



# GP4L in GÉANT-5 project

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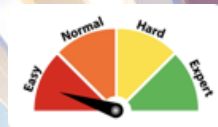
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2023 Internet2 Technology Exchange

20 September 2023

# Agenda

- Few words about GÉANT-5
- Global P4 Lab
  - Current footprint
  - Nodes & links composition
  - NMaaS as monitoring system
- 2 types of GP4L usage
  - Network experimentation
  - Tools conceptions “around” the network
- Automation & Orchestration
- Final words



# [TL;DR] GÉANT-5 in a nutshell

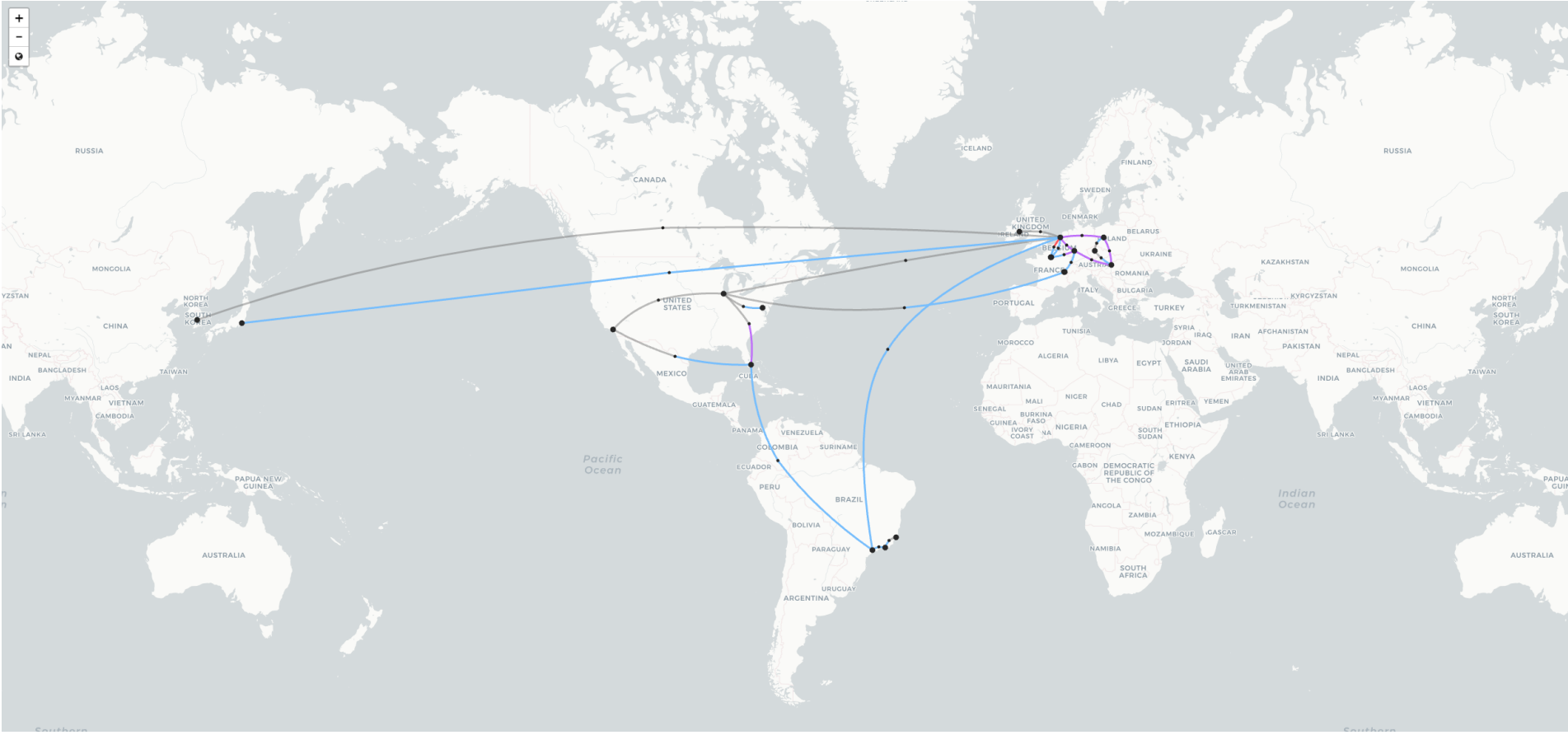
## GÉANT-5 in a nutshell



- GÉANT-5 is under **Horizon Europe**
  - « Research and innovation funding programme until 2027 »
- GÉANT-5 encompasses 43 countries
  - is in 1<sup>st</sup> iteration → **GN5-1** till end of 2024
- GN5-1 is divided into:
  - **Work packages** that in turns are divided into **Tasks**
  - Tasks can include inter-related **subtask**
  - **Global P4 Lab** is included in WP6-T2 (aka. platform)

# Global P4 Lab. aka “GP4L” in GN5-1

# Global P4 lab: “Persistent Programmable testbed” current footprint [2023/09]





## Global P4 lab: Node types

Available now in GP4L !



