Casestudy

Eindhoven, leading in technology

On the fibre-optic networking of a city

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ABSTRACT

Since 2000, broadband[1] has been high on the political agenda in the Dutch city of Eindhoven. Following the publication of the policy memorandum *Glasrijk Eindhoven* ('Fibre-Rich Eindhoven'), the development and deployment of a fibre-optic infrastructure there has been proceeding apace. A working fibre-to-the-home network serving about 7000 households has recently been completed. In September 2005 a dark-fibre network more than 90 kilometres in length for businesses and other organisations enters service. Both of these initiatives are on the verge of upscaling. So now is a good moment to reflect upon the role of a local authority in the 'fibre-wiring' of its community. This article concentrates upon the development of the infrastructure and less upon the services it carries. For regular readers of *IT Management Select*, the article is of interest in the context of the commercial use of such an infrastructure and because it opens up opportunities for the supply of broadband services.

History

On 13 July 2000 the Eindhoven region won the national Kenniswijk ('knowledge community') competition (see boxes). That firmly placed broadband, including an infrastructure based upon fibre-optic technology, on the city's political agenda. Jointly with the local authority in nearby Helmond, Eindhoven began work on a policy memorandum on creating a broadband infrastructure. Published in mid 2001, that outlined a vision, ambitions and an implementation plan. Due mainly to unfavourable market conditions, subsequent developments were very slow. The launch of a demand-stimulation subsidy scheme by the Kenniswijk Project in 2002 did not really start to speed things up again either. At the end of 2002 a consortium of four commercial organisations began a pilot project to provide 800 homes with a fibre-optic connection and asked the local authority for a financial contribution. That request was granted at the same time, forcing the authority to hone and augment its earlier policy memorandum. In particular, this was necessary because the dominant paradigm up until that moment had been the notion that the driving force in developments would be the market, with the local authority not being asked for financial contributions and retaining relatively limited control.

Policy: 'Fibre-Rich Eindhoven'

On 22 September 2003 the City Council adopted a new broadband policy memorandum entitled *Glasrijk Eindhoven* ('Fibre-Rich Eindhoven'). Amongst other things, this defines the local authority's vision, ambitions, policy principles and role in implementation. Below we summarise the policy as it then stood, about two years ago now.

Considering the socio-economic importance of broadband for the city and its residents, the local authority formulated the following *vision* for the creation of a broadband infrastructure in Eindhoven:
'The City of Eindhoven recognises the importance of broadband infrastructure for the city and the region. The presence of a good communications infrastructure enhances the *city's appeal as a business location*, and a place to live and study.

'Since such an infrastructure can be expected to *encourage technological activity*, in particular, it will be a major stimulus for the local and regional knowledge economy. It is also to be expected that attracting highly-skilled workers will have a positive impact upon employment in other sectors, such as services, hospitality and retail.

'Moreover, connecting all the city's residents to a high-quality infrastructure will make a major contribution towards *enhancing and improving social cohesion, community participation and quality of life*. It can also *prevent* a so-called *'digital divide'* appearing.

'Finally, such an infrastructure will *contribute towards the region's 'high-tech' image* and help Eindhoven profile itself as 'leading in technology'.'

This has led to the following *ambition* being formulated:

'The City of Eindhoven will make an active effort to ensure that, in principle, all its residents and all the companies and organisations within its area have access to a high-quality broadband infrastructure based upon fibre-optic technology by 2010.'
Based upon the vision defined and upon a number of assumptions and experiences, a nine-point set of policy principles was formulated. This is based upon the so-called broadband layer model, as shown in Figure 1 (see also the boxed explanation).
To ensure open access to the network and its services, Eindhoven believes that the different layers should be operated separately as far as possible. In respect of its own position in the passive layer, the local authority has defined the following principles.

- The local authority regards the passive fibre-optic infrastructure to homes, businesses and other premises as monopolistic in nature. The City of Eindhoven is therefore entitled to intervene actively in respect of such infrastructure in its area.
- The City of Eindhoven will make an active effort to achieve the construction of a passive network based upon fibre-optic technology. Its principle activity in this respect will be to create sound investment opportunities. Natural partners will be sought in order to broaden support in this regard.
- The new passive infrastructure will be open and accessible to third parties wishing to offer services using it. The access conditions and fees must not discriminate in any way. Maximum competition in the use of the infrastructure will be sought.

