

Introduction to the SERENATE Final Workshop

0. Purpose of this note

SERENATE has produced a number of reports, which are available from www.serenate.org/publications/. Copies of these reports and drafts or summaries of other reports still under preparation will be provided at the SERENATE Final Workshop in Bad Nauheim on 16-17 June 2003. However, we cannot expect workshop participants to have read all that material before the event. This note gives a concise summary of some of the most important SERENATE findings and possible recommendations. We hope that the contents of this note will help participants to prepare for the workshop and encourage them to take an active part in the discussions.

1. Background

SERENATE is a series of strategic studies into the future of research and education networking in Europe. It investigates the strategic aspects of the possible developments over the next 5-10 years, looking into the technical, organisational and financial aspects, the market conditions and the regulatory environment. SERENATE is funded by the EU as an accompanying measure in the 5th Framework Programme. The project partners are TERENA, DANTE, the Center for Tele-Information (Technical University of Denmark), the Academia Europaea and the European Science Foundation. However, the work needs the active involvement of all stakeholders: research and education networking organisations, governments and funding bodies, network operators and equipment vendors, and the users of research and education networks.

2. User requirements

Great progress has been made in the past five years, so that in many parts of Europe researchers have a reasonable environment of research and education networking. However, in several regions in Europe the situation is far from satisfactory, and arguably getting worse in relative terms. When comparing the three levels of infrastructure provision – on the campus, nationally and internationally –, for many European researchers the major source of limited network performance is primarily at the campus.

Networking requirements will grow dramatically over the next 5-10 years, in all areas of research and in all countries. There are opportunities to start completely new research activities that were prohibited until now by lack of very high performance networking facilities. There is a remarkable interest in Grid computing.

User expectations have evolved beyond the provision of pure bandwidth towards the supply of more complex services. There will be a large demand for Authentication & Authorisation, as well as for mobility – the ability to access networks wherever the researcher happens to be. Visualisation and videoconferencing are two examples of applications that will become more widespread and result in increased demand for bandwidth.

3. Technology evolution

We believe that the move from electrical to optical transmission represents a fundamental change. It will be a major technical enabler for reducing costs and for obtaining increasing capacities at constant costs. Over a timeframe of several years, we should expect moves towards optical switching. Even in the short term we should look at moving towards heterogeneous networks, with general network use (many-to-many) carried via classical packet-switching services and dedicated high-speed traffic (few-to-few) carried via special optical paths. There will be pressure to create end-to-end optical paths, including on the campus.

We need improved techniques to Authenticate users, to Authorise them to use various services and to Account for the resources that they have used (AAA). The ideas have been around for several years, but deploying them as production services requires widespread and intensive co-ordination: inside the campus, between campuses and ultimately at the pan-European and global level.

4. Transmission scenarios and cost evolution

The EU framework for telecommunications regulation aims to create a competitive market for telecommunications services. However, in practice in many countries the development of real competition is still hampered by political obstacles and lack of investment. Four groups of countries can be distinguished:

- Liberal markets with transparent pricing (BE, FR, DE, IT, NL, CH, UK and the Nordic countries)
- Liberal markets with less transparent pricing structure (AT, CZ, HU, IE, LU, SK, ES)
- Emerging markets without transparent pricing (HR, PL, SI)
- Traditional monopolist markets (BG, CY, EE, GR, LV, LT, MT, PT, RO).

Prices for high-capacity international connectivity are a factor of 18-39 higher in the last group of countries than in the first group.

It is difficult to predict how the telecommunications markets will develop in the next years, for Europe as a whole and for individual countries. An optimistic scenario would show an annual price reduction of 10% in the liberal markets and a convergence of the other markets to the same price level, thereby removing the Digital Price Divide in Europe. This is however not very likely to happen, and it would require significant political initiatives. A neutral scenario would produce an annual price reduction of 10% for all markets, and therefore a continuation of the very unequal opportunities in different parts of Europe. In a pessimistic scenario there would be small price increases in the liberal markets, while the emerging and monopolistic markets would remain stable.

Traditionally research networks have been relying for national and international connectivity on the leasing of capacity, with the National Research and Education Networks (NRENs) and DANTE installing switches and routers and providing additional services such as DNS and security. This way of working makes them heavily dependent on the telecommunications markets as described above.

In principle, the current regulation allows NRENs to establish their own network infrastructure instead of leasing capacity from public network operators. There are various possible forms for this Do It Yourself approach:

- *Full ownership*: investments in fibres (construction costs) and expenses for operations and maintenance, as well as full ownership of transmission equipment.
- *Dark fibre*: leasing or buying a dark fibre. A dark fibre may come with amplification and regeneration where necessary, but the NREN can also choose to be responsible for those itself.
- *Direct access*: leasing or buying a wavelength connection.

In less-than-liberal markets the Do It Yourself (DIY) approach can offer NRENs an attractive alternative. In view of the market situation in some countries, some form of DIY appears to be the only feasible way forward for them to narrow the gap with the rest of Europe. Many financial, managerial, organisational and technical issues are involved here, but some countries (CZ, PL, CH) already have positive experiences.

The entire pan-European research networking infrastructure – including the campus, national, trans-European and intercontinental levels – is already to a certain extent a combination of leased capacity and different forms of DIY. It is to be expected that DIY will become more widespread, mostly at the local level (solving local-loop problems) and the national level, and especially in markets without transparent pricing. The way the pan-European infrastructure is acquired will therefore become more heterogeneous. There is also an interaction there with the heterogeneous technology implementations (packet-switching for many-to-many and the return of the circuit switch for very high-capacity traffic few-to-few) as described in the previous section.

