The EuroHPC Network from the operations point of view

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SIG-NOC
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Introduction to EuroHPC JU

EuroHPC
Joint Undertaking

- The EuroHPC Joint Undertaking (JU) was created to enable the EU and EuroHPC JU participating countries to coordinate their efforts and pool their resources to make **Europe a world leader in supercomputing**.

- It has already procured **11 supercomputers** across Europe – 3 of these (JUPITER in Germany, LUMI in Finland and Leonardo in Italy) are ranked among the world's top 10 most powerful supercomputers.

- The EuroHPC JU is also overseeing the implementation of **13 AI factories** across Europe and deploying a **European Quantum Computing infrastructure**.

The role of GÉANT

- The EuroHPC JU has signed a contract with GÉANT, to provide ultra-high bandwidth, secure, pan-European, interconnect services for the EuroHPC supercomputing infrastructure.
- Contract value: **€60 million**. Duration: **48 months**.
- The hyperconnected infrastructure expands upon the existing GÉANT network and leverages the reach and expertise of European NRENs. Thanks to major investments such as the GÉANT GN4-3N project, the GÉANT network is uniquely suited to meet the demands of HPC at scale.

Transmission speeds targeted in the terabits-per-second range.

Trusted & Secure architecture for sensitive, cross-border data.

Federated connectivity connecting European, national and HPC centres.

Flexible ecosystem with adaptable services and future-proof technology.

Why it matters

- **Pan-European collaboration**, combining continental reach with national strengths.
- Faster and seamless **access to HPC resources** for researchers across Europe.
- Support to **future innovations and start-ups** with world-class computing power.
- **Pushing existing technology to new limits** to deliver high-capacity monitoring and throughput testing.
- Wider access to include **smaller HPC centres** and new players.
- Access to GÉANT's **global network** across over 65 countries.
- Long-term sustainability to strengthen **Europe's digital sovereignty**.

