Router for Academia Research Education

RARE/freeRtr in a nutshell

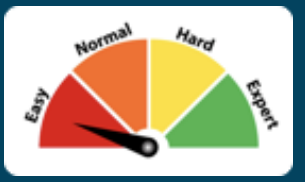
LOUI Frédéric
RENATER – RARE technical leader

ESNOG 28

May 12th 2022

Public

www.geant.org



GÉANT-4 programme

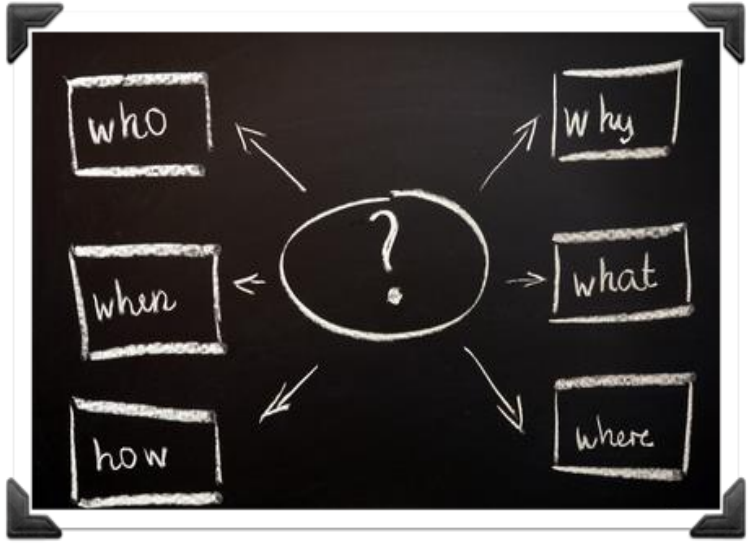
- 39 participants country
  - NREN participants
  - But also NREN staff members !

- GN4 phase 3 cooperation programme
  - 44 months
  - Budget 78 M€
- GN4-3 divided in “Work Package”
  - 9 WP divided in “Tasks”
  - Task 1 encompasses 6 Sub-tasks
  - **RARE** is one of these sub-task

WHY are we doing all of this ?

Problems statements

- Needs of **network aware** applications
- Traditional procurement life cycle workload related to network equipment acquisition
- Reduce vendor lock-in
- Ability to implement ADHOC features
- Reduce digital divide affordable network solution without functionality trade off
- Software sovereignty ?



RARE/freeRtr mission statement

- One unified & Opensource routing platform
  - Multiple solutions (=dataplanes)
  - That fit R&E use case

At TREMENDOUS line rate !

Why RARE now?

- Starting from early 2010:
  - Several valuable Open Source control plane usage besides well know commercial vendor

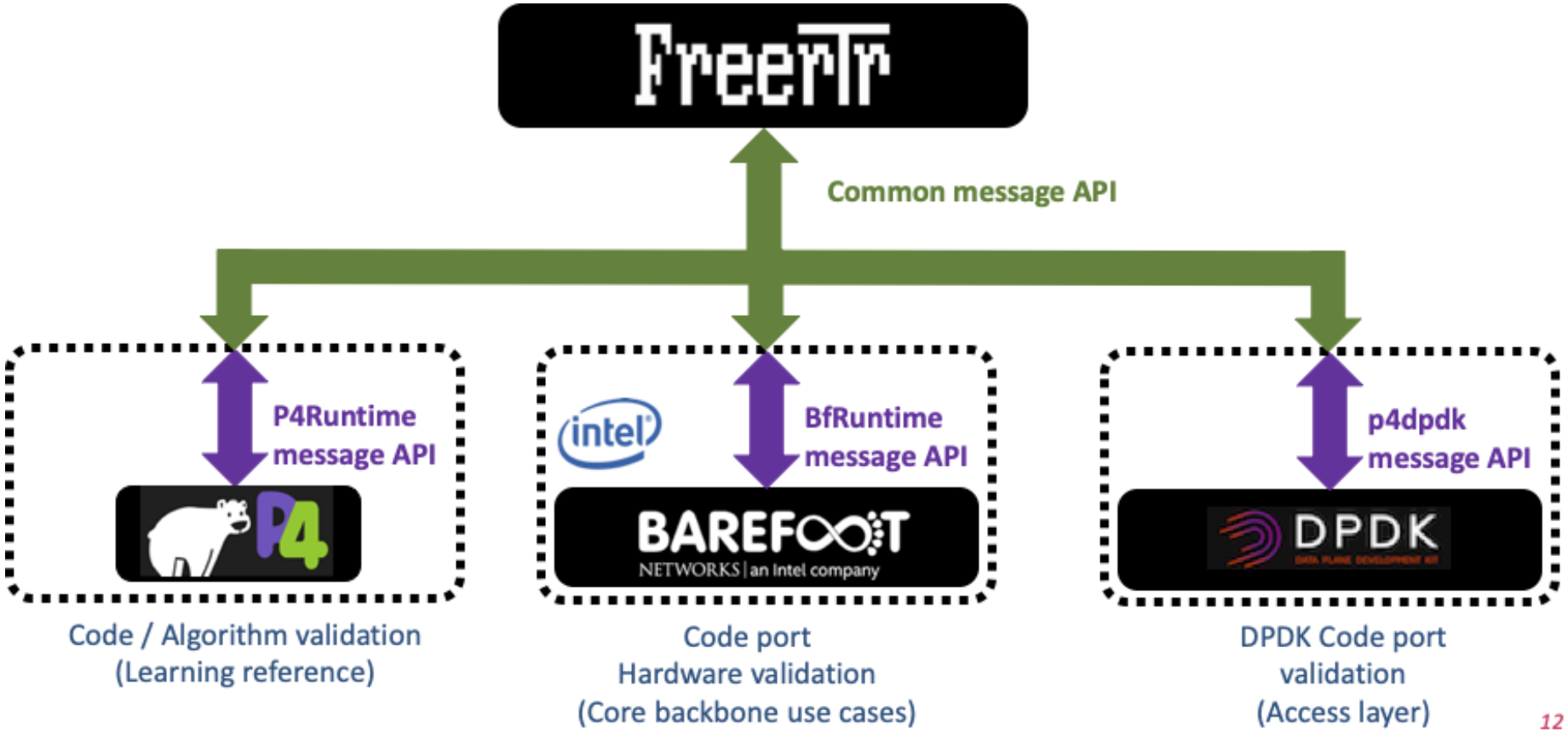
- Starting from 2020:
  - Dataplane solution reached maturity ready to implement production grade use case

