Neutral fibre as a platform for innovation

European Parliament Seminar

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Europe's push for innovation

Digital Decade Policy Programme

- EU **Digital Decade Policy Programme Decision** adopted in December 2022

- Establishes high level targets for communications for 2030
  - All end-users to be served by a **Gigabit network** up to the NTP, and all populated areas covered by wireless networks with performance equivalent to 5G
  - At least **10,000 climate neutral high security edge nodes** to guarantee access to data services with low latency wherever businesses are located; and
  - Union should be at the **cutting edge of quantum capabilities** by 2030

- Targets also for businesses and public administrations to embrace leading-edge technologies
  - At least 75% of enterprises should have taken up cloud computing, big data and/or AI
  - More than 90% of SMEs should reach at least a basic level of digital intensity
  - Public services **should be** accessible online
  - Citizens and business should be able to interact online with public administrations

Stockholm as an innovation leader

- Stockholm holds a leading position for innovation amongst regions in the EU and surrounding area

- Stockholm is home to Europe's most valuable private start-up Klarna, as well as providing the launchpad for other well-known companies such as Spotify, Mojang, and Skype

- Its main strengths lie in the number of scientific publications and patents, and the number of SMEs introducing product innovations, innovation expenditure per person employed and sales of new to market innovations. Stockholm is a leader in public private co-publications

- Public support has been a key factor: Sweden invests 0.8% of public funds in R&D.

Highest ranking regions of the 2023 European Innovation Scoreboard
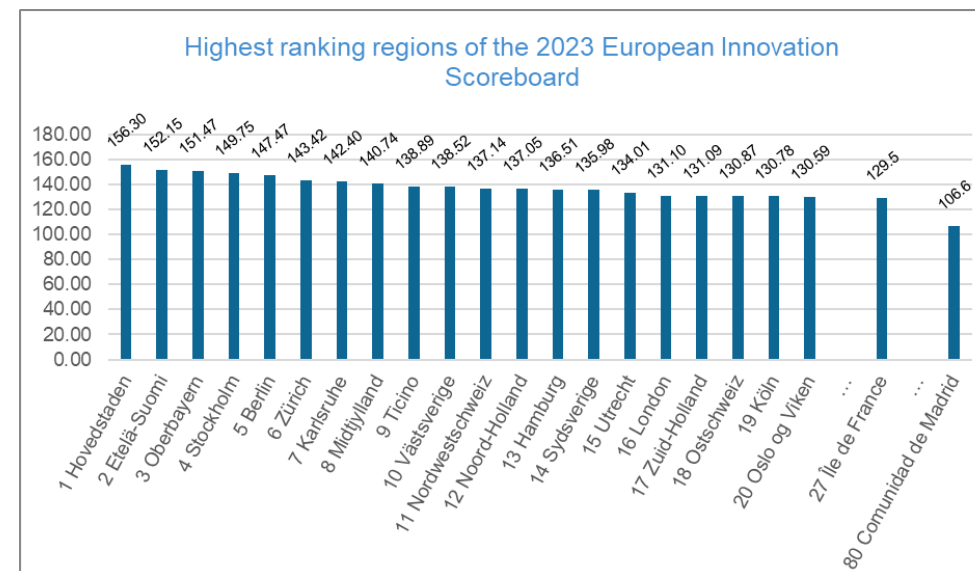
Source: European Innovation Scoreboard (EIS) 2023

Stokab's neutral fibre network

Network architecture, coverage and performance

- Established in 1994 by the City of Stockholm

- Aim: build a competition-neutral IT-infrastructure capable of meeting future communication needs, spur economic activity, competition, diversity and freedom of choice

- Customers include >100 ISPs, MNOs, enterprises and public institutions. Connectivity for the City (incl. educational and cultural facilities and smart city services) is supported through the Stokab subsidiary S:t Erik Kommunikation.

- Network reaches 26 local authorities and involves 1.9bln km of fibre in 9,900 optical cables

- Covers 90% HH, 99% businesses and nearly all major healthcare, educational and research facilities + Stockholm innovation centre Kista

- Each premise served with 2 point to point dark fibre access lines per HH / company– accessible at 400 access nodes

- Each access node provides access to ~ 40 buildings (~2,000 apartments). Cross-connecting nodes support redundancy

- Spare fibres (8 spare per building) and ducts (2 ducts in parallel accommodating 4 cables (each supporting 90-1,700 fibres) provide scope for evolving demand

Stokab's business model
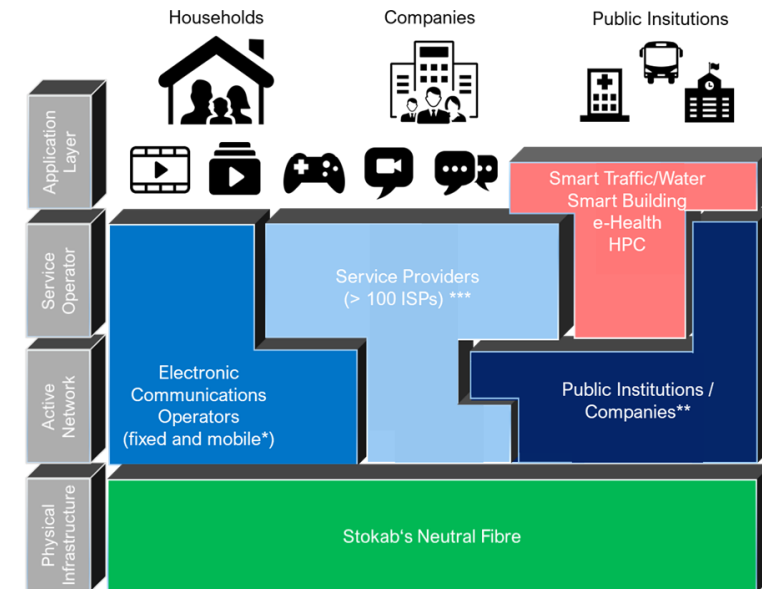
Stokab's network architecture

