



Research and education networking in Europe

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www.terena.nl



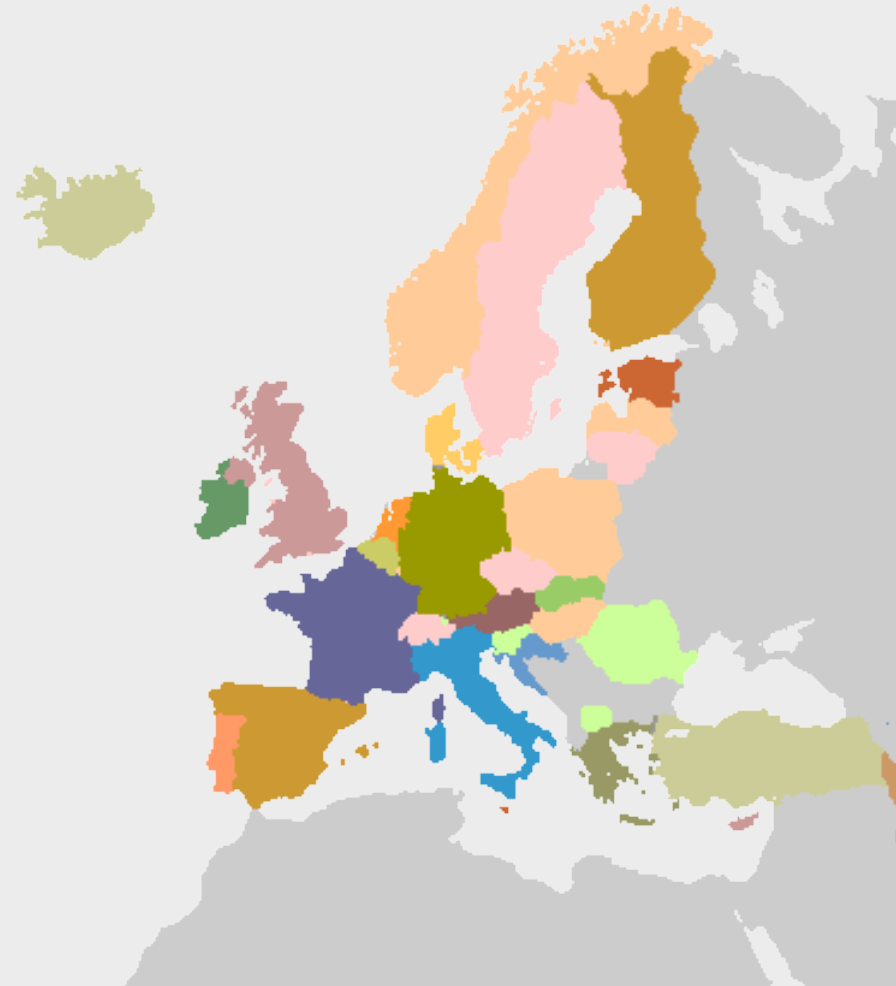
My curriculum vitae

- Researcher and teacher, Leiden University 1975-1979
- General Manager of the Department of Mathematics and Computer Science, Delft University of Technology 1980-1984
- IT policy advisor, Ministry of Education and Science 1984-1991
- Head of Unit for Information and Infrastructure, Ministry of Education, Culture and Science, 1992-1996
- Secretary-General of TERENA, 1996-.....



TERENA

- The European association of research and education networking organisations
- 34 National Members
- 2 International Members: CERN, ESA
- 10 Associate Members (including DANTE, equipment vendors and telecoms operators)





Contents

- (from the SERENATE studies:)
 - **Structure and organisation of research networking**
 - **Optical networking is coming now**
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 - **Evolution of users' needs**
 - **Widening the user community of an NREN**
 - **The role of the European Union**
- (from the Varna conclusions:)
 - **The drive to the Information Society**
 - **The leading role of NRENs**
 - **Government interest in supporting NRENs**
 - **The scope of NRENs**
 - **The importance of the infrastructure and the government's role**



What was SERENATE?

