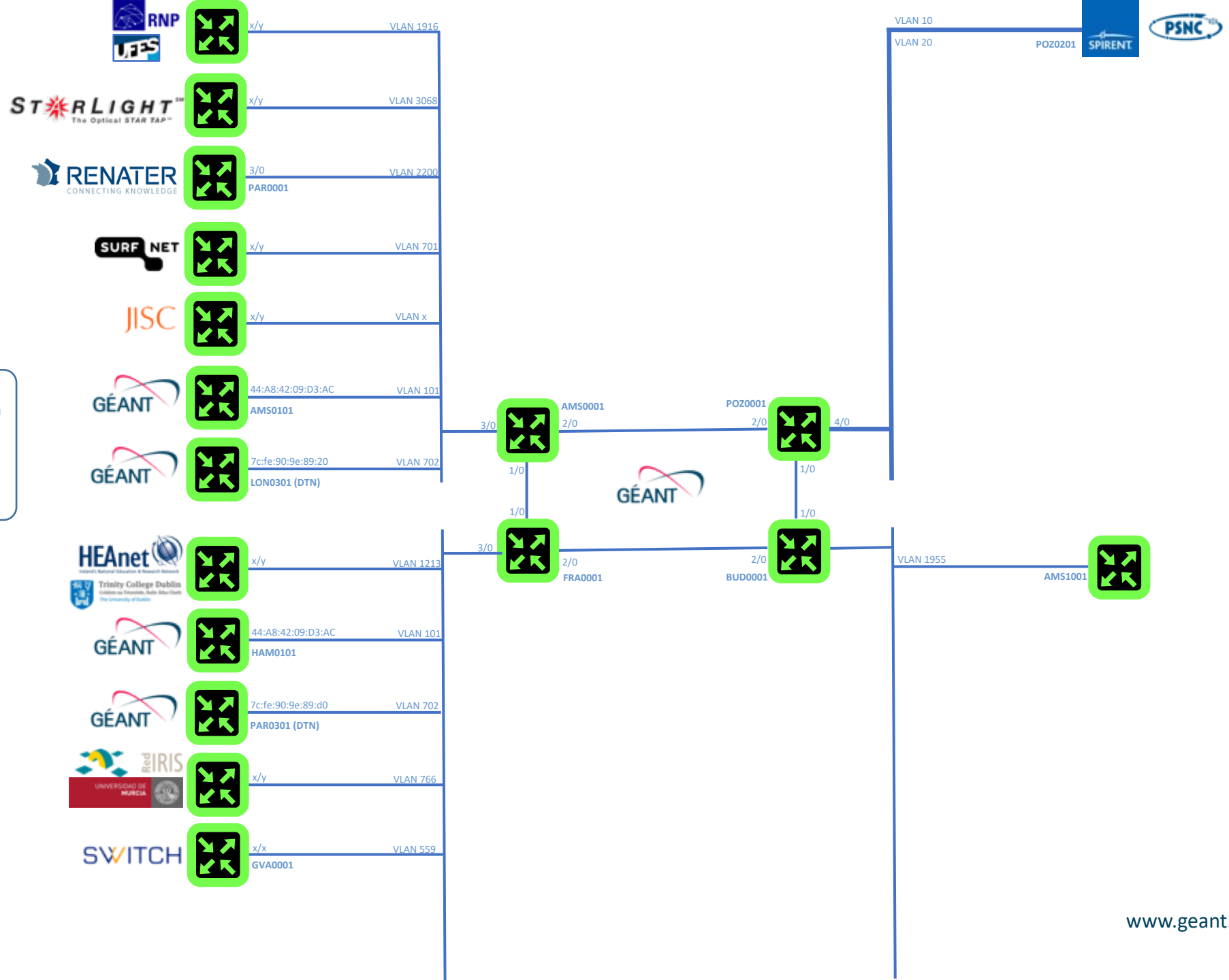
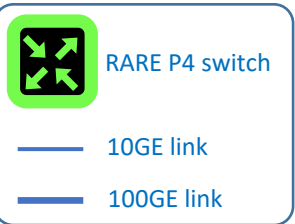
Complete feature list