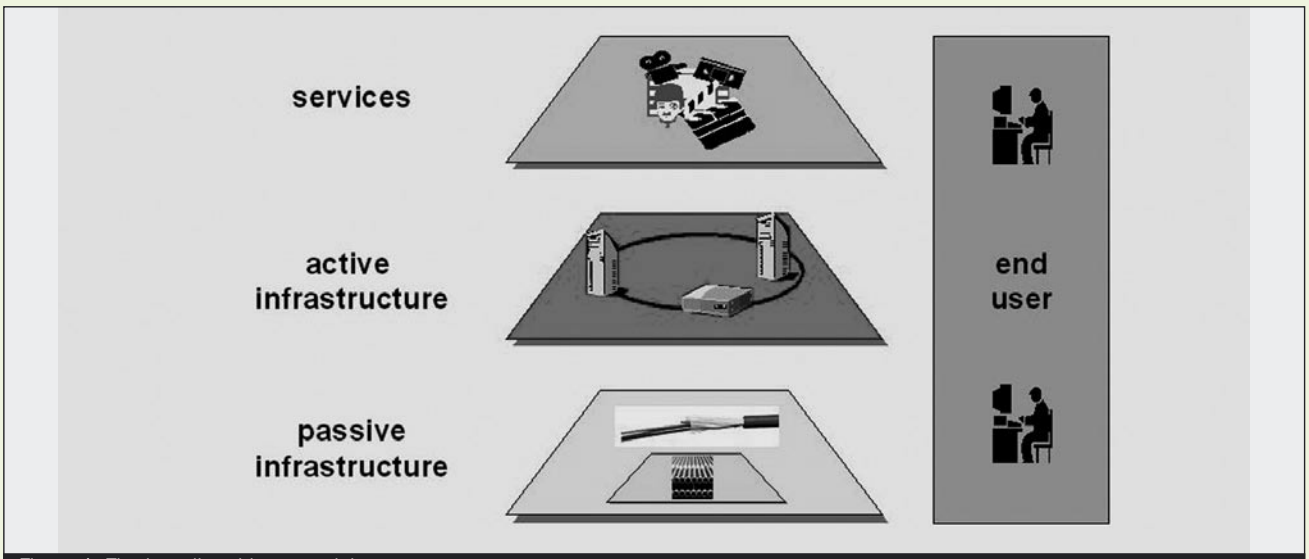

Figure 1. The broadband layer model

- The infrastructure will at least cover the entire Eindhoven local authority area.

These principles correspond very closely with those contained in the Broadband Manifesto published recently by the eleven Dutch towns and cities which make up the Stedenlink network. In that they list ten 'building blocks' for broadband policy, based upon their own practical experiences (Stedenlink, 2005). It needs be remembered that the interests of existing market players are often at odds with the creation of new utility-style broadband infrastructures of the type being described here (see also www.oplan.org and Matson, 2004). Initiatives of this kind therefore tend to evoke a strong response.

Given the policy principles it has formulated, the City of Eindhoven sees its own role in *achieving* its broadband ambitions as developing both the demand and the supply side. Its underlying rationale in developing *demand* is to create an attractive environment for investment by market players in broadband. In this respect, the priorities it has chosen include the following.

- Bundling demand for broadband within its own organisation and by its partners in the public, not-for-profit and private sector.
- Encouraging broadband demand by local companies.
- Supporting residents' initiatives in respect of the demand for broadband.
- Developing electronic broadband services from within the local-authority organisation (the authority as 'launching customer').

Despite initiatives to combine demand and the Kenniswijk Project's demand-stimulation subsidy scheme, by September 2003 no commercial player had come forward on its own initiative with any proposal to construct a large-scale fibre-optic network at its own expense and risk and within a foreseeable period. As a result, the local authority decided that – with a view to the practical public interest – more active involvement on its part was required. It has therefore defined the following priorities on the *supply side*.