- NOS emergence

- Hypervisor Technology convergence

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

One control to rules all dataplanes



12

What about ISP and commercial use case ?

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

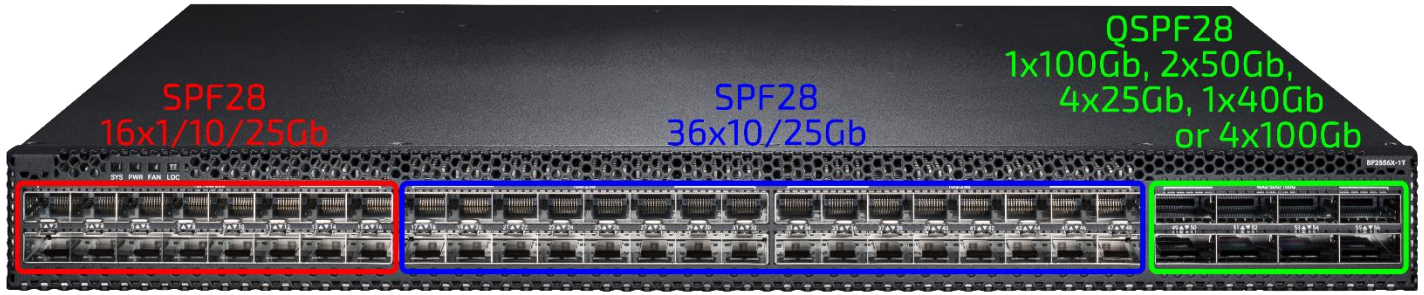
GÉANT

Practical use case #002 BRAS-BNG/LNS router

- DPDK and P4 dataplane
  - ➔suitable for CAMPUS / EDGE BACKBONE router
- nx1GE, nx10GE, nx100GE

APS Networks

BF-2556X-1T



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

intel BAREFOOT TOFINO

Practical use case #004 LER router

TAKE AWAY
TAKE AWAY
Hello
Здравствуйте
ПРИВЕТ
Zdravo
Olá
Hej
Ahoj
Hoi
Hallo
Salut
Ciao
Hola
Witaj
Merhaba
Olá
Hej
Ahoj
Hoi
Hallo
Salut
Ciao
Hola
Witaj
Merhaba
Здравствуйте

Practical use case #005 high performance BGP RR

TAKE AWAY
Hello
Здравствуйте
ПРИВЕТ
Zdravo
Olá
Ahoj
Hej
Dia duit
Lorem
Sveiki
hoy