Milestones

2026

High Level Design (HLD) and HyperConnectivity Service Area (HCSA) *

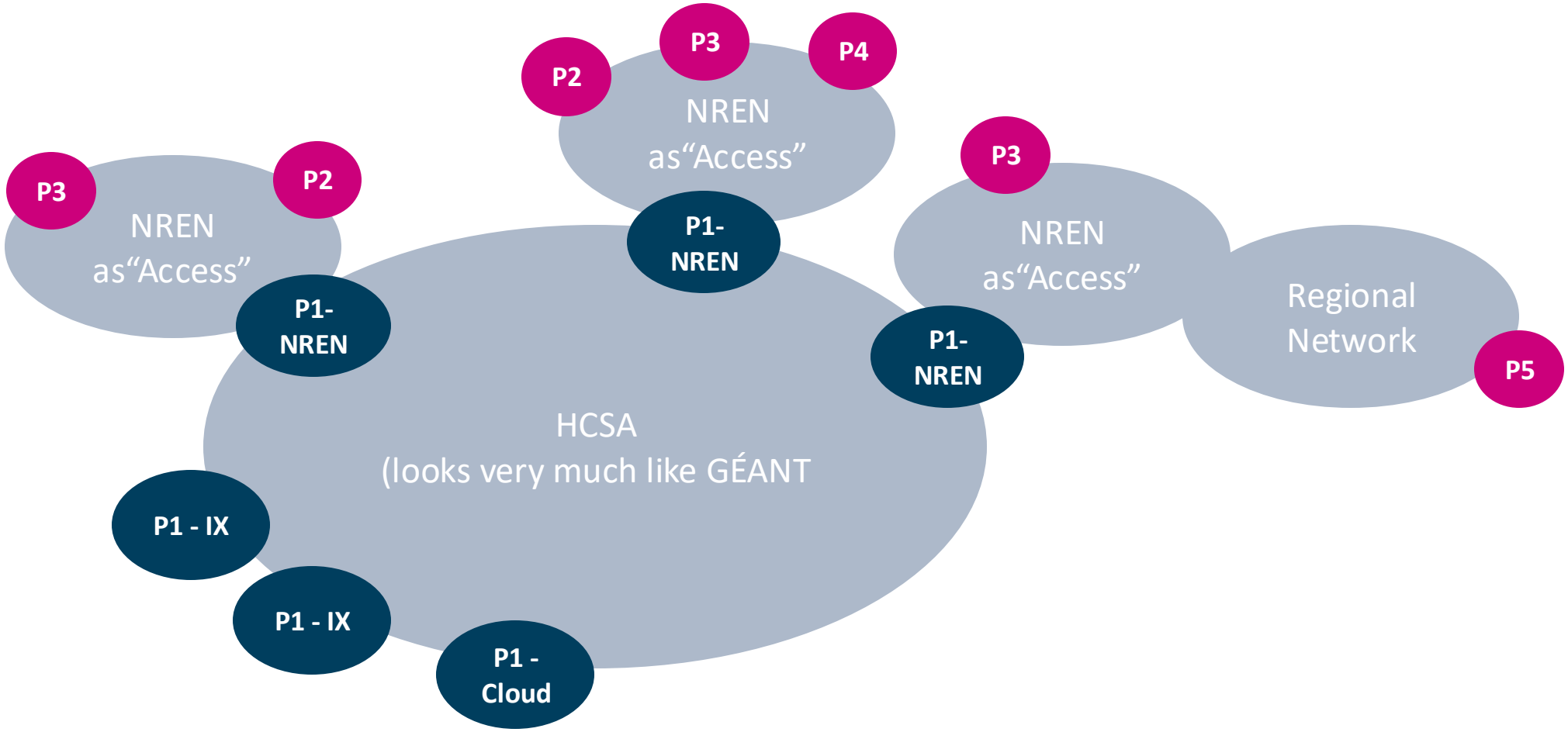
2026 - 2029

Progressive inclusion of Points of Interest (PoIs)

2029

Fully hyperconnected ecosystem in operation

Simple view: The HCSA – Core Network, Access



Service Area and Access – Points of Interest

- **Priority 1:**
  - All NREN connections, IXes, “Cloud parties”
  - **This is the HCSA – this maps onto GÉANT + NREN interconnections**

- **Priority 2:**
  - **Main EuroHPC sites** – connect to HCSA via NRENs
  - Mandatory connection

- **P3/P4 - P5/P6:**
  - P3/P4 – still mandatory connection – typical NREN connected sites
  - P5/P6 - range of sites, quality parameter how much we can connect

Terminology

- HCSA – Hyperconnectivity Service Area, GEANT Backbone, NREN APs, IXes and Cloud Providers.
- Access network – NREN (or direct) downstream interfaces to PoIs.
- PoIs – Points of Interest
  - Priority 1: Hyperconnectivity Service Area (HCSA).
  - Priority 2: EuroHPC hosting sites, including the planned ones.
  - Priority 3: Major European and national HPC centres and data providers from which HPC users retrieve their data, making them of vital importance.
  - Priority 4: Other important national HPC centres and data providers.
  - Priority 5: Small-scale national or regional HPC centres and data providers.
  - Priority 6: Other smaller-scale national or regional HPC centres and data providers.

The first 6 / 8 months – why it's critical

- First 2 months – HLD production – we are about 3 weeks in!
- Next 6 months – deliver HCSA
  - GÉANT core
  - NREN Access Ports
  - IXes
  - Cloud Providers
  - 1 x P2, 1 x P3, 1 x P4 (being identified)
- Demonstrate SLAs, systems and process functionality
- This triggers the main payment

What we've done so far

- Technical working group
- This consisted of key personnel in GEANT and a smaller NREN group
- A questionnaire last year sent to all NRENs
- Produced tender response
- Won the tender
- Work started on HLD
- Held calls with 27 NRENs
- So we now have a good idea of what we can do!

Pre-Implementation Study

- Sent to each PoI by the NREN (the PoI remains the NREN customer)
- Key points:
  - Assessment of the current status
  - Delivery of the required capacity
  - Access profile transition
  - CPE
  - Performance monitoring probe
  - Needs to be complete 4 weeks prior to joining the HCSA

SLAs – Connectivity Availability

- **Definition**: Measures the percentage of time the HCSA is operational and accessible to users.
- **Metric**: A minimum of 99.99% network availability must be required, ensuring the network is available 24/7 with minimal downtime.
- **Monitoring**: Continuous monitoring through the Performance Monitoring Platform to track any disruptions and provide alerts for downtime events.

SLAs – Port Availability

- **Definition**: Measures the percentage of time the access ports of each PoI is operational and are delivering service to end-points.
- **Metric**: A minimum of 99.9% port availability must be required, ensuring that all ports participating in the access profile of each PoI is available 24/7 with minimal downtime.
- **Monitoring**: Continuous monitoring through the Performance Monitoring Platform to track any disruptions and provide alerts for downtime events.