- SERENATE (May 2002 – December 2003) was a series of strategic studies into the evolution of research & education networking in Europe over the next 5-10 years.
- SERENATE was funded by the EU as an accompanying measure in the 5th Framework Programme.
- Project partners were TERENA, DANTE, CTI, the Academia Europaea and the European Science Foundation.
- SERENATE has produced 15 public reports, which are all available from

www.serenate.org/publications/



1. Introduction (1/2)

- The Internet had its origins in the world of research and universities. Today, many years later, and despite enormous changes, research networks are still the most advanced part of the Internet.
- Technologies and applications find their way from research networks to the general Internet. Research networks are an important source of innovation.



1. Introduction (2/2)

- The liberalisation of telecommunications markets has had an enormous impact. Prices to be paid to telecommunications operators have been reduced enormously.
- Europe is now a world leader in many aspects of research networking.
- However, progress has not been uniform.

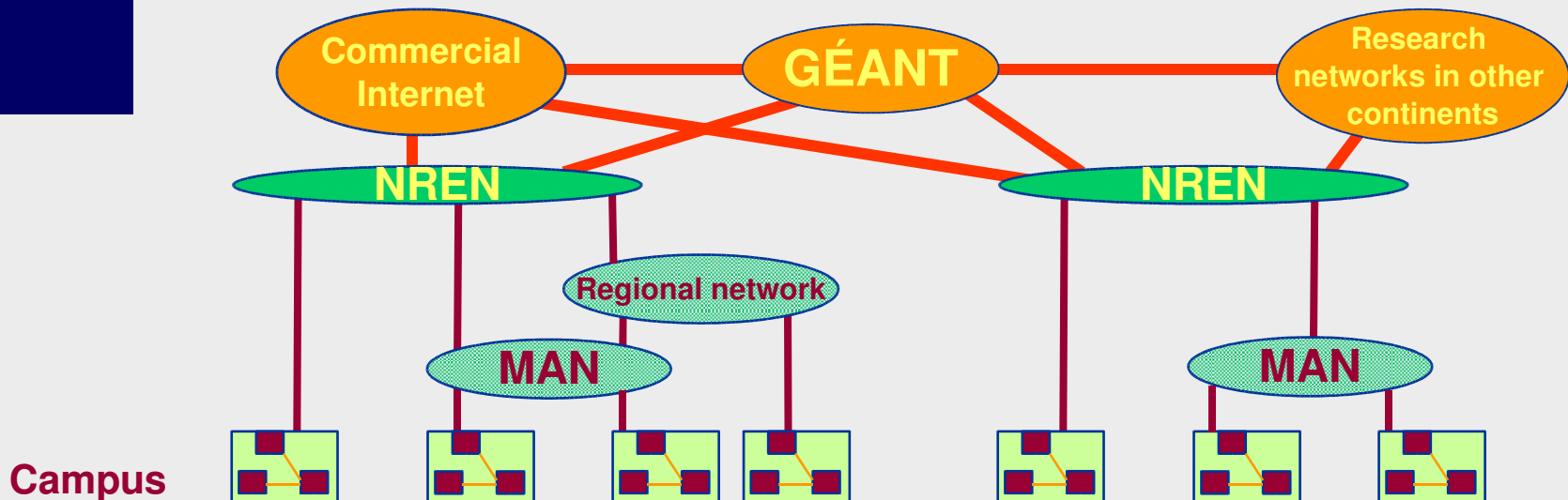


2. The organisational model (1/7)

- In Europe, research network services are organised at three (or four) levels:
 - the Local Area Network (campus)
 - the national network provided by the National Research and Education Network organisation (the NREN)
 - international connectivity in Europe provided by GÉANT
 - [intercontinental connectivity]

2. The organisational model (2/7)

- Peering with the commercial Internet takes place both at the NREN level and at the GÉANT level.
- Connectivity to research networks in other continents is through GÉANT or is provided directly by the NREN.
- In some countries, campuses are connected to the national networks via MANs and/or regional networks.