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Innovation in communications
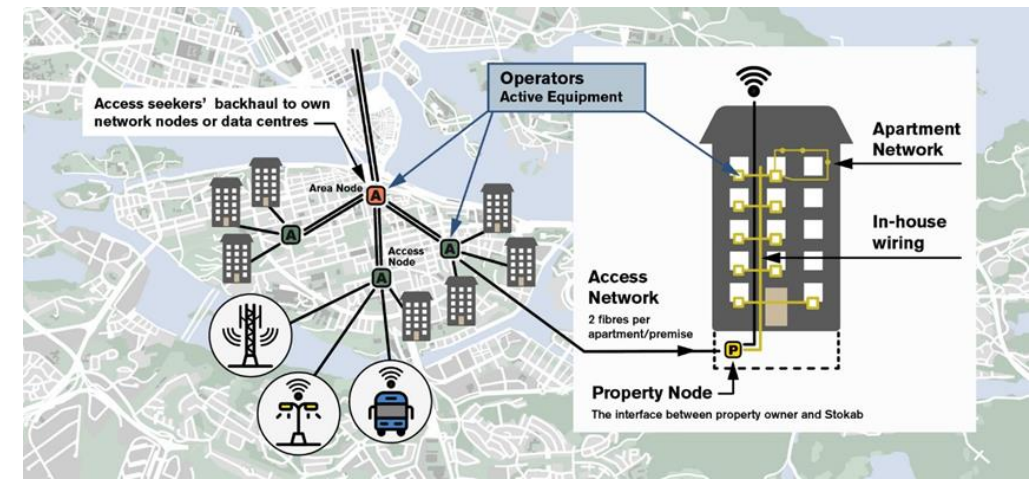
A platform for 5G deployment

> "We profit from being independent of the incumbent and at the same time fibre availability pushes competition and forces everybody to be in the race".
>
> *Kent Norman, Manager for transmission and data* at Tele2

> "It is a point of pride for the City that despite having a population of only 1m, [in Q2 2023] the city is served by 4 mobile operators offering 5G services".
>
> *Staffan Ingvarsson, CEO of Stockholm Business*

- Mobile broadband speeds in Stockholm outperformed those in other European capitals in the 4G era (see 2017 WIK study)

- Dark fibre has supported rapid 5G deployment. Stockholm was found to have the fastest 5G download speeds in an Ookla benchmark of Nordic cities in Q2 2022, and continues to perform well globally.

- Availability of dark fibre for backhaul has enabled speeds offered by alternative mobile operators to approach those of the incumbent, in contrast with cities (e.g. London, Hamburg) where MNOs lack access to fibre and are not themselves deploying FTTH

- The Q2 2022 Ookla report found that the 3 alternative mobile operators offered higher 5G download speeds than Telia

Innovation in communications

Pushing the boundaries of fibre performance

- The availability of dark fibre has supported innovation in business communications and the further enhancement of capacity
- Layer Mesh has deployed a meshed network throughout Stockholm using fibre from Stokab and other providers
  - L&M's network is characterised by a flat network hierarchy involving directly connected fibre without intermediate technologies or protocols enabling low latencies of <0.1ms
  - The network utilises passive Coarse Wavelength Division Multiplexing (CWDM) with up to 16 channels or wavelengths
  - Over the last 5 years, the lowest capacity has been 10Gbps symmetric, and 100Gbit/s symmetric is available within 10 days to 93% of buildings in Stockholm
- Experts at RI.SE see benefits from being able to rent a fibre pair without transmission equipment. Without an amplifier, it is possible to use fibres for different purposes, whereas when renting a wavelength it is necessary to adapt to the direction and stability of the wavelength
- Routable Optical Networks (RONs) where routing is conducted at wavelength lever rather than via downstream ethernet or IP protocols are seen as the future solution, but are not known to have been implemented

"Our network is really self-healing, we don't even have to think about redundancy and there is no need for human interaction. We have not have a single outage for the past 6 years"

Daniel Persson, founder and CEO of Layer & Mesh

Research on improving modulation has delivered more wavelengths per fibre, as well as supporting more data per wavelength. Bandwidths of up to 400Gbit/s are now possible for each wavelength.

Innovation in communications

Supporting quantum communications

"We were the first in the EU to have a quantum link. Innovation would not have happened without this link from Stokab. In any area you need good will and good collaboration for innovation to happen."

Val Zwiller, Professor in Quantum Photonics at KTH

"Secure quantum communications are important to keep democracy alive"

Val Zwiller, Professor in Quantum Photonics at KTH

- Dark fibre is important input for quantum communication, a technology which enables security in communication via physical means rather than encryption

- Quantum communication will be essential for security when quantum computing cracks existing encryption methods

- Trials involving KTH Royal Institute of Technology and Ericsson
    - Stokab regular fibre connects KTH lab to Ericsson's lab in Kista – 17km
    - Transmission without amplification
    - Communication via individual photons, one particle of light at a time
    - Aim to expand the network eventually to cover Sweden

- EC plans to support the extension of quantum communication infrastructure to