Network Monitoring

- The hyperconnectivity provider is required to continuously monitor the network's health 24x7, ensuring that all aspects of network performance are actively supervised. To support this, the operator must have teams ready to respond to incidents and requests at any time, with responses prioritised according to the severity of events.
- We'll do this as much BAU as possible, getting NREN and PoI stats into BRIAN and utilising Dashboard – this will automatically open an incident ticket and send to affected party, meeting the 20 minute to pick up an incident SLA
- We also ask any events picked up by NRENs are sent to GEANT to open a ticket
- In discussions with NRENs it appears we can use SNMP / ST / API / proxy to get traffic stats and BGP state into dashboard – capacity and incident management
- Priority Matrix already produced according to ITIL

Priority Matrix

		IMPACT		
		High (HPC Centre)	Medium (Country Wide users)	Low (Single User / Local)
URGENCY	High (Service Down)	1 - Critical	2 - High	3 - Moderate
	Medium (Service impacted and usability impaired)	2 – High	3 - Moderate	4 - Low
	Low (Service impacted but still usable)	3 - Moderate	4 - Low	4 - Low

SLAs – Round Trip Time

- **Definition**: Measures the delay experienced in transmitting data from each PoI in the network.
- **Metric**: Latency must be defined in milliseconds (ms) and measured across critical paths. Each member of the network must experience a **maximum 40ms Round Trip Time** to the centre of the network (the PoPs that will host a PMP host i.e. Paris, Frankfurt, Amsterdam, Milan) and **average 15ms** to the nearest hyperconnectivity network aggregation node.
- **Monitoring**: Continuous latency measurements via performance monitoring probes deployed across key PoPs.

SLAs – Packet Loss / Drops

- **Definition**: The percentage of data packets that fail to reach their destination.
- **Metric**: Packet loss must not exceed 0.1% in the part of any communication session that belongs within the Hyperconnectivity Service Area. End points must be key PoPs hosting PMP probes.
- **Monitoring**: Packet loss should be measured at regular intervals, with the specific thresholds triggering alerts for corrective action.

Performance Management Platform - PMP

- **Requirement: Demonstrate performance of the solution**
  - Performance metrics: Round Trip Time, Latency, Jittter, Loss, and **throughput**
  - Requirement: Scheduled and on-demand testing (we are proposing the former)
  - Requirement: Probe should be able to saturate 80% of access link (**!??**)
  - Concept: **End-site probes and centralised analysis tooling**
    - Where: GÉANT POPs (6), 100% P2 (21), 10% P3 (12), 5% P4 (2)

- **Approach: Centralised router stats & packet probes, end-site throughput testers**
  - GÉANT centralised polling of GEANT & NREN routers
  - GÉANT centralised ICMP probes – packet performance stats
  - HPC POI site deployment of perfSONAR servers – throughput primarily
  - HPC POI site deployment of packet blasting hardware testers (if required)

Performance Management Platform - PMP

1. Central Performance Management Platform

- Data acquisition, SNMP/Streaming Telemetry/API integration via:
  - GÉANT and NREN router SNMP/ST/API polling, SNMP traps, BGP state etc.
  - GÉANT-hosted telegraf polling infrastructure
    - ping and traceroute probes targeting HPC <> NREN ptp link IPs – providing RTT, jitter, packet loss
  - HPC POI-hosted PMP probe data
    - perfSONAR servers upto 100G
    - Teledyne LeCroy Xena 1RU hardware testers (or similar)

- Data reporting:
  - BRIAN/Grafana EuroHPC dashboard
    - Traffic stats - HPC access links, NREN access links
    - perfSONAR test stats – throughput, etc.
    - Telegraf ICMP probe stats – GEANT <> HPC end site ping probes, RTT, jitter, loss, etc.
  - MADDASH perfSONAR matrix
  - perfSONAR Toolkit UI / Measurement Archive for detailed analysis and troubleshooting

Performance Management Platform - PMP

2. HPC POI site probes

1. Build on **PerfSONAR** as the basis – some 40 sites could need a probe/server
   - Delivers RTT, latency (OWAMP), jitter, packet loss and ”link saturation” up to 100G
   - Aim to be flexible in how this is delivered (site/NREN/GÉANT can provide)
   - Need to have a central database, maintenance of infrastructure; test data captured in:
     - GÉANT perfSONAR Measurement Archive // pS-specific database
     - GÉANT central InfluxDB // PMP platform database