2. The organisational model (3/7)

- All these networks are run by different organisations.
- A network session between research establishments in two different European countries involves at least five organisations.
- In some countries, MANs and/or regional networks add extra complexity.



2. The organisational model (4/7)

- The European organisational model, with a single NREN per country and close collaboration at the European level, has been a success factor for research and education networking. It is increasingly being copied in other continents.
- We expect this model to remain a key to success for at least the next 5-10 years.



2. The organisational model (5/7)

- NRENs are very different as regards organisation, tasks, staff size, budget etc.
- Directly or indirectly, research & education networks are largely funded from taxpayers' money.



2. The organisational model (6/7)

- For NRENs, expenditures of general and long-term benefit must in any case be funded centrally.
- Charging, if any, must never be at a lower level in the organisation than the central budget of the university, research centre etc.
- New, very demanding applications may make changes to the funding model necessary.



2. The organisational model (7/7)

- Strict adherence to an official Acceptable Use(r) Policy will avoid complaints about unfair competition.
- If we have found any problems when research networks are opened up for schools, libraries, museums etc., it is more about conflicts with general public-sector networks than with commercial service providers.



3. Optical networking is coming and everyone can and should participate

(1/4)

- The move towards optical techniques in data transmission is a fundamental change that will not be reversed.
- Likely impacts:
 - A major technical enabler for reducing costs and increasing bandwidth at constant costs (by improving fibres, lasers and receivers)
 - On a longer timescale, move to optical switching
 - Evolution towards hybrid networks (many-to-many via classic packet switching, and high-speed traffic few-to-few via optical paths)
- Direct access to fibres is a critical resource for research networks.



3. Optical networking is coming and everyone can and should participate

(2/4)

- The current telecommunications regulations
 - have liberalised the markets, hence promoting competition, hence reducing prices
 - allow an NREN or any organisation to operate its own infrastructure (including construction, if that is what you want to do).



3. Optical networking is coming and everyone can and should participate

(3/4)

- So there is a wide variety of offerings:
 - build your own fibre
 - sale of optical fibre
 - long- and short-term lease of optical fibre
 - dark fibre or managed fibre
 - wavelength services
 - leasing SDH circuits
- Which commercial solution will be sustainable in the longer term?



3. Optical networking is coming and everyone can and should participate

(4/4)

- Conclusions:
 - Optical-fibre infrastructure becomes an asset of crucial importance, not only for research and education, but for the economy and society in general
 - A competitive market should therefore be promoted
 - And access to fibre at reasonable prices should be ensured

