

# What are NRENs & why they are important?

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# NREN Catalysts



- A key factor: Popularity of the *Internet*: More than 1 billion users → Virtual **Global Village**
  - On-line knowledge base
  - Social networking (e-mail, chat, games, p2p content sharing)
  - Web 2.0
  - On line shopping, trading, auctioning....
  - Voice (video) over the Internet, double/triple play
  - Increasing broadband access penetration (wireless, DSL, FTTx ?)
- Use cases pushing for NREN deployment as public e-Infrastructures
  - Scientific collaborations, **e-Science** distributed computing/Grids (environmental research, irrigation, earth-quake monitoring, marine sciences, energy research, archeology, biomed, physical sciences....)
  - Higher education needs (virtual collaborations, on-line content, on-line courses, tele-teaching...)
  - School networks, OLPC (One Laptop per Child )
  - Related public e-Services (libraries, museums, e-health...)

# Some NREN Success Factors



- **Government commitment → sustainability**
  - Legal entity, one NREN per country, not related to TELCOs or ISPs
  - Not for profit, public support + **Accepted Use Policy** (AUP)
    - via Ministry of Science & Education directly and/or cost based charging end-users: Universities, Research Centres, R&D Projects...)
  - Stable governance, user involvement
  - Commitment for connecting all R&E campuses
- **Mature telecom markets → regulatory issues**
- **R&E community pressure**
  - Schools
  - Universities
  - Libraries
  - Scientific Collaborations
  - Cultural Exchanges
  - ....
- A **local champion** with **leapfrogging vision**
- **International solidarity** (EU – EuropeAid & INFSO-M, UNESCO...)

# European NREN's & GÉANT2: e-Science Enablers and Equalizers



- NRENs as Research & Education networking traffic aggregators
  - Commodity Internet? → **Acceptable Use Policy (AUP)**
- e-Science (GRID) Virtual Organizations obtain via NRENs – GÉANT – **EUMED connect**... production quality hybrid networking, beyond leasing individual circuits, wave-lengths or dark fibers
- e-Infrastructures as equalizers, reduce the **DIGITAL DIVIDES** in Europe & globally: **Big Science affordable via virtual e-Science**
- NRENs help built solidarity based on common interest → stability and friendship by encouraging collaborations (**virtually** and **f2f**)
- NRENs as large demanding customers contribute to **Telco market development & liberalization**

# European NREN's – GÉANT:

## A Success Story



- Century old Telecom (+ 40 years ARPAnet - Internet) experience: Proven strong *“Network Externalities”* → Sharing tradition
- Industry needs for *Next Generation Network* proofs of concept: The ARPAnet paradigm @ the US of America, inspiring the *“US of Europe”*
- **Foresight** of National + EU funding authorities, triggered by NREN planning – SERENATE, EARNEST Studies
- Success in serving R&E needs of the Continent → Smoothing-out *“digital divides”* & serving powerful communities (educators, students, pupils?)
- NREN's as public utilities for the R&E communities – *“commons”*
- **Solidarity** – human networking of NREN community
- Stable **Governance**: NREN Policy Committee (NREN PC)



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# R&E Networking Model in Europe



**A 3-tier Federal Architecture**, partially subsidized by National and EU Research & Education funds:

- The Campus Network (LAN/MAN) > 3,500 Institutions, > 40 M Users
  - The 34 NREN's (MAN/WAN)
  - The Pan-European Interconnection: **TEN34 → TEN155 → GÉANT** (GN1 in EC FP5) → **GÉANT2** (GN2 in EC FP6): **Hybrid Optical Backbone (+ Cross Border Fibers)**
- **Total GN2 Cost: 40 M€/year (co-funded by the EC and NREN's)**

**GN2 EC Subsidy < 10% of total European R&E Networking Cost**

- **GÉANT Governance:** NREN Policy Committee
- **GN2 Project Management:** Exec, DANTE



