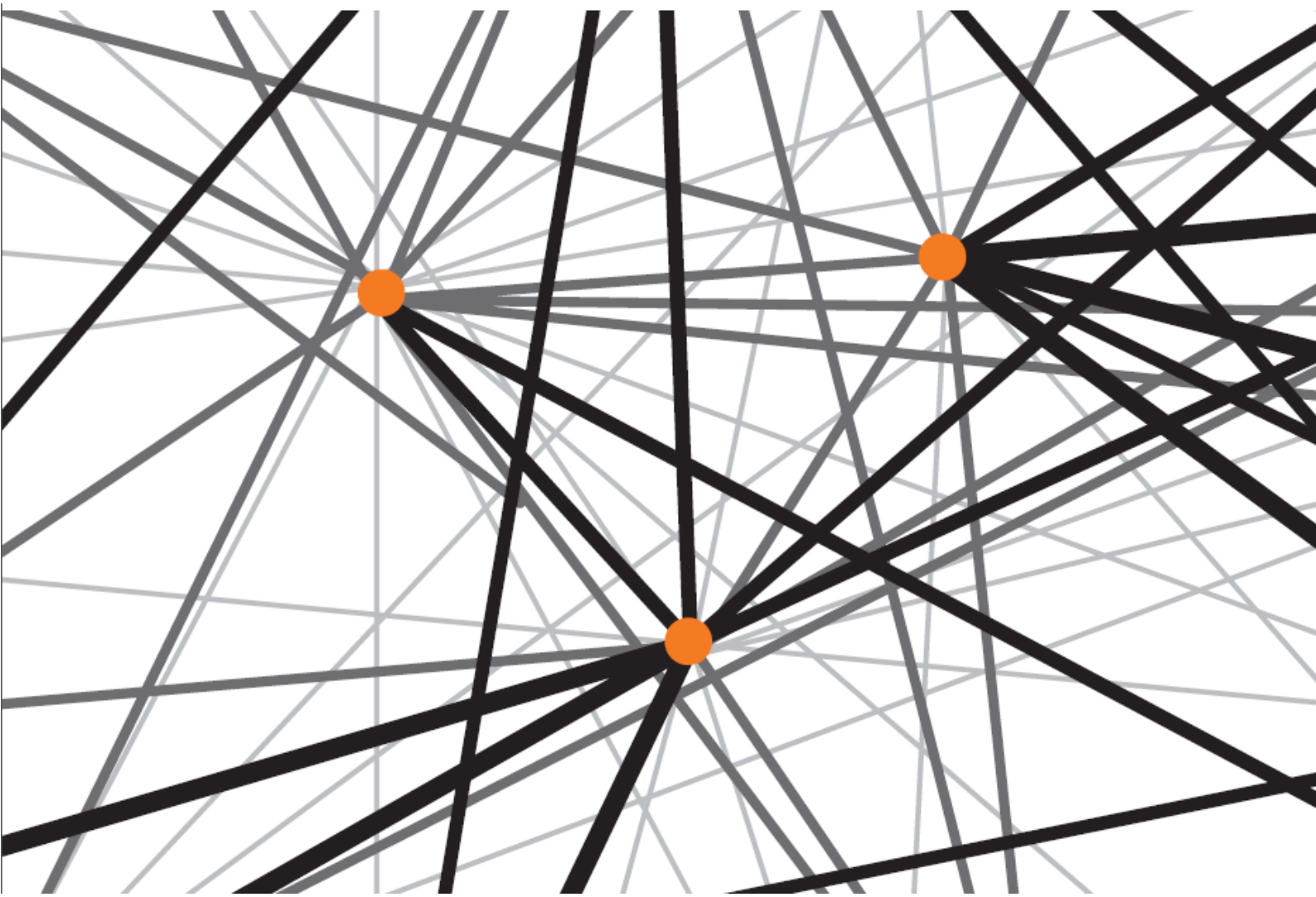
SWEDENS LOCAL FIBRE NETWORKS

CREATING COMPETITION AND PROVIDING CONSUMERS AND OPERATORS WITH FREEDOM OF CHOICE

DECEMBER 2014



SVENSKA STADSNÄTS FÖRENINGEN

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SUMMARY

Over the last 20 years, local fibre networks have played a major role in helping to deploy fibre optic networks, thereby contributing to the development of our information society. Sweden lies at the forefront of this development.

Local fibre networks are usually operated by municipal companies (86%), local fibre network companies (25%) or as part of energy companies (41%). Small municipalities with smaller fibre networks have organized operations within their municipal administrations (20%). There are also privately owned local fibre networks, such as IP-Only and Svenska stadsnät (9%).

Since beginning their deployment (prior to 2000), local fibre networks in Sweden have invested a total of nearly SEK 30 billion in broadband networks. In 2013, local fibre networks invested a combined SEK 1.6 billion. The forecast for 2014 points to a total investment of SEK 1.9 billion.

The Swedish Local Fibre Alliance estimates that local fibre networks currently own approximately 60 per cent of the access fibre network in Sweden. Investments by local fibre networks have laid the foundation for competition at the infrastructure and service level that does not exist to the same extent in any other market internationally.

A well-developed fibre network is a major strategic asset and a key competitive factor for the municipalities. Local fibre networks influence a municipality's attractiveness and development, especially with regard to the development of services industries and welfare.

Fifty-four per cent of Swedes have access to broadband with bit rates of at least 100 Mbps. However, we still have work to do before we achieve the national broadband goal *of 90 per cent of all households and businesses having access to broadband with bit rates of at least 100 Mbps.* Deployment of broadband infrastructure needs to be stimulated, particularly by Sweden's municipalities, which are key players.

The Swedish Local Fibre Alliance promotes open networks. The open networks model involves the local fibre network assuming responsibility for ensuring equal and non-discriminatory terms are observed and for ensuring healthy competition. A local fibre network is not vertically integrated, i.e. it does not offer end-customer services in competition with other service providers. This means that local fibre networks safeguard competition at all levels, whether dark fibre or capacity services. Local fibre networks have an important role to play in the broadband market as they often represent an alternative to the former incumbent's (TeliaSonera) infrastructure. Operators can enquire about a connection with the various providers and choose the one that best suits their needs. Operators can buy infrastructure services, selecting from among competitive alternatives, meaning prices for Swedish consumers are also low in international comparisons. Prices in open networks where the local fibre network allows service providers to compete on a service portal are even lower, according to the Swedish Post and Telecom Authority (PTS)[1]. Services in open networks also have shorter contractual periods, which is good for consumers.

A communications provider's basic role is to be a neutral player who maintains an open technology platform and ensures the flow of data traffic on the local fibre network. Up to thirteen different functions have been identified for local fibre networks acting as communications providers. Each function can either be provided in-house or procured externally and provided by a contractor. Our study has shown that almost all local fibre networks have procured one or more of the 13 different functions.

[1] Price trends within mobile telephony and broadband – PTS-ER-2012:26.

Consolidation among communications providers in recent years has seen neutral communications providers bought up by vertically-integrated service providers. This risks resulting in reduced competition for consumers and we need to monitor these developments carefully. Forty-five per cent of local fibre networks have an external communications provider. Forty-eight per cent of local fibre networks act as communications providers. None of the local fibre networks are considering abandoning their communications provider role and bringing in an external provider. However, several local fibre networks are now considering developing the communications provider role internally.

Since the single-family home market took off in 2013, competition has intensified. In several cities, parallel fibre infrastructures are being installed in areas with single-family homes. According to the local fibre networks, SEK 1.1 billion will be invested to bring fibre to single-family homes in 2014. This is an increase compared to 2012, when the local fibre networks invested SEK 0.8 billion in the single-family home market.

Sixty per cent of local fibre networks feel that there is no competition in the single-family home market in their municipality. In these single-family home areas homeowners have little interest in paying for the services and the market is not particularly interested in investing due to the prohibitive costs. If Sweden is to maintain its position as a prominent IT nation, commitment and new government incentives are required. [2]

Facts about Swedish Local Fibre Networks

- A local fibre network is a broadband network that is locally established, usually within a municipality.
- Local fibre networks own about 60 per cent of the access fibre network.
- Local fibre networks are open networks, based on fibre optics.
- The majority of Sweden's municipalities have a local fibre network that is expanded and evolves with the needs of the local community.
- Local fibre networks operate in nearly 200 municipalities. Over 150 municipalities have a local fibre network with a clear commercial focus.
- Sixteen per cent of municipalities with local fibre networks have a private local network (a single local fibre network can cover multiple municipalities) and 85 per cent are municipal-owned.