Type	Test #	Name			
acl	01 ^g	copp	✓	✓	✓
acl	02 ^g	ingress access list	✓	✓	✓
acl	03 ^g	egress access list	✓	✓	✓
acl	04 ^g	nat	✓	✓	✓
acl	05 ^g	vlan ingress access list	✓	✓	✓
acl	06 ^g	vlan egress access list	✓	✓	✓
acl	07 ^g	bundle ingress access list	✓	✓	✓
acl	08 ^g	bundle egress access list	✓	✓	✓
acl	09 ^g	bundle vlan ingress access list	✓	✓	✓
acl	10 ^g	bundle vlan egress access list	✓	✓	✓
acl	11 ^g	bridge ingress access list	✓	✓	✓

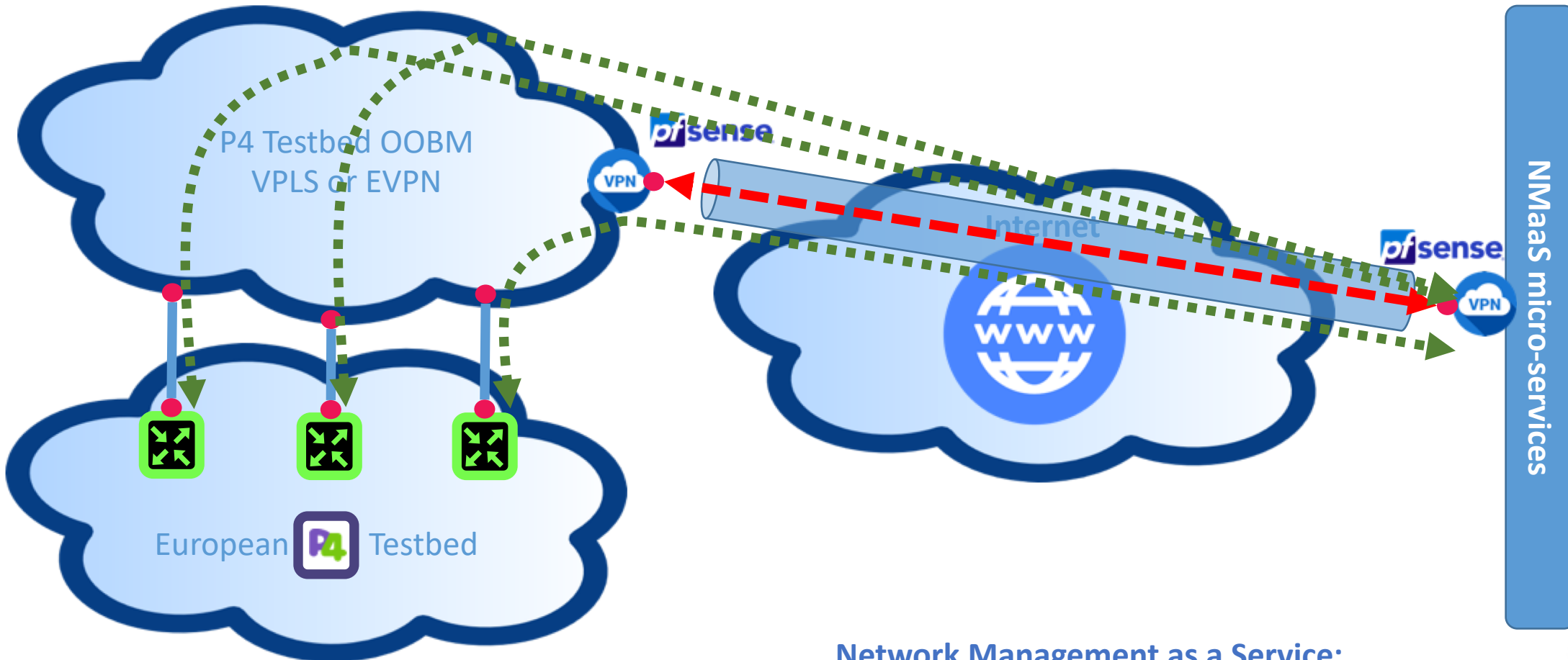


And more features !

