[EuroHyPerCon](https://eurohypercon.eu/), funded by the [European High Performance Computing Joint Undertaking](https://eurohpc-ju.europa.eu/index_en) (EuroHPC JU), is conducting a pivotal study on the hyper-connectivity of High-Performance Computing (HPC) resources. This study, in line with the strategic objectives of EuroHPC JU, aims to examine the connectivity requirements of international and national HPC systems across Europe. Our goal is to design a robust, future-proof connectivity service, including a detailed implementation roadmap.

The anticipated outcome of this study is a thorough analysis of the connectivity needs among EuroHPC systems, encompassing other significant European and national supercomputing and data infrastructures. We aim to understand the dynamics between these systems and their potential or future users, exploring the user landscape, available technologies, and service providers. Additionally, the study will offer insights into implementation strategies, detailing the service offerings, network architecture, implementation tools, and budget considerations. Ultimately, the study will present detailed specifications for the selected network design.

To achieve these objectives, we have developed three targeted questionnaires for different stakeholders: [HPC users](http://surveys.eurohypercon.eu/788866), [HPC providers](https://surveys.eurohypercon.eu/727227), and [network providers](http://surveys.eurohypercon.eu/283724) (the one you are now browsing). We are also engaging in various other forms of data collection, such as interviews with major users, focus groups, and a series of workshops.

We greatly appreciate your time and valuable contributions to this survey. Your input is crucial in shaping the future of HPC connectivity in Europe.

For further information or any clarifications, please feel free to reach out to us at surveys@eurohypercon.eu.

**GDPR Statement:**

EuroHyPerCon is committed to safeguarding the personal data that will be collected via its surveys and other instruments, applying data protection rules in line with the General Data Protection Regulation (GDPR), as well as with corresponding national data protection regulations. In particular, EuroHyPerCon may collect non-sensitive personal information from the survey participants such as first and last name (optional), business-email, affiliation, role, country, and related projects, along with other information relevant to the provision or usage or services related to HPC sites. The information entered by the participants are stored in the LimeSurvey related electronic systems in Germany according to its related [Privacy policy](https://www.limesurvey.org/privacy-policy). An agreement between LimeSurvey and EuroHyPerCon has been prepared following the rules for EU countries and clients.

The data collected will be processed by the EuroHyPerCon consortium for the sole [objectives of the study](https://eurohypercon.eu/) contracted to the EuroHPC Joint Undertaking (JU). The data will be kept by the consortium for the duration of the study (which will end in 2024). Participants who would like to remove their data can contact us at the information below. In general, no individual data will be published. Public presentations and a public report at the end of the study may be provided aggregating and summarising technical only related data, in particular for the design of the network and related services. In case of significant requirements from big users that may require special links and services, their consent will be requested for publishing their data. EuroHyPeCon may be asked to share some data also with its contracting authority (EuroHPC JU) (see [EuroHyPerCOn Privacy Policy](https://eurohpc-ju.europa.eu/privacy-policy_en#:~:text=The%20EuroHPC%20JU%20processes%20personal,free%20movement%20of%20such%20data.)).

Data Controller: [EuroHyperCon](https://eurohypercon.eu/partners/), surveys@eurohypercon.eu. Contact persons: Fotis Karayannis, Innov-Acts, project coordinator and Dimitrios Kalogeras, Enomix.

**Section A: Contact Details**

A1. Please provide us with your contact details:

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First Name (optional) Last Name (optional) E-Mail (Mandatory) Country (Mandatory)

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Affiliation (Mandatory) Role (Mandatory)

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Contact Details of your Institution, if different (Mandatory)

**Section B: About Users/HPC centres**

We are collecting information regarding the HPC Users and Centers that you serve so as to understand sizing and nature of involvement).

