# The EuroHyPerCon Study: **Towards hyperconnectivity for HPC resources**

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# O EuroHyPerCon







### **EuroHyPerCon fact sheet**

- **Title:** Study for **hyper-connectivity** for HPC resources
- Funding: EuroHPC JU (LC-02450379)
- **Runtime:** 5 October 2023 4 July 2024 (9 months) • May be extended
- · Partners
  - Innov-Acts (SME/e-Infrastructures)
  - HLRS (Major HPC centre)
  - Enomix (SME/connectivity + policies)
- Website: https://eurohypercon.eu/









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Slide 2



### **EuroHyPerCon Study scope**

- · **Objective:** EU HPC hyper-connectivity service specification, laying out an HPC and data infrastructure
- Focus: Requirements analysis & network/services design

**Comprehensive Needs and Services Analysis** 

- Engage with communities
- Covering various facets such as traffic, capacity, availability, network architectures, security/privacy, and the evolution of technology





# implementation roadmap for a secure, federated, and hyper-connected European

**Forward-Looking Solutions** 

• Aim to accommodate new usages related to scientific instruments and AI, with progressive and flexible solutions to adapt to evolving data traffic needs and changing use cases



# **Tender proposed approach for EU Hyper-Connectivity**

As outlined in the tender specifications:

- Leveraging GÉANT & NRENs' Networks
  - Leveraging GÉANT and National Research and Education Networks (NRENs) for HPC hyper-connectivity solutions
- **Complementary Connectivity** 
  - Align with ongoing European activities, like the GN5-FPA, to address • untargeted HPC-specific needs without redundancy
- Federation Interoperability
  - Ensure compatibility and interoperability for future HPC infrastructure federation, considering ties to EU initiatives (e.g., Cloud Federation, DestinE, Human Brain Project, EOSC, European Common Data Spaces)
- **Collaborative Study Approach:** 
  - Conduct the study closely with EuroHPC hosting sites, HPC stakeholders, and connectivity players (GÉANT/NRENs) for comprehensive insights and seamless coordination

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### **Study methodology**



27/5/2024

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Project Management

Slide 6

### **Stakeholders Identification**





### **HPC Providers**

- **EuroHPC** Hosting Sites
- Other EU / National HPC systems

### **HPC Users**

- Thematic users of the HPC systems
- Big users (e.g., DestinE (ECMWF, EUMETSAT, ESA), CERN, etc.)
- Other users









### **Network Providers**

- GÉANT
- NRENs and regional research networks
- Other connectivity providers

**Data Providers and AI** Users -**Other Stakeholders** 

- Data providers (e.g., ESFRI & Other RIs, EU Data Spaces)
- Al users
- Online Registration Form

# **Activities performed**

### Methodology being executed as planned •

### **Workshops** – There was high interest

- Stakeholder Identification and User Journeys 30 October 2023 •
- <u>Feedback from HPC users and providers</u> 22 November 2023
- <u>Feedback from network providers</u> 27 November 2023
- **Focus-Groups/Interviews** •
  - Focus group with Exascale & Pre-exascale network providers 18 December 2023
  - Interview with Destination Earth/ECMWF 18 December 2023 •
  - <u>Meeting with EuroHPC JU and GÉANT 11 January 2024</u>
  - Focus group with Exascale & Pre-Exascale HPC providers 5 February 2024
  - Interview with Destination Earth/ECMWF-EUMETSAT-ESA 9 February 2024
  - Interview with Destination Earth/EUMETSAT 1 March
  - <u>Focus group meeting with AI users</u> 12 March 2024 •
- - EuroHPC Hosting sites, EU/National HPC Providers ~ 165 (345 systems)
  - HPC Users (~175)
  - Data Providers (~130)
  - Al stakeholders (~30)
  - <u>Geo-location information</u> for some of the stakeholders (GIS-enabled)



### **Development of EuroHyPerCon stakeholders' database ~ 500 stakeholders** (680 entries)

# **Stakeholders population density - HPC providers/users**



### EuroHyPerCon $\bigcirc$

# **Stakeholders mapping – Nautobot tool (1)**

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Register as stakeholder: <u>t.ly/e5FE8</u>

# **Stakeholders mapping – Nautobot tool (2)**

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### Register as stakeholder: <u>t.ly/e5FE8</u>

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### **Stakeholders mapping – Nautobot tool (3)**

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Register as stakeholder: <u>t.ly/e5FE8</u>

### **Stakeholders mapping – Nautobot tool (4)**



### Register as stakeholder: <u>t.ly/e5FE8</u>





### **EuroHyPerCon questionnaires**

- Questionnaires now closed  $\rightarrow$  165 full responses (>400 partial, not all useful) ٠
  - HPC Users: 111 •
  - **HPC Providers: 32** •
  - **Network Providers: 22** •
- •
- Questionnaires remained open until the end of March Now closed! •

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Initial deadline in January (first phase) – More inputs received, e.g. Al stakeholders (iterative approach)