3.2/6.4 Tbps



12.8 Tbps



200 Gbps

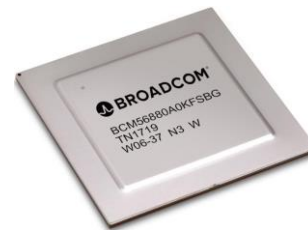


200 Gbps

Under the radar ...



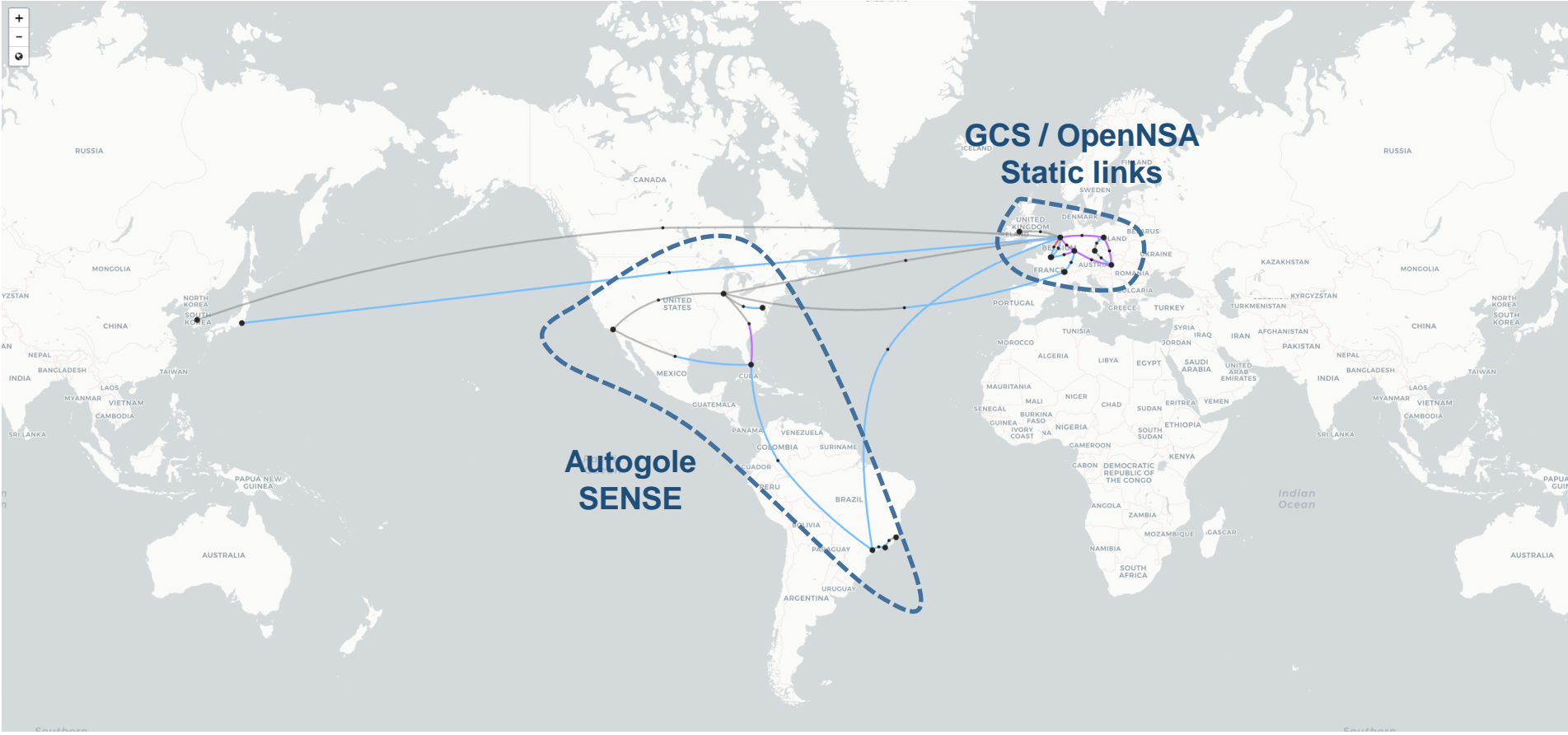
12.8 Tbps



12.8 Tbps



# Global P4 lab: Links




# Global P4 lab: Monitoring NMaas



**Grafana**  
★★★★★5

Open source analytics & monitoring solution for every database




**Prometheus**  
★★★★★5

Monitoring system & time series database




**Icinga2**  
★★★★★0

Scalable and extensible monitoring system



**SPA Inventory**  
★★★★★0

Resource and Service Inventory with TMF-compliant API




**Routinator**  
★★★★★0

RPKI Validator




**WebDAV Server**  
★★★★★5

WebDAV Server with Git versioning




**Uptime Kuma**  
★★★★★5

Self-hosted monitoring tool like "Uptime Robot"



**NetBox**  
★★★★★5

Infrastructure resource modeling application




**WiFiMon**  
★★★★★0

Wireless Crowdsourced Performance Monitoring and...