[2] *Svenska Dagbladet*, Brännpunkt: *Villor får vänta på snabbt bredband*, 9 October 2013.

OWNERSHIP AND GOVERNANCE OF LOCAL FIBRE NETWORKS IN SWEDEN

Organization of Operations and Ownership Structure for Local Fibre Networks

As in previous years, the majority of Sweden's local fibre networks (86 per cent) are municipally operated. The way they are organized has basically undergone no significant change since the last survey in 2012.

Respondents indicating that their operations are organized in "another form" have varying motives for this, such as regional partnerships. Three per cent of responding local fibre networks indicate that they have changed how they are governed during the past two years. The reason given for the changes is their conversion into companies.

Table 1 Local fibre networks' forms of ownership 2006, 2010, 2012 and 2014 (per cent)

Form of Ownership	2006	2010	2012	2014
Municipal administration	10%	20%	19%	20%
Municipal energy company	53%	36%	39%	41%
Municipal local fibre network company	29%	27%	27%	25%
Economic co-operative	2%	4%	3%	3%
Private company	7%	12%	7%	8%
Other form	N/A	N/A	5%	3%

Each municipality is free to choose how it structures its company and a variety of forms exists among them. The following is a somewhat simplified picture of how different municipalities choose to organize their operations:

- Municipal administration – This structure is more common in small municipalities.
- Municipal energy company – Municipalities where the energy company has played a clear role in rolling out fibre networks from the start, for its own and municipal needs.
- Municipal local fibre network company – Municipalities that consider broadband deployment a separate activity, and municipalities lacking an energy company that could otherwise naturally take on this role.
- Private company – Usually in areas where the municipality has consciously or indirectly chosen not to establish a local fibre network under its own operations.

Local limited companies are not a new phenomenon. Swedish municipalities began running some of their operations as companies as early as the late 1800s. Municipally-owned companies' operations are based on a combination of public benefit and commercial interest. Unlike operations within a municipal administration, a municipal-owned company can compete in deregulated markets where there are specific requirements for the clear disclosure of costs. There is a clear demarcation from the municipality and often an explicit goal for the company to operate and survive on its own merits as well as the idea that the municipality should not inject additional money into the company. Profits from municipal-

owned companies should result in reasonable returns for their owners at the same time as the relevant public benefit utility objectives are achieved. Profits are also often reinvested in the company.

The differences between privately- and municipal-owned limited liability companies is evident in legislation, for example. Besides the Companies Act, a municipal limited liability company is affected by regulations contained in the Local Government Act, the Freedom of Press Act, the Official Secrets Act, the Public Procurement Act and the Competition Act.

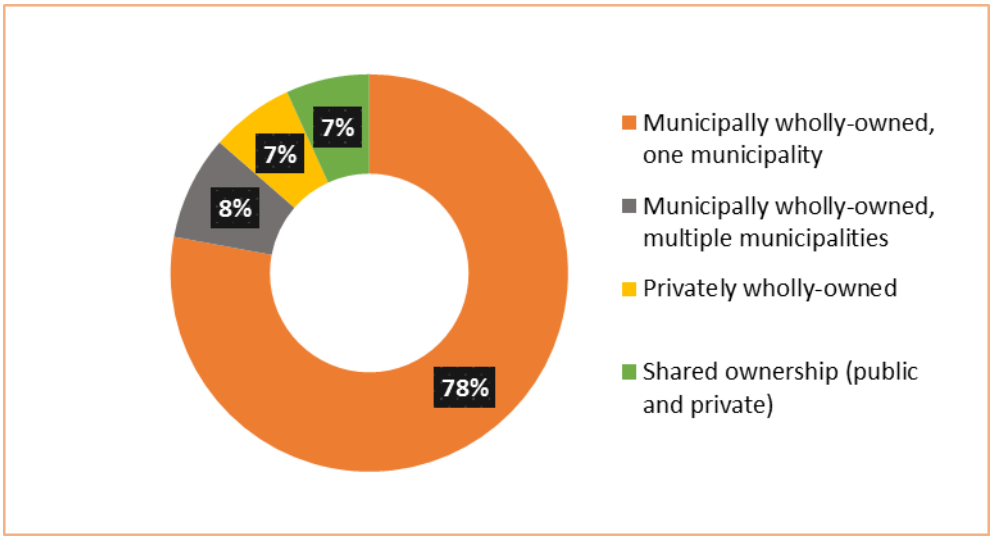
Regional Co-operation

Ownership structures follow the way operations are organized and 78 per cent of local fibre network operations are municipally owned by *one* municipality and nine per cent are part of a regional co-operation, where the local fibre network operations are owned by *multiple* municipalities.

Over the years, local fibre networks in Sweden have co-operated with one another. This has been important in interconnecting the different local networks across municipal borders and because communication needs extend beyond municipal boundaries. In recent years, some partnerships have developed and been formalized in company form. For example:

- The company Stadsnät i Svealand. Västerås, Eskilstuna, Hallstahammar and Arboga municipalities.
- The companies Wexnet AB, Växjö Energi AB, Alvesta Elnät AB, Tingsryds Energi AB and AB Lessebo Fastigheter.

Figure 1 Company structures of local fibre networks, 2014



Stadsnät i Svealand AB

Since 1 January 2014, the company has been co-owned by the Västerås, Eskilstuna, Hallstahammar and Arboga municipalities. The company's operations consist of building, acquiring, owning, operating, developing and marketing the broadband network within the municipalities that own it. With a regional perspective and local presence, the company is intended to create benefit and added value for municipal residents, businesses and municipal operations.

The regional network is to be competition-neutral; that is, service providers who wish to sell their services on the shared network must be allowed do so. Each municipality will continue to own its own fibre network while operation, maintenance and sales and marketing of the fibre is handled by the jointly-owned company. Through the jointly-owned company, the municipalities also gain access to a platform for the development of future e-services within each municipality's operations.

Regional collaboration creates synergy effects that result in better finances, greater operational reliability and quality and a greater range of choice for end-customers, with increased competition as a result.

Wexnet AB

In 2013, Växjö Energi AB, Alvesta Elnät AB, Tingsryds Energi AB and AB Lessebo Fastigheter formed a joint regional company, Wexnet AB. Ownership in Wexnet is distributed proportionally, with Växjö Municipality as the largest shareholder.

Wexnet AB has taken over the broadband investments made by each municipality and thus owns the infrastructure in each municipality. Today, Wexnet operates in both larger and smaller towns and in the countryside.

Wexnet manages the network and operations. In the open local fibre network, service providers and operators are given access to the network on equal terms. The company is commercially operated, while observing the municipality's objective for its operations and the principles specified in its articles of association and owners' directives.

The municipalities share the costs and they can afford a high level of service with a high level of expertise in customer service, marketing and IT systems. They encourage the creation of new, affordable and socially beneficial services that make life easier for the municipalities' residents.

Wexnet also currently handles all network management and all communications for Växjö Municipality. Nearly 500 emergency medical alarms have been connected to the local fibre network as part of a solution provided to the municipal care administration. Work continued during the year to replace the entire active network, upgrading it from 100 Mbps to 1,000 Mbps. This will facilitate new services and higher speeds in the network.

INVESTMENTS IN FIBRE BROADBAND

Since the mid 1990s, Sweden has had a few main types of investors in access fibre networks: local fibre networks, TeliaSonera (Skanova) and a limited group of other private players.

Fibre investments in Sweden continue to increase, with some private actors and many municipal local fibre networks investing. The reason why more private players are not investing in fibre infrastructure may be that infrastructure investments are expensive, which can constitute a barrier to entry that limits competition.

Local Fibre Networks' Investments

Since beginning their deployment (prior to 2000), local fibre networks in Sweden have invested a total of nearly SEK 30 billion in broadband networks. Investments by local fibre networks have enabled competition at the infrastructure and service level that is unparalleled internationally. In municipalities with local fibre networks, there is generally more fibre access than in other municipalities. Local fibre networks have also resulted in smaller towns and rural areas being connected faster.