B1. 1a. At which HPC centres does your Institution provide services to? HPC Centre 1

Name of HPC Centre

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HPC category (EuroHPC JU hosting site, Other national site, Other: please describe)

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B2. 1b. At which HPC centres does your Institution provide services to? HPC Centre 2

Name of HPC Centre

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HPC category (EuroHPC JU hosting site, Other national site, Other: please describe)

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B3. 1c. At which HPC centres does your Institution provide services to? HPC Centre 3

Name of HPC Centre

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HPC category (EuroHPC JU hosting site, Other national site, Other: please describe)

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B4. 1d. At which HPC centres does your Institution provide services to? HPC Centre 4

Name of HPC Centre

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HPC category (EuroHPC JU hosting site, Other national site, Other: please describe)

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B5. 1e. At which HPC centres does your Institution provide services to? HPC Centre 5

Name of HPC Centre

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HPC category (EuroHPC JU hosting site, Other national site, Other: please describe)

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B6. 2a. Name the most important HPC users or Data providers that your institution serves: HPC User 1

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Name of HPC User/ Data provider

Short Description

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B7. 2b. Name the most important HPC users or Data providers that your institution serves: HPC User 2

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Name of HPC User/ Data provider

Short Description

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B8. 2c. Name the most important HPC users or Data providers that your institution serves: HPC User 3

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Name of HPC User/ Data provider

Short Description

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B9. 2d. Name the most important HPC users or Data providers that your institution serves: HPC User 4

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Name of HPC User/ Data provider

Short Description

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B10. 2e. Name the most important HPC users or Data providers that your institution serves: HPC User 5

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Name of HPC User/ Data provider

Short Description

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B11. 3a. Do you serve or plan to serve commercial R&D users?

No

Yes - We serve/plan to serve SMEs

Yes - We serve/plan to serve large-companies/industrial sector only

Yes - We serve/plan to serve any kind of private company

Yes - We serve/plan to serve some private companies under special conditions

B12. 3b. Do the industrial users have special requirements that called for a change in your connectivity strategy (VPNs/secure tunnels, Private 5G etc.)? Please describe:

B13. 3c. Do you have special requirements in order to serve industrial users?

**Section C: HPC specific Infrastructure & Services**

EuroHPC-JU would like to know the breadth and depth of services which cater to the HPC community.

C1. 4a. Please provide details on the connectivity services of the HPC centres you are providing services to: HPC Centre 1

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Name of HPC Centre Service Description (IP, L2-VPN, L3-VPN, ...)

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Bandwidth

MTU (L2\_MTU/L3\_MTU)

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High Availability/Redundancy (e.g. single access-single home or dual access

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dual home etc)

C2. 4a. Please provide details on the connectivity services of the HPC centres you are providing services to: HPC Centre 2

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Name of HPC Centre Service Description (IP, L2-VPN, L3-VPN, ...)

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Bandwidth

MTU (L2\_MTU/L3\_MTU)

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High Availability/Redundancy (e.g. single access-single home or dual access

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dual home etc)

C3. 4a. Please provide details on the connectivity services of the HPC centres you are providing services to: HPC Centre 3

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Name of HPC Centre Service Description (IP, L2-VPN, L3-VPN, ...)

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Bandwidth

MTU (L2\_MTU/L3\_MTU)

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High Availability/Redundancy (e.g. single access-single home or dual access

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dual home etc)

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| **C4. 4a. Please provide details on the connectivity services of the HPC centres you are providing services to: HPC Centre 4**Name of HPC Centre Service Description (IP, L2-VPN, L3-VPN, ...)BandwidthMTU (L2\_MTU/L3\_MTU)High Availability/Redundancy (e.g. single access-single home or dual accessdual home etc) |
| **C5. 4a. Please provide details on the connectivity services of the HPC centres you are providing services to: HPC Centre 5**Name of HPC Centre Service Description (IP, L2-VPN, L3-VPN, ...)BandwidthMTU (L2\_MTU/L3\_MTU)High Availability/Redundancy (e.g. single access-single home or dual accessdual home etc) |
| **C6. 4b. What other connectivity services are you offering?** |
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| **C7. 5a. Please provide details on special connectivity services for the HPC Users or Data Providers you are providing services to: HPC user / data provider 1***EuroHPC-JU would be able to have a rough estimate of the terminating technology and cost.*Name of HPC user/data providerCustom connectivity L1 solution (lambda, CWDM, to address this request).Pls use textbox in question 5b to elaborate.Solution addressing security concerns (e.g. Wireguard, DDoS protection, Firewalling, IPsec VPN etc.). Pls use textbox in question 5b to elaborate.Overlay VPN solution (L3VRF, L2-VPLS, etc.). Pls use textbox in question 5bto elaborate. |
| **C8. 5a. Please provide details on special connectivity services for the HPC Users or Data Providers you are providing services to: HPC user / data provider 2***EuroHPC-JU would be able to have a rough estimate of the terminating technology and cost.* |
| Name of HPC user/data provider |  |  |
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Custom connectivity L1 solution (lambda, CWDM, to address this request).