# GÉANT2: A European Team Effort



- The **GÉANT2 Network Footprint**: Interconnects 30 (34) National Research & Education Networks (NREN's) of the Extended European Research Area
- **GN2 Project**: co-funded by the European Commission (DG INFSO-M) and the Consortium (30 NREN's + DANTE + TERENA)
  - (Human) Networking Activities (NA's)
  - Service Activities (SA's)
  - Joint Research Activities (JRA's)
- **Global Outreach**: Extending the Team Collaborations in all Continents

# Evolution of European NREN Interconnection



- From *2 Mbps* to *155 Mbps*:
  - **EuropaNet** → **TEN34** → **TEN155** (pre-FP5 EC Projects)
- From *155 Mbps* to *Gigabit IP*:
  - **TEN155** → **GÉANT** (FP5 EC Project **GN1**)
- From *Gigabit IP* to *Hybrid Networking over Dark Fibers*:
  - **GÉANT** → **GÉANT2** (FP6 EC Project **GN2**)  
**Paradigm Shift**, predicted by the **SERENATE** study & made possible by the availability of dark fibers in liberalized markets

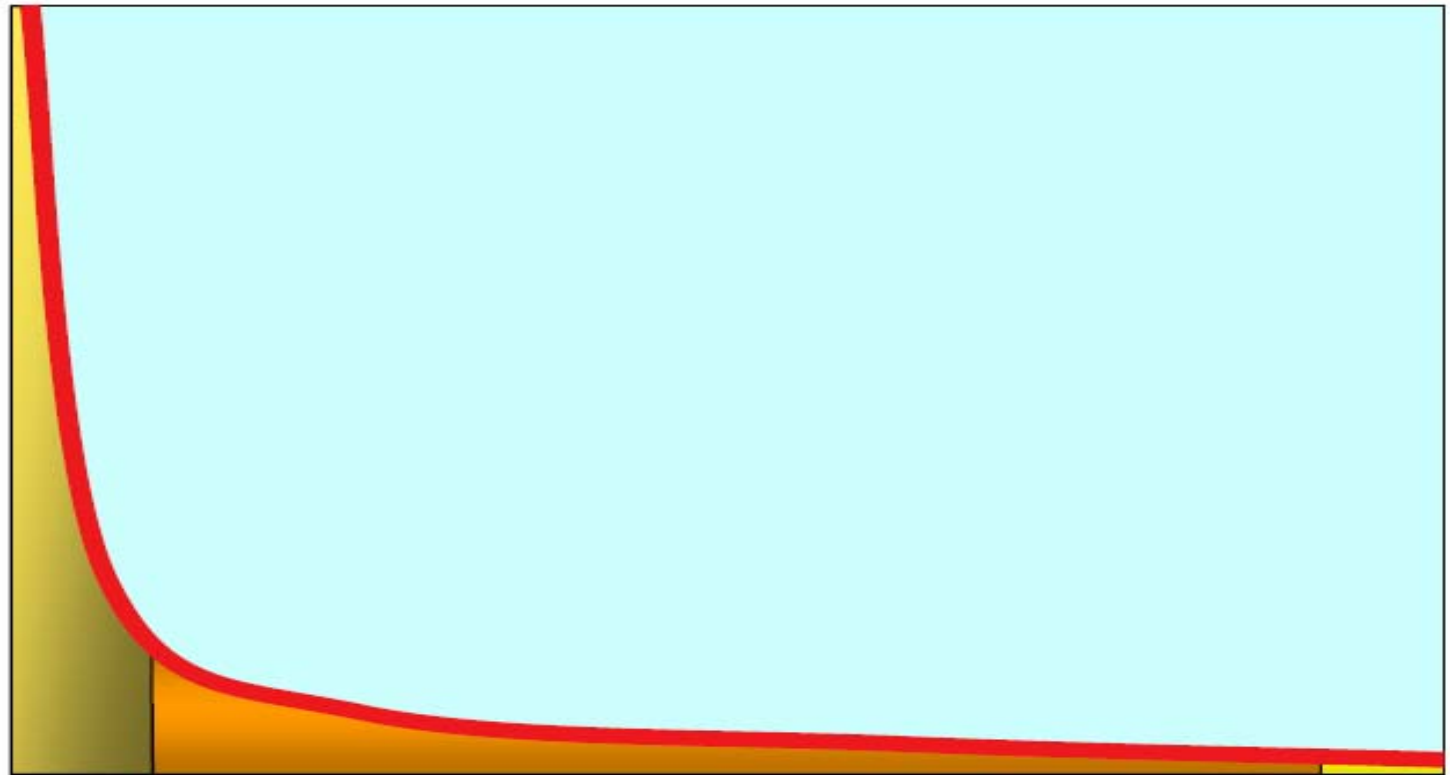
# Bandwidth Requirements per User

SERENATE Study Final Report, 2003

*Cees De Laat, David Williams et. al.*



# of users



ADSL

GigE

# The NREN Policy Committee

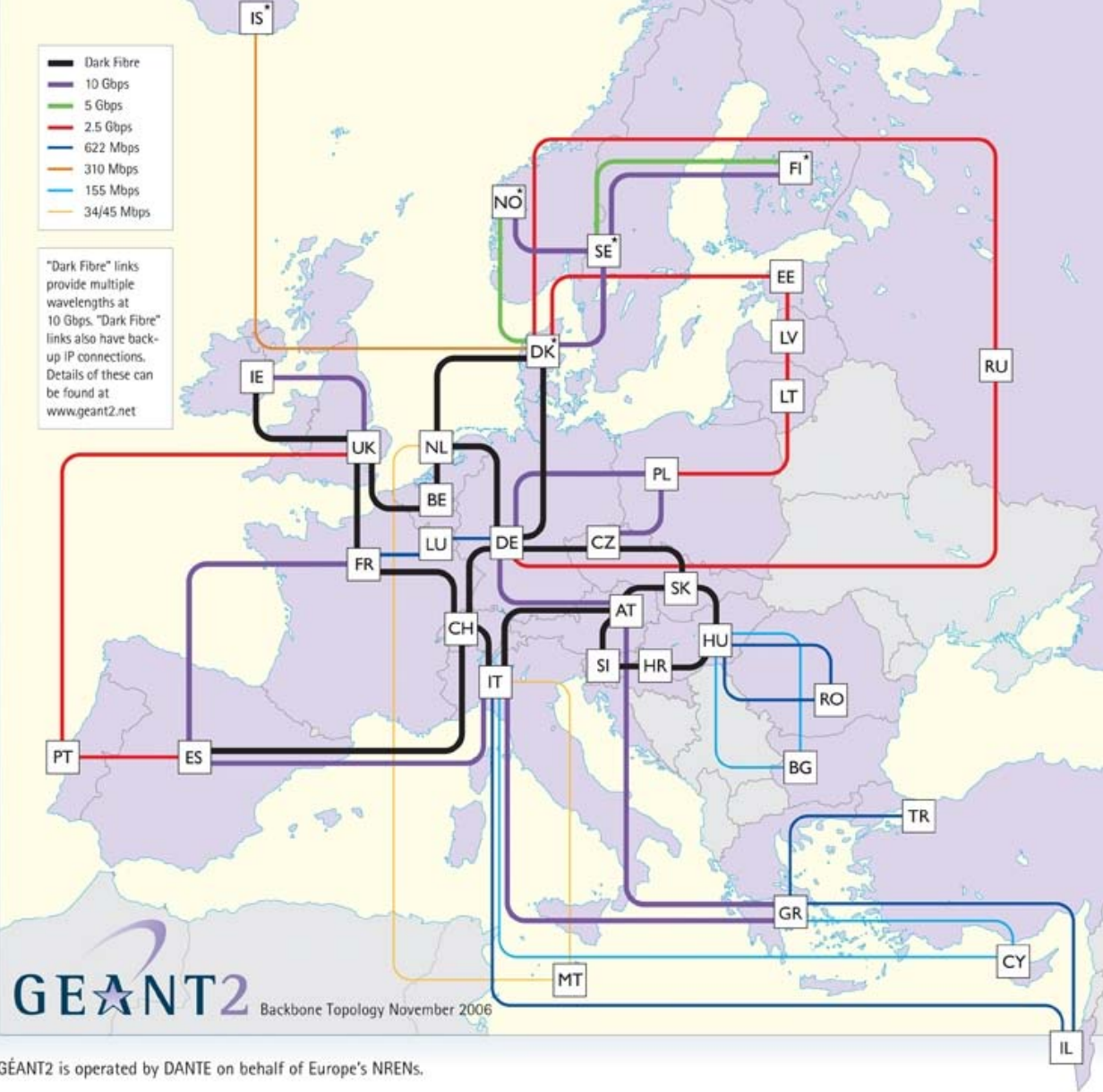


- |   |   |
|---|---|
| <ol style="list-style-type: none"><li>1. Austria (<b>ACOnet</b>)</li><li>2. Belgium (<b>BELNET</b>)</li><li>3. Bulgaria (<b>ISTF</b>)</li><li>4. Croatia (<b>CARNet</b>)</li><li>5. Czech Republic (<b>CESNET</b>)</li><li>6. Cyprus (<b>CYNET</b>)</li><li>7. Germany (<b>DFN</b>)</li><li>8. Estonia (<b>EENet</b>)</li><li>9. France (<b>RENATER</b>)</li><li>10. Greece (<b>GRNET</b>)</li><li>11. Hungary (<b>HUNGARNET</b>)</li><li>12. Ireland (<b>HEANet</b>)</li><li>13. Israel (<b>IUCC</b>)</li><li>14. Italy (<b>GARR</b>)</li><li>15. Latvia (<b>LATNET</b>)</li><li>16. Lithuania (<b>LITNET</b>)</li><li>17. Luxembourg (<b>RESTENA</b>)</li><li>18. Malta (<b>UoM</b>)</li><li>19. Netherlands (<b>SURFNET</b>)</li></ol> | <ol style="list-style-type: none"><li>20. Nordic Countries – Denmark, Finland, Iceland, Norway, Sweden (<b>NORDUNET</b>)</li><li>21. Poland (<b>PSNC</b>)</li><li>22. Portugal (<b>FCCN</b>)</li><li>23. Romania (<b>RoEduNet</b>)</li><li>24. Russia (<b>JSCC</b>)</li><li>25. Slovakia (<b>SANET</b>)</li><li>26. Slovenia (<b>ARNES</b>)</li><li>27. Spain (<b>RedIRIS</b>)</li><li>28. Switzerland (<b>SWITCH</b>)</li><li>29. Turkey (<b>ULAKBIM</b>)</li><li>30. United Kingdom (<b>UKERNA</b>)</li></ol> <p><b><u>PLUS NON-VOTING MEMBERS:</u></b><br/>Delivery of Advanced Network Technologies to Europe Ltd. (<b>DANTE</b>)<br/>Trans-European Research &amp; Education Networking Association (<b>TERENA</b>)</p> <p><b>PERMANENT OBSERVERS: CERN, AMRES, MARNET</b></p> |
|---|---|