Performance Management Platform - PMP

2. HPC POI site probes

2. Provide an option for high-capacity link saturation => **dedicated high-capacity test devices** n x 100G, n x 400G

- This is not advisable for many reasons, but can be offered
- Intended only to be used (think DMC challenge):
  - Infrequently
  - Only inside maintenance windows
- Market engagement with Teledyne LeCroy
  - Testers would be suitable for this purpose
  - GUI, CLI, API functionality is good
  - € level requires us to run procurement

TELEDYNE LECROY
Everywhereyoulook™

Reporting

- Quarterly Reports
- Annual Reports
- Dedicated Service Manager to bring this together
- Recruitment for this role has started
- As long as we can get the data into InfluxDB we can then use PowerBi to produce the reports

Reporting


View: Original
Subscriptions
Share
Home
Tickets Report
Network Changes
Long Outages
Availability
IP Avail Summary
Utilisation
Volume
Physical Topology
GÉANT
Network Service Report
Contact Us
Hover mouse cursor over various elements to see more detail. Click on any area to navigate to the more detailed dashboard. Click GEANT logo to return to the home page.
For Topology Maps, log in to https://tools.geant.org/wp-login.php. then scroll down.
For Availability and Utilisaton stats for 2010 to 2021, use https://eu-west-
Network Changes During Nov 2024
• GEANT's connection at DE-CIX in Marseille was upgraded from 20 Gbps to 100 Gbps.
• The IP trunks from Geneva and Madrid to Marseille have been upgraded from 200 Gbps and 300Gbps (respectively) to 400 Gbps.
• PIONIER has new 100 Gbps MWS links from Poznan to Frankfurt, Geneva, and Amsterdam.
• RedIRIS' IP access has been upgraded to 400 Gbps.
• A backup peering with HARNET (Hong Kong) is now live in Amsterdam.
• ESnet has a set of three new 400 Gbps MWS links between Amsterdam, London & Geneva forming a second ring.
• Two new GEANT Plus connection (with a backup) were implemented between SingAREN and RedCLARA for the Quantum Computing at SC24.
IP Access Port Availability
Click a circle to see other products
2023
2024
100
98
96
94
92
90
88
86
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Average NREN traffic
Avg From Peers
Avg To Peers
2.0G
1.5G
1.0G
0.5G
0.0G
Tickets Processed Over Past Year
1000
900
Total IP Traffic Volume in Terabytes
100K
90K
80K

Multilingual Tiered Customer Support

- Given the diverse organisation of the HPC community, the network operator is required to provide a **multilingual, tiered customer support system**. Based on the span of the network services, support should be organised in a distributed manner allowing though a **centralised reporting service** to be available. The first level of support must ideally respond in the **local language of the member seeking assistance, with English, French or German offered as a universal alternative. Escalation to more advanced Network Operations Centre (NOC) layers must be provided to ensure complex issues are handled by specialised teams.** As part of his offer, the tenderer must include a detailed description of the Customer Support scheme that will be provided to the Hyper Connectivity network, ensuring the that his solution provides culturally relevant assistance at the initial level, while maintaining the flexibility to handle more complex issues in a universally understood language.