- Encouragement to the establishment of a broadband enterprise. The local authority itself will make active efforts to ensure that an enterprise or development corporation is formed to take on the construction and operation of a fibre-optic infrastructure in Eindhoven, particularly over the proverbial 'last mile'.
- Acquisition of its own fibre-optic hardware. Directly commissioning the construction of a fibre-optic infrastructure in a particular area is the most direct way to stimulate supply. The ultimate intention is not that the local authority build, maintain and operate a network itself. But in the transitional phase pending formation of a broadband enterprise in Eindhoven, this has become a very real option, albeit on a temporary basis only. And one which is receiving more and more support. As Mark van der Horst, a pro-market member of the Amsterdam City Executive, put it, 'The market has to be encouraged to do things itself. If I have to correct a bit of market imperfection temporarily in order to give Amsterdam real broadband, then I will choose to do so.' (M&I/PARTNERS, 2004.)
- Research and support policies. In this respect, the local authority is investigating possible additional sources of funding and how it can further encourage the integration of broadband into its own regular processes and those of its partners. The objective here is to create conditions under which broadband can be rolled out effectively and, as far as possible, to remove barriers to that process.

Naturally, the local authority has to comply with the applicable legislation and regulations in all the activities it is involved in. Relevant items in this respect include the European rules on state aid and competition, as well as the national Telecommunications Act. Some of the authority's activities are outlined in more detail below.

Bundling demand of companies and other organisations

Immediately after adopting the 'Fibre-Rich Eindhoven' policy, the local authority acted to revive and take the reins of an earlier, at that moment dormant initiative to bundle demand for broadband. Its aim is to achieve substantial savings compared with a situation in which each participant acquires broadband separately. At the end of 2003, similar initiatives in places like Leeuwarden, Arnhem and Nijmegen had already shown that this model works.

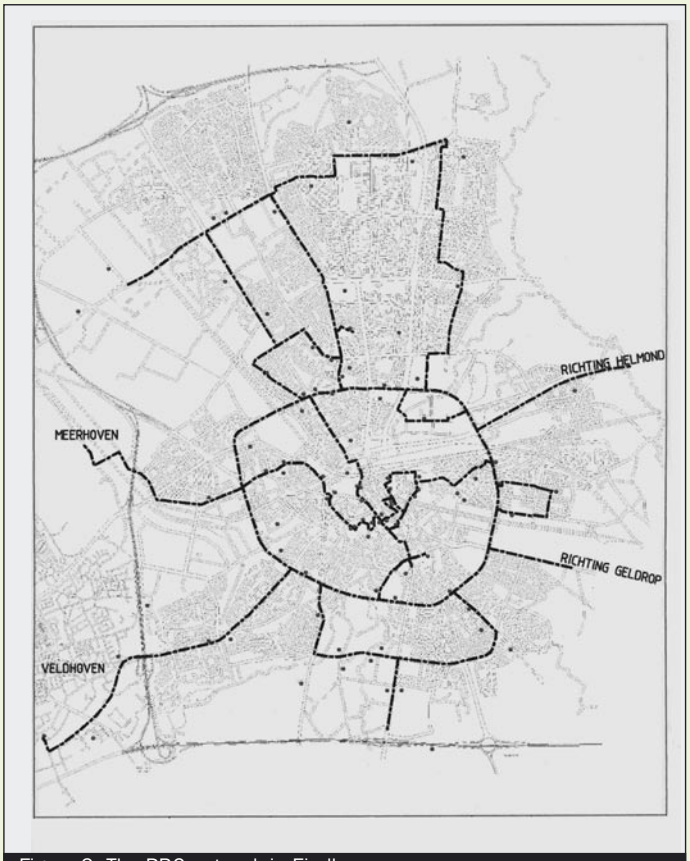

Figure 2. The RBC network in Eindhoven

The working title of the initiative is the South-East Brabant Regional Broadband Consortium (RBC). Following a founding meeting in November 2003 and a European tendering procedure during the first half of 2004, the agreement with the contractor was signed in January 2005. The network will become fully operational in September 2005, with more than 100 locations being connected to a total of 90 kilometres of fibre-optic cable. Figure 2 shows the network as it is being constructed in Eindhoven itself.