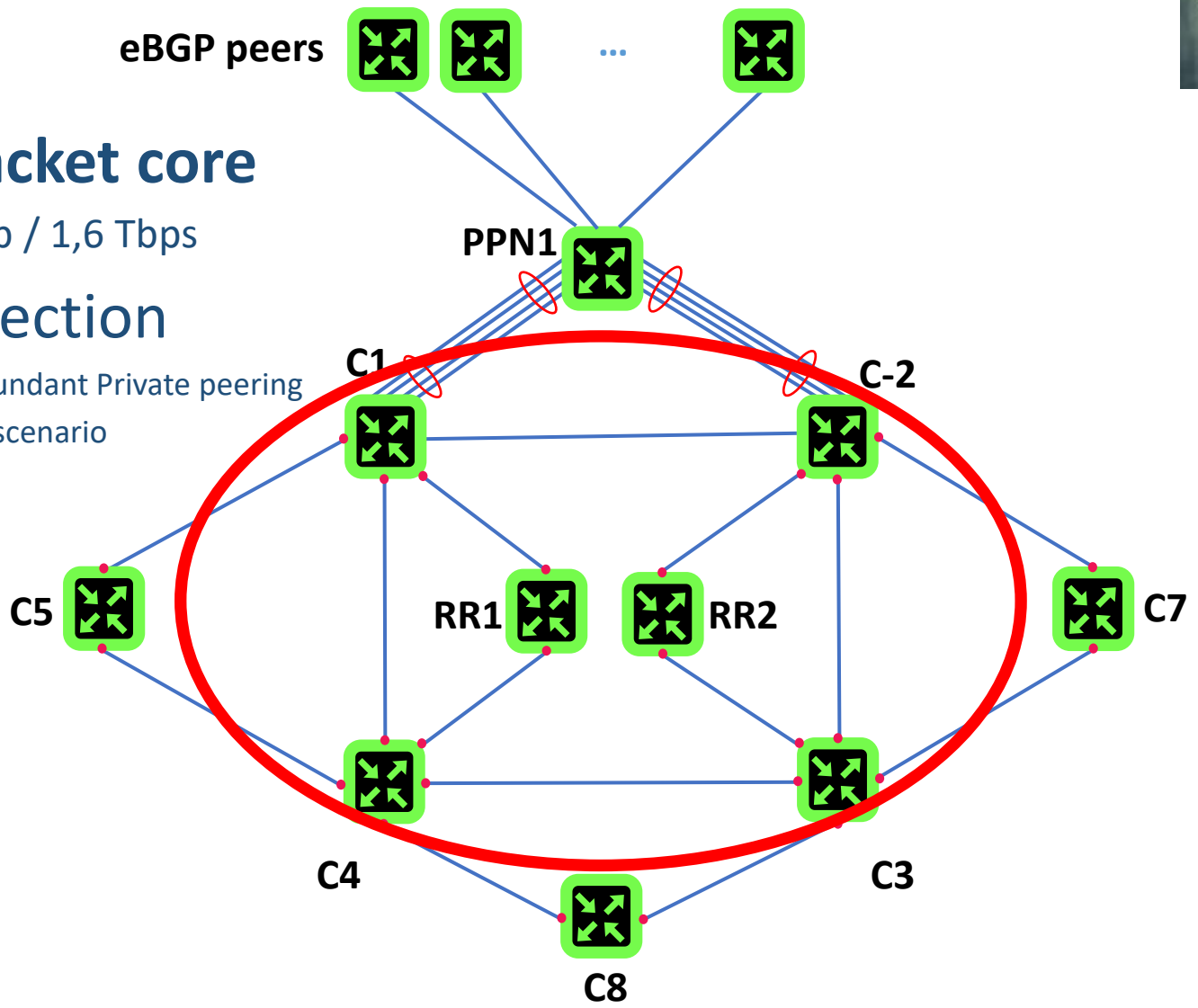
Practical use case #006 « small PE » Practical

Ideal for aggregation

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

Practical use case #007 100GE Private Peering node

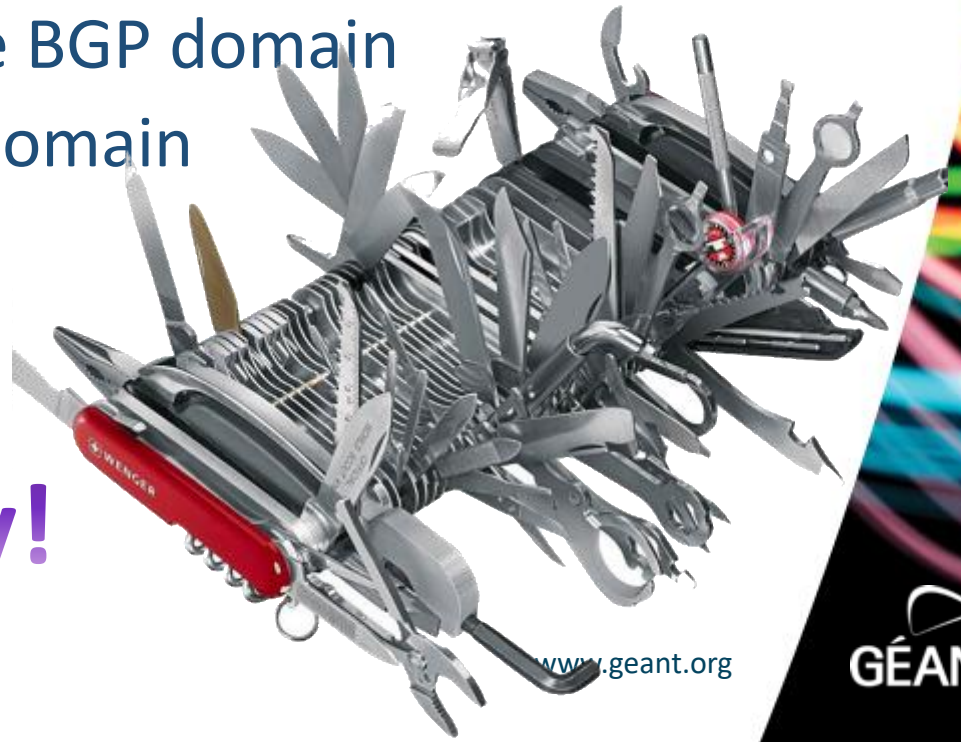
- High resilient **Packet core**
  - 2 direction @ 400Gb / 1,6 Tbps
- User ports connection
  - 24 ports left for 2x12 redundant Private peering
  - 1:3 ratio with redundant scenario



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!



Acknowledgements …

GÉANT

European Commission

FreeRTr

P4

DPDK
DATA PLANE DEVELOPMENT KIT

intel

APS Networks

debian

TCPDUMP & LIBPCAP

OpenJDK

Useful links

- Project
  - **freeRtr control plane's home:** freertr.org
  - **more information on dataplanes:** rare.freertr.org
  - **Project members' journey:** blog.freertr.org
  - **FreeRtr configuration guide:** docs.freertr.org
- 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**
  - **IRC@DN42 #freertr**
  - **RARE/freeRtr guild**

RARE/freeRtr 1st release is out !

- CI/CD deployment: ~ 2500 tests automated weekly
- ONIE image : one liner installation

- TOFINO based switches
  - Wedge 100BF-32X
  - Wedge 100BF-32QS
  - Wedge 100BF-64X
  - APS6064X
  - APS2556X1T
- An extensive list of specific tailored profile. RARE/freeRtr can act as P/PE,BNG,BRAS, CGNAT, traffic cleaner and more !
- An innovative software life cycle management leveraging **Nix package manager paradigm**.