**Zabbix**  
★★★★★0

Enterprise-class monitoring solution for networks and applications



**SPA**  
★★★★★0

SPA for the E-Line service



**Healthchecks**  
★★★★★0

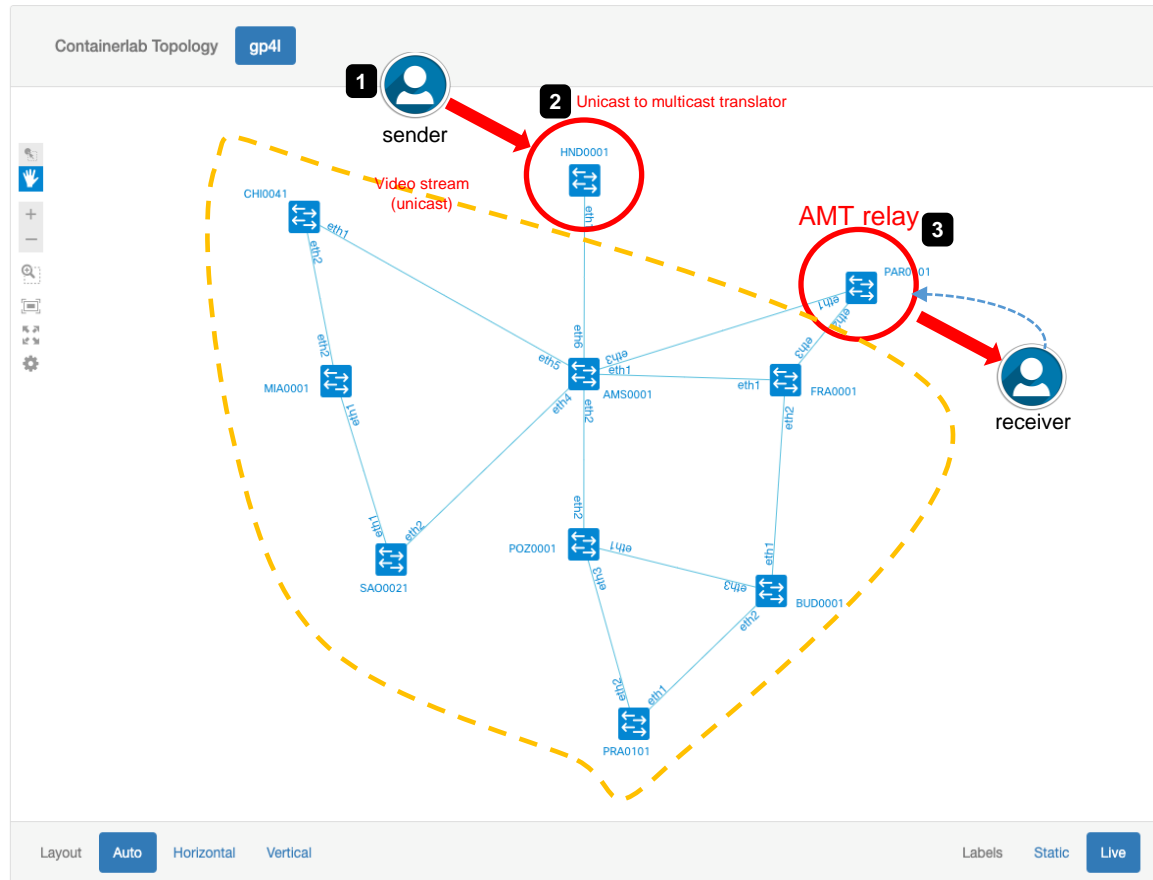
A cron monitoring tool

kubernetes  
inside

# GP4L usage: Network experiment → Multicast with **RARE!**

- 1- BIER MPLS core
- 2- AMT-relay  
(AMT=Automatic Multicast Tunnel)
- 3- Unicast → Multicast translator
- 4- Can you guess the missing piece of the puzzle ?