The participants in the RBC are together building a so-called 'managed dark-fibre' infrastructure; that is, one equivalent to the passive infrastructure shown in Figure 1. Combining efforts at this passive level makes the most effective contribution possible to the separation of layers which, as described above, is one of the basic principles of the network's design. As many organisations as possible were encouraged to connect as many of their locations as possible to this infrastructure. As well as generating the volume needed to make the network economically attractive to participants, it also enabled the creation of a backbone structure which covers as much of the city as possible and can contribute to the local authority's fibre-to-the-home (FTTH) ambitions alongside the RBC initiative itself. In the end, it was decided to build two separate networks simultaneously over the same trajectory: Managed Dark Fibre 1 for RBC and Managed Dark Fibre 2 for FTTH.

All the founding participants have become co-owners of the infrastructure. This direct ownership option was preferred over a model under which the network was leased. The primary reason for this was that existing market parties were not prepared to attractively lease out dark fibre, since it would put pressure on the margins from their traditional bundled services. Today, in mid 2005, the market has changed to such an extent that the Netherlands' first carrier-owned combined-demand projects are now under way in Almere, Breda, Deventer and elsewhere. A second reason was that the local authority, in particular, wanted to retain as much influence as possible over the process given its ambitions for an FTTH infrastructure.

In bundling demand, primarily public-sector organisations were approached in areas as health, education, government and housing. Also a number of selected companies were contacted. The fact that four general hospitals joined the initiative at an early stage was a particularly important stimulus at the regional level, extending the network to the neighbouring villages of Geldrop-Mierlo, Helmond and Veldhoven. The hospitals plan to use the network for such activities as the sharing of radiological and cardiological images and, at a later stage, for more far-reaching co-operation in the field of ICT. The key advantages for most participants are that bandwidth is no longer a restricting factor and that additional costs associated with increasing capacity will now be negligible. This will enable ICT facilities to be organised efficiently in the short term and opens the way to the introduction of a wide range of new applications in the medium term.

Organisationally, the RBC has now been divided into two legal entities: a non-profit foundation, the Stichting Glasrijk, and a limited company, Breedband Regio Eindhoven BV. The original participants in the initiative, also known as the 'founding

fathers', are all members of the foundation, which in turn owns a priority share in the company and so has a decisive say in a number of areas of its decision-making. Both the backbone and the individual branches of the network are owned by the company. The following apportionment key applies to participation in this BV's capital: (i) contributions towards investment in the backbone are proportionate to the number of fibres used within it; (ii) the participant pays the full amount of the investment in the branches from the backbone to its own locations. Operational management of the network has been outsourced by the company to NRE Netwerk BV, the operator of the regional gas, water and power infrastructure.

For more information about the RBC and demand combination, visit www.breedbandregioeindhoven.nl.

Fibre to the home

With the local authority's involvement in the RBC, an important aspect of Eindhoven's broadband strategy has been achieved: the ability to connect large companies and other organisations with a need for 'dark fibre', as well as the creation of an open network within the city. This, however, serves only a limited number of users. For smaller businesses and domestic users, additional measures are required.

For home connections, the local authority entered into a dialogue with the housing corporations in Eindhoven. The starting point for that was the 'Fibre-Rich Eindhoven' policy. As a result, on 23 June 2004 the City of Eindhoven signed a joint letter of intent with the housing corporations Hertog Hendrik van Lotharingen (HHvL), SWS, Trudo, Domein and Wooninc to launch the project Start 5000+ and to connect more than the 6000 homes to a fibre-optic network within a year. This represented a breakthrough. In the years before fibre-to-the-home development in Eindhoven had been limited to two pilot complexes set up by the Swedish company Bredband in 2000 and the Pilot-800 project mentioned earlier, which was completed by a consortium of four market parties in 2002. Since then, talks had been held with many new and existing commercial organisations.

The five Eindhoven housing corporations, which together own about 50 per cent of homes in the city, view the project as offering important opportunities to help achieve their own visions for the future. As the press release of 23 June 2004 puts it, 'The fibre-optic infrastructure brings new possibilities within reach to serve their customers with countless new products and services at an affordable price. The investments in fibre-optic are future-proof, value-guaranteed and innovative. Residents are being given the chance to make their own choices. Not just in standard services such as TV, telephony and the internet, but also in such things working at home, studying at home, receiving care at home and so on.'

