

Organising the Interconnection of National Research and Education Networks in Europe – a sustainable approach for the European Research Area

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1. Introduction and Scope of the Paper

This paper is written in the context of the EGI_DS project. EGI is dealing with Grid technology which is heavily dependant on high quality data networks. The paper does neither deal with Grid technology directly nor does it discuss technological strategies or operational issues of European networking. It is its main purpose to describe some of the economic and organisational problems, which had to be solved in order to roll-out successfully several generations of data networks for the benefit of the scientific, research and education community in Europe.

As the technological progress in networking is similar to other IT areas such as Grid-computing, the hope is that for EGI driven by Grid technology some experiences can be taken from the networking community. It is clear however that this is not a one-to-one mapping but things have to be adapted in a meaningful way.

The following paragraphs describe some background of pan-European networking and show the organisational and economic development of the European body before some weaknesses of the present set-up are discussed. Finally some references to the EGI_DS problem are tried.

2. Some Research Network History

Roughly two decades ago data networking became an interesting technology for groups of researchers doing their work in different locations. During the time before, this technology had been experimental although the potential was soon detected, but its "state of the art" was not sufficient to become an infrastructure. Since the early eighties of the last century in the US and in several countries in Europe activities started to develop national data network infrastructures for the research and education communities, they started with pilots and finally developed into a nationwide infrastructure – today such an infrastructure is called National Research and Education Network (NREN) and all of the NRENS provide a stable network service and often other services to universities and research laboratories in their country. Most networks have names, which do not always coincide with the name of the NREN. This reflects an ongoing technological development of any NREN: all NRENS provide their services - having their financial, organisational and local market options in mind - according to the highest possible technical standard.

It was clear from the beginning that a technical European networking overlay structure is needed to interconnect NRENS in Europe appropriately. The main tasks of this trans-European structure would be therefore to provide to the NRENS a European interconnect service and as much as economically meaningful worldwide connectivity. Figure 1 is showing these two technical tasks.

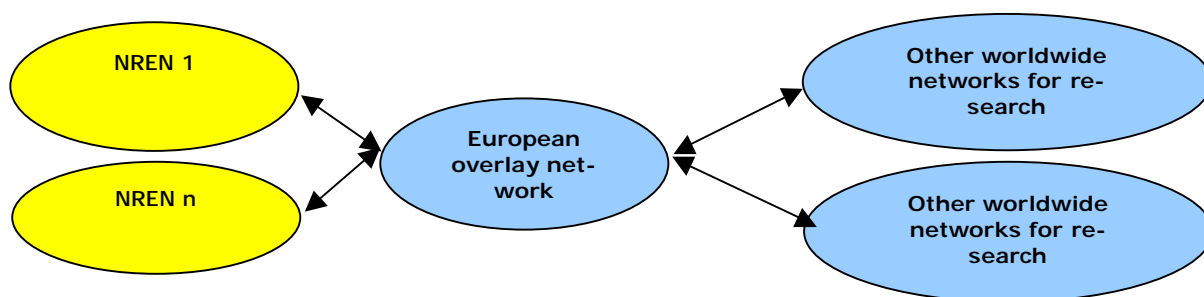


Figure 1: Main tasks (blue) of the European NREN overlay structure

It is clear that a European overlay network must also always follow the latest technological development in steps of several “generations”. In appendix 1 the topologies of some of the European network generations related to the technological development are shown; it reflects implicitly three lines of development:

- a) a technological development from 64Kbit/s- to a fibre (optical platform) based multi-10Gbit/s networks,
- b) important market developments which were initiated on the governmental and European Union level and which made the technical options reality and
- c) an approach by the NRENs to commonly organise networking on a European scale as well.

Today the combined NREN and European structure, which is named Geant2 and which is provided through the common European organisation DANTE, deliver indispensable services to their clients in Europe and contribute significantly, through new generations of the pan-European network, to the further development of the European Research Area.

3. The Organisational Background

When data networking developed to be a mature technology, which could be transferred into an infrastructure and when the first NRENs were created in Europe it became very soon clear that a cooperation between NRENs on the European level would be instrumental for reaching the NREN's goal: to serve their clients which were about to organise more and more of their research on an international scale. Therefore the organisation RARE was created already in 1985 although details of the cooperation were – due to the infancy of the technological basis – still unclear. Major organisational and financial findings were later elaborated within the Eureka project COSINE. This project started with the idea that a real pan-European network, which should be “owned” by the NRENs, had to be organised. This will be summarized in the following section.

