

NREN's – The Economic Benefits.

1. Introduction

There are many reasons why a country should create a specialist service organisation to develop and manage ICT in its Research and Education community. Most countries have established a National Research and Education Network (NREN) to provide this capability. As well as the obvious benefits, in terms of pooling of expertise, gaining access to advanced technology etc., achieved by creating a national centre of excellence via an NREN, there are also economic benefits to be achieved. These come principally from cost savings achieved through centralising procurement.

There are other economic benefits that an NREN can bring to a country. These derive mainly from the expertise that an NREN can bring as a sophisticated purchaser of services. ICT services are notoriously complicated to purchase. This is especially true in more monopolistic markets where suppliers do not experience the requirement to justify value for money. There are two areas where NREN expertise can be of particular value:-

- i. As a knowledgeable procurer of services. Quality of telecommunications services is a difficult parameter to evaluate. Much depends on the capacity of a network related to the load that it carries. The ability to understand and quantify these factors, and to make rational purchasing decisions based on this knowledge is an important skill that an NREN can contribute.
- ii. As a barometer of market competitiveness. The equipment that is used in constructing telecommunications networks is available from a relatively small number of global suppliers. The equipment market is transparent and very competitive. The input costs for telecommunications service providers are, therefore, broadly similar. There is nevertheless a huge variation in the cost of service as offered to the consumer. This is almost entirely due to lack of market competition. As an independent and knowledgeable purchaser of service an NREN is in a unique position to advise government on the efficiency of the market for telecommunications both nationally and internationally.

All these points, where an NREN can contribute to national value, are considered in more detail below.

2. Better Value through Procurement

Telecommunications is a business characterised by very high fixed cost investments and relatively low marginal costs. The biggest single cost element in any wide area network is the transmission infrastructure, (the pipes that carry the data). In a typical network Transmission will represent typically, at least 70% of the total network cost. Looking at building a transmission route, most of the cost will be in the physical construction of the route. The difference in cost of installing a 96 pair cable, as compared with a single pair cable, will be relatively small when compared with the overall cost of the route.

Transmission systems are designed to carry the aggregate traffic on a route. Thus, the capacity of a transmission system will generally be hugely larger than the size of an individual data stream. A fibre will carry multiple wavelengths and each wavelength will be broken down into smaller, more manageable, elements of connectivity. The creation of this 'hierarchy' involves investment and, the lower down the hierarchy, the more the investment. Thus, a 155Mbps capacity connection will be derived from a 622 Mbps capacity connection and so on until you reach the basic transmission building block, which, these days, is a 10 or 100Mbps wavelength. The extra investment in creating smaller blocks of connectivity is reflected in their cost. There is a fairly standard relationship between the cost and capacity. Figure (i) below shows this relationship, evidenced by many years of European procurement. Figure (i) shows that the cost, per Mbps, for a 155 Mbps circuit is roughly half the cost, per Mbps, for a 34Mbps. Likewise a 10Gbps circuit is a factor of fourteen cheaper per Mbps than an equivalent 34 Mbps.