Pls use textbox in question 5b to elaborate.

Solution addressing security concerns (eg Wireguard, DDoS protection, Firewalling,IPsecVPN etc). Pls use textbox in question 5b to elaborate.

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Overlay VPN solution (L3VRF, L2-VPLS, etc). Pls use textbox in question 5b

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to elaborate.

C9. 5a. Please provide details on special connectivity services for the HPC Users or Data Providers you are providing services to: HPC user / data provider 3

*EuroHPC-JU would be able to have a rough estimate of the terminating technology and cost.*

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Name of HPC user/data provider

Custom connectivity L1 solution (lambda, CWDM, to address this request).

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Pls use textbox in question 5b to elaborate.

Solution addressing security concerns (eg Wireguard, DDoS protection, Firewalling,IPsecVPN etc). Pls use textbox in question 5b to elaborate.

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Overlay VPN solution (L3VRF, L2-VPLS, etc). Pls use textbox in question 5b

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to elaborate.

C10. 5a. Please provide details on special connectivity services for the HPC Users or Data Providers you are providing services to: HPC user / data provider 4

*EuroHPC-JU would be able to have a rough estimate of the terminating technology and cost.*

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Name of HPC user/data provider

Custom connectivity L1 solution (lambda, CWDM, to address this request).

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Pls use textbox in question 5b to elaborate.

Solution addressing security concerns (eg Wireguard, DDoS protection, Firewalling,IPsecVPN etc). Pls use textbox in question 5b to elaborate.

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Overlay VPN solution (L3VRF, L2-VPLS, etc). Pls use textbox in question 5b

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to elaborate.

C11. 5a. Please provide details on special connectivity services for the HPC Users or Data Providers you are providing services to:HPC user / data provider 5

*EuroHPC-JU would be able to have a rough estimate of the terminating technology and cost.*

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Name of HPC user/data provider

Custom connectivity L1 solution (lambda, CWDM, to address this request).

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Pls use textbox in question 5b to elaborate.

Solution addressing security concerns (eg Wireguard, DDoS protection, Firewalling,IPsecVPN etc). Pls use textbox in question 5b to elaborate.

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Overlay VPN solution (L3VRF, L2-VPLS, etc). Pls use textbox in question 5b

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to elaborate.

C12. 5b. Elaborate here:

**Section D: Connectivity Service Architecture**

We need to collect information on how connectivity services to HPC centers have been realized such as fiber ownership, demarcation points, CPE type of equipment).

D1. 6. Please provide details on the connection/equipment installed at each HPC centers or Big Data providers (e.g. Destination Earth) you are providing services to: HPC Centre 1

*EuroHPC-JU would like to assess the possibility of utilizing a collapsed architecture via daisy-chained L1 or/and L2 technologies where L3 occurs*

*deep in the topology.*

Name of HPC Centre Offered Bandwidth

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Fiber owned operated by: (Accepted response HPC or NREN)

Access L1 technology (DWDM, CWDM, Alien W/L Coherent Optics)

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Max. capacity w/o any upgrade

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|  |

L2 CPE equipment deployed (NO CPE, L1[optical], L2[switch], L3

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[router])

D2. 6. Please provide details on the connection/equipment installed at each HPC centers or Big Data providers (e.g. Destination Earth) you are providing services to: HPC Centre 2

*EuroHPC-JU would like to assess the possibility of utilizing a collapsed architecture via daisy-chained L1 or/and L2 technologies where L3 occurs*

*deep in the topology.*

Name of HPC Centre Offered Bandwidth

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Fiber owned operated by: (Accepted response HPC or NREN)

Access L1 technology (DWDM, CWDM, Alien W/L Coherent Optics)

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Max. capacity w/o any upgrade

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|  |

L2 CPE equipment deployed (NO CPE, L1[optical], L2[switch], L3

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[router])

D3. 6. Please provide details on the connection/equipment installed at each HPC centers or Big Data providers (e.g. Destination Earth) you are providing services to: HPC Centre 3