**(S,G) advertisement !  
(Application software?)**



# GP4L usage: Network experiment → Multicast with **RARE** !

```

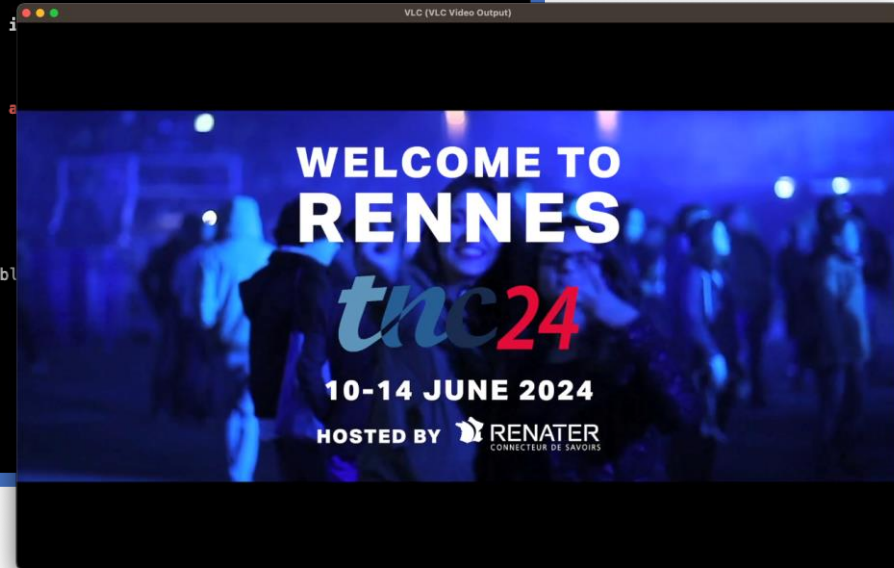
PAR0101#show ipv4 nat CLEARNET translations
original
proto source target translated source target age last timeout pack byte
17 62.40.109.125 34831 62.40.109.31 2262 62.40.109.31 57453 232.123.41.49 1234 14:49:53 00:00:00 00:01:00 17750667 20732779056
17 62.40.109.125 42455 62.40.109.31 2262 62.40.109.31 58916 232.123.41.49 1234 14:49:53 00:00:00 00:01:00 44792394 52317516192
17 62.40.109.125 54017 62.40.109.31 2262 62.40.109.31 58946 232.123.9.30 1234 14:49:53 00:00:00 00:01:00 95777049 111867593232
17 62.40.109.125 58920 62.40.109.31 2262 62.40.109.31 61381 232.123.97.117 1234 14:49:53 00:00:00 00:01:00 30054341 35103470288
  
```

Multicast (S,G)

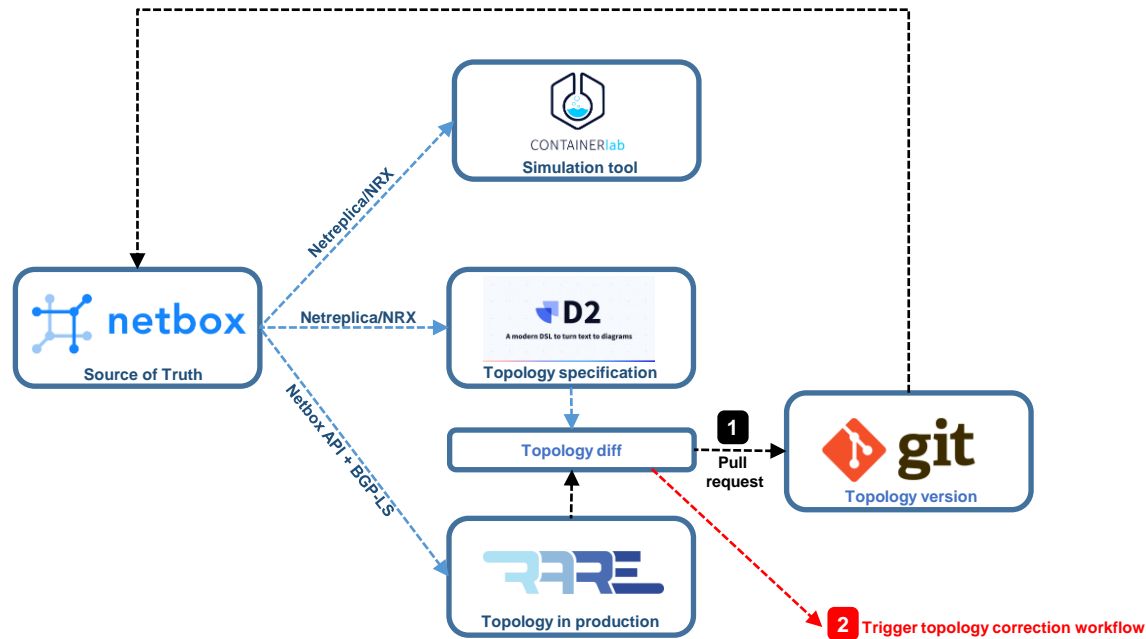
AMT-relay

```

> vlc amt://62.40.109.31@232.123.41.49:1234 --amt-relay 62.40.109.31
VLC media player 4.0.0-dev-Otto-Christ (revision 4.0.0-dev-21200-g774142361a)
[000060000051c000] main libvlc: Running vlc with the default interface. Use 'cvlc' to use vlc without i
[00006000010280c0] bonjour services discovery: starting discovery
[0000600001018d80] upnp services discovery: Initializing libupnp on 'utun3' interface
[0000600001021260] main services discovery error: cannot join multicast group: Invalid argument
[0000600001021260] main services discovery error: cannot join multicast group: Can't assign requested a
[0000600001021260] main services discovery error: cannot join multicast group: Invalid argument
[0000600001021260] main services discovery error: cannot join multicast group: Invalid argument
[0000600001021260] main services discovery error: cannot join multicast group: Invalid argument
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[0000600001021260] main services discovery error: cannot join multicast group: Invalid argument
2023-09-07 12:09:00.941 VLC[21907:808725] Warning: Column selection is not supported in view-based tabl
00>).
2023-09-07 12:09:01.137 VLC[21907:808725] Can't find app with identifier com.apple.iTunes
[0000600000d0df80] amt access error: Native multicast receive time-out
2023-09-07 12:09:05.906 VLC[21907:808725] Can't find app with identifier com.apple.iTunes
[000060000054b840] window_macosx window: using the macOS new video output window module
[00007f892a80aa00] videotoolbox decoder: Using Video Toolbox to decode 'h264'
[00007f892a80aa00] main decoder error: buffer deadlock prevented
[00007f892a80aa00] videotoolbox decoder: Using Video Toolbox to decode 'h264'
  