The COSINE project was created in the mid eighties of the last century and was the first publicly funded infrastructure project for research data networks organised on a European scale. The project partners were NRENs from nearly all – during the project's lifetime mostly western – European countries and the project management Board, the COSINE Policy Group, was comprised by official ministerial representatives from the respective countries and in addition, not to forget, from the European Commission.

The work relevant for the topic under discussion was finally summarised in a report „Towards a Single European Infrastructure“ Final Report, January 1992; it was conceived by a task force on the establishment of the Operational Unit. This report is given in appendix 2. The main findings were:

- The basic economic / organisational concept build through the COSINE project is called today “federated approach”. This means that there should be one NREN per country and only one European entity responsible for the European overlay network and other services provision to interconnect national NREN provided data services. Moreover national and European activities in this field should mainly be organised in a complementary and collaborative fashion. This differs in a lot of aspects from other more centralised approaches, which were debated at that time. In several areas, a huge economy of scale effect made this organisational approach even more attractive. One prominent example of this kind, where an economic and operational benefit could be seen immediately was the link provisioning to the US research networks.
- The European entity DANTE is a direct consequence of the COSINE project as well. For a couple of reasons, most of them of economical or organisational nature, it was clear that RARE as the organisation carrying the COSINE project organisation couldn't be used as the organisation for service provision after COSINE's end. The

problem therefore was to organise a sustainable framework, i.e. to create a new organisation, which could fulfil this task. This organisation was named Delivery of Advanced Network Services in Europe (DANTE) and is a success story as it still serves the same general goals although it had to adapt to upcoming new technologies, ongoing technical challenges and, especially in the beginning, a bigger economic challenge. DANTE still serves European NREN's needs by providing the overlay network to the NRENs on behalf of the NREN consortium and DANTE is acting as the coordinator for the NREN consortium in the EU framework programs.

The main achievement of the COSINE project was, that it created a stable environment for collaboration in the technical, the economic / organisational and the political / public financing domain. It was by no means trivial that such an achievement had been made: already the size of the NRENs in Europe – as the countries – is very different. There are smaller and bigger NRENs and the organisational set-up of each NREN has always been adapted to country needs and there are not very many similarities in the formal organisation between single NRENs in Europe. However the whole construct is now working for more than 15 years and it has made constructive use of dramatic technology changes and changes in the communication market through deregulation and even survived the turmoil on the Internet economy at the end of the nineties without any damage.

The crucial element of the COSINE project was that it brought together people from NRENs, who shared already common ideas, with official representatives of country ministries and the EU. The official representatives were forming the COSINE Policy Group. During the project – and especially due to some individuals, on the policy level two names have to be mentioned: Peter Tindemans from the Dutch ministry and Horst Hünke from the EU – the project developed into a platform to create a common view how research networking in Europe should be organised and how policy for networking should be set in place. It is a remarkable result that after COSINE finished, the (further) development of policies for research networking was left to representatives of NRENs and no longer directly to ministerial people. The formation of the NREN Policy Committee (NRENPC) was done immediately after the project's end and the NRENPC is still then the decisive body for all strategic and policy problems in European networking. It governs for example all project consortia which were since then built in order to organise EU / NREN funded projects to build the European overlay network generations.

Directly after the end of the COSINE project the EU has taken this important responsibility – as part of their technological programs – for pan-European research networking.

4. The Creation of DANTE and its Development (economic perspective)

It is clear that the creation of an NRENPC is necessary but not sufficient for the deployment of network generations: it is the common (legal) body, DANTE, which is the vehicle to implement strategic decisions of an NRENPC. The following paragraph focuses on economic and organisational issues of that approach. It mainly makes use of the findings reported in appendix 2 but it gives some numbers how things developed since the report was published.

The most important general step in the creation of DANTE was the idea to have a commonly owned pan-European backbone; for further details see paragraph 2 of the report in appendix 2. Together with some other services the report describes the so called "business case". In the report this is called "Business Plan", documented in its annex 4.

Moreover several organisational options were checked, the final recommendation was to create in one of the European countries a private, not-for-profit-distribution and preferably tax-exempt status company according to the national law of that country and the company should be governed by shareholders (NRENs only!) who own shares according to their size. The reasoning for creating a private company is given in paragraph 3 of the report; the most important reasons were that DANTE needed a certain capitalisation and

that this approach is the easiest way of implementation. It is noteworthy that since then only a few specific deficits of that general construct have come up, which will be dealt with later – this is by no means trivial because most NRENs in Europe which are the constituency of DANTE have strong ties to the public sector. DANTE being a not-for-profit-distribution company is pivotal to that issue. It is obvious that rules for the governance of the common company have been developed as well (see paragraph 5 of the report in appendix 2) and finally some specific considerations have been made about financial issues of DANTE.

