

The changing landscape of Education and Research networking

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The CESNET network



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Dark shading: connected to regional network Light shading: eligible to connect to regional network

Multiples of 100Gbps
100Gbps
Multiples of 10Gbps
1-10 Gbps
<1Gbps

Optimised for research data transfers (2017)

Public Internet

Geneva to Canberra 10 9 8 7 Gbit/s 6 5 BW 4 з 2 1 50 100 150 200 250 300 350 400 0 Buffer size Mbyte

Geneva to Canberra



GÉANT and R&E partners

Geneva to Canberra GÉANT + R&E networks US to Australia



R&E networks are designed for different goals than the Internet

Comparative Times for a 100TByte data transfer.

File Size (TB)		Data rate (Gbit/s)	Time taken (Hours)	Time Taken (Days)
NREN	100	9.27	34.0	1.4
ISP A	100	1.72	183.2	7.6
ISP B	100	0.11	2864.3	119.3



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Pan European tender for Infrastructure as a Service GÉANT "adds value" to cloud services









R&E Networks Respond to User Needs in the face of COVID-19



















Scientific user groups we liaise with

Physical Sciences Exploring the universe, e.g. SKA, JIVE, NEXPRES, LIGO-VIRGO and CERN, Neutrino observation (KM3NET)



e-Infrastructures e.g. PRACE, EGI, EUDAT, EOSC-hub, HelixNebula)





Social Sciences Music, art, language, e.g. CLARIN, ASTRA, LoLa

Earth and Environmental Sciences

Group on Earth Observation, WMO

Earth observation, climate monitoring, sustainable

development, e.g. EUMETSAT, Copernicus, ESA,

Health and Food Pharmaceutical research, e.g. EMBL-EBI, Human Brain Project



Energy Nuclear power, fusion energy research, e.g. ITER





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NREN Traffic Growth (in a year of COVID-19)

- Across all NRENs, the recorded traffic grew by about 27% in 2020.
- NRENs expect this trend to continue into the medium
- Growth is expected for
 - Research Institutes (75%)
 - Schools (73%)
 - Universities (67%).



8 Diversification of NREN Organisation Models

• Integration of national ICT Infrastructure:

- Merge with other national e-Infrastructure provider to create one ICT offering to R&E sector in country,
- Considered "Risk and Opportunity"

• Expansion of user base

- Majority of NRENs connects all or nearly all universities and HE institutions, saturated market
- Better utilization of public infrastructure
- Risk of unfair competition
- Expansion particularly to schools as 2nd largest user base
- Commercial revenue streams
 - Set up of commercial arms to enable joint procurement, offer commercial cloud services,
 - Cloud offerings become a more stable part of NRENs portfolio
- Role of the funding body



Development of total NREN budgets





- NRENs continue to move beyond their core role as connectivity providers and providing additional services
- response to technological changes and changes in the demands of their R&E community



- Expansion and improvement of the **AAI** to deal with a continuing increase of cooperation and sharing of resources across institutions and borders.
- Ongoing commodification of ICT services, i.e cloud services and other centralised procurement services
- Supporting specific education content and services such as learning platforms— NRENs that choose this path may become an important gatekeeper or mediator between content/service providers and consumers in the education sector.



GÉANT and the NRENs in Digital Europe

GN5 (Horizon Europe)

EuroHPC

Quantum Networking

EOSC



- Framework Partnership
- (Intercontinental) network
- Hyperconnectivity
 - Between supercomputing centers
- Quantum networking
- Founding member of EOSC Association
- Member of EOSC Association Board
- Engaged in set up of new EOSC WGs
- Partner in EOSC Future project
- CESNET mandated member



NRENs are very active on European level

Shaping Europe's digital infrastructure providing expertise and insights from their day-to-day business as service providers to the R&E community

31 individual NRENs participated in a total of 106 unique projects (other than GN4-3)

e-infrastructure projects, (pan-EU) Science collaboration and Technology projects

CESNET is 5th highest NREN contributor



NRENs' participation in EC-funded projects – total number of projects per NREN (Compendium 2020) 14



Design a pan-European optical network for the distribution of very accurate time and frequency information

Transition signal transmission of 300 atomic clocks from satellite to optical fiber to increase top level performance, traceability, interoperability & redundancy

Goal to create the fastest and most precise infrastructures comparing atomic clocks yet

→ greater accuracy in a.o. navigation systems, improved measurements of the Earth's gravitational field or in recording climate change.





Thank you

Any questions?

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