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# **Questionnaires' analysis – Work in progress**

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- Feedback from users' questionnaires show national and pan-European needs Considerable cross-border needs only for operational EuroHPC hosting sites •
- Some active countries have more responses •
- Some countries could have benefited from more answers •
- Additional inputs from all other means (workshops, interviews, focus groups, etc.) Inputs are analysed and cross-checked – Final phase of analysis •



# Users Questionnaires – Some statistics (1/2)

### **Type of HPC usage - Now**



### HPC usage timeframe



### Type of HPC usage - 2030



### Amount of resources used





### **Security requirements?**



### Most data transferred...



# Users Questionnaires – Some statistics (2/2)

### Data size



Data size growth (%) 2025-2028-2030+







### Data transfer times



### Satisfied with data transfer times?



Some of the challenges: Local network, policies limiting bandwidth usage, routing rules, storage capacity limitations at HPC centre, security/firewalls/ssh connection failures

# **Summary of preliminary findings**

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### Multiple inputs from several workshops, focus groups, interviews and questionnaires:

- Users are satisfied by services provided by **GÉANT & NRENs** •
- x 400 Gbps and then Tbps levels;
  - GÉANT: Soon 400Gbps for backbone/user access
  - Main issues on accessing & uploading/downloading data to/from HPC Providers
    - **Security** related aspects: SSH access may affect network performance
    - •
    - Majority of users request national HPC resources / some pan-European
    - Pan-European requirements can be mostly satisfied by GÉANT •
    - solutions→ <u>A bespoke solution may be required</u>



The majority of NRENs & GÉANT ready to upgrade access and backbone links reaching n

Different levels of security/practices across sites  $\rightarrow$  harmonization needed

**DestinE:** champion user/data provider: Data infrastructure deploying commercial

# Way forward

- countries and also having global reach
  - Adaptation to HPC needs, upgrades when needed, evolution over time •
  - 400Gbps, etc.)
  - Over the top services (NOC/user support/helpdesk, transport security, etc.) •
- **Bespoke solutions for big users/data providers** (e.g. DestinE) •
- ullet
  - looking high-throughput exchange of data.
- <u>Aim for "as a service" solution; outsource to network providers;</u> •
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**End-to-end** solution for EuroHPC, spanning panEuropean+national segments (to reach HPC sites): Leverage GEANT / NRENs that could meet the vast requirements, currently reaching all

Plain IP service: Class-based access ports (e.g. Class A 400Gbps to 1Tbps, Class B 200Gbps to

**<u>Connect external Cloud providers:</u>** Commercial (Amazons)/user-deployed (Nextclouds)

Peerings with major cloud providers needed in relevant locations with ample capacity to facilitate forward-

EuroHPC JU will need to only oversee; no need for an internal network management team;

**Integrated connectivity service provision** - From HPC Providers to an EuroHPC Ecosystem!

Homogenized services/practices across HPC sites: Common access/methods for upload/download data, VPN/encryption services; This will enhance user experience!  $\rightarrow$  Input to Federation call project

# **Hypothesis validation: Techno-economic analysis of different solutions**

### **Approach A - GÉANT / NRENs**

- <u>Upgrade access speeds of ~80-100 HPC systems / ~80-100 Data Providers</u> •
- Need cost info about <u>access upgrades from a good sample of NRENs (East/West,</u> • North/South, big/medium/small) and backbone upgrades from GEANT
  - CAPEX (Upgrade access cards/equipment/links and backbone cards/equipment/links) and • OPEX (New personnel needed, extra energy for the new equipment, etc.)
    - For both the Optical (layer 1) and IP/MPLS layers (Layers 2/3)
- Cost evolution: 2025, 2028, 2030+

→ Proposed approach: Incremental cost based on GÉANT and sample of NRENs (compared to 2024 status)

### **Approach B - IP transit service from commercial providers**

- IP transit interconnecting a set of end points: •
  - ~165 HPC systems / ~130 Data Providers / ~60 Internet Exchange Points
- Based on recent procurement prices (industry benchmarks) Telegeography.c •
- Inspired by the current DestinE model (which is based on a commercial provider)
- Cost evolution: 2025, 2028, 2030+
- Commercial Service based on IP transit + Local Loops (e.g. DWDM / Metro Ethernet)  $\rightarrow$
- **Technical analysis for both solutions to run in parallel**

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### **Conclusions and Next steps**

- Stakeholders' identification performed •
  - Surveys closed •
- Needs analysis submitted for comments from the EuroHPC JU •
- Proceeding with Gap analysis (from current solutions, i.e. GEANT/NRENs) •
- Then alternative solutions design •
  - Techno-economic analysis ongoing
- innovation, security, impact.
- Validation workshops •
  - One online with NRENs on Wednesday •



Proceed with technical assessment: fitness for purpose, performance, support for



More info

- <u>https://eurohypercon.eu</u> (surveys, stakeholder • registration form, summary of workshops)
- info at eurohypercon . eu •
- surveys at eurohypercon . eu

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Thank you!