The following table summarises the financial development of DANTE since then. It gives on a yearly basis the turnover, the cost of sales (which are all bought on the market through public tenders), the administrative expenses (i.e. all expenses necessary to cover costs of the establishment at DANTE's seat in Cambridge (UK)) and finally the surplus. The expenditure of DANTE has to be matched by income. The income for most services is coming from the NRENs and from EU subsidies provided through projects like GN2, normally the EU subsidies cover around 50% of the backbone expenditure.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
BB capacity	2M	2M	8M	34M	155M	155M	622M	2.5G	10G	10G	10G	10G	N*10G
turn-over	5.9	8.1	18.1	35.0	49.5	43.4	43.1	46.7	51.1	48.5	48.9	46.7	55.8
Cost of Sales	4.5	6.5	16.4	32.8	47.2	41.2	41.0	45.2	48.7	45.8	45.4	43.2	52.2
Admin. Exp.	1.2	0.8	1.3	2.0	1.6	2.4	2.4	2.5	2.6	2.7	3.8	3.9	3.9
Surplus	0.4	0.9	0.6	0.4	0.9	0.3	0.4	0.4	0.2	0.2	0.2	0.3	0.7

Table 1 : Financial development of DANTE 1994-2006 (all figures in M € rounded)

One problem must be mentioned as it played a bigger role in the beginning of DANTE's life: the capitalisation of DANTE. The question was: how much capital is needed to implement the business case (i.e. mainly the pan European backbone provision) without a financial collapse during a financial year. The need to have capital for the operational purpose was clear and the actual number has been derived from the business plan (see appendix 2, annex 4). Actually every year DANTE provides its owners (i.e. shareholders) with a yearly budget plan which contains a cash flow analysis as well and which solves this problem. A typical cash-flow analysis for DANTE's first year is given in the report in annex 4. Such a cash-flow analysis is done for every yearly budget, which is decided in the DANTE Board since then. Without the shareholding capital, which was in the order of 1 M €, without some public funds received through the COSINE project and without slowly building operational reserves, the process of moving the turnover from ca. 6 M € in 1994 to roughly 55 M € in 2006 would not have been possible.

5. Weaknesses of the DANTE Shareholding Model

The main weakness of the Shareholding model of DANTE is its limitation to NRENs which are already Shareholders. As reported above the main driver for the construct were the ministerial people which developed their view within the COSINE project. After COSINE was finished it became more difficult to convince people in ministries of non-member countries that the construct (company limited by shares) is a useful construct. Fortunately in the beginning most active NRENs were in DANTE – and in so far the capitalisation target could be met – but especially NRENs from middle and eastern Europe have now difficulties to join as they are in most cases bound to strong public rules which in some cases make a formal joining of DANTE as shareholders impossible. NRENs have successfully used the construct of the project consortium to overcome these difficulties, however mainly two items are not solved in a satisfactory way: the duplication of management bodies and the problem of ownership of project related assets. The duplication of management issues is reflected in two bodies, the parallel existence of a (project-)

Executive, elected by the NRENPC and the DANTE Board, elected by the DANTE Shareholders. There is an overlap by members of these bodies, however this is not an ideal construct. Moreover assets gained through a project like GN2 (for example DWDM devices or long term fibre contracts) are formally "owned" by DANTE, as DANTE holds all contracts on behalf of the consortium.

There is presently a discussion to change DANTE's formal status from a Shareholding company to a company limited by guarantee. This is a possible option according to UK law and would overcome the two deficits. Presently the DANTE Shareholders have come to the conclusion that this would be a better option for the next years and discussions with the (15 out of 30) consortium members, which are not formal Shareholders of DANTE have started.