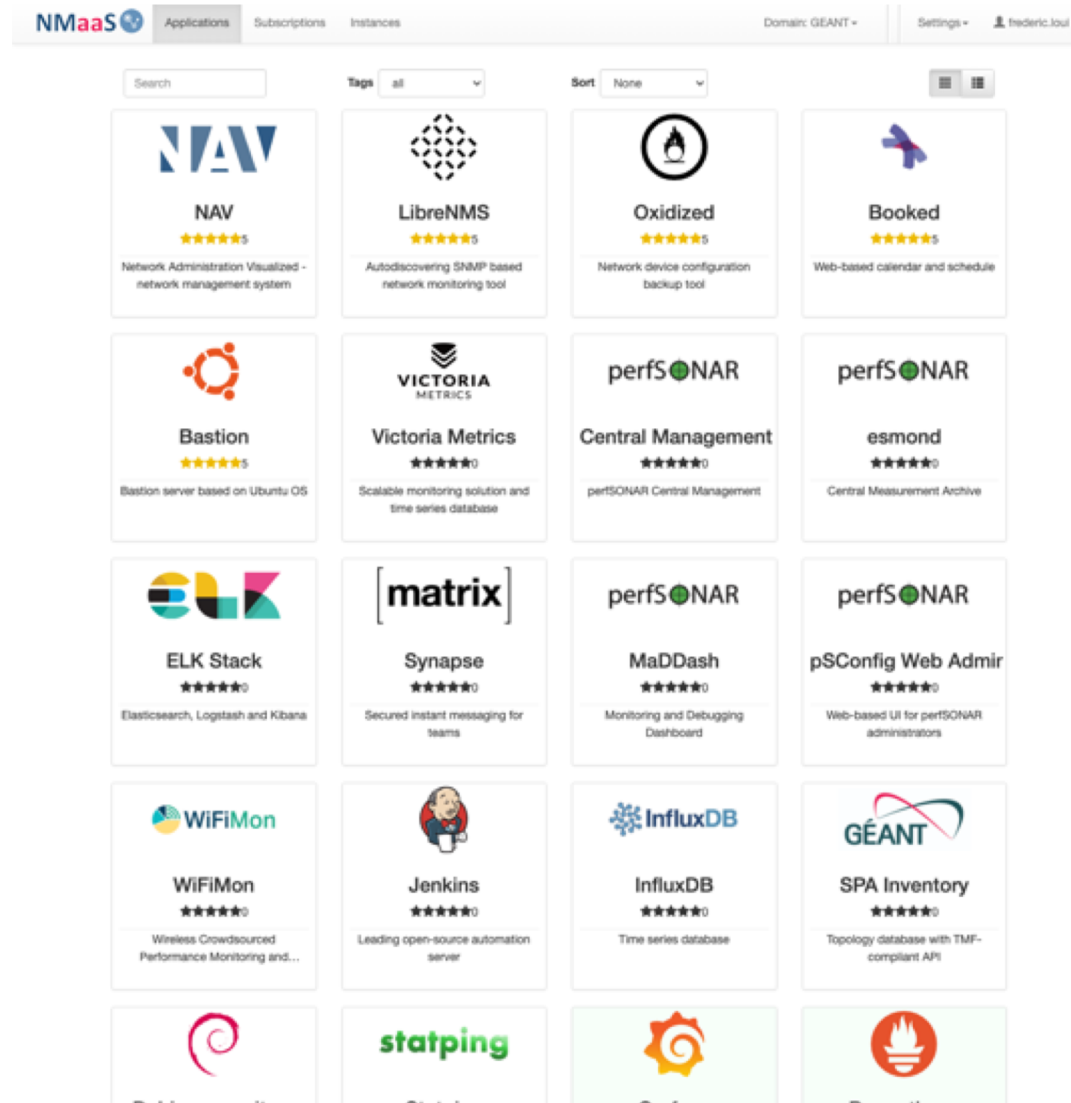
Please come @IRC #freertr and submit your idea!