```



## GP4L usage: Tools conception “around” the network ecosystem – Digital twin



Via GP4L Automation & Orchestration

# GP4L Orchestration: The Goal

Orchestrate different components of the GP4L management environment in a user transparent way

User actions in one management tool trigger automated reactions in other tools/systems/devices

User does not need to do anything other than essential actions

# Automation & Orchestration Use Case

User keeps inventory up-to-date  
= Single Source of Truth

- Essential information for all GP4L devices

Auto devices' health monitoring

Auto network device configuration backup



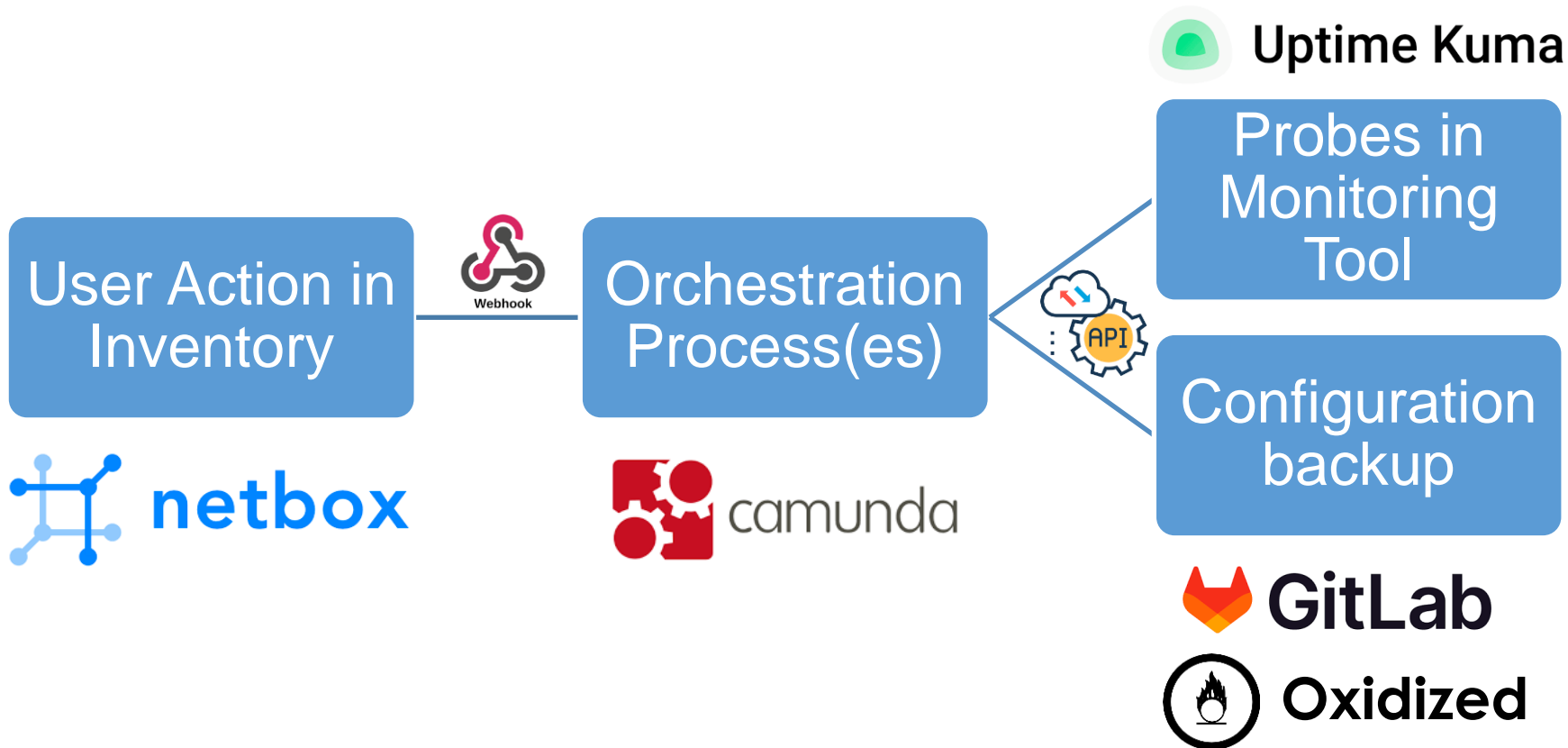
Keep track of any subsequent device changes