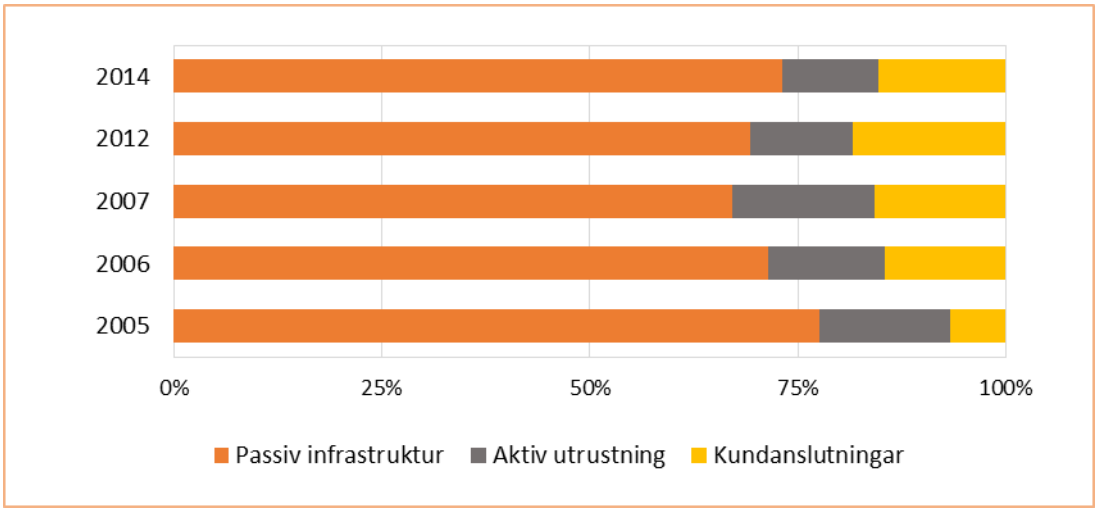
Distribution of Investments

Local fibre networks have primarily invested in passive infrastructure. This is natural, as this area requires the most investment. Compared with the previous year, this investment pattern has remained essentially unchanged. Investments are made in the following areas:

- Passive infrastructure (fibre and passive nodes)
- Active equipment (switches, routers in the core and distribution networks)
- Customer connections (combination of passive and active equipment for connecting end-user addresses)

Over the years, the primary change has been that the percentage of investment in customer connections has increased. This is because local fibre networks have worked to increase the density of their infrastructure. The increase in the proportion of passive infrastructure may be due to many local fibre networks now focusing on single-family homes. Comparatively, more passive infrastructure is needed per single-family home than for multi-family residences.

Figure 2 Distribution of Investments over Time



Own Investments vs. Subsidies

Subsidies for broadband deployment are an important supplemental measure for increasing broadband access in areas where it is expensive to deploy and difficult to achieve feasible investments. There are three main types of subsidies for broadband deployments: the rural deployment programme, structural funds and channelization subsidies for fibre-optic pipes. Government broadband subsidies are paid through counties and municipalities.

In 2014, government subsidies equalled about 10 per cent of the total investments made by local fibre networks. However, this figure varies depending on the local fibre network. Support for broadband via EU funding is used mainly by small local fibre networks. All types and sizes of local fibre networks throughout Sweden utilize government, regardless of how they are organized, whether as part of municipal administrations, municipal companies or private companies.

OPEN NETWORKS – INFRASTRUCTURE COMPETITION

Infrastructure competition refers to competition between different alternative parallel infrastructures that a company, household or organization can connect with to gain access to broadband services. The main alternative infrastructures are fibre, cable TV, copper and mobile.

Infrastructure competition or infrastructure-based competition can be created on two levels/in two ways:

- By a property having access to *parallel* infrastructures, such as a copper network with xDSL and a property network that is connected to a fibre optic network.
- By a property having access to an open network at the infrastructure level, i.e., the owner of the connecting network leasing connections to operators *in parallel and on equal terms*. This is often referred to as infrastructure-based competition.

The Swedish Local Fibre Alliance promotes open local fibre networks, a model that has been very successful. The open networks model means that the local fibre network is responsible for the open network, is to ensure equal and non-discriminatory terms are observed, and is to ensure real competition in the network. An open local fibre network is not vertically

integrated, i.e. it does not offer end-customer services in competition with other service providers. This means that local fibre networks safeguard competition at all levels, whether dark fibre or capacity services.

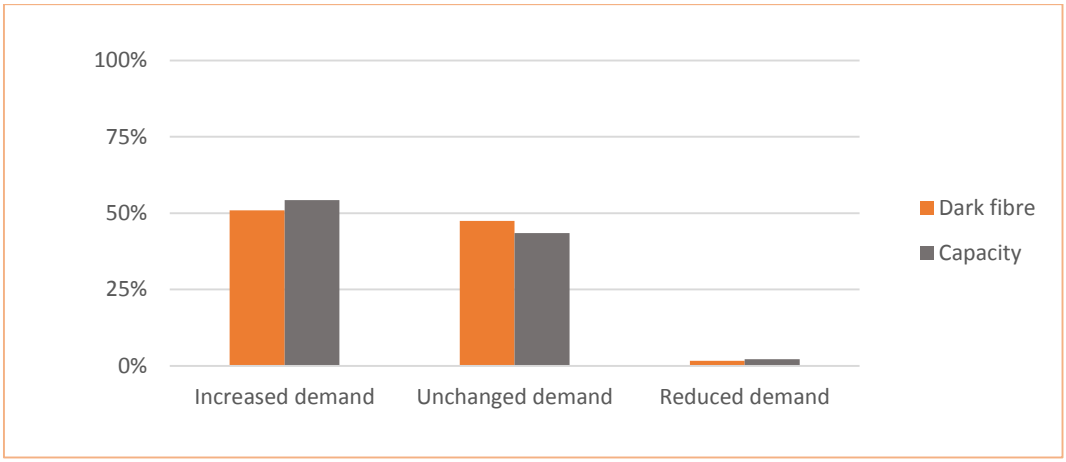
Local fibre networks have an important role to play in the broadband market as they represent an alternative to the former incumbent's (TeliaSonera) infrastructure. Operators can enquire about a connection with both TeliaSonera and the local fibre network and choose the one that best suits their needs. The open network has created competition in Sweden, which has resulted in the world's lowest dark-fibre prices. This benefits the entire market; everyone from operators to service providers, businesses and households.

The Infrastructure Products: Capacity and Fibre

Different operators can utilize a fibre-optic infrastructure by either leasing fibre or a fibre connection (capacity). In this way, the operator can establish its 'own' network that connects the areas, cellular base stations and properties where the operator has customers. In municipalities without a local fibre network, operators are usually only able to lease a connection from another operator.

The market's operators need both the 'infrastructure products' of capacity and fibre, and local fibre networks see that the demand for both products is increasing. The figure below shows the estimated demand over the past twelve months[3] compared with the previous twelve-month period. We see a clear increase in the demand for both capacity and fibre. The figure only refers to the products capacity and dark fibre for operators, i.e. excludes any sales to end-customers (companies).

Figure 3 Demand for dark fibre and capacity products, 2014



Demand for dark fibre is increasing due to the increasing use of demanding electronic communications services and the upgrading to new technologies. The technology shift occurring as mobile operators have upgraded their networks and invested in LTE (4G) over the last four years has increased the demand for fibre. The 4G network requires fibre connections between cellular base stations and the regional node to deliver good broadband speeds.

Since 2006, the Swedish Local Fibre Alliance has run the business system CESAR to facilitate the business processes between local fibre networks and operators. This year, the new

[3] September 2013 – September 2014.

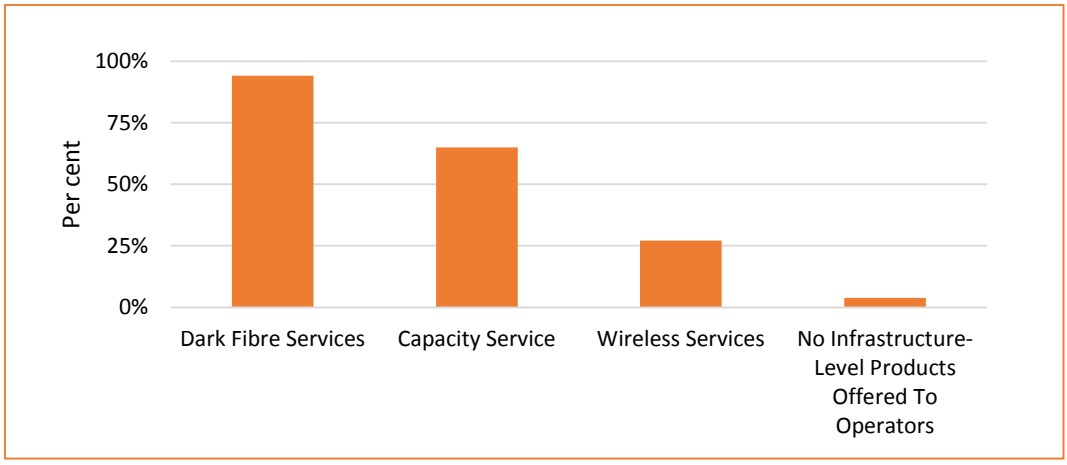
CESAR2 service was launched. This service handles requests from operators for products, such as dark fibre and Ethernet capacities, for local fibre networks. The business processes and products are standardized in a joint package of agreements. This means that an operator can ask for the same product, with the same technical specification, throughout the country regardless of which local fibre network the request is made to.