RARE validation designs: P4 LAB network management via NMaas *! (Network Management as a Service)

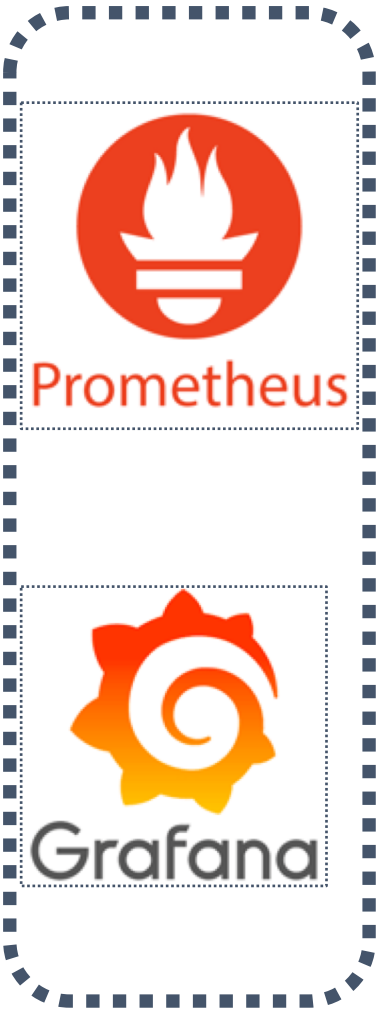


P4 LAB network management via (Network Management as a Service)



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

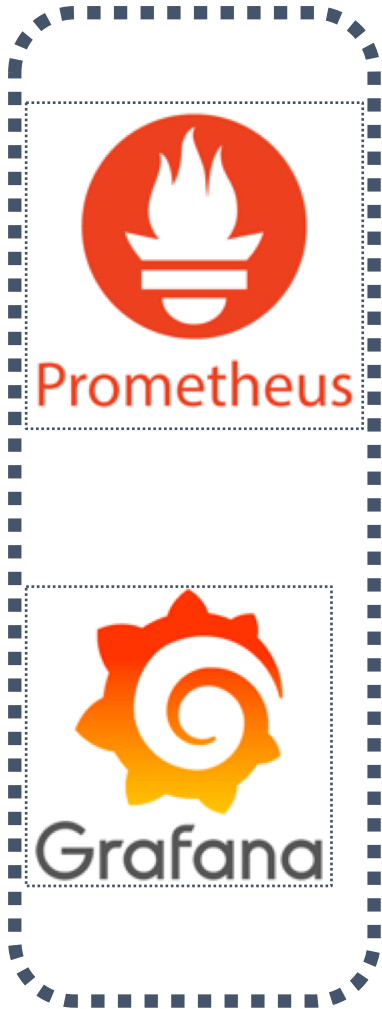
Monitoring at node level! (Prometheus agent)



More **API/Agents** are available !



Monitoring at node level! (Grafana dashboard)

The screenshot shows the Grafana Labs website. At the top, there is a navigation bar with links for Grafana, Products, Open Source, Learn, Downloads, My Account, and Contact us. Below this is a secondary navigation bar with links for 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, author, description, and download/review counts.



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-away – We are ready to roll into production



- Automated testing
- 3rd party testing via Spirent usage
 - (thanks PSNC@WB team)
- P4 profile calibration for  only
-  currently in operation SOHO
- Production deployment