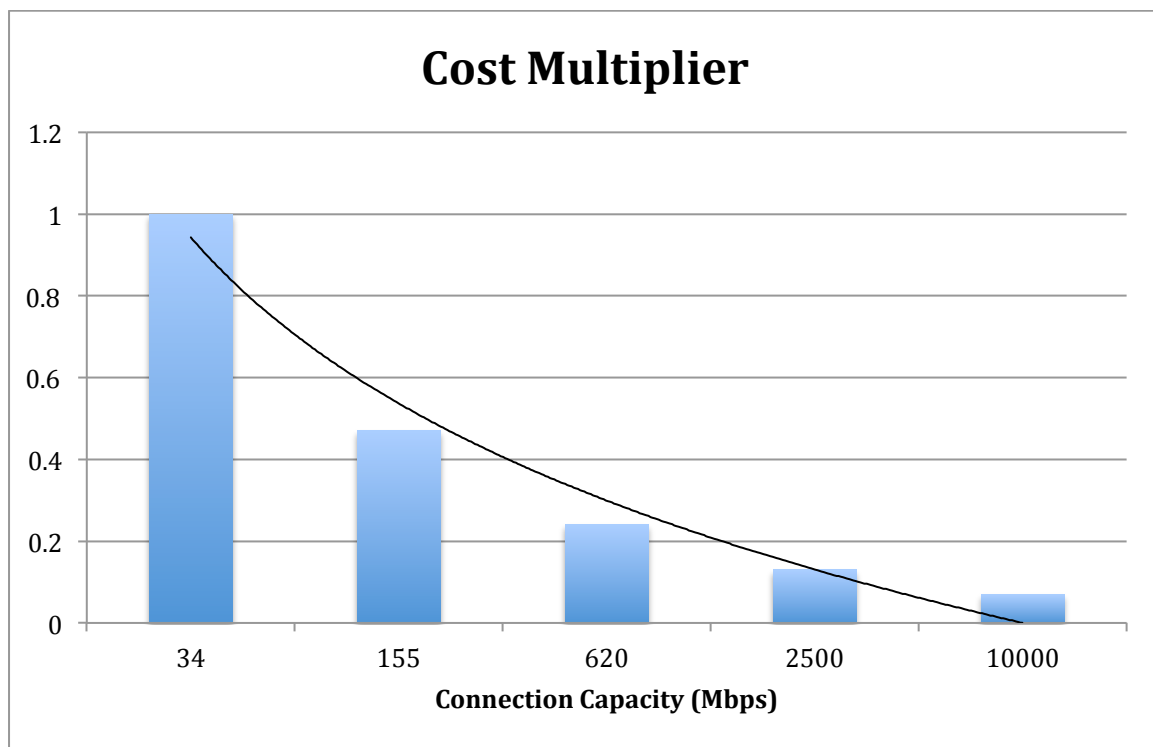


Figure (i) relationship between Cost and Capacity of Transmission

Figure (i) illustrates the economies of scale that can be achieved by aggregating demand. It shows that, by bringing together demand, it is possible to acquire the higher capacity connections needed to support such demand significantly more cheaply. As noted above, Transmission costs represent in 70% of the total costs of a network. The ability of an NREN to aggregate demand, as opposed to having individual institutions separately purchasing connections, represents major potential cost savings. These are achieved by exploiting the economies of scale identified above in a way that is impossible for an individual institution to achieve.

3. Assuring Service Quality and Value for Money

Telecommunications Networks are based on the principle of sharing facilities. It is completely unrealistic to consider a direct connection between all connected parties. As a consequence the main way of defining value for money, as far as a network is concerned, is the level of resources available for sharing.

Sharing is defined by two aspects:-

- i. **Access Network.** Multiple network users will share a common access to the core network. The number of users sharing an access (the contention ratio) is an important component in defining the quality of a network.
- ii. **Core Network.** The core network is shared by all users of the network. The performance of the core depends on the level of simultaneous usage. As usage increases for a given-sized core, so to does delay and data (packet) loss.

Networks are normally priced simply in terms of Access speed. Since network usage is time dependent (most usage will occur during common periods of the working day) it is important that the network capacity is dimensioned to cope with traffic when the network is most heavily loaded. Since network capacity is primarily defined transmission capacity, and this represents the bulk of network costs, there is a strong temptation for commercial suppliers to limit network capacity, defined by access speed. This will enable them to compete on cost of access, a simple comparison to make. The quality of a network, which is a much more difficult, but also the most relevant comparison, is much harder to make as it is determined by the capacity available when the network is most heavily loaded.

There are well-understood models of the way that a network performs under load. Figure (ii) below shows the basic model. It illustrates that, as network load increases so to does the delay in transferring data.