In CESAR2, buyers and sellers can use maps to locate their exact area of interest. In November 2014 there were 104 members using the service and together they offer 170 different sales areas within Sweden. The number of enquiries has increased significantly since the system's launch during the autumn. The more local fibre networks that begin using CESAR2, the more business operators can channel through the service.

Access to transmission products (that include capacity products) may be more important than one imagines. In a country like Sweden, which is characterized by sparsely populated areas and long distances, an investment in network infrastructure can be very costly. Interest in leasing transmission, i.e. meaning the operator does not need to invest in active equipment, may exist, however. The more densely populated an area, the more potential customers there are and this makes it worth investing further down the value chain. Some sparsely populated and geographically remote areas lack a sufficient customer base. In these areas, competing operators are interested in leasing transmission products. Small operators may also not want to invest in equipment and instead choose to enter the open network at a transmission level.

Each local fibre networks chooses which infrastructure products to include in its portfolio. Ninety-four per cent of local fibre networks offer dark fibre. Sixty-five per cent offer capacity on equal terms.

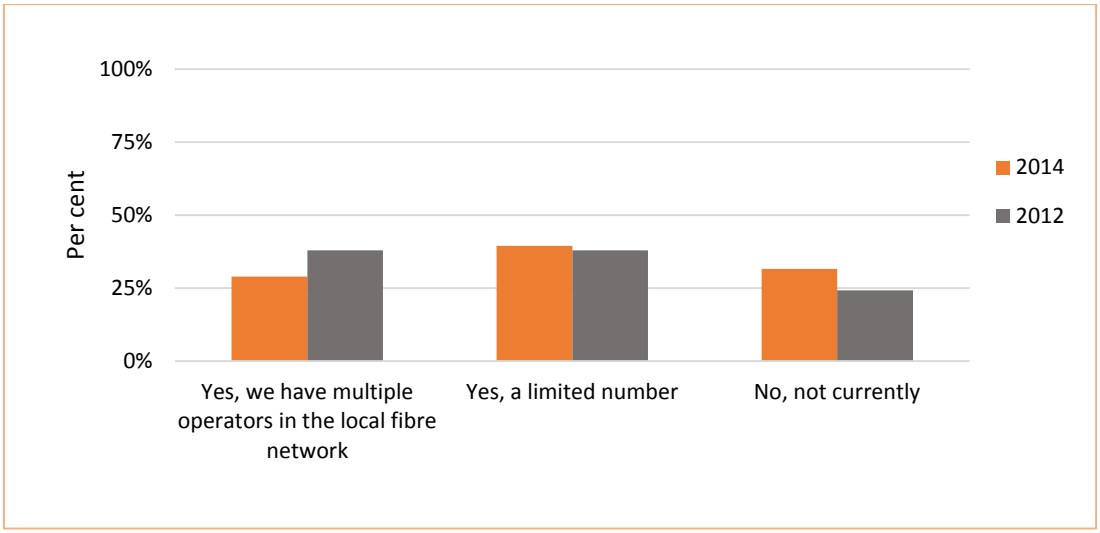
Figure 4 Infrastructure services offered to market operators on competition-neutral terms



As local network owners, local fibre networks also offer their networks for use by smaller local operators. This contributes to an additional dimension of infrastructure competition. Local operators can include IT companies that offer various types of data, voice and security services, and that can combine these with communications services through the local fibre network. Two of three local fibre networks are used by one or more local operators.

In 2014, fewer local operators used local fibre networks compared with 2012. This may be due to the on-going consolidation in the market.

Figure 5 The presence of local operators using local fibre networks



Dark Fibre Rates

The CESAR2 service lets infrastructure product retailers add price areas, enabling the interested operator to quickly find rates for leasing a connection. Some local fibre networks have begun to utilize this option.

There are various pricing models to choose from, such as fixed prices for one-time fees and monthly leasing, fixed meter prices or price per quote. Since the last survey, the Swedish Local Fibre Alliance has developed guidelines for this. Business opportunities for local fibre networks increase when their pricing of dark fibre is more fully adapted to market requirements. This also increases the total public benefit of existing and future investments.

The guidelines emphasize the importance of developing price lists. This enables the customer to produce indicative dark-fibre pricing for parts of, or all of the local fibre network, but especially for parts that have, or are expected to have, medium or high earning potential. In concrete terms, the production of price lists means the following:

- It provides an overview and simplicity in understanding and comparing prices
- It increases efficiency for both local fibre networks and customers
- It reduces the time and resources required for producing quotes
- It reduces response times for enquiries
- It allows customers a greater opportunity to develop indicative prices.

Local fibre networks must work through their pricing themselves and create their own price lists, however. Dark fibre prices vary among local fibre networks in Sweden. Each local fibre network sets its own prices. Nearly 70 per cent of local fibre networks offer pricing on equal terms for their infrastructure products.

In a report, the Swedish Post and Telecom Authority (PTS) [4]concludes that both the range of and demand for fibre infrastructure continue to grow, as reflected in falling prices for fibre.

[4] Förstudie för strategiska analyser på områdena accessnät och samtrafik PTS-ER-2013:11.

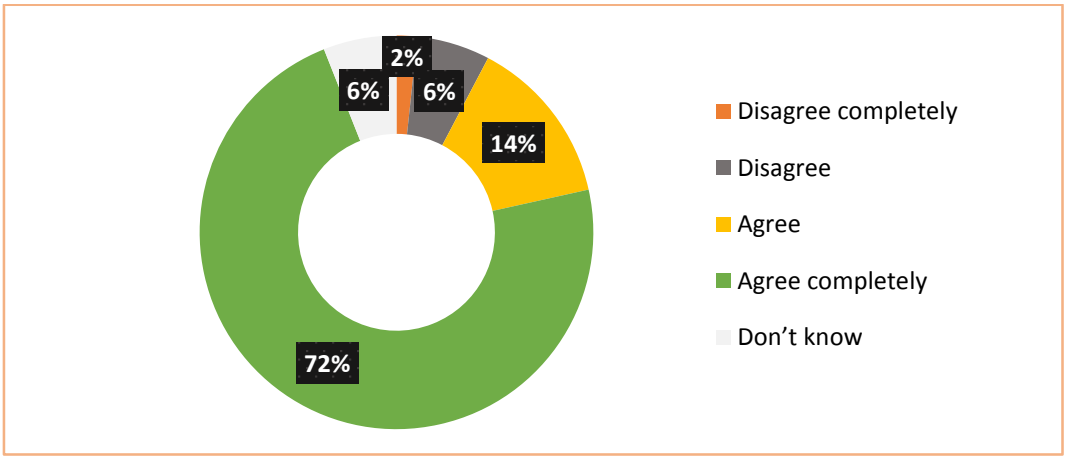
PTS also concludes that there are several positive signs of increased competition in the broadband market, which benefits households, businesses and the public sector.

Local Fibre Networks' View of Their Role and of the Local Market

Broadband deployment is no longer just about a fast connection for TV or Internet services, but also about building a digital infrastructure that can support all of society's functions. It is important to ensure that municipal residents have access to fast and quality-assured broadband both at work and at home. This creates new opportunities, not least since digital services can create a digitized welfare that provides more personalized, high-quality care.

Local fibre networks have ensured fibre deployment in their respective municipalities. Many municipalities believe that the open fibre network is strategically important for their development and growth. Fifteen per cent of local fibre networks believe that they have had a positive impact on infrastructure competition locally and 77 per cent believe that their presence has had a significant impact.

Figure 6 The local fibre network has had a significant impact on infrastructure competition locally.