- Work in progress production deployment





**Let's get practical ...
and present you
actual real life 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)

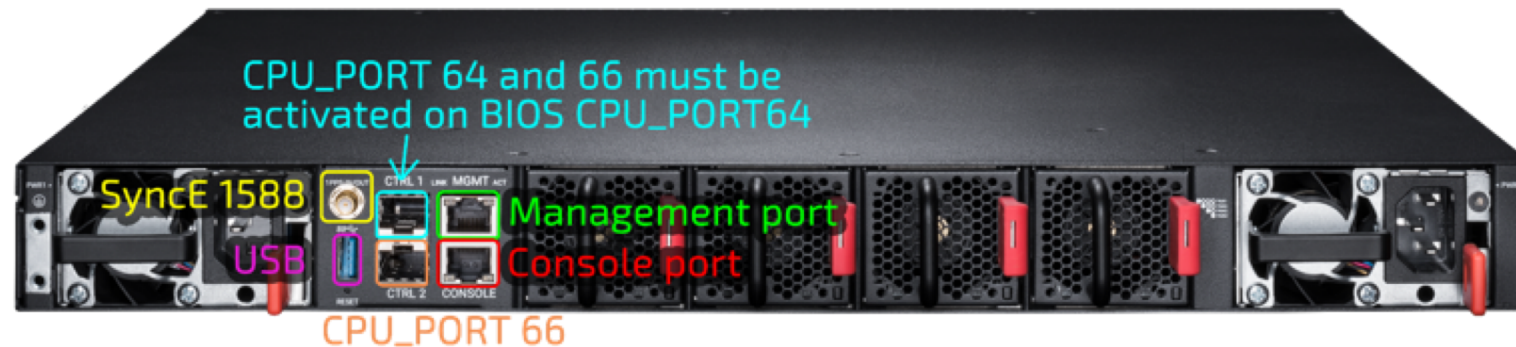
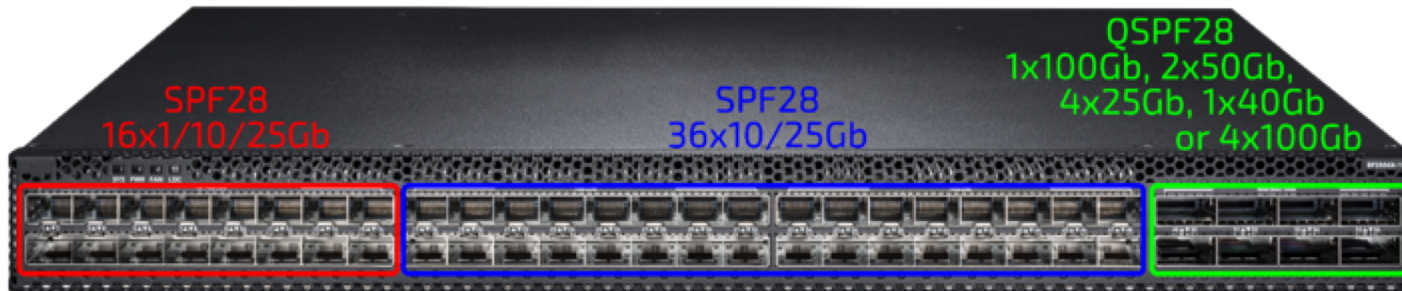


DPDK
DATA PLANE DEVELOPMENT KIT

TCPDUMP & LIBPCAP

Practical use case #002 BRAS-BNG/LNS 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



Edge-core
NETWORKS

WEDGE-100BF-32X



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!



Edge-core
NETWORKS

WEDGE-100BF-32X



Practical use case #005 high performance BGP RR

- Recycling new 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 » Practical