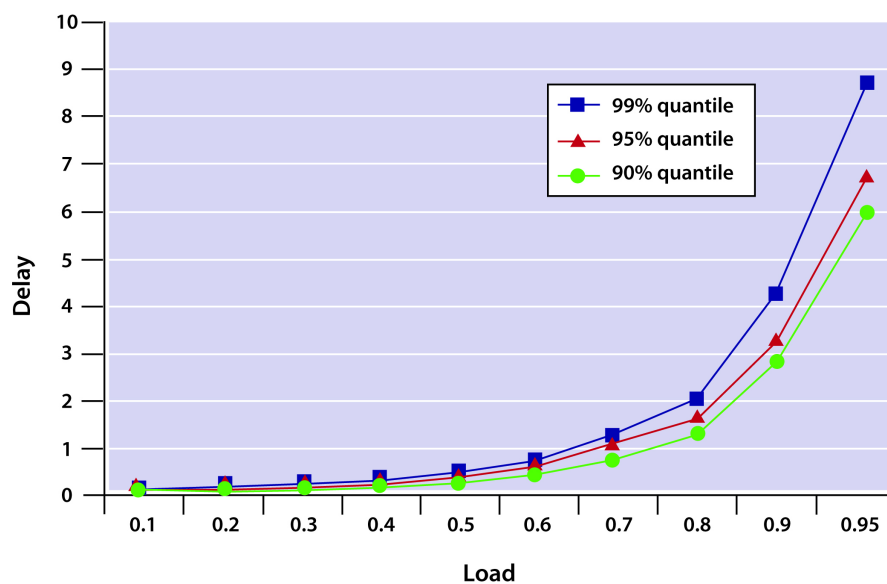


Figure (ii) Relationship between Network delay and Loading

Network delay is also important because, as it increases, there is also an increasing tendency for data to be discarded, a phenomenon known as 'packet loss.' Packet loss is doubly destructive. It either leads to the loss of information or to a requirement to re-transmit lost data leading to additional network load. It can be seen from Figure (ii) that, above a peak network loading of 60% performance degradation becomes a real problem. This all shows that it is dangerous to rely on simplistic price comparisons particularly as the incentives to under-dimension networks, when compared with their maximum load, are extremely large.

An NREN has a key role in ensuring that the quality of service offered represents value. This requires the technical knowledge of networks and the ability to measure actual performance.

4. Assisting Government to Achieve an Efficient Telecoms Market

An NREN represents a knowledgeable purchaser of telecommunications. It, typically, does so from the position of an advanced and demanding user of service. Its users will generally have demands ahead of the commercial market place. As such an NREN is in a strong position to act as a barometer for the competitiveness of the relevant telecommunications market. The experience of DANTE in Europe is a very relevant example. In 1993 when DANTE was established the international market for telecommunications in Europe was, essentially, provided by a set of co-operating monopolies. Prices for connectivity were uniformly high. Access to capacity was restricted. As a comparison, in 1993 the maximum circuit capacity available was 2Mbps. In contrast, in the USA a more open market, 45Mbps was available at significantly lower prices. This had strongly negative effects on the development of pan-European research networking. DANTE lobbied the EC about this unsatisfactory situation.

Liberalisation of the European market for international telecommunications started in 1997 and gradually had a significant effect on the competitiveness of most of the international telecommunications market within Europe. DANTE's procurement activities within this market represented a good way of assessing the reality of liberalisation. Figure (iii) below shows the development of prices in Europe over the period

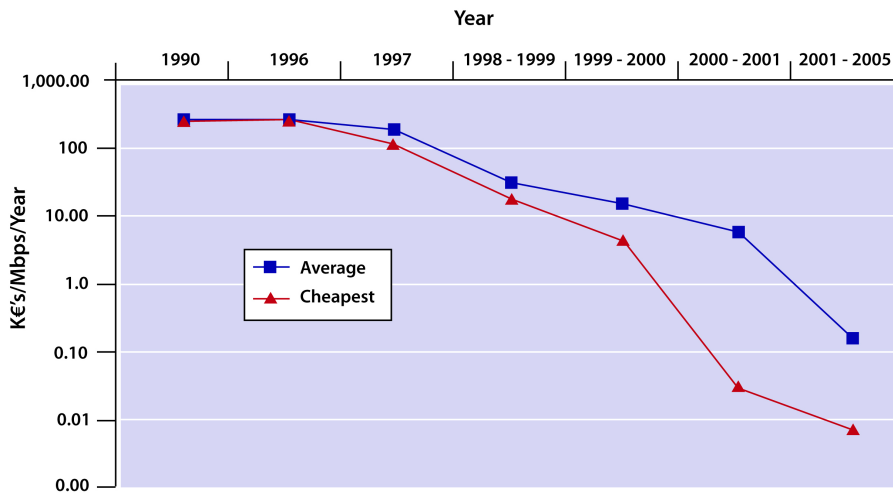


Figure (iii) Bandwidth cost evolution of the pan-European research network (log scale)

It shows the development of the cost of core network capacity expressed as K€'s/Mbps/year (The annual cost of a connection divided by its capacity) derived from a series of European procurements over a period of approximately 15 years. The average cost represents the average across the whole procurement; the cheapest cost represents the best price at which connectivity was acquired. The effect of liberalisation from 1997 onwards is clearly seen, as is the dramatic reduction in the cost of connectivity over the period. These figures were used as an input to the EC to help measure the effects of policy.

They illustrate the role that an NREN can play in encouraging the development of a competitive market in telecommunications, which is vital for economic development. Government needs a centre of expertise, independent of the major service providers in the marketplace, to evaluate and lobby for competitive service provisioning. ICT services are recognized as being a key to economic development. This will be especially true where markets are uncompetitive. An NREN, both as a procurer of advanced services and also as technically skilled organisation is the natural partner for government in ensuring national competitiveness in ICT.