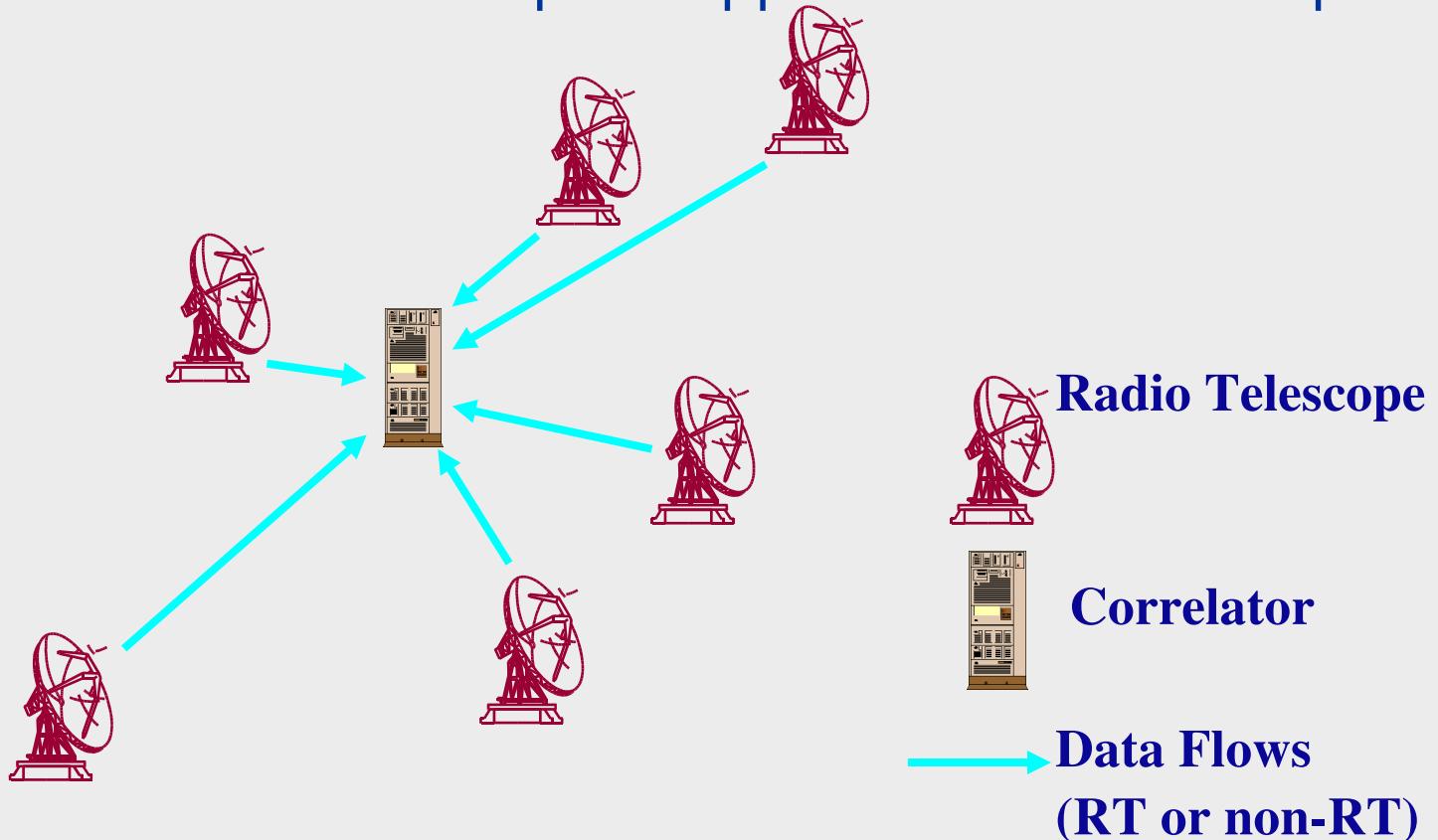


4. Very demanding applications are coming and need careful attention (1/5)

- In general, researchers appear to be satisfied with the progress in research networking in recent years.
- Network requirements will grow dramatically over the next 5-10 years, in all disciplines and in all countries.
- We heard examples where research would become much more efficient or where completely new research activities could be undertaken if networks were 10- or 100-times faster.