Ideal for aggregation

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





Practical use case #007 100GE Private Peering node

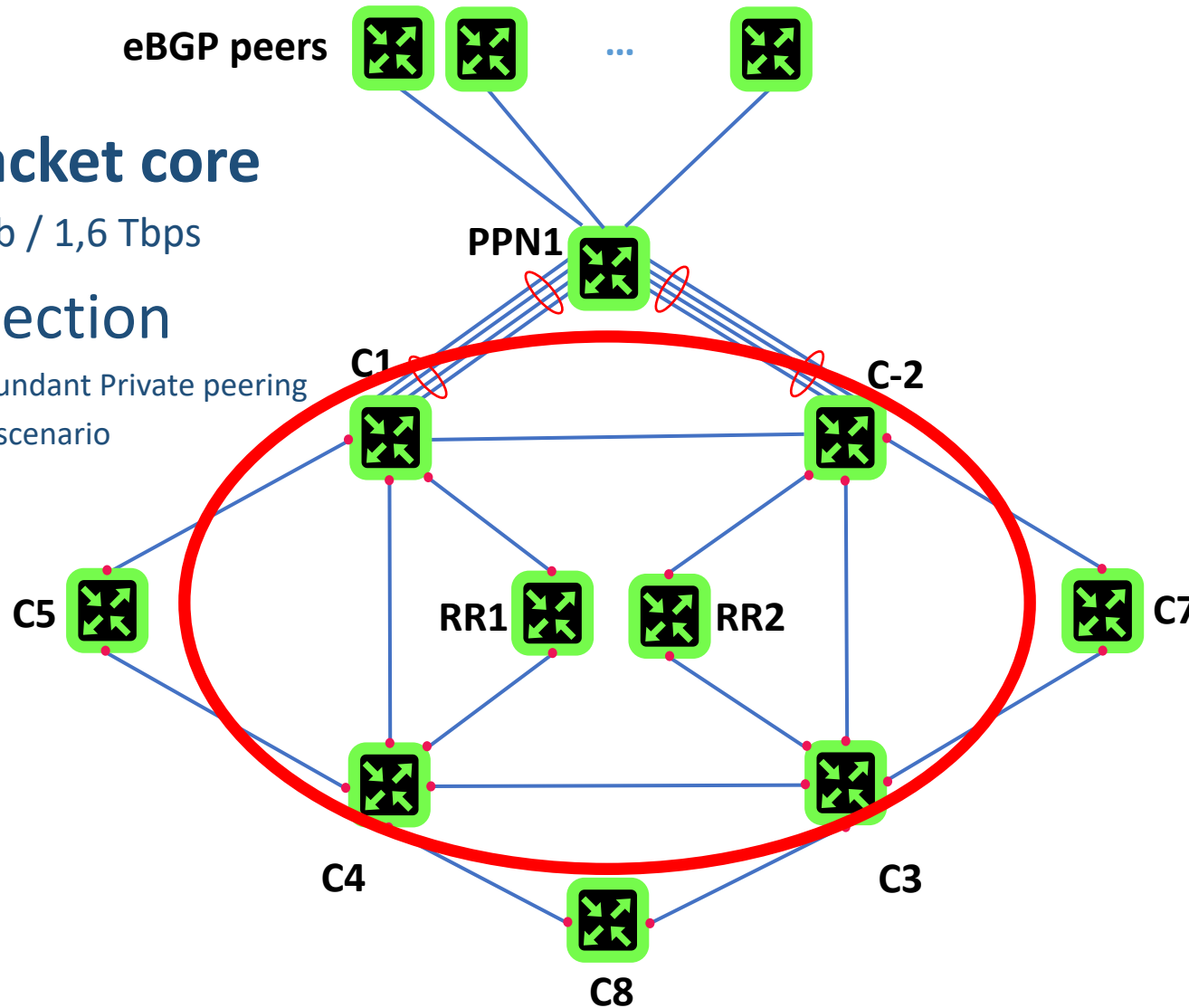


- High resilient **Packet core**

- 2 direction @ 400Gb / 1,6 Tbps

- User ports connection

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



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-away – 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-away – 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
 - **Rethink how Network Management is handled**
- Opportunity to integrate **existing automation initiatives**



**Instantaneous & Flexible
Network Services for the users!**

Acknowledgements ...



APS Networks



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  [@rare_freerouter](https://twitter.com/rare_freerouter)



IRC@DN42 #freertr



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*

Looking ahead: Finalize transition to production



Join the RARE project !

Extend HCL:

new TOFINO based hardware support
new DPDK release

New target:

TOFINO2
NVIDIA DPU
P4 SmartNIC
FPGA

New idea:

Polka
P42VPP
T4P4S ELTE
Leverage Nix paradigm

And more ...

Thank you

Any questions?

www.geant.org