One study estimates that the economic returns to the City of Stockholm from Stokab's investments in fibre infrastructure total SEK 16 billion[5]. Another study shows that every krona invested in fibre infrastructure returns SEK 1.50 over a five-year period.[6]

Single-family Homes

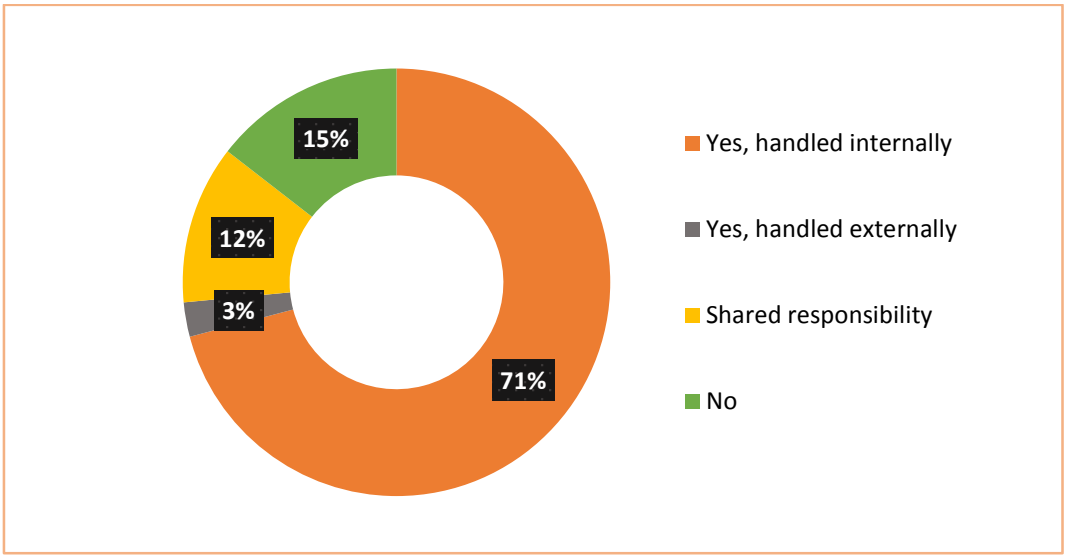
A major challenge for Sweden is to supply fibre to single-family homes. Compared to multi-family properties, supplying fibre to single-family homes is much more difficult and more costly. Network owners need to sign agreements with each individual homeowner. In practice, it means laying an underground fibre-optic cable for each individual house and doing so involves expensive infrastructure investments. On the other hand, the Swedish single-family-home market took off in 2013 and the deployment of fibre infrastructure has since been intense.

[5]https://www.acreo.se/sites/default/files/pub/www.acreo.se/upload/publications/nytta_med_stokab_-_sammanfattning.pdf.

[6]See References, Item 8.

Eighty-five per cent of local fibre networks believe they have a solid strategy for connecting individual single-family homes and are working this market actively. While questions of this nature tend to elicit positive responses, the Swedish Local Fibre Alliance anyway believes it to be positive that local fibre networks have faith in the approaches they have developed. Most local fibre networks manage their own single-family-home strategy, while one-tenth shares this responsibility with their communications operator. Fifteen per cent of local fibre networks have no strategy due to time or resource constraints, although the majority report that they intend to develop a strategy.

Figure 7 Does the local fibre network have a functioning single-family-home strategy?



Several local fibre networks allow homeowners to decide whether they want to install underground fibre cables themselves or let the local network install the fibre on the property. It seems to be as common for homeowners to install the fibre themselves as it is to let the local fibre network take care of the entire excavation process from the street to the house.

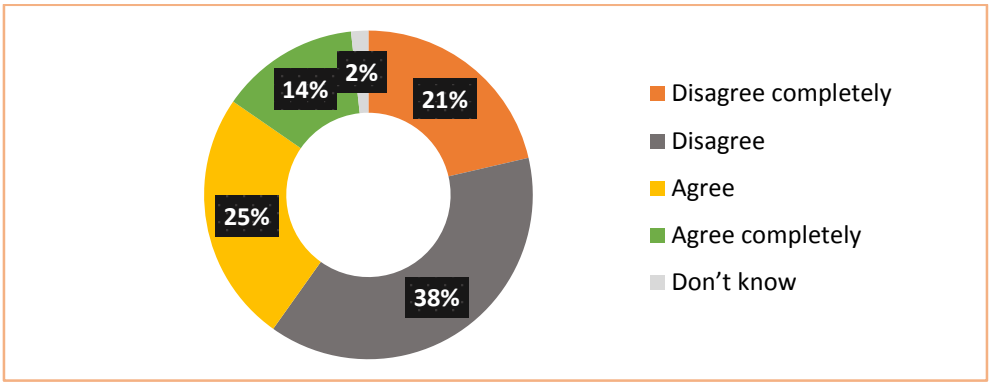
Once the cable is in place, installation and the process of bringing the connection online begin. At that point, the homeowner begins paying for the connection. A homeowner pays between SEK 5,000 and over SEK 30,000 to connect a single-family house to the fibre network. The cost varies depending on the length of the cable trench to the house and how many other homeowners in the area are installing cable at the same time as well as other factors. The more homes involved, the lower the cost for the excavation contractor and other installers.

When local fibre networks began targeting the single-family-home market, homeowners' interest in paying for fibre broadband was very low and most homeowners felt that ADSL or mobile broadband were sufficient to supply the household's broadband needs. However, over the last year demand for fibre grew in Sweden and this was reflected on the single-family-home market. Seventy per cent of local fibre networks say that demand for fibre to homes is high in their municipality. In some areas, fibre almost sells itself. In other areas, local fibre networks still spend a lot of time on sales.

Since the single-family-home market took off last year, competition has intensified. Several cities are expanding fibre infrastructure in parallel in areas with single-family homes. Not all areas of Sweden are experiencing this type of competition, however. When asked whether their single-family home market is competitive, most local fibre networks report that competition is either non-existent or very limited. Thirty-nine per cent of local fibre networks feel that competition exists for deploying fibre broadband to homes in their municipality. Of these, just over ten per cent report that competition is stiff, even. Of all the investments

made by local fibre networks in 2014, more than half went to installing fibre to single-family homes.

Figure 8 There is strong competition in the single-family home market



OPEN NETWORKS – COMPETITION FOR SERVICES

A communications operator's basic role is to be a neutral actor who ensures access to the local fibre network. Communications operators offer an open technical platform where all providers of content services can have equal access to the network. This enables service providers to promote their services through open networks by leasing connections, thus avoiding having to invest in their own equipment. This opens up a market for more providers and even smaller providers to enter.

Communications operators give households and businesses the ability to choose freely their provider of various content services while using the same infrastructure. This creates healthy competition on the market. Competition among service providers via a provider-neutral communications operator is unique to the Swedish market.

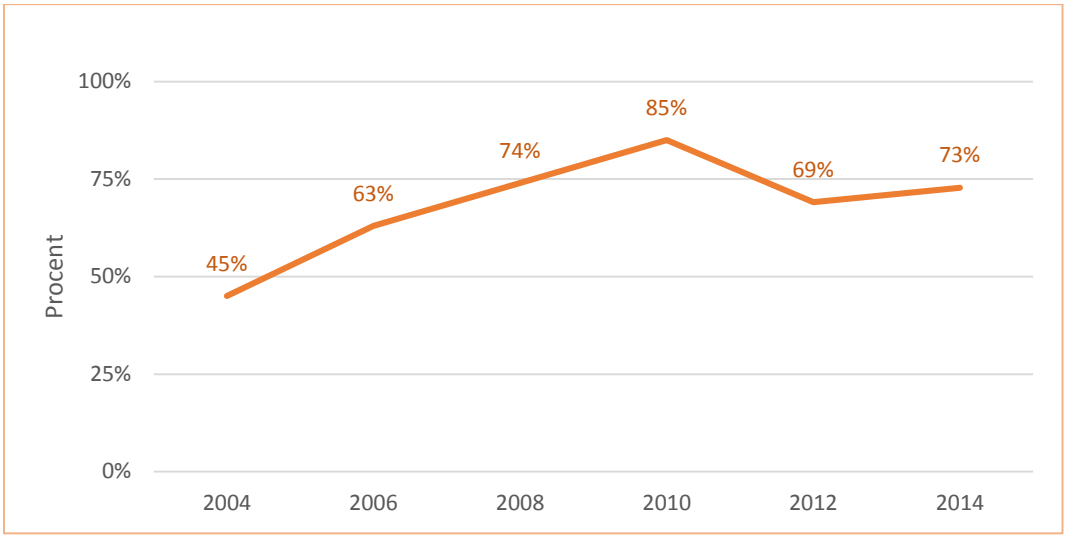
The function was established in Sweden primarily because local fibre networks procured services with the requirement for openness and the ability for consumers to choose their own service provider. Communications operators could also aggregate a number of smaller local fibre networks to create the necessary volumes of end-customers to attract service providers.