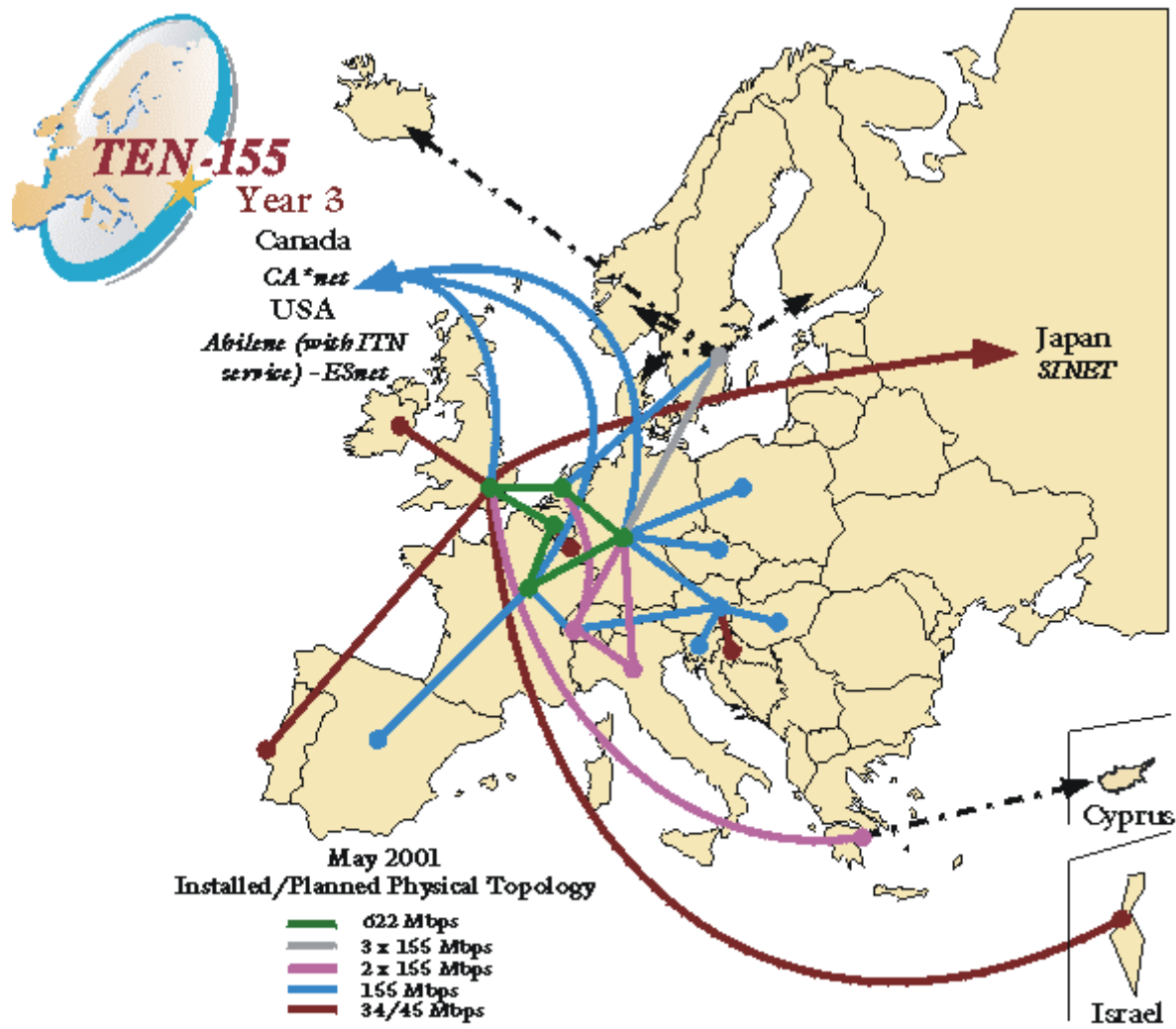
6. Two Conclusions for EGI

- (a) The main work for EGI has to be invested in the elaboration of the "business case", the first step to such a business case or business plan development is called within EGI "use case definition for EGI". This has a very concrete economic background: from the use cases the service portfolio of EGI including a (finally) financial estimate of the associated costs must be derivable. This is not a political exercise but very practical and must finally result in a consensus about what the future EGI should do for the NGIs. The network counterpart has been described in appendix 2 in the paragraphs 2, 6 and 7. The main issue is the definition of an EGI (i.e. common) operational footprint. This can be co-ordination only (as one extreme) or a full blown operation including EGI owned (in a formal sense) resources (the other extreme) or something in between.
- (b) The definition of the organisational set-up is then the next step. Comparisons to the networking approach can be found in paragraphs 3, 4, 5 and partially 7 of appendix 2. Experience in the research network world would prompt to follow a pragmatic approach.