*EuroHPC-JU would like to assess the possibility of utilizing a collapsed architecture via daisy-chained L1 or/and L2 technologies where L3 occurs*

*deep in the topology.*

Name of HPC Centre Offered Bandwidth

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Fiber owned operated by: (Accepted response HPC or NREN)

Access L1 technology (DWDM, CWDM, Alien W/L Coherent Optics)

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Max. capacity w/o any upgrade

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L2 CPE equipment deployed (NO CPE, L1[optical], L2[switch], L3

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[router])

D4. 6. Please provide details on the connection/equipment installed at each HPC centers or Big Data providers (e.g. Destination Earth) you are providing services to: HPC Centre 4

*EuroHPC-JU would like to assess the possibility of utilizing a collapsed architecture via daisy-chained L1 or/and L2 technologies where L3 occurs*

*deep in the topology.*

Name of HPC Centre Offered Bandwidth

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Fiber owned operated by: (Accepted response HPC or NREN)

Access L1 technology (DWDM, CWDM, Alien W/L Coherent Optics)

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Max. capacity w/o any upgrade

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L2 CPE equipment deployed (NO CPE, L1[optical], L2[switch], L3

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[router])

D5. 6. Please provide details on the connection/equipment installed at each HPC centers or Big Data providers (e.g. Destination Earth) you are providing services to: HPC Centre 5

*EuroHPC-JU would like to assess the possibility of utilizing a collapsed architecture via daisy-chained L1 or/and L2 technologies where L3 occurs*

*deep in the topology.*

Name of HPC Centre Offered Bandwidth

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Fiber owned operated by: (Accepted response HPC or NREN)

Access L1 technology (DWDM, CWDM, Alien W/L Coherent Optics)

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Max. capacity w/o any upgrade

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L2 CPE equipment deployed (NO CPE, L1[optical], L2[switch], L3

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[router])

D6. 7a. Please provide details on the aggregation points of your network related to the HPC centres or big Data Providers you serve: 1.

*EuroHPC-JU would like to assess the indirect cost of regional backbone upgrade inside the NREN network so as to fulfill HPC needs.*

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Aggregation PoP

Location (City name)

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# of NREN network nodes to be upgraded up to GEANT PoP (in case it is

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needed)

Equipment type to be upgraded (one or more of the following: NO upgrade,

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L1 [optical], L2 [switch], L3 [router])

Estimated unit cost for 100G link upgrade up to Geant PoP + target year

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D7. 7a. Please provide details on the aggregation points of your network related to the HPC centres or big Data Providers you serve: 2.

*EuroHPC-JU would like to assess the indirect cost of regional backbone upgrade inside the NREN network so as to fulfill HPC needs.*

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Aggregation PoP Location (City name)

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# of NREN network nodes to be upgraded up to GEANT PoP (in case it is

needed)

Equipment type to be upgraded (one or more of the following: NO upgrade,

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L1 [optical], L2 [switch], L3 [router])

Estimated unit cost for 100G link upgrade up to Geant PoP + target year

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D8. 7a. Please provide details on the aggregation points of your network related to the HPC centres or big Data Providers you serve: 3.

*EuroHPC-JU would like to assess the indirect cost of regional backbone upgrade inside the NREN network so as to fulfill HPC needs.*

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Aggregation PoP

Location (City name)

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# of NREN network nodes to be upgraded up to GEANT PoP (in case it is

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needed)

Equipment type to be upgraded (one or more of the following: NO upgrade,

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L1 [optical], L2 [switch], L3 [router])

Estimated unit cost for 100G link upgrade up to Geant PoP + target year

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D9. 7a. Please provide details on the aggregation points of your network related to the HPC centres or big Data Providers you serve: 4.

*EuroHPC-JU would like to assess the indirect cost of regional backbone upgrade inside the NREN network so as to fulfill HPC needs.*

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Aggregation PoP

Location (City name)

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# of NREN network nodes to be upgraded up to GEANT PoP (in case it is

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needed)

Equipment type to be upgraded (one or more of the following: NO upgrade,

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L1 [optical], L2 [switch], L3 [router])

Estimated unit cost for 100G link upgrade up to Geant PoP + target year

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D10. 7a. Please provide details on the aggregation points of your network related to the HPC centres or big Data Providers you serve: 5.