A central part of the mission and business model for many local fibre networks is, and has been, establishing and developing competition for services through a communications operator.

Level of Competition for Services

The Swedish Local Fibre Alliance has regularly surveyed local fibre networks on their view of the state of competition in the open networks and how it is developing. Over the years, the local fibre networks have seen increasingly developed competition arise, resulting in a well-developed range of services and good conditions for households and businesses connected to the local network. This year's survey once again reveals an upward trend in this area.

Figure 9 Level of competition for services in local fibre networks (percentage of local fibre networks that consider that competition is working well, with many service providers using the networks)



Number of Service Providers on the Network

As in previous years, 85 per cent of local fibre networks offer an open network for the end-customer market[7], i.e., they favour promoting competition in the local fibre network. A slightly lower percentage, 76 per cent, provide an open network for the operator market. Only seven per cent do not offer an open network, half of which are themselves Internet service providers (ISPs).

Local fibre networks that offered their own end-customer services have previously shied away from this model, and local fibre networks that only provide passive networks either assume the role of a communications operator on the open local network or contract with an external communications operator.

Eighty per cent of local fibre networks feel believe that an open local fibre network results in lower prices for consumers, compared with prices offered by a vertically-integrated provider.

Competition is high in the open network, and this means low, attractive prices and short contract periods for companies and households. The range of services is extensive since consumers can choose between different competing services from a number of national or local providers. Moreover, consumers can easily switch services if dissatisfied. The open network entails greater freedom of choice. Many people feel that competition has increased quality while simultaneously driving prices [8]down.

The table below shows the average number of service providers on the open networks, both in this year's market survey and in equivalent surveys conducted in 2010 and 2012. While the changes observed are not significant, today, fewer local fibre networks have 'no service providers' and more networks have more than ten service providers compared with two years ago.

[7] Here, the end-customer market refers to both households and businesses.

[8] Price trends for telephony and broadband through the first half of 2009, PTS-ER-2009:30

Table 3 Number of service providers in open local fibre networks

Year	>10	5-9	1-4	None
2014	60%	23%	14%	3%
2012	47%	31%	22%	1%
2010	28%	31%	25%	16%

The percentage of local fibre networks with at least one local service provider has increased since 2010, but is unchanged since 2012. Instead, it is the percentage of networks with two local service providers that has increased in this year's survey. The way local fibre networks work with local service providers varies greatly. We believe that the potential for more local services to be offered through local fibre networks is great.

Table 4 Number of local service providers in open local fibre networks

Year	>4	3	2	1	None
2014	8%	12%	29%	21%	29%
2012	11%	15%	14%	31%	29%
2010	19%	17%	15%	26%	24%

Service Areas

Eighty per cent of local fibre networks believe that a well-known national brand makes a service provider more competitive. Interestingly, however, just as many local fibre networks (76 per cent) point to a well-established, local brand as being equally important.

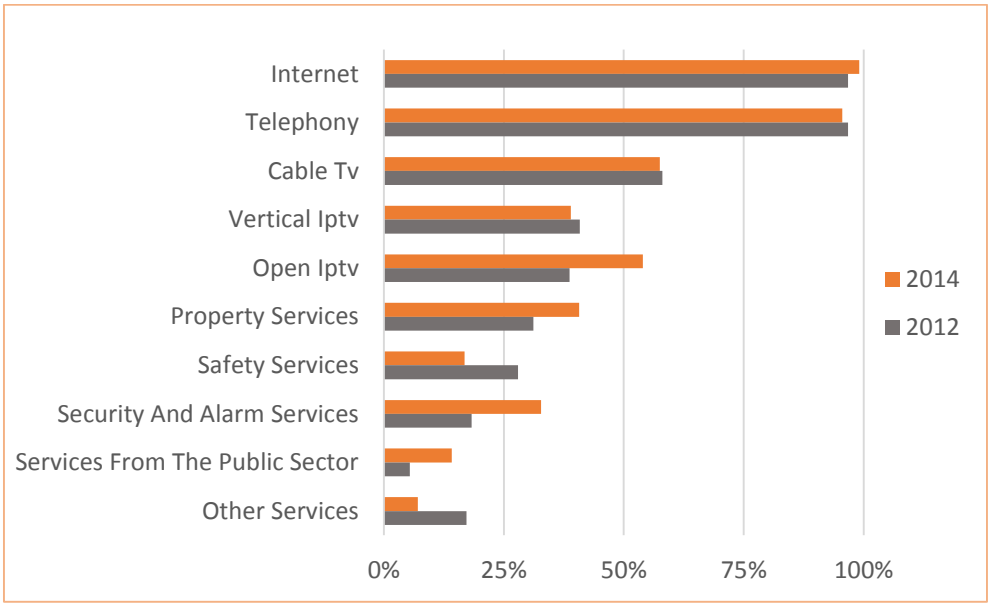
The figure below shows the different types of broadband services offered by service providers in the open local fibre networks. Internet and telephony are dominant and are available in close to 100 per cent of the cases. TV services are offered via cable TV in nearly 60 per cent of local fibre networks, while IPTV is now available in about 40 per cent of local fibre networks.

Open IPTV is now offered in half of all local fibre networks; an increase over the past two years. Open broadband TV means that users have a basic subscription and that their digital receiver is not tied to just one provider of television services. Instead, there are many different providers to choose from and consumers can also choose between different combinations of TV channels and packages.

Property services is another service area that is expanding rapidly. This type of service enables the use of entry phones, alarms, lock and booking systems (e.g., for laundry rooms), smart energy services, video surveillance and fire alarm systems.

Security and alarm services have increased since 2010. These include home security, antivirus protection and other security solutions that protect computers and the homes of private individuals or business premises.

Figure 10 Occurrence of different services on open local fibre networks



In addition to the services described above, several local fibre networks indicate that storage services are commonly offered by service providers on local networks. Public e-services are also identified as a priority area in which the local fibre networks play an important role. They are to make the infrastructure available and must also ensure that the network is open, with room for public services, both over the Internet and through other communications platforms. Currently, some local fibre networks reserve a separate port in all connected households for public services. Public services are transmitted in parallel with services from various commercial providers and have an open route through the local fibre network.

The City of Västerås – Working with Welfare Services

The City of Västerås is considered to lie at the forefront of IT and digital tools use for public welfare and management. At the close of 2012, the City approved a Digital Agenda for welfare in Västerås.

The goal is for ten per cent of home care services to be managed via e-home care and that these should be both based on the needs of the individual and optional. The City of Västerås collaborates with Stadsnät Svealand to develop welfare broadband and to ensure the delivery and features of e-home care via welfare broadband.

In 2013, Västerås was the first municipality in Sweden to introduce large-scale e-home care services (eHemtjänst). For example, the 'giraffe' – a remote video phone on wheels – is used for communication between individuals and home care service providers. The city also uses the technology for night-time home care monitoring. A camera is used to ensure nothing unexpected happens to those in need of care.

Växjö Municipality – Working with Welfare Services

Wexnet has begun a collaboration with Kronoborg County Council, Växjö Municipality and property company Växjöbostäder to develop and introduce digital welfare services.

The digital welfare services are intended to help care recipients feel safe at home even when nursing staff are not there. Using digital fibre technology to provide welfare services enables people to continue living in their own homes as they age or require greater care for other reasons.