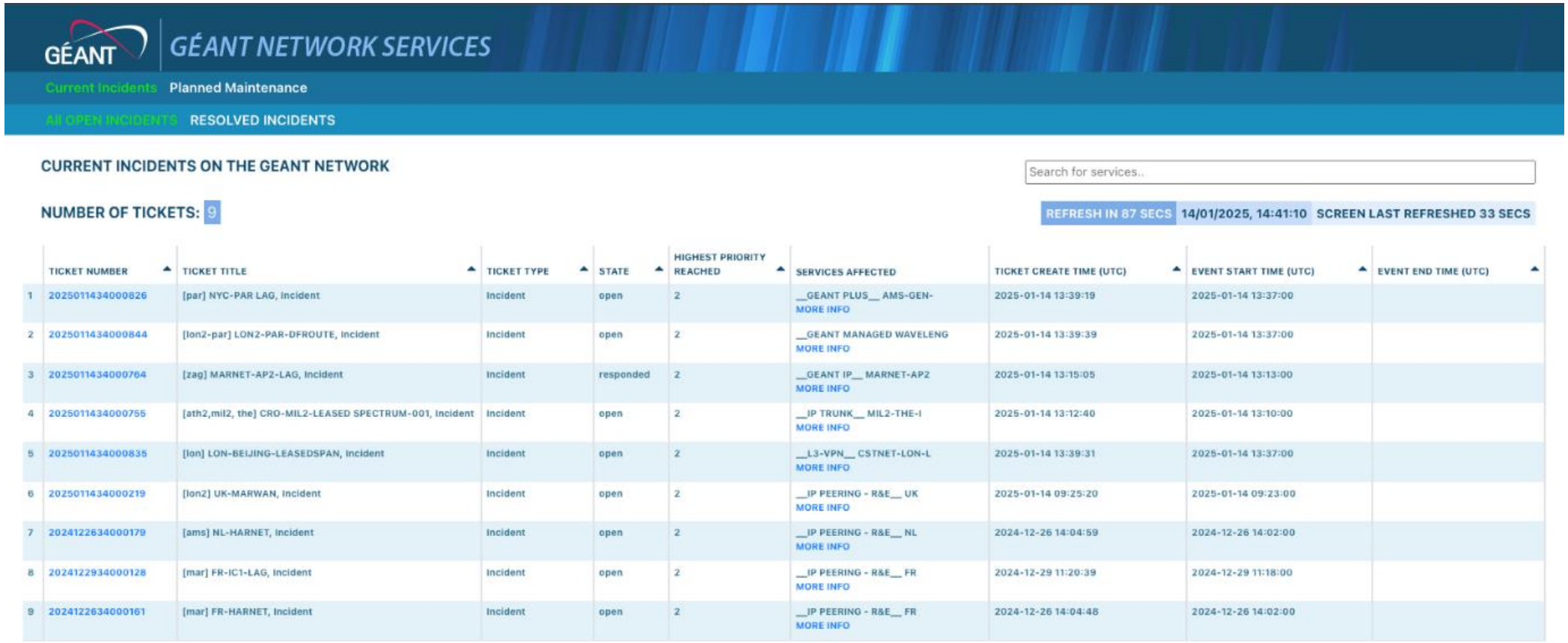
Multilingual Tiered Customer Support

- Keep this as BAU as possible
- This will ensure local language, culture, existing relationship
- Some NRENs have 24 x 7, some BAU with on-call
- These are NREN customers, we don’t expect anything to change
- We will have the GEANT OC for Critical incidents
- The tender was written with the NRENs and GEANT in mind so this shouldn’t be problem
- The JU has in early discussions stated they wish to work with us all to make this work!!

Incident Management Environment

- The hyperconnectivity provider is required to provide a comprehensive incident management environment where PoI's technical teams, Service Managers, EuroHPC JU representatives, or other authorised personnel can report, escalate, and close network incidents. This service must offer a unified user interface (UI) that presents incidents in a stacked row format, allowing users to easily track the status and progression of each incident. The system must facilitate clear communication and efficient management of incidents, ensuring that issues are resolved promptly and transparently. This structured approach to incident management is crucial for maintaining network reliability and user satisfaction.
- This is very wordy and just means they want to see all tickets!!!