*EuroHPC-JU would like to assess the indirect cost of regional backbone upgrade inside the NREN network so as to fulfill HPC needs.*

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Aggregation PoP

Location (City name)

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# of NREN network nodes to be upgraded up to GEANT PoP (in case it is

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needed)

Equipment type to be upgraded (one or more of the following: NO upgrade,

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L1 [optical], L2 [switch], L3 [router])

Estimated unit cost for 100G link upgrade up to Geant PoP + target year

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| **D11. 7b. Please provide more details:***Please specify more details about the costs, the corresponding year, the duration of the contract etc.* |
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| **D12. 8. Do you provide internet connectivity to the HPC center or Data Provider connected to your network through the same link?**YesNo |
| **D13. 9a. Which of the HPC centres from the table in question 6 advertise Provider Aggregated (P.A) IP space to you?**HPC centre 1HPC centre 2HPC centre 3HPC centre 4HPC centre 5 |
| **D14. 9b. Which of the HPC centres from the table in question 6 advertise Provider Independent (P.I) IP space to you?**HPC centre 1HPC centre 2HPC centre 3HPC centre 4HPC centre 5 |
| **D15. 10a. In case your network is directly connected to any IXP(s), do you allow exchange of traffic between commercial HPC users and the HPC centres?**Yes No |

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| **D16. 10b. Please elaborate:** |
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| **D17. 11a. Do you support QoS in your network?**YesNo**D18. 11b. Is it enabled in the link with the HPC(s)?**YesNo**D19. 12a. Do you have public traffic graphs of the HPC centre(s) traffic covering the utilization of relevant links?**YesNo |
| **D20. 12b. Would you please provide them? 1.**HPC CenterURL**D21. 12b. Would you please provide them? 2.**HPC CenterURL**D22. 12b. Would you please provide them? 3.**HPC CenterURL**D23. 12b. Would you please provide them? 4.**HPC CenterURL |
| **D24. 12b. Would you please provide them? 5.**HPC CenterURL |

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| **D25. 13a. Do the HPC centre(s) have diverse connectivity with other providers?**Yes NoI don't know |
| **D26. 13b. What is the capacity of the alternative circuits?** |
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| **D27. 14. Do you have traffic analytics based on flows? If yes, can you elaborate on the traffic patterns related to the HPC centres? What percentage of the traffic stays within your AS/network, what percentage of traffic stays within the GEANT network and what percentage of the traffic ends up to the commercial providers? (If those are public pls provide corresponding URL) 1.***EuroHPC-JU would like to better understand the patterns of the flows (eg NREN/Country wide/Europe wide).*HPC Center% of traffic within your NREN% of traffic within GEANT% of traffic flows towards commercial ASesURL |
| **D28. 14. Do you have traffic analytics based on flows? If yes, can you elaborate on the traffic patterns related to the HPC centres? What percentage of the traffic stays within your AS/network, what percentage of traffic stays within the GEANT network and what percentage of the traffic ends up to the commercial providers? (If those are public pls provide corresponding URL) 2.***EuroHPC-JU would like to better understand the patterns of the flows (eg NREN/Country wide/Europe wide).*HPC Center% of traffic within your NREN% of traffic within GEANT% of traffic flows towards commercial ASesURL |

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D29. 14. Do you have traffic analytics based on flows? If yes, can you elaborate on the traffic patterns related to the HPC centres? What percentage of the traffic stays within your AS/network, what percentage of traffic stays within the GEANT network and what percentage of the traffic ends up to the commercial providers? (If those are public pls provide corresponding URL) 3.

*EuroHPC-JU would like to better understand the patterns of the flows (eg NREN/Country wide/Europe wide).*

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HPC Center

% of traffic within your NREN

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% of traffic flows towards commercial ASes

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D30. 14. Do you have traffic analytics based on flows? If yes, can you elaborate on the traffic patterns related to the HPC centres? What percentage of the traffic stays within your AS/network, what percentage of traffic stays within the GEANT network and what percentage of the traffic ends up to the commercial providers? (If those are public pls provide corresponding URL) 4.