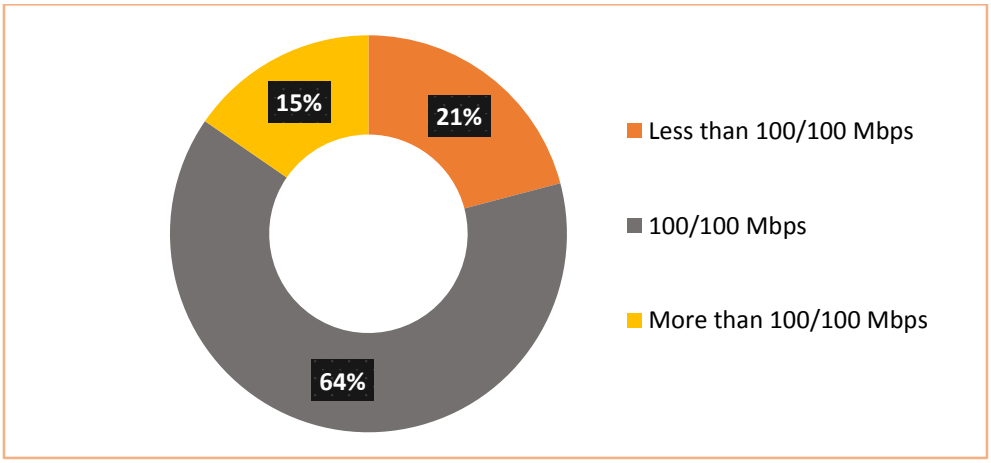
Växjö uses the fibre network to offer digital security alarms and digital night monitoring, care services, automated lighting when dark, alarms when doors or windows are opened and fire, motion, and water detectors and stove guards.

Services Offered to Service Providers

Service providers in local fibre networks are dependent on the local network's ability to deliver the transmission speeds they want. In the last few years, an increasing number of local fibre networks have upgraded their networks so that service providers can provide services at higher speeds. Networks are primarily being upgraded to be able to handle 1,000 Mbps (1,000 Mbps = 1 Gbps).

Local fibre networks' standard offering to service providers is still a wholesale product that is 100/100. However, 15 per cent of local fibre networks offer 1 Gbps. Of these local fibre networks, 60 per cent can offer service providers 1 Gbps throughout their entire network. The remaining local fibre networks can offer 1 Gbps in parts of their network.

Figure 11 Local fibre networks' standard offering to operators and service providers



The Role of Communications Operators in Local Fibre Networks

Communications operators' basic role is to be a neutral actor who ensures traffic in the local fibre network. Communications operators offer an open technical platform where all service

providers can have equal access to the network. This means that households and businesses are free to choose their provider of various services.

In 2012, the market began to consolidate. Several independent communications operators were acquired by other operators. Today, virtually all independent communications operators are linked to a vertically-integrated service provider, which is concerning, given that it could threaten neutrality.

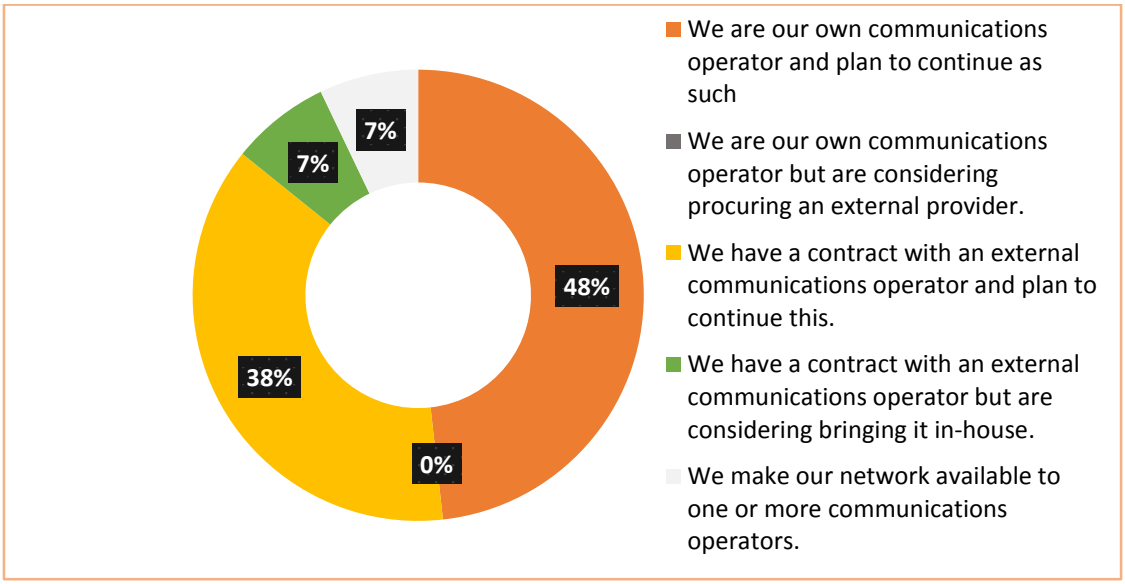
After its acquisition of Zitius, TeliaSonera is now the largest communications operator in Sweden. The second largest is Open Universe, which was largest in 2012. As a result of these acquisitions, ViaEuropa is now the only independent communications operator remaining.

Independent communications operators have played an important role for many smaller local fibre networks. These neutral operators have been able to aggregate end-customers from many small local fibre networks and, thus, attract large content providers and contribute to freedom of choice for these customers. These local fibre networks now risk having buyer power shift in favour of the large, vertically-integrated service providers. In small local fibre networks, it can be difficult to find financial justification for establishing and serving as their own communications operator. This means it has been difficult for small municipal local fibre networks to find alternatives to the external operator and, thus, their ability to negotiate is diminished.

The way the role of communications operator is organized varies between local open fibre networks. It is most common for local fibre networks themselves to act as the communications operator (48 per cent). Almost as many, 45 per cent, have procured agreements with an external communications operator.

Seven per cent have no agreement with any specific communications operator. Instead, they grant access to the local fibre network to different operators, including communications operators. For this reason, these networks can have several communications operators. Examples of local fibre networks using this type of solution are Stokab and GothNet.

Figure 12 The role of communications operators in local fibre networks



In recent years, local fibre networks have worked to increase the density of existing infrastructure. This is something that local fibre networks take responsibility for themselves (78%). Twelve per cent of local fibre networks share responsibility for increasing density with

the external communications operator and the external communications operator takes full responsibility in nearly 10 per cent of local fibre networks. Of local fibre networks working to increase density, 65 per cent have developed their own marketing materials and almost as many employ their own marketing campaigns. Half of local fibre networks report that they have also hired their own salespeople.

Each level of the value chain has economies of scale. The service provider level requires large customer volumes to cover the joint costs of service production. In addition to sharing the costs of, for example, the core network, support systems, operation and customer service among many customers, large customer volumes also mean advantages when purchasing Internet capacity and TV rebroadcast rights.

The economies of scale that characterize the communications operator level mean that local fibre networks often require a larger customer base than that offered by their own municipality to cover the joint costs. Unlike fibre networks, the role of the communications operator is not burdened by the same geographical limitations for achieving the necessary economies of scale. Under current regulations (the Local Government Act's localization principle), however, municipalities are prevented from participating in the efficiency gains being achieved in the industry within the role of communications operators.

Thirteen Different Functions

Up to thirteen different functions have been identified for local fibre networks serving as communications operators. Each function can either be provided in-house or procured externally and provided by a contractor. This section describes these 13 functions, together with statistics from this year's survey.

Functions:

1. **The Local Access Network**
   Access to a network for the delivery of services is a requirement. A communications operator can either own this network, or choose to lease space from a network owner. Most commonly, a communications operator operates its own network (80%). A few place the function with a supplier and even fewer share the network function with a supplier.

2. **Network Operations Center (NOC)**
   An NOC is responsible for monitoring the network, servers and equipment. Forty per cent of local fibre networks running communications operator activities in their networks have chosen to locate the NOC function internally. Just over one-third have procured the function and an additional 17 per cent have chosen to share the function between the local fibre network and a supplier.