  ➔it is possible to upgrade and rollback without any hitch at the software distribution level (think of an "apt upgrade" with the possibility to "apt downgrade #n » at the router level)

- And more !

For those who wants to start their journey:

http://docs.freertr.org/guides/installation/

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*

GitHub organisation: https://github.org/rare-freertr

Looking ahead: Finalize transition to production

Extend HCL:
new TOFINO based hardware support
new DPDK release

New target:
TOFINO2
NVIDIA DPU
P4 SmartNIC
FPGA

New idea:
Polka / mPolka
Leverage Nix paradigm

And more …

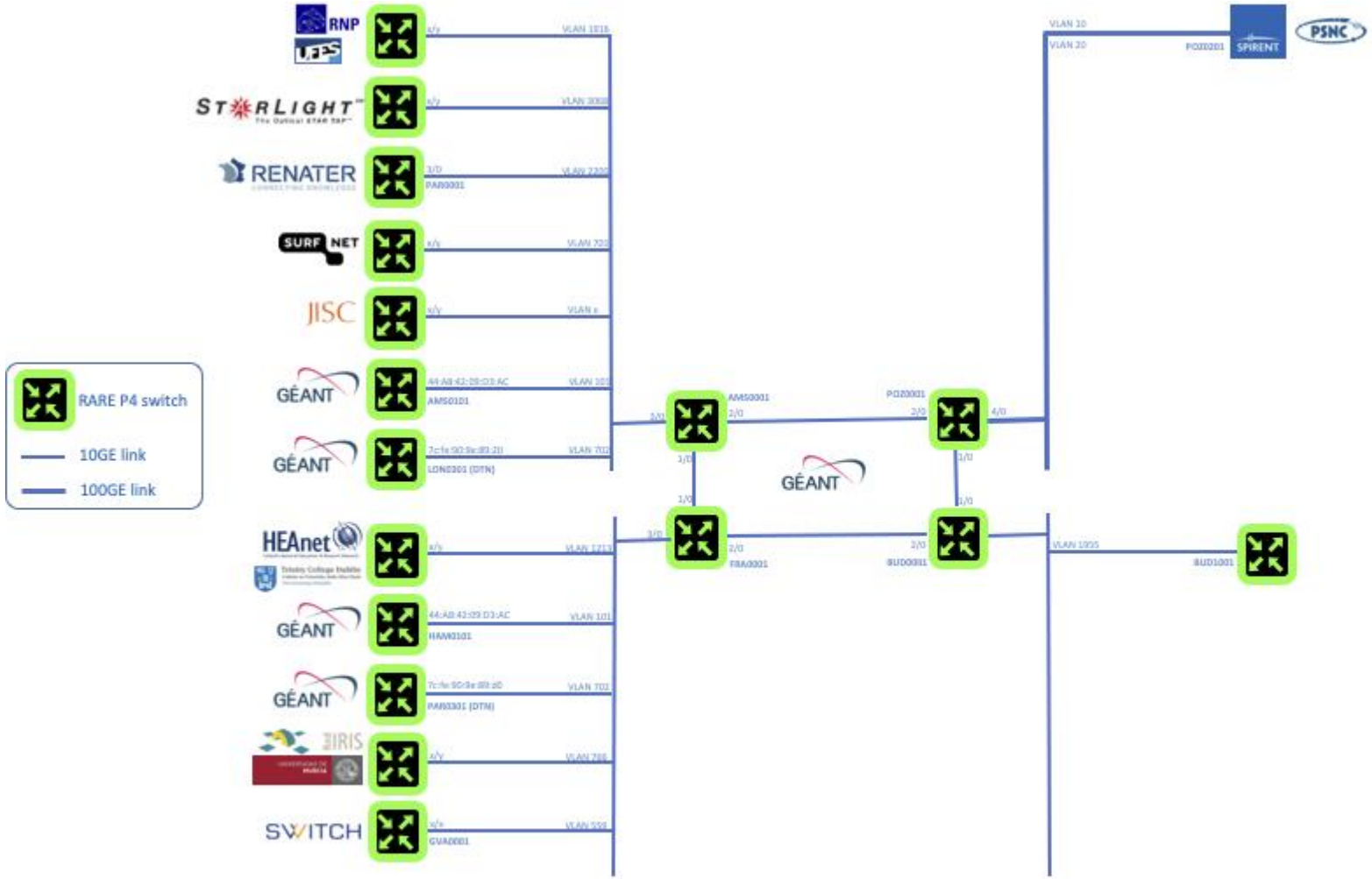
Join the RARE project !