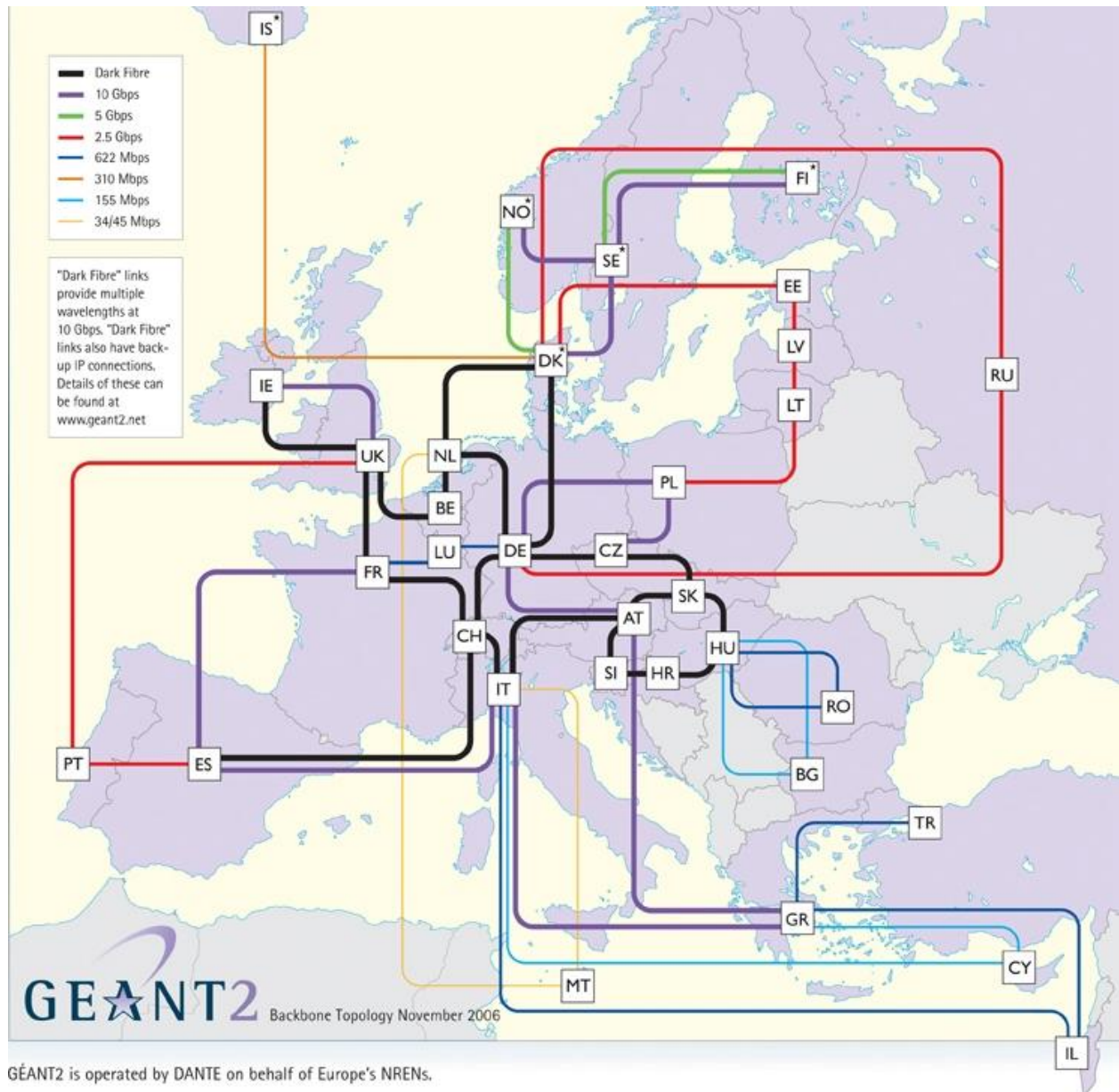
7. Summary

The NRENs in Europe have with constant financial support of their home countries and the European Union developed a scheme for collaboration which produced a leading edge networking infrastructure for research and education community in the European countries. DANTE, which is owned by NRENs, plays a pivotal role in that arrangement in both (overlay-) network provision and co-ordinating partner for NREN consortia over several generations of pan-European projects. Many ideas how to organise such a collaboration are not restricted to networking only but they may be applied to other collaborative forms such as Grid computing. In so far this report hopes to make a constructive contribution to the EGI_DS project.

The TEN-155 Backbone (1998-2000)



The Geant2 Backbone (2006-...)



GEANT2 is operated by DANTE on behalf of Europe's NRENs.

**Appendix 2: “Towards a Single European Infrastructure”, Final Report,
January 1992**