Shortly after the letter of intent was signed, the Ministry of Economic Affairs decided to extend the Kenniswijk demand-stimulation subsidy scheme by six months, to 1 July 2005. To qualify for a subsidy under the scheme, connections had to be operational by that date.

During the summer of 2004, it was decided to approach Start 5000+ using the Ons Net ('our network') model which had been rolled out successfully in Nuenen earlier in the year (see www.onsnetnuenen.nl and Be_linked, 2005). The initiative for that came from local housing corporation Helpt Elkander, owner of about 1100 homes, and Close the Gap. Ons Net is a co-operative association which the residents of an area, both tenants and owner-occupiers, can become member of an individual basis. The co-operation then buys shares in the network operating company, Netwerk Exploitatiemaatschappij BV (NEM), thus acquiring a say in its activities. NEM is responsible for the construction, management and maintenance of the passive and active layers of the network. It also makes sure that services are actually offered over the network.

The introduction of the Ons Net model is no quick fix. Considerable effort has been put into creating broad support amongst residents, the network's future users. Methods used include the formation of a 'focus group' of residents and the appointment of so-called ambassadors drawn from the community's informal leaders. This 'warm' approach, creating a feeling of 'belonging' to the project, has resulted in a participation rate of 97 per cent of the population in Nuenen. In the first year, they all receive free inter-

net access with a capacity of 10Mbps (symmetrical). Telephony, with free calls to other Ons Net members, has also been introduced and has achieved a penetration rate of over 60 per cent. Radio and television will follow later this year. In parallel with this, community services are being prepared – for example, church services on video and the chance to watch the local football club's games via the local video server.

The City of Eindhoven was very pleased with the choice of the Ons Net model for its Start 5000+ project. This is because residents' interests are an inherent part of the model. It creates an open network for all service providers, an openness which will be demonstrated in practice in the near future. Moreover, the model's zoned approach means that the network reaches every front door within the coverage area: there is no 'cherry picking' involved. And this choice means that no further financial participation is required on the part of the local authority. Despite the fact that the authority has a fairly limited role, it remains an important one. Particularly in providing endorsement for the initiative to the various stakeholders. The local authority also played an important role in facilitating the necessary excavation permits.

More than 6000 homes in the Tongelre district of Eindhoven have now been connected to the network (see also www.onsneteindhoven.nl). This is an area with a relatively high proportion of ethnic-minority residents. More than half of the homes there are owned by housing corporations. The network's penetration rate is more than 80 per cent.

The Eindhoven Fiber Exchange

Above we have described a number of initiatives to create open fibre-optic networks: the RBC in Eindhoven and the Ons Net projects in Nuenen and in the Tongelre district of Eindhoven. More such initiatives are expected soon. In order to achieve the best possible level of synergy between them, a 'neutral' central hub needs to be available at which these networks can connect with one another and with the outside world. In partnership with Eindhoven University of Technology, the City of Eindhoven has decided to build this hub on the university's campus. Called the Eindhoven Fiber Exchange (EFX), it has three functions.

1. Linking local networks
The EFX has to facilitate the interconnection of local fibre-optic networks at several levels. Data traffic between RBC participants or to and from organisations connected to other networks linked to the exchange – FTTH networks, for example, or those on business parcs – does not have to travel over the public internet or through a commercial internet service provider (ISP). They usually charge a fee for carrying data traffic on their networks, based upon the bandwidth used or the quantity of data. Thanks to the EFX, traffic within and between the networks connected to it no longer has to use an ISP network.

2. Linking interlocal networks
The EFX will act as Eindhoven's hub for connections to similar exchanges elsewhere. This function is regional (as part of the Regional Broadband Rings project), provincial (within Noord-Brabant), national (providing links with, for example, the NDIX in Enschede) and international (including facilitating links with Aachen and Louvain as part of the so-called 'top technology triangle').

3. A marketplace for service providers
Once a sufficient number of users with a demand for services like internet feeds, hosting, remote storage and backup or telephony are connected to the EFX, a lot of service providers are expected to want their own link to it. With just one fibre-optic connection to the exchange, they can serve countless organisations. For the buyers of those services, that means more choice, more competition and the faster introduction of new services.