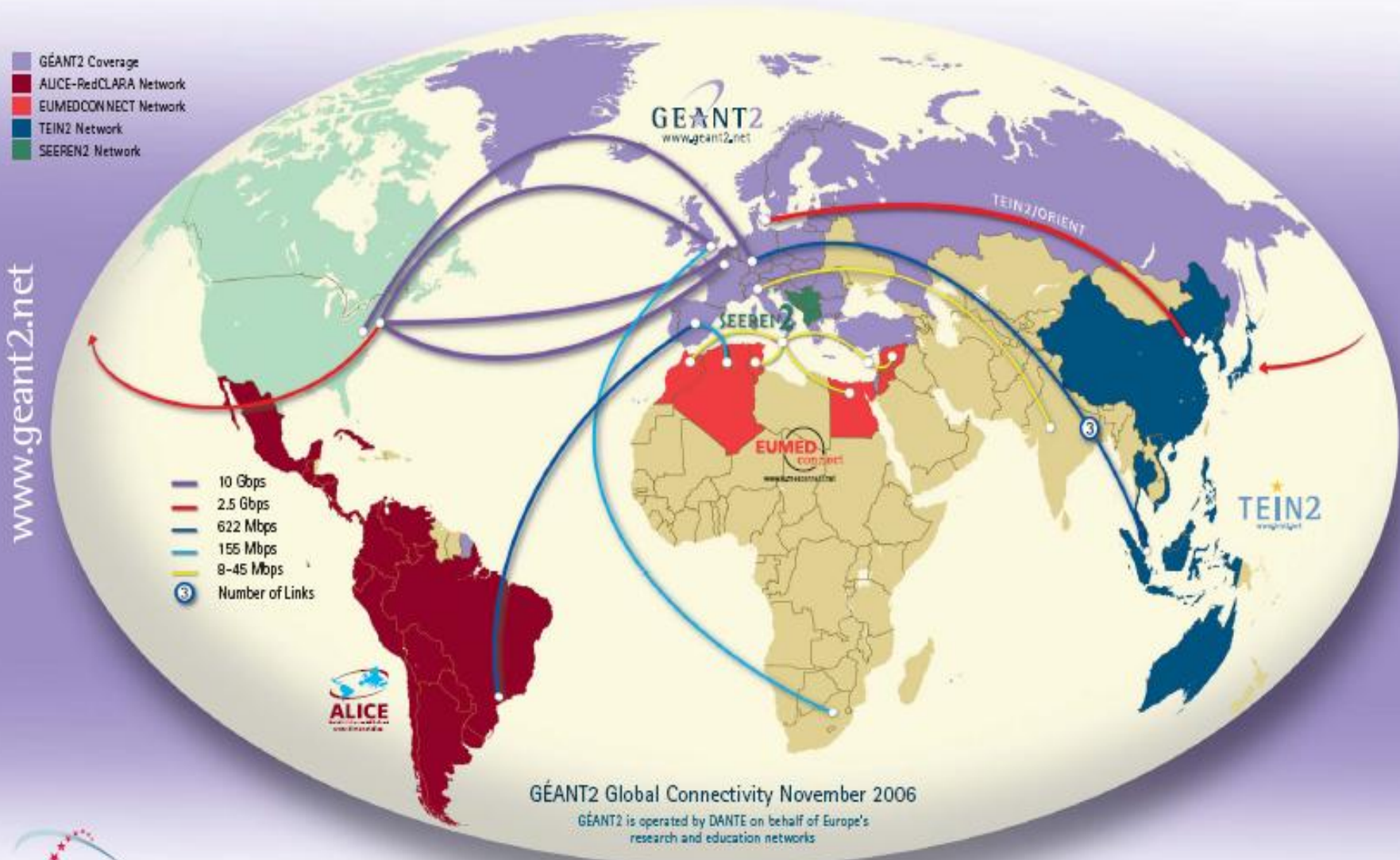
# GÉANT2 Topology

15+ NRENs  
interconnected  
within the Dark  
Fibre (DF) “cloud”

Rest, via leased  
“lambda” and  
SDH circuits



# GEANT2 At the Heart of Global Research Networking



# Some Open Issues

- Are NRENs instruments for **National Grid Initiatives** – NGIs?
  - Grids are by nature end-user driven
  - Is there a sharing mentality amongst various Virtual Organizations?
  - Are there strong **network externalities**?
- Is there a need for NREN supplied **Data Repositories & Utility Computing?** An opportunity but an issue to debate
- Is **convergence of e-Infrastructures** affect NRENs - GÉANT?
  - Are these NREN – GÉANT tasks?
  - Is there a conflict with distributed GRID – Super Computing infrastructures?
  - Can we compete with advanced commercial offerings e.g. **Google, Amazon**?
  - Are NRENs/GEANT3 **third trusted parties** for national data repositories?
  - ....

# *ICT e-Infrastructures:* A CONCERTED EUROPEAN EFFORT



Research Networking & HPC/GRID communities common mission:

Provision of leading edge *e-Infrastructures* for Research & Advancement of HPCN technologies as **European added value**



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