Retain history whenever possible



Delete / deactivate = pause

# Use Case Tools





# Relevant device information in NetBox

The screenshot displays the NetBox web interface for a specific device, **GP4L-AMS-01**. The interface is dark-themed and includes a sidebar on the left with navigation options like Organization, Devices, and Connections. The main content area is divided into several sections:

- Device Information:** Shows the device name **GP4L-AMS-01** (highlighted with a red box), creation and update timestamps, and tabs for Device, Interfaces (1), Config Context, Render Config, Contacts, Journal, and Changelog.
- Device Details:** A table listing various attributes such as Region, Site (GEANT), Location, Rack, Position, Tenant, Device Type (siemens 234 (1U)), and Description.
- Management:** Displays the device's status as **Active** (highlighted with a red box), its role as **router**, and its platform as **—**. It also lists the **Primary IPv4** address as **172.16.26.151** (highlighted with a red box) and the **Primary IPv6** address as **—**.
- Tags:** A section showing two tags: **oxidized:group:wedge-bf100-32x** and **oxidized:model:rare** (highlighted with a red box).
- Services:** A table with columns for Name, Parent, Protocol, Ports, and Description, currently showing no services found.
- Images:** A table with columns for Content type, Parent, Image, Name, Size (bytes), and Created, currently showing no image attachments found.

The interface also features a search bar at the top right, a user profile dropdown for 'admin', and action buttons for '+ Add Components', 'Clone', 'Edit', and 'Delete'.

# Tracking User Actions

Add new  
device/interface

Change  
device/interface  
properties

Remove  
device/interface

# Uptime Kuma information synchronisation

The screenshot displays the Uptime Kuma interface, divided into two main sections: a device list on the left and a detailed monitor view on the right.

**Left Panel: Devices**

Search: [Search] | All Objects [Filter] [Search] | admin [Dropdown]

Buttons: + Add, Import, Export, + Add New Monitor

Results: 5 | Filters

Quick search: [Input] | Configure Table [Icon]

Name	Status	Tenant	Site	Location	Rack	Role	Manufacturer	Type	IP Address	Actions
GP4L-AMS-01	Active	—	geant	—	—	router	siemens	234	194.149.137.199/24	[Edit] [Delete]
GP4L-PAR-01	Active	—	geant	—	—	router	siemens	234	—	[Edit] [Delete]
GP4L-PAR-02	Active	—	geant	—	—	router	siemens	234	194.149.137.199/24	[Edit] [Delete]
GP4L-POZ-01	Offline	—	geant	—	—	router	siemens	234	140.82.121.4/32	[Edit] [Delete]
GP4L-POZ-02	Active	—	geant	—	—	router	siemens	234	83.97.93.30/32	[Edit] [Delete]

Per Page [Dropdown] | Showing 1-5 of 5

Buttons: + Add Components, Edit Selected, Delete Selected

**Right Panel: GP4L-AMS-01[25]**

Ping: 194.149.137.199

Buttons: Pause, Edit, Delete

Progress: [Progress Bar] | Up

Check every 60 seconds

Ping	Avg. Ping	Uptime	Uptime
(Current)	(24-hour)	(24-hour)	(30-day)
47.5 ms	47 ms	100%	100%

Recent [Dropdown]

Graph: Resp. Time (ms) vs Time

Buttons: Clear Data

Status	DateTime	Message
Up	2023-05-19 10:17:32	

# Uptime Kuma information synchronisation – part 2

The screenshot displays the Uptime Kuma interface with the following components:

- Header:** Search bar, 'All Objects' filter, user 'admin', 'Uptime Kuma' title, 'New Update' button, 'Status Pages', 'Dashboard', and a user profile dropdown.
- Devices Section:**
  - Buttons: '+ Add', '+ Import', '+ Export', '+ Add New Monitor'.
  - Search: 'Quick search' and 'Configure Table'.
  - Table with columns: Name, Status, Tenant, Site, Location, Rack, Role, Manufacturer, Type, IP Address.
  - Table Data:
 

Name	Status	Tenant	Site	Location	Rack	Role	Manufacturer	Type	IP Address
GP4L-AMS-01	Active	—	geant	—	—	router	siemens	234	62.40.99.225/32
GP4L-PAR-02	Active	—	geant	—	—	router	siemens	234	194.149.137.199/24
GP4L-POZ-01	Active	—	geant	—	—	router	siemens	234	—
GP4L-POZ-02	Decommissioning	—	geant	—	—	router	siemens	234	83.97.93.30/32
GP4L-renamed	Active	—	geant	—	—	router	siemens	234	150.254.160.152/32
  - Buttons: '+ Add Components', 'Edit Selected', 'Delete Selected'.
  - Footer: 'Per Page' dropdown, 'Showing 1-5 of 5'.
- Monitor List:**
  - Search bar.
  - GP4L-AMS-01[25]: 100% uptime.
  - GP4L-PAR-02[16]: 3.9% uptime.
  - GP4L-POZ-01[23]: 100% uptime.
  - GP4L-renamed[15]: 0% uptime, marked as 'Down'.
  - GP4L-POZ-02[14]: 100% uptime.
- Monitor Details (GP4L-renamed[15]):**
  - Ping: 150.254.160.152.
  - Buttons: 'Pause', 'Edit', 'Delete'.
  - Status: 'Down' (red button).
  - Check every 60 seconds.
  - Summary Table:
 

Ping	Avg. Ping	Uptime	Uptime
(Current)	(24-hour)	(24-hour)	(30-day)
N/A	N/A	0%	0%
  - Graph: 'Recent' response time graph (0-1.0 ms).
  - Log: 'Clear Data' button, status 'Down', DateTime '2023-05-19 10:31:50', Message: 'PING 150.254.160.152 (150.254.160.152) 56(84) bytes of data. --- 150.254.160.152 ping statistics --- 10 packets transmitted, 0 received, 100% packet loss, time 210ms'.
- Notification:** 'Modified device GP4L-POZ-01' (green bar at the bottom).

# Oxidized information synchronisation

Search  admin

## Devices

+ Add Import Export

Results 5 Filters

Quick search  Configure Table

Name	Status	Tenant	Site	Location	Rack	Role	Manufacturer	Type	IP Address
<input type="checkbox"/> GP4L-AMS-01	Active	—	GEANT	—	—	router	siemens	234	172.16.26.151/24
<input type="checkbox"/> GP4L-PAR-01	Active	—	GEANT	—	—	router	siemens	234	172.16.26.156/24
<input type="checkbox"/> GP4L-PAR-02	Active	—	GEANT	—	—	router	siemens	234	192.168.122.126/24
<input type="checkbox"/> GP4L-POZ-01	Active	—	GEANT	—	—	router	siemens	234	172.16.26.154/24
<input type="checkbox"/> GP4L-POZ-02	Active	—	GEANT	—	—	router	siemens	234	172.16.26.152/24

Per Page  Showing 1-5 of 5

+ Add Components Edit Selected Rename Delete Selected

2023-09-05 15:43 CEST rare-netbox-1069-nmaas-netbox-59868df758-pxcsp (v3.5.2)
















Oxidized Stats Migration

Search in Configs

## nodes /

Show / hide columns Refresh Reload

Show 50 entries Search:

Name	Model	Group	Last Status	Last Update	Last Changed	Actions
GP4L-AMS-01	RARE	wedge-bf100-32x	<span style="color: green;">■</span>	2023-09-05 15:44:42 CEST	unknown	  
GP4L-PAR-01	RARE	wedge-bf100-32x	<span style="color: green;">■</span>	2023-09-05 15:44:47 CEST	unknown	  
GP4L-PAR-02	RARE	wedge-bf100-32x	<span style="color: green;">■</span>	2023-09-05 15:44:53 CEST	unknown	  
GP4L-POZ-01	RARE	wedge-bf100-32x	<span style="color: green;">■</span>	2023-09-05 15:45:01 CEST	2023-09-05 15:45:02 CEST	  
GP4L-POZ-02	RARE	wedge-bf100-32x	<span style="color: green;">■</span>	2023-09-05 15:45:08 CEST	2023-09-05 15:45:10 CEST	  