All this makes the EFX an important component in the region's developing broadband infrastructure, as set out in the local authority's strategy.

Services

At the beginning of this article we stated that it would concentrate upon infrastructure. But because infrastructure and services are bound up inextricably, we should mention at least some of those servic-

es briefly. Since September 2003, meetings of Eindhoven City Council have been broadcast live on television and the internet, and can also be viewed later on the internet. This makes Eindhoven the first local authority in the Netherlands, and perhaps in Europe, to provide searchable video excerpts of its council meetings in digital form. The project was evaluated a year after it began, at which time it was decided to continue it (see http://www.bestuuronline.nl/live/eindhoven/raad_in_beeld.htm).

Even before the RBC network as a whole has been completed, it has been extended to a number of locations in Eindhoven city centre. This will enable

Eindhoven and its region

Together with Stockholm, Helsinki and Munich, Eindhoven is one of the four European 'hot spots' for advanced technology and innovation. A quarter of all jobs in the region are technology-related, with such companies as Philips, AMSL and DAF. Eindhoven's reputation as a centre of knowledge is borne out by the fact that more than half of all Dutch spending on research and development occurs in and around the city. The construction of the High-Tech Campus (see Van Eekeren and Stemkens, 2003), at which amongst others Philips plans to concentrate all its R&D activities, will only increase that. Eindhoven is also home to a technical university, a design academy and several other renowned academic institutions. With its recently awarded 'Brainport' status, the region can be regarded as the innovation and knowledge centre of the Netherlands. The Brainport implementation programmes includes an ambitious ICT-component (see www.be-linked.nl).

With more than 200,000 inhabitants, Eindhoven is the largest city in the southern Netherlands and the fifth largest in the country. The Eindhoven region consists of 21 local authority areas with a total population of more than 700,000.

Kenniswijk

Kenniswijk, or 'Knowledge Community', is an initiative by the Post and Telecommunications Directorate of the Dutch Ministry of Economic Affairs. It is an experimental environment in the Eindhoven region where consumers have access to innovative products and services related to computers, mobile and fixed-line communications and the internet. The Eindhoven region was chosen as the national Kenniswijk in July 2000, its bid beating those from 14 other Dutch regions. Later converted into a limited company, the Kenniswijk project organisation is founded upon three key elements: infrastructure, services and consumers. In 2002, subsidy schemes for both infrastructure and services entered force. Known as the demand-stimulation subsidy scheme, that for infrastructure gives consumers a one-off payment of €500 plus a further €300 over a one-year period if they purchase broadband services through a working communications connection with a capacity of at least 10Mbps. The Kenniswijk experiment ends on 1 October 2005. The Kenniswijk zone covers part of Eindhoven, part of Helmond and Nuenen. This area is home to approximately 47,500 households, or 100,000 people altogether.

Since 1 July 2005, approximately 15,000 homes in Eindhoven and Nuenen have an active fibre-optic connection. More than 100 new services are available. These range from First Mile TV, featuring public-service television programmes for on-demand viewing in TV/DVD quality on a television set or PC (http://portal.omroep.nl/firstmile) to Video4All for sending and viewing video messages on the internet (http://www.video4all.nl/), and from online healthcare service HeartsPoint – you no longer have to leave home for a blood check – (http://www.heartspoint.nl/) to Peace of Mind, which lets keep an eye on your loved ones, pets and property online (http://www.peaceofmind.nl/). The City of Eindhoven is one of the 27 shareholders in Kenniswijk BV.

Broadband layer model

The supply of broadband services – not just internet access, radio, TV and telephony, but also remote storage, remote backup and 'vertical' applications in health, education and security – to end users like consumers, businesses and other organisations requires several 'layers' of infrastructure.

The lowest, 'passive' layer is the underground ducts and cables. The is also known as 'managed dark fibre'. The middle, 'active' layer consists of the equipment used by the supplier and the customer to transmit electric or optical signals through the passive layer. The uppermost level is services or content: what is actually carried by the signal. This can be subdivided into the supply and the development of services.