RARE/**freeRrt GÉANT**

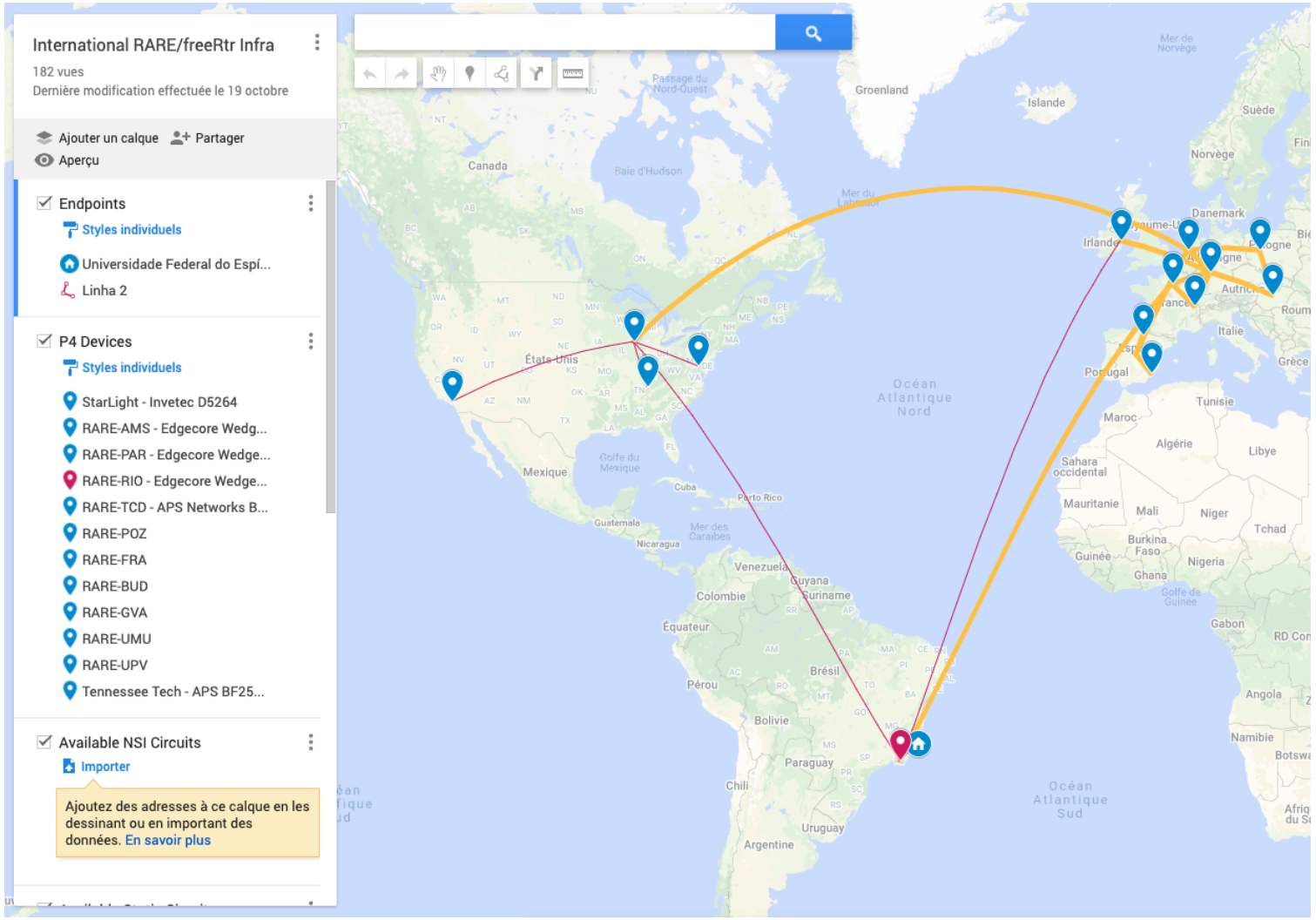
P4 lab use cases

GP4L – GÉANT P4 LAB

GP4L – GÉANT P4 LAB



GP4L – GÉANT P4 LAB



PolKA: [1]
Polynomial Key-based Architecture for Source Routing in Network Fabrics

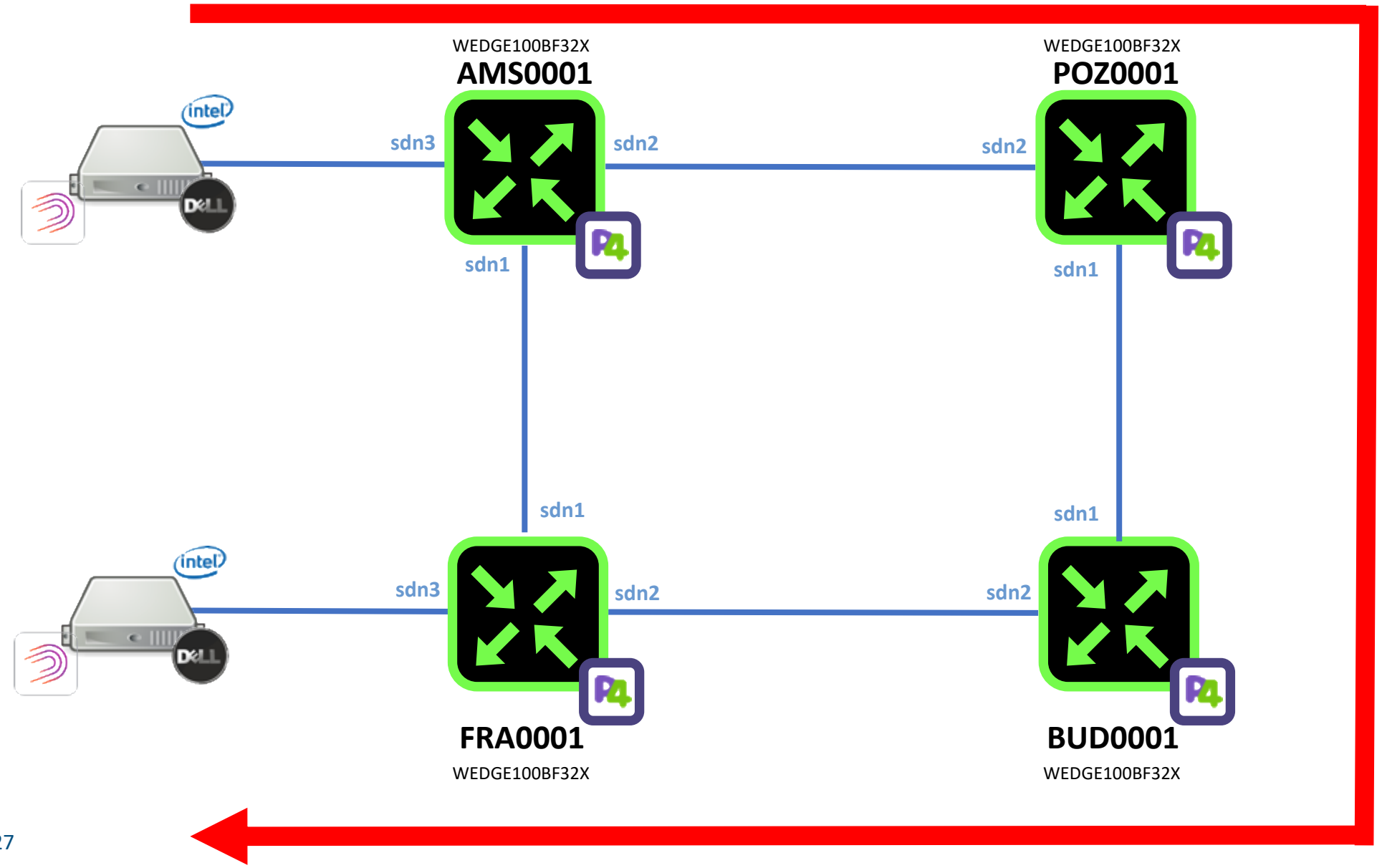
How does PolKA work?