5. Six strategic questions

The SERENATE findings and the discussions with the stakeholders lead us to six strategic questions:

1. What action, if any, do the NRENs need to take concerning the move from electrical transmission to optical transmission and fibres?
2. What, if anything, should be done about Europe's Digital Divide?

3. Does research and education networking have any political role to play in Europe's relations with the developing world?
4. Should NRENs become more inclusive towards other user communities?
5. What action, if any, should be taken by the research and education community as IT and network technologies assume an ever more important and integrated role in the whole process of delivering research and education?
6. What will be the future of the NRENs?

We will discuss these questions in the next sections of this note.

6. Optical transmission and fibres

NRENs should respond to the challenges described in section 3 above by investigating the opportunities offered by heterogeneous networks. It will be useful for them to participate in Grid projects to better understand the needs of those users. NRENs could also experiment with traffic segregation of heavy flows onto switched paths.

Where there are signs that prices in the (national) transmission market are excessive, NRENs would do well to experiment with one or more of the forms of DIY approach. If the market situation does not evolve in a positive way, they should plan to move to DIY solutions as production services.

It could be useful if a few NRENs together with DANTE would explore the extent to which a highly reliable and high-performance long-distance path can be created by joining segments of national fibres.

7. Europe's Digital Divide

Europe has a serious internal Digital Divide. The essential symptom of the Digital Divide is excessively high pricing for connectivity. The fundamental cause for that is lack of competition, which in many cases is due either to an out-of-date regulatory regime, or to the lack of political will to implement the (already legislated) changes. However, lack of competition can sometimes be due to essentially economic factors alone. Telecommunications operators wish to make a return-on-investment in a reasonable period, and look to invest in locations where they think that there is a strong market. We have noticed reluctance to invest in fibre infrastructure both in (small) peripheral countries without strong high-tech industry, but also in remote regions of the most prosperous European countries.

What can be done about the problem? The Digital Divide inside Europe must be better measured and monitored. In the absence of progress towards competitive transmission prices, the national, regional and local governments concerned (or the European Union) should take action to stimulate open access and hence competitive ducting and fibre supply. The European Commission should consider whether the regulatory regime should be adapted to ensure wide access to fibre infrastructure at cost-based pricing.

8. European networking and the developing world

Maybe unlike their US counterparts, European NRENs see research and education networking as an organisational and collaborative issue perhaps even more than as a simple set of technical and/or economic problems. This could probably give Europe a political opportunity to use its extensive experience in linking national networks together to extend its influence in the developing world. Obvious tasks are to help build up NREN expertise, to help build up regional groupings of NRENs, and to help such groupings to connect to the European research networking backbone infrastructure GÉANT. A political strategy needs to be agreed at EU level.

9. Including more communities

In quite a few European countries the use of the NREN is no longer restricted to research establishments and institutions of higher education. The user community in these countries may also include different kinds of schools, libraries, museums or government organisations. However, the communities that are served vary greatly from country to country: choices have been made and are still being made that are very much dependent on

national political decisions that go beyond research and education networking policy. For small countries, serving users outside research and higher education is essential to allow the NREN a critical mass that will enable it to acquire and maintain the some expertise in its staff that is more easily achieved by NRENs in larger countries. But the SERENATE case studies show that also in large countries using the expertise and possibly the infrastructure and services of the NREN can be a cost-effective solution to obtain high-quality networking facilities for educational, cultural and governmental institutions.

10. Integration of IT and networking technologies in the research & education world

The time is past that research networking and academic computing could co-exist as separate worlds. In this context, both geographic and disciplinary co-ordination will be important. Intensive and widespread co-ordination and collaboration is needed at the national level and at the pan-European (and probably global) level to ensure that all solutions that are adopted for Authentication and Authorisation allow mobility for students, teachers and researchers that is as easy and as transparent as possible. As Grid technologies emerge, decisions will be needed in each (sub)discipline on a range of “IT standards”, such as data storage conventions, metadata definitions, ontology definitions, recommendations for software libraries and tools, and community agreements for sharing data and computing resources. As always, it will be important to avoid taking incompatible decisions on these “standards” in different geographical areas.

Universities, NRENs and academic authorities need to collaborate closely to ensure that the AAA services that are put in place over the next few years interoperate smoothly across Europe. A large initiative is needed here, possibly to be followed up by a sizeable project in the 6th Framework Programme.

11. The future of the NRENs

Research networks are needed because of a number of reasons that remain valid. Research and education forms an international community where high-bandwidth applications have obvious potential. This community has expertise and interest to explore leading-edge products and is willing to accept that such products will sometimes be not fully reliable. It has a track record of helping move these technologies into widespread use. There are no signs that over the next 5-10 years the need for NRENs will go away. Rather the opposite.

12. Strategic recommendations

NRENs should give attention to the integration of regional networks into the chain NREN-regional-campus. Heterogeneous networks need to be investigated. DIY solutions may offer alternatives where prices in the (national) transmission market are excessive.

Universities and other research centres need to provide campus networks with serious ongoing investment of resources, including personnel.

The EC should assume responsibility for measuring Europe’s internal Digital Divide and monitoring progress in reducing it. Among others, the EC should assume responsibility for monitoring the availability and pricing of high-speed connectivity and fibres. It should continue to play the federative role that it has assumed over the past six years in enabling the interconnection of Europe’s NRENs.

In the ongoing presence of excessively high prices for transmission, national, regional or local governments should take action to stimulate access (and hence competitive) ducting and fibre supply.

Telecommunications operators should recognise that NRENs have no particular desire to build and operate their own transmission systems, but that they do have a reasonable understanding of the costs involved. They should remember that NRENs are potentially interested in various small and large collaborative projects that have the potential to bring major mutual benefits.