The client is interested in services, not infrastructure. Traditionally, market parties make a business case by linking long-term investment in infrastructure – in the case of the passive fibre-optic network, depreciation periods of between 15 and 25 years are standard – to the supply of broadband services. End users only have access to the services admitted to the network by its owner. The linking of services with the network is known as vertical integration. This creates a non-open infrastructure, since service providers are either denied access to the end user by the network owner or are only allowed it subject to conditions. Much of the effort and input being put into the development of a fibre-optic infrastructure by public-sector organisations is designed to prevent vertical integration by keeping the layers separate.

'smart' CCTV surveillance of streets in the entertainment district over the fibre-optic network.

Another interesting application is the recently completed Digistein project. This was a so-called 'digital breeding ground' for experiments with ICT to encourage social cohesion and community participation in the Strijp district of Eindhoven. Although the project itself was not dedicated specifically to broadband applications, several Digistein activities were broadband in nature. For example, a project in which historical stories from Strijp were recorded on video and published online in the form of a digital newspaper. Another broadband initiative was Strijp TV, which made programmes for and about the neighbourhood from a mobile studio for broadcast on the internet (see www.digistein.nl and Steyaert & Linders, 2004).

Next steps

At the time of writing, there are many projects under way to continue the fibre-optic networking of Eindhoven and the surrounding region.

- Plans are being drawn up to network the entire city in accordance with the Ons Net model. Since the demand-stimulation subsidy scheme has now ended, that model must present a viable business case without it.
- The City of Eindhoven is carrying out a feasibility study to prepare for the construction of an open fibre-optic infrastructure on five business parcs, based on demand bundling.
- The Eindhoven Regional Alliance (SRE) has recently presented its Masterplan for Regional Broadband Rings. The aim of this is to create an open dark-fibre network connecting all 21 local authority areas in the Eindhoven region, giving them access to a wide range of broadband services.

Lessons learned

The following lessons have been learned from the above projects.

- **Stamina and perseverance are essential.** Creating a new fibre-optic infrastructure actually means building an entirely new utility network comparable with the existing gas, water, power and sewerage systems. One key difference, however, is that this is a new type of network involving a lot of new technological, organisational, legal, financial and other challenges. As yet, there is no best practice. But plenty has been learned about fibre

optic in recent years. It needs to be borne in mind that the delay between the initial idea and final completion is considerable, with a lot of ups and downs on the way. It is better if all involved realise that from the outset.

- **A clear and appealing vision works.** The moment that the broadband policy memorandum *Glasrijk Eindhoven* appeared marked a clear turning point in developments. The local authority had revealed a clear picture of its ambitions and its chosen role. Based upon this, it approached partners and market players with a focus. In the document, the local authority clarified its own position and challenged others to choose where they stood. In Eindhoven, that led to a positive response from many quarters.
- **A clear deadline helps.** In the case of the fibre-to-the-home project, the end of the subsidy scheme represented a very clear deadline. Overcoming difficult obstacles can lead to delay, but that was simply not an option here. The deadline made a major contribution towards ensuring that strategic decisions were taken quickly and the project set and kept to its own tight deadlines. And the same applied to the demand-combination process. For the participating hospitals, in particular, completion within a set time was an absolute must, otherwise they would have to choose an alternative solution.
- **Define responsibilities clearly.** When Eindhoven started thinking about broadband, it was still not clear where political and administrative responsibility for developing the infrastructure lay. Once that issue was clarified in 2002, it became much more obvious how things would fit together, communication became more direct and progress easier to achieve.
- **Break things up.** With broadband, there is a danger that everything becomes interconnected, creating a complexity which makes it impossible to make decisions. The approach developed in Eindhoven allowed interdependent but separate 'building blocks' to be defined, each of which could be tackled on an individual basis: demand bundling, fibre to the home, demand bundling for business parcs, the Eindhoven Fiber Exchange, service development and so on.

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This article was completed on 13 July 2005.

Note

1. By broadband we mean communication links of at least 10Mbps symmetric (up and down stream). Although it may be that the capacity of existing connections in the local loop – such as copper and co-ax – can be further expanded, experts throughout the world agree that fibre-optic represents a futureproof infrastructure. Plans by a number of providers in the Netherlands, including KPN and several cable operators, confirm that.

About the author

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