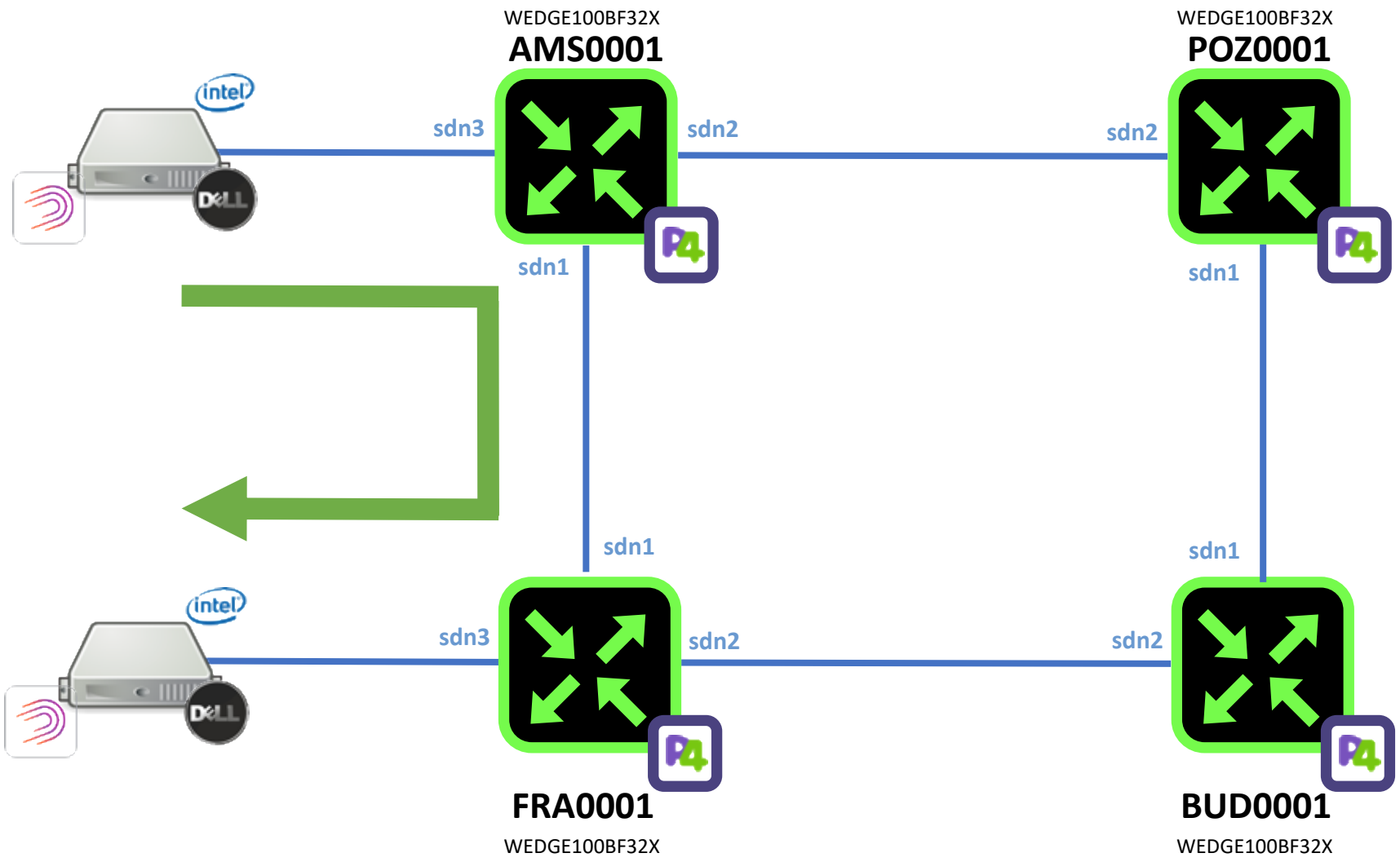
- Three polynomials:
  - **routeID**: a route identifier calculated using the CRT.
  - **nodeID**: to identify each core node.
    - Irreducible polynomial
  - **portID**: to identify the ports of each core node.