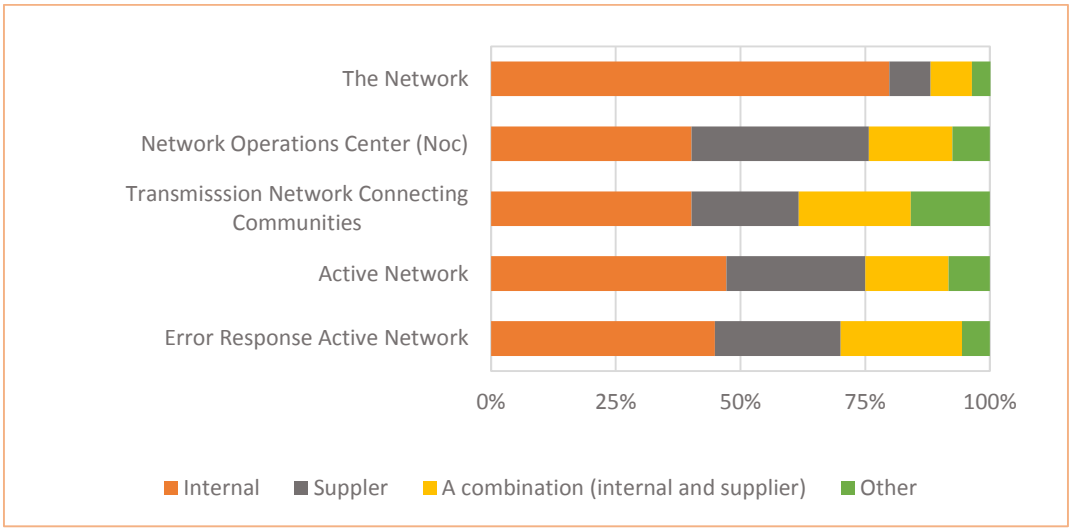
3. **Transmission and Inter-community Networks**
   This network allows service providers to access local access networks. This function that allows service providers to access the active network from their own operations is currently provided internally in 40 per cent of cases. It is just as common to use a supplier as it is to share the function between a supplier and the local fibre network.

4. **Active Network**
   It is after the optic fibre is fitted with terminating equipment that light impulses are sent in the cable and the data can be transported. This equipment can often be monitored and supplied with electricity, which connects different parts of the network. Almost half

of local fibre networks take responsibility for the active network. One-third have procured a supplier to shoulder this responsibility.

5. **Fault Clearance in the Active Network**
When the system malfunctions, a technician troubleshoots the network, makes repairs and fixes the system as soon as possible. Forty-five per cent of local fibre networks are responsible for their own fault clearance in the active network. One-quarter have procured a supplier to handle this function.

Figure 13 How functions 1-5 are organized by communication operators



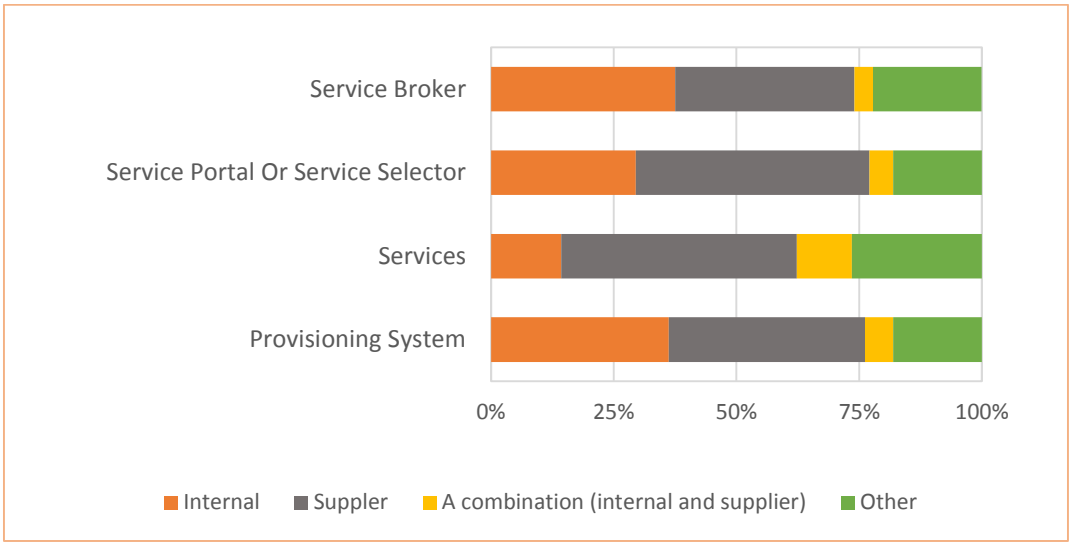
6. **Service Brokers**
Service brokers' basic task is supplying the network (network owner) with services from the service providers so that end-customers have a selection to choose from. One-third of local fibre networks handle the task of ensuring a range of services themselves. A further one-third have a supplier that handles this function. The rest share responsibility between themselves and a supplier and others have found other solutions.

7. **Service Portal or Service Selector**
Customers order broadband services from the portal. In its most primitive form, this is a list of available service providers (Internet, IPTV, VoIP) that customers contact themselves. More advanced portals offer self-activation, i.e. customers can choose services and change service providers directly using the portal. The majority of local fibre networks have procured this function from a supplier. Thirty per cent of local fibre networks manage the service portal themselves.

8. **Services**
This refers to services produced internally, such as Internet, telephony, TV or other end-customer services. Primarily, suppliers provide this function. A few local fibre networks handle this in-house, and it is these that reported that they provide their own end-customer services.

9. **Provisioning System**
Service providers must be able to invoice the right customer for the right service. They also have to be able to share income with other players, such as owners of passive networks, the backbone, property owners and so on. It is almost as common for a supplier to manage and assume responsibility for the provisioning system as it is for a local fibre network to handle the function internally.

Figure 14 How functions 6-9 are organized by communications operators



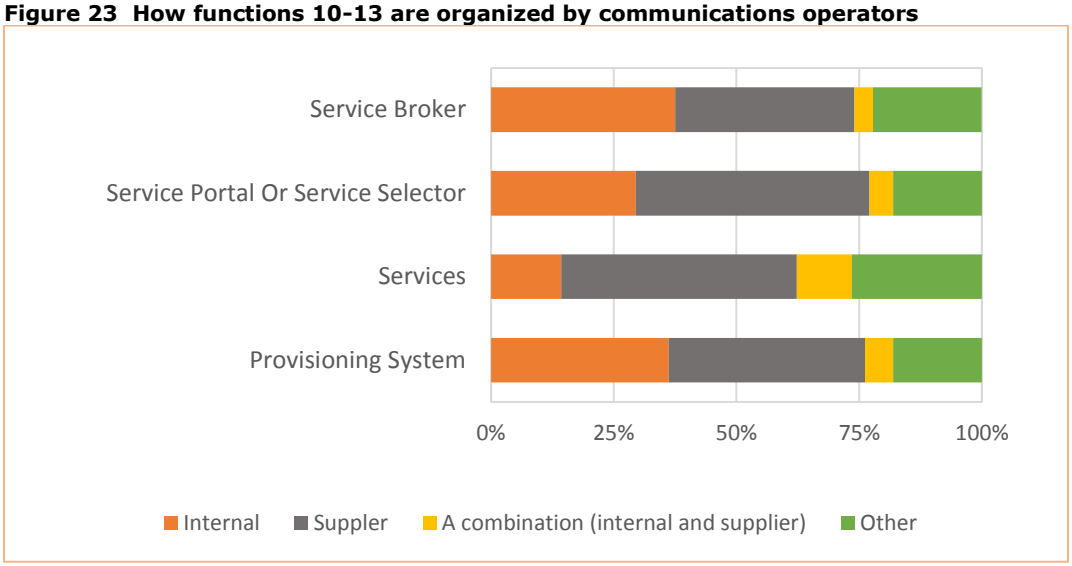
10. **Sales to Property Owners**
    The network must reach the end-customers and these either live or work in different properties, such as single-family homes, multi-family homes, or offices and industrial premises. These properties are owned by a company or a household, which means that negotiations are needed for property owners to want to connect to the network. Most common is for local fibre networks to handle negotiations and sales to property owners themselves (60 per cent). If another party is to handle this function, local fibre networks prefer to share the responsibility with a supplier.

11. **Sales of Infrastructure within Properties**
    A property consists of, for example, several households/apartments or companies and a property network is needed to reach end-customers. Nearly 50 per cent of local fibre networks have procured this function from a supplier. The supplier is either fully responsible for sales of property networks or the responsibility is shared with the local fibre network.

12. **Marketing Targeting End-customers**
    Sales and marketing of broadband and end-customer services either occur together with a supplier or are handled internally. Thirty-eight per cent of local fibre networks handle marketing themselves and an equal percentage have engaged a supplier. Fifteen per cent share responsibility with a supplier and 9 per cent have found an alternative solution.

13. **Management of Hardware for End-customers**
    This can involve TV boxes, phone connectors for IP telephony, or a router that wirelessly transmits data to other devices in the home. This function is almost exclusively handled by a supplier, either in co-operation with the local fibre network or on their own.

Figure 23 How functions 10-13 are organized by communications operators



The role of a communications operator includes both its own work and collaborating with one or more suppliers. Sometimes, responsibility for certain functions is shared. Our study has shown that almost all local fibre networks have procured one or more of the 13 different functions.

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