4. Very demanding applications are coming and need careful attention (2/5)

- Current example: support to VLBI in Europe

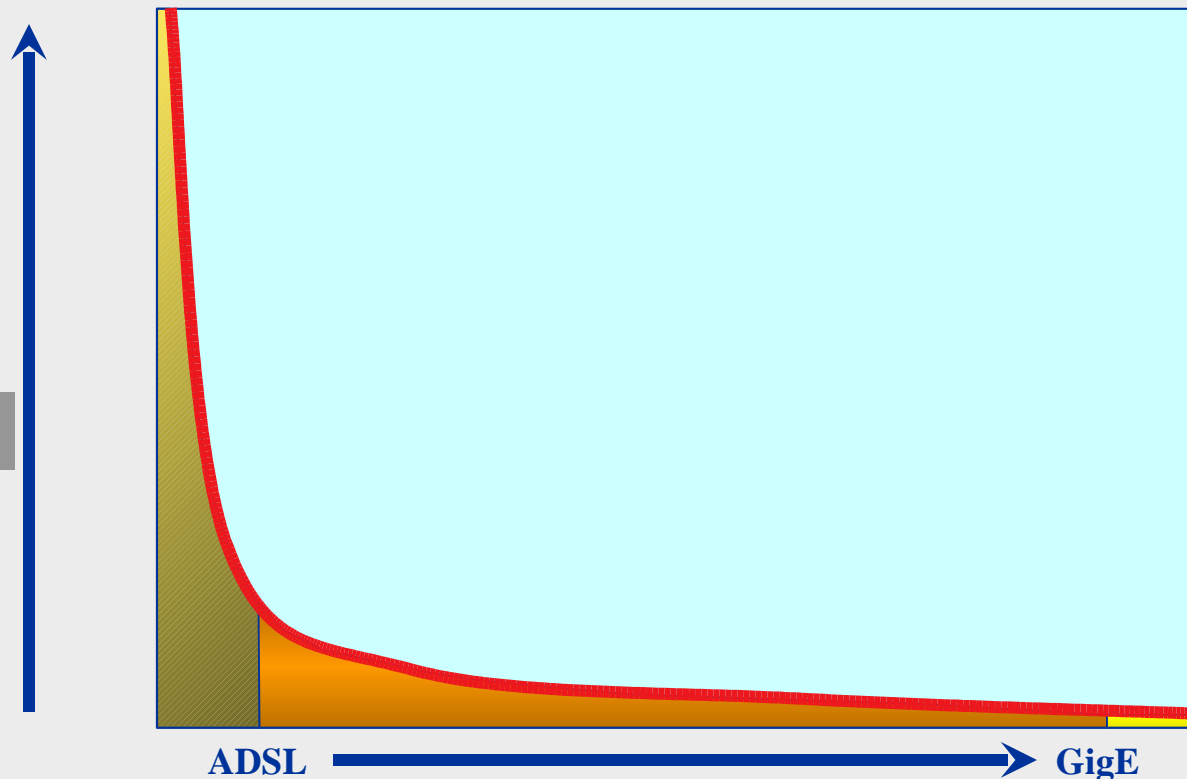




4. Very demanding applications are coming and need careful attention (3/5)

- There is a growing diversification of needs:

of users



bandwidth requirements per user tsch@terena.nl



4. Very demanding applications are coming and need careful attention (4/5)

- The most demanding scientific applications now require very high network capacities and put heavy demands on network availability and end-to-end performance.
- There are cases where a single instance of a new application (e.g. Grid transfer, remote immersive virtual-reality session) exceeds the aggregate flow that we usually see for a whole country with thousands of simultaneous users.



4. Very demanding applications are coming and need careful attention (5/5)

- Existing research network organisations will be able to cater for the needs of the most demanding users, thanks to technical developments and market developments.
- But they will need to introduce new infrastructures, technologies and network architectures.
- And funding and cost-sharing models will need to be adjusted to accommodate the increasing diversity in network use.