- The forwarding uses a **mod** operation (remainder of division):

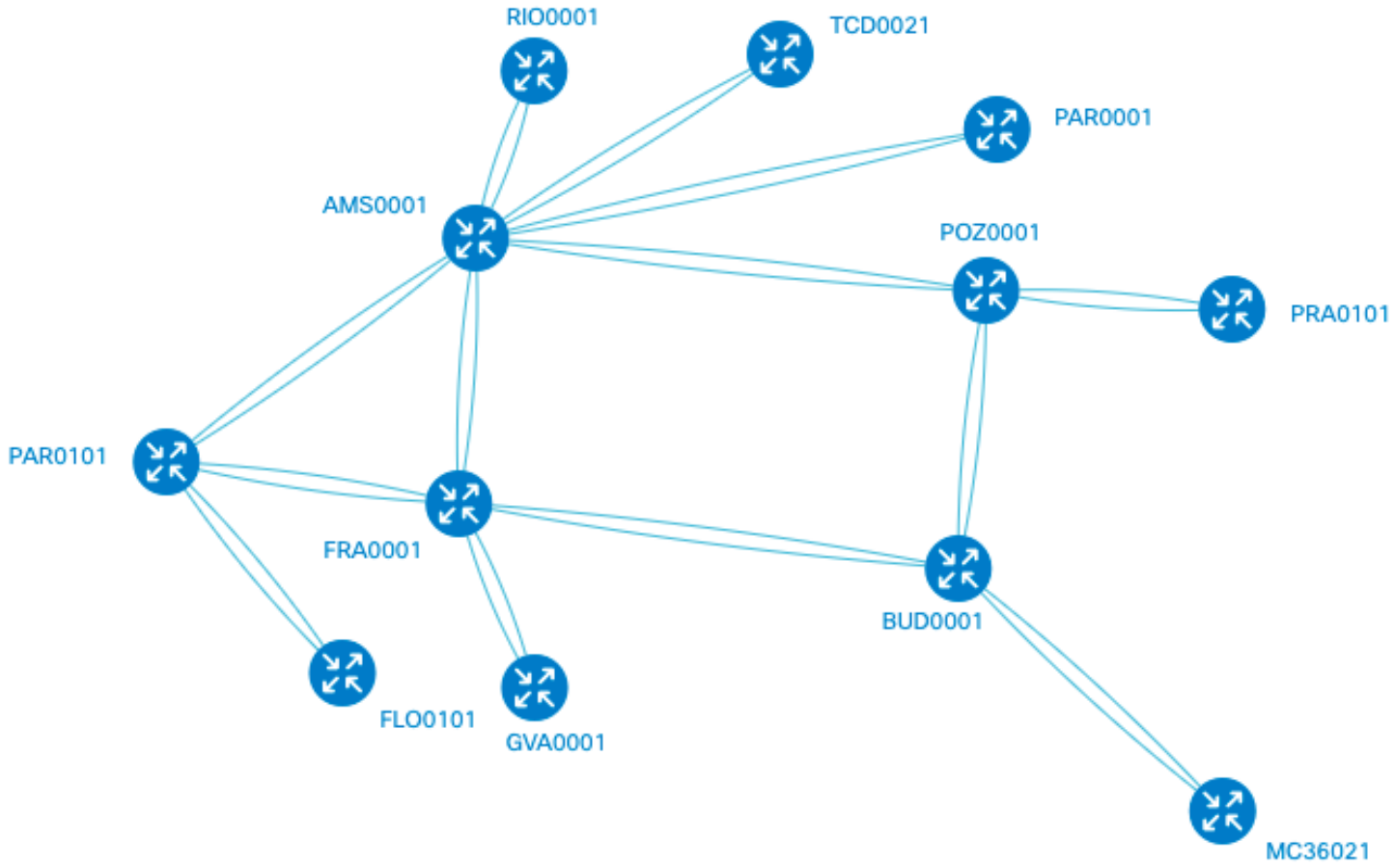
$$portID = < routeID >_{nodeID}$$

[1] https://ieeexplore.ieee.org/document/9165501
Polka at https://ondm2021.chalmers.se/full-program/


WEDGE100BF32X
AMS0001
WEDGE100BF32X
POZ0001
intel
sdn3
sdn2
sdn2
sdn1
sdn1
sdn1
sdn1
intel
sdn3
sdn2
sdn2
FRA0001
WEDGE100BF32X
BUD0001
WEDGE100BF32X