Incident Management Environment



GÉANT NETWORK SERVICES

Current Incidents | Planned Maintenance

All OPEN INCIDENTS | RESOLVED INCIDENTS

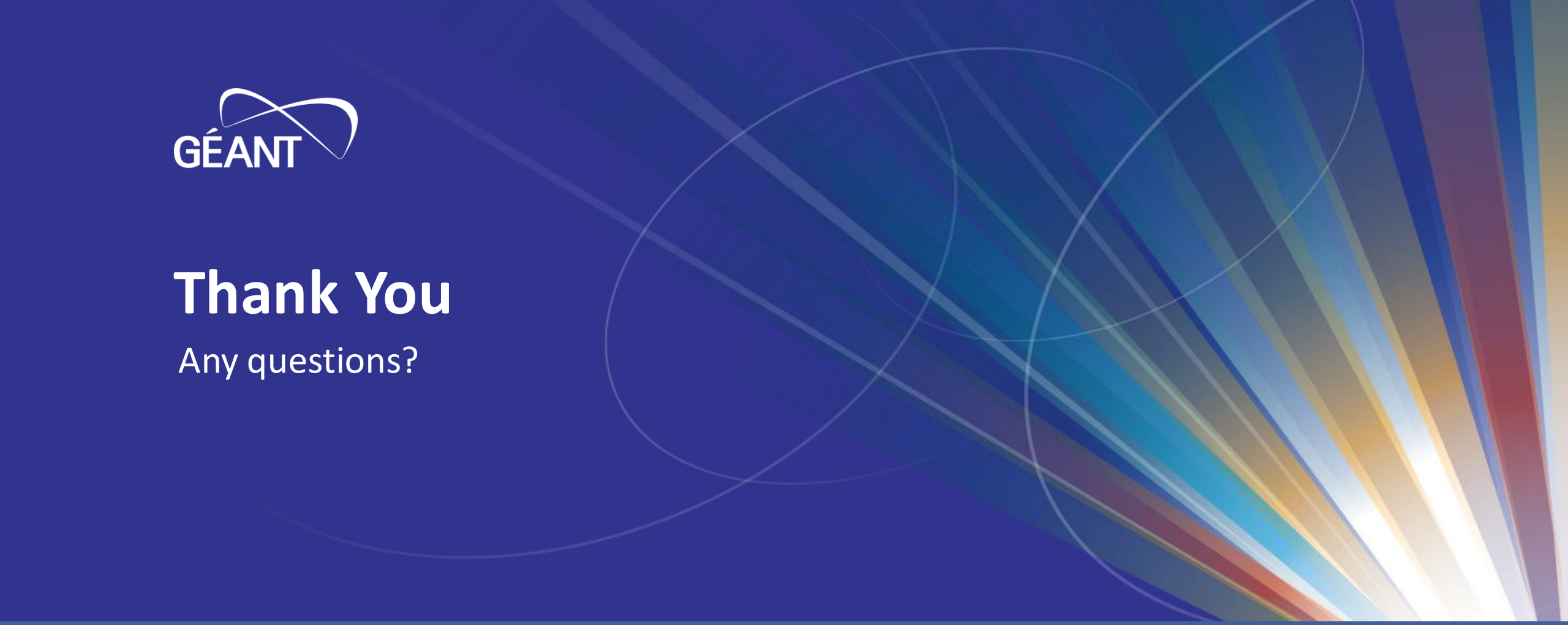
CURRENT INCIDENTS ON THE GEANT NETWORK

Search for services..

NUMBER OF TICKETS: 9

REFRESH IN 87 SECS | 14/01/2025, 14:41:10 | SCREEN LAST REFRESHED 33 SECS

	TICKET NUMBER	TICKET TITLE	TICKET TYPE	STATE	HIGHEST PRIORITY REACHED	SERVICES AFFECTED	TICKET CREATE TIME (UTC)	EVENT START TIME (UTC)	EVENT END TIME (UTC)
1	2025011434000826	[par] NYC-PAR LAG, Incident	Incident	open	2	__GEANT PLUS__ AMS-GEN- MORE INFO	2025-01-14 13:39:19	2025-01-14 13:37:00	
2	2025011434000844	[lon2-par] LON2-PAR-DFROUTE, Incident	Incident	open	2	__GEANT MANAGED WAVELENG MORE INFO	2025-01-14 13:39:39	2025-01-14 13:37:00	
3	2025011434000764	[zag] MARNET-AP2-LAG, Incident	Incident	responded	2	__GEANT IP__ MARNET-AP2 MORE INFO	2025-01-14 13:15:05	2025-01-14 13:13:00	
4	2025011434000755	[ath2,mil2, the] CRO-MIL2-LEASED SPECTRUM-001, Incident	Incident	open	2	__IP TRUNK__ MIL2-THE-I MORE INFO	2025-01-14 13:12:40	2025-01-14 13:10:00	
5	2025011434000835	[lon] LON-BEIJING-LEASEDSPAN, Incident	Incident	open	2	__L3-VPN__ CSTNET-LON-L MORE INFO	2025-01-14 13:39:31	2025-01-14 13:37:00	
6	2025011434000219	[lon2] UK-MARWAN, Incident	Incident	open	2	__IP PEERING - R&E__ UK MORE INFO	2025-01-14 09:25:20	2025-01-14 09:23:00	
7	2024122634000179	[ams] NL-HARNET, Incident	Incident	open	2	__IP PEERING - R&E__ NL MORE INFO	2024-12-26 14:04:59	2024-12-26 14:02:00	
8	2024122934000128	[mar] FR-IC1-LAG, Incident	Incident	open	2	__IP PEERING - R&E__ FR MORE INFO	2024-12-29 11:20:39	2024-12-29 11:18:00	
9	2024122634000161	[mar] FR-HARNET, Incident	Incident	open	2	__IP PEERING - R&E__ FR MORE INFO	2024-12-26 14:04:48	2024-12-26 14:02:00	



Thank You

Any questions?

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