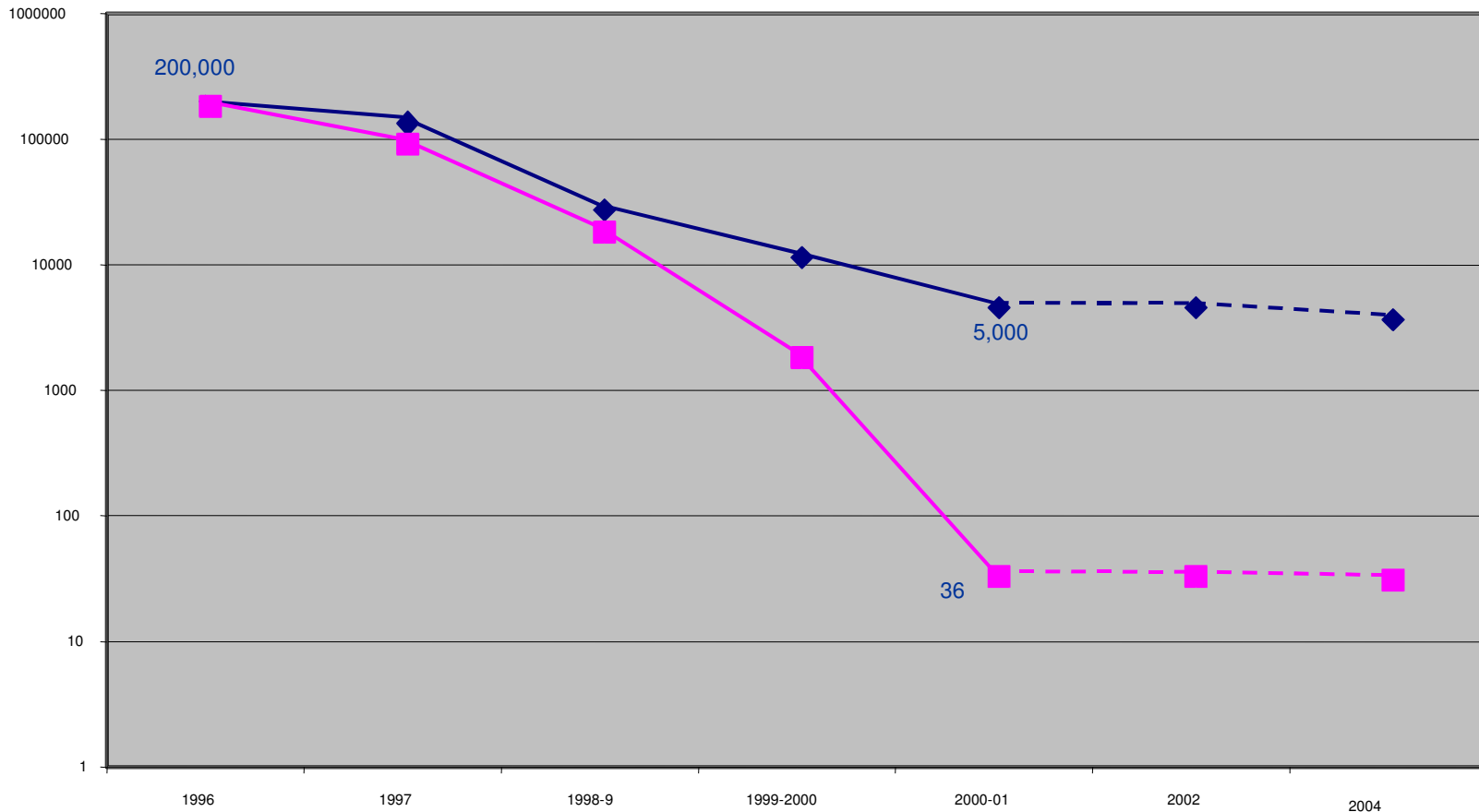
5. There is a digital divide inside the European research and education community (1/6)

- One of the main objectives of the European Research Area and of the eEurope Action Plans is to provide equal opportunities to researchers, teachers and students, independent of location.
- Unfortunately, there is a significant digital divide between countries in Europe with respect to the network infrastructures and services that are available to the national research and education communities.



5. There is a digital divide inside the European research and education community (2/6)

- Price decreases have been enormous but not uniform:





5. There is a digital divide inside the European research and education community (3/6)

- Pricing is far from uniform – between countries:

International Connectivity Costs in the Differing Market Segments

Market segment	Number of Countries	Cost Range
Liberal Market with transparent pricing	8	1-1.4
Liberal Market with less transparent pricing structure	7	1.8-3.3
Emerging Market without transparent pricing	3	7.5-7.8
Traditional Monopolist market	9	18-39