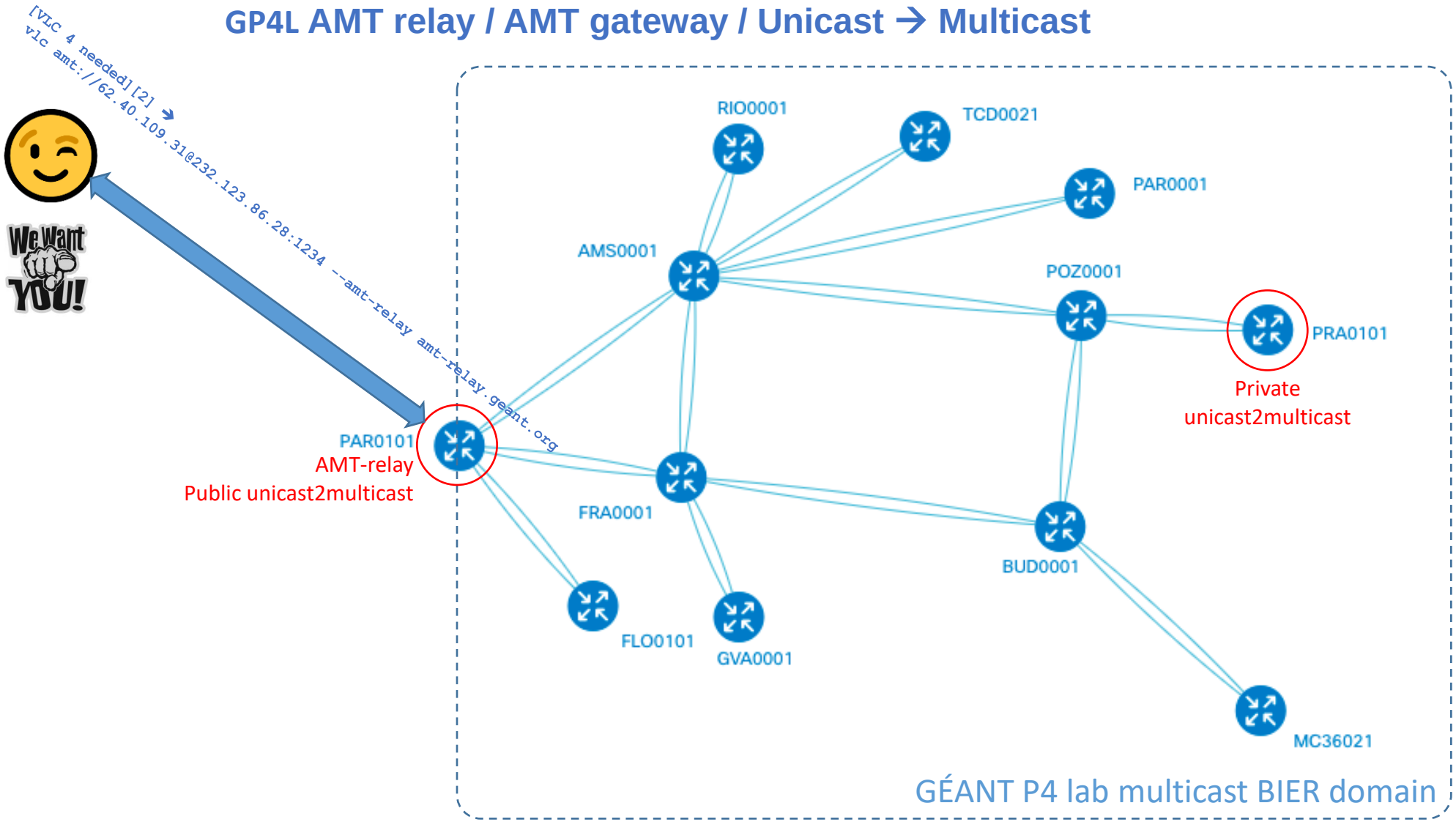

WEDGE100BF32X
AMS0001
WEDGE100BF32X
POZ0001
sdn3
sdn2
sdn2
sdn1
sdn1
sdn1
sdn1
sdn3
sdn2
sdn2
FRA0001
WEDGE100BF32X
BUD0001
WEDGE100BF32X

GP4L Topology rendering via BGP-LS [1]



[1] http://gp4l.geant.org/

GP4L AMT relay / AMT gateway / Unicast → Multicast



[1] http://gp4l.geant.org/
[2] https://nightlies.videolan.org/

AN INNOVATIVE MULTICAST STREAMING SERVICE !

AMT relay / AMT gateway / Unicast → Multicast

http://mcast-menu.par.geant.org/

http://mcast-menu.pra.geant.org/

sho ipv4 nat CLEARNET trans

	original		translated						
proto	source	target	source	target	age	last	timeout	pack	byte
17	62.40.109.125 38337	62.40.109.31 2262	62.40.109.31 59487	232.123.86.28 1234	23:51:15	00:00:00	00:01:00	22711663	26527222384
17	62.40.109.125 45392	62.40.109.31 2262	62.40.109.31 61222	232.123.45.36 1234	23:51:15	00:00:00	00:01:00	1850481	2161361808
17	62.40.109.125 59210	62.40.109.31 2262	62.40.109.31 59051	232.123.33.114 1234	23:51:15	00:00:00	00:01:00	48333709	56453772112

sho ipv6 nat CLEARNET trans

	original		translated						
proto	source	target	source	target	age	last	timeout	pack	byte

sho ipv4 mrou CLEARNET

source	group	interface	upstream	targets	bytes

sho ipv6 mrou CLEARNET

source	group	interface	upstream	targets	bytes

sho ipv4 mrou CORE

source	group	interface	upstream	targets	bytes

sho ipv6 mrou CORE

source	group	interface	upstream	targets	bytes

- **INSTALL VLC 4**

https://nightlies.videolan.org/

- **Launch** VLC AMT client

vlc amt://62.40.109.31@232.123.76.124:1234 --amt-relay amt-relay.geant.org

Thank you

Any questions?

www.geant.org

© GÉANT Association on behalf of the GN4 Phase 3 project (GN4-3).
The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 856726 (GN4-3).