*EuroHPC-JU would like to better understand the patterns of the flows (eg NREN/Country wide/Europe wide).*

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HPC Center

% of traffic within your NREN

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% of traffic within GEANT

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% of traffic flows towards commercial ASes

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URL

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D31. 14. Do you have traffic analytics based on flows? If yes, can you elaborate on the traffic patterns related to the HPC centres? What percentage of the traffic stays within your AS/network, what percentage of traffic stays within the GEANT network and what percentage of the traffic ends up to the commercial providers? (If those are public pls provide corresponding URL) 5.

*EuroHPC-JU would like to better understand the patterns of the flows (eg NREN/Country wide/Europe wide).*

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HPC Center

% of traffic within your NREN

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% of traffic within GEANT

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% of traffic flows towards commercial ASes

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D32. 15. Are there any administrative limitations making it harder for you to provide /upgrading connectivity services to HPC centre(s) if you have been asked to do so?

**Section E: Network Details**

E1. 16a. Please provide details on connectivity to your upstream provider (e.g. GEANT, Internet Exchange). Regional Network

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Upstream Provider

Next Hop Bandwidth

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Service Description (NREN VRF/Cloud VRF etc)

Redundancy

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E2. 16a. Please provide details on connectivity to your upstream provider (e.g. GEANT, Internet Exchange). GEANT1

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Upstream Provider

Next Hop Bandwidth

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Service Description (NREN VRF/Cloud VRF etc)

Redundancy

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E3. 16a. Please provide details on connectivity to your upstream provider (e.g. GEANT, Internet Exchange). GEANT2

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Upstream Provider

Next Hop Bandwidth

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Service Description (NREN VRF/Cloud VRF etc)

Redundancy

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E4. 16a. Please provide details on connectivity to your upstream provider (e.g. GEANT, Internet Exchange). GEANT3

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Upstream Provider

Next Hop Bandwidth

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Service Description (NREN VRF/Cloud VRF etc)

Redundancy

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E5. 16a. Please provide details on connectivity to your upstream provider (e.g. GEANT, Internet Exchange). IX

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Upstream Provider

Next Hop Bandwidth

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Service Description (NREN VRF/Cloud VRF etc)

Redundancy

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E6. 16a. Please provide details on connectivity to your upstream provider (e.g. GEANT, Internet Exchange). Tier-1

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Upstream Provider

Next Hop Bandwidth

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Service Description (NREN VRF/Cloud VRF etc)

Redundancy

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E7. 16a. Please provide details on connectivity to your upstream provider (e.g. GEANT, Internet Exchange). Other commercial peering

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Upstream Provider

Next Hop Bandwidth

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Service Description (NREN VRF/Cloud VRF etc)

Redundancy

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E8.

16b. Please provide more details:

E9.

17. Could you provide a brief description of your high availability setup of your network related to HPC centres connectivity?

**Section F: Upgrades & Expansion plan**

F1.

18. Can you describe any recent upgrades or investments in your network infrastructure to enhance HPC connectivity?

F2. 19. Are there any planned initiatives to upgrade infrastructure for the next 3 years? Can you provide a brief description (deployment of new equipment or upgrade of the existing, what is going to be the targeted high capacity interface, are you introducing new architecture for delivering L1/2/3 services, etc.)?

Also indicate the median load of your backbone links over the past year and at what load factor do you add capacity.



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| **F3. 20. What is a typical lead time for upgrading the capacity of an existing link (i.e. from 100Gbps -> 400Gbps)?** |
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| **F4. 21. For the next 3 years, are you participating or plan to participate in any advanced networking initiatives (i.e. Terabit Connectivity, Quantum Networking etc.)** |
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| **Section G: Other comments****G1. 22a. Do you have any further comments?** |
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| **G2. 22b. Please provide any attachments (documents, diagrams, etc...):****We would like to thank you for your participation!**You are encouraged to **reach out to other relevant stakeholders** regarding EuroHyPerCon, forwarding our questionnaires, including other users. EuroHyPerCon will present some initial results at the EuroHPC Summit in March 2024 and also organise a validation workshop later in 2024. In case you would like to keep in touch, please subscribe at [EuroHyPerCon Study Stakeholder Registration - Forms](https://edocs.hlrs.de/nextcloud/apps/forms/s/K8Xn5B27pGtLzJmo95YiXfQg). |