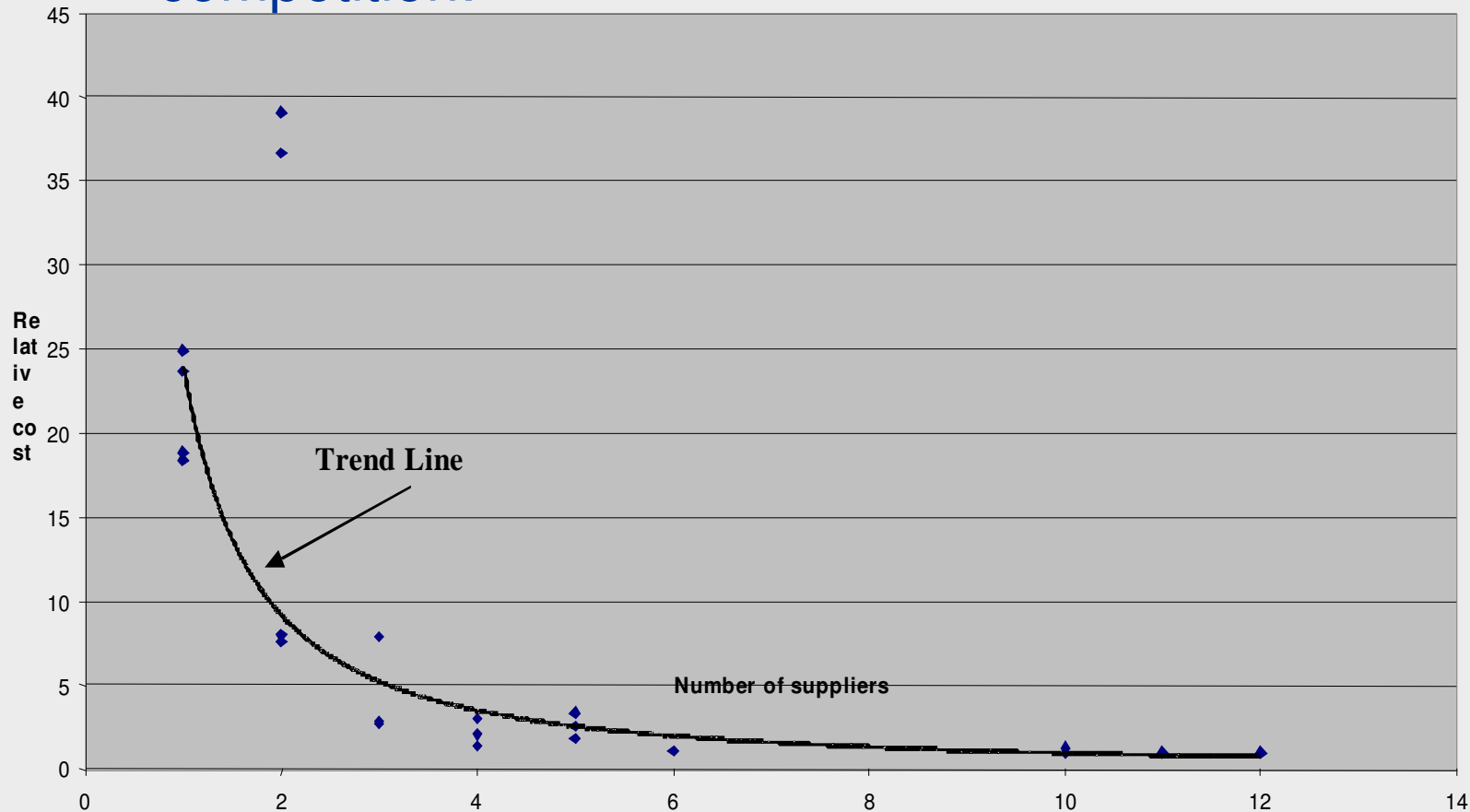
5. There is a digital divide inside the European research and education community (4/6)

- How is this possible? Officially, the EU regulations about telecommunications markets liberalisation have been implemented in all EU member states and candidate member states. In reality, the situation leaves much to be desired in a number of countries. Consequences:
 - no real competition between network carriers
 - no access to fibre for research networks (and others)



5. There is a digital divide inside the European research and education community (5/6)

- You need at least 4 operators to have real competition:





5. There is a digital divide inside the European research and education community (6/6)

- Conclusions:
 - The EU institutions and national governments should take energetic measures to reduce the digital divide.
 - Creating a truly competitive telecommunications market and access to infrastructures at reasonable prices is essential.
 - Investments in research & education networking are needed, including investments in infrastructure such as fibre. (The EU's Structural Funds should also be used for this.)



6. The campus is often the weakest link in the network chain (1/1)

- Campus networks:
 - In recent years, research networks at the national and international level have achieved substantial improvements.
 - Campus networks are now often the weakest link in the chain of end-to-end services.
 - Investments are needed.
 - In general, expenditure for ongoing technical upgrade in campus networks is best treated as a budget expense on an annual basis.