Showing 1 to 5 of 5 entries

Previous 1 Next

Oxidized v.0.28.0

# Oxidized information synchronisation – part 2

Search  admin

## Devices

+ Add Import Export

Results 5 Filters

Quick search  Configure Table

Name	Status	Tenant	Site	Location	Rack	Role	Manufacturer	Type	IP Address	
<input type="checkbox"/> GP4L-AMS-renamed	Active	—	GEANT	—	—	router	siemens	234	172.16.26.151/24	
<input type="checkbox"/> GP4L-PAR-01	Active	—	GEANT	—	—	router	siemens	234	—	
<input type="checkbox"/> GP4L-PAR-02	Active	—	GEANT	—	—	router	siemens	234	192.168.122.126/24	
<input type="checkbox"/> GP4L-POZ-01	Planned	—	GEANT	—	—	router	siemens	234	172.16.26.154/24	
<input type="checkbox"/> GP4L-POZ-02	Active	—	GEANT	—	—	router	siemens	234	172.16.26.152/24	

Per Page  Showing 1-5 of 5

+ Add Components Edit Selected Rename Delete Selected

2023-09-05 16:13 CEST rare- Modified device GP4L-AMS-renamed

Oxidized Stats Migration Search in Configs

## nodes /

Show / hide columns Refresh Reload

Show 50 entries Search:

Name	Model	Group	Last Status	Last Update	Last Changed	Actions
GP4L-AMS-renamed	RARE	wedge-bf100-32x	<span style="color: green;">■</span>	2023-09-05 16:15:19 CEST	2023-09-05 16:15:20 CEST	
GP4L-PAR-02	RARE	wedge-bf100-32x	<span style="color: green;">■</span>	2023-09-05 16:15:09 CEST	unknown	
GP4L-POZ-02	RARE	wedge-bf100-32x	<span style="color: green;">■</span>	2023-09-05 16:15:14 CEST	unknown	

Showing 1 to 3 of 3 entries

Previous 1 Next

Oxidized v.0.28.0

# Ready, Set, Go!

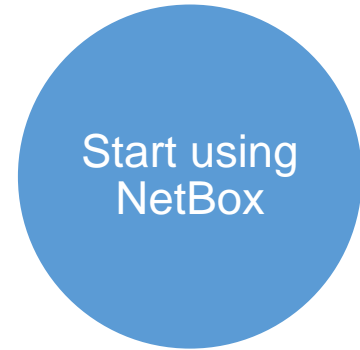


- NetBox
- Oxidized
- Camunda with Uptime Kuma



Orchestration configuration

- API points
- webhooks
- ssh key
- user credentials
- e-mail notifications



synced info in Uptime Kuma and Oxidized

# Get the tools to talk to each other...

Webhooks

Results 2 Filters

Quick search

Name	Object types	Enabled	Create	Update	Delete	Job start	Job end	HTTP method	URL
device-webhook	Device	✓	✗	✓	✓	✗	✗	POST	https://gp4l-orch.rare.nmaas.eu/custom-api/process-notification
ipadress	IP Address	✓	✗	✗	✓	✗	✗	POST	https://gp4l-orch.rare.nmaas.eu/custom-api/process-notification

Per Page

Showing 1-2 of 2

Edit Selected Delete Selected



NMaaS

Applications

Subscriptions

Instances

Domain: RARE -

sonja.filiposka -

CAMUNDA

Installation pro...

Validation Environment

Additional Information

Configuration

Base

Username for the Camunda administrator \*

admin

Password for the Camunda administrator \*

.....

Default Camunda email recipient \*

Send email on create \*

Yes

No

Send email on modify \*

Yes

No

Send email on pause \*

Yes

No

Send email on resume \*

Yes

No

NetBox API URL \*

Cancel

General Camunda

E-mail notifications setup

camunda

Configuration

NetBox API URL \*

https://netbox.example.com

NetBox API token \*

Suggested format: 0123456789abcdef0123456789abcdef01234567

Username for the Uptimekuma web user \*

Password for the Uptimekuma web user \*

Password for the Uptimekuma API \*

Oxidized Git repository URL \*

ssh://...

Email addresses to receive the generated repository access SSH public key \*

example1@example.com, example2@example.com

The name to use for all Git commits created by Camunda \*

The email to use for all Git commits created by Camunda \*

Apply configuration

Cancel

NetBox API

Uptime Kuma GUI & API

Git & Oxidized



## Future work

This use case targets the GP4L admin side

Next: Introduce automation and orchestration for the GP4L users

- Reservation booking process
- Automated monitoring
- Automated configuration handling

**Thank You!**

**Any question or comment? Please contact us at**

[gn5-1-wp6-t2-gp4lab@lists.geant.org](mailto:gn5-1-wp6-t2-gp4lab@lists.geant.org)