7. Users need end-to-end quality, a compatible European AAI, and value-added services (1/2)

- The expectations of network users have moved beyond the provision of pure bandwidth to more complex services.
- There are concerns about security, privacy and confidentiality.
- There will be a strong demand for authentication and authorisation services (for access to facilities, research materials etc.)



7. Users need end-to-end quality, a compatible European AAI, and value-added services (2/2)

- Increasingly, researchers and teachers want to be able to access networks and their own usual set of network and information services wherever they happen to be.
- The establishment of a pan-European Authentication and Authorisation Infrastructure will be an important contribution to meeting these requirements.



8. Inclusiveness of the user community of an NREN is a national decision (1/3)

- Several national governments in Europe have initiated projects to provide network connections and services to schools, libraries, museums and other public institutions.
- Some of these initiatives involve the NREN, but others do not.
- Such initiatives, and the way they are implemented, have to be decided at the national level.



8. Inclusiveness of the user community of an NREN is a national decision (2/3)

- Greater “inclusiveness” is particularly important for small countries. By extending their user community beyond research and higher education, NRENs in small countries can achieve a critical mass and economies of scale that are obtained naturally by NRENs in large countries.



8. Inclusiveness of the user community of an NREN is a national decision (3/3)

- If network connections and services are to be provided through the NREN in a given country, then adequate resources must be allocated, additional to those needed to cater for the needs of the research and higher-education communities.



9. There is a crucial role for national governments and the EU (1/2)

- The importance of government support:
 - Research & education network organisations are most effective when they have good relations with their user community, and are recognised by their national government as an important and effective tool for advancing the pursuit of the “knowledge society”.
 - It is not easy to be a research & education network organisation, because you are the focal point for multiple tensions.



9. There is a crucial role for national governments and the EU (2/2)

- The role of the European Commission:
 - The EC should continue to play the federating role that it has so effectively assumed over the past seven years in enabling interconnection of European national research networks.
 - The money helps, but the EC are the only people with the political authority to guide people to decisions.



What was the Varna event?

- A workshop about “Policy Issues for NRENs in Southeast Europe” (Varna, September 2003)
- Organised by TERENA, CEENet and the EU-funded SEEREN project
- Supported by NATO

www.terena.nl/conferences/nato-anw2003/



1. The drive to the Information Society

- Lisbon target: by 2010, Europe is to be the world's leading knowledge-based economy.
 - There is no knowledge-based society without the appropriate information and communication infrastructure
- The research networking environment drives the development of the Internet.
 - It develops new technologies and services
 - It produces university graduates who expect advanced Internet applications



2. The leading role of NRENs

- Research networking in a country requires a strong, dynamic, stable, professional, not-for-profit organisation: an NREN.
- NRENs should not just be reactive (serving the wishes of the users) but pro-active, being a national focus for IT development.



3. Government interest in supporting NRENs

- Government is responsible for education and research, and those sectors need advanced networking facilities.
- NRENs contribute to IT innovation and deployment, and hence to economic prosperity.
- Need one NREN per country, supported by the government and with representation of the major stakeholders.



4. The scope of NRENs

- Roles of NRENs and commercial Internet Service Providers are complementary.
 - ISPs also benefit from the innovations developed in the research networking environment.
- Including schools, libraries, hospitals and other public institutions in the user community of an NREN is advantageous, especially in small countries.
- Competition between NRENs and ISPs is not an issue.



5. The importance of the infrastructure and the government's role

- Governments need to ensure that sufficient financial resources are made available to the NREN.
- Governments should exert their influence to ensure that NRENs can obtain the telecommunication facilities that they need at reasonable prices.
- When prices are not reasonable, governments should encourage NRENs to own the (optical) infrastructure themselves.



Summary

- Research and education networking is very important, and not just for research and education.
- You need one NREN in the country.
- You need many competing telecommunications operators in the country.
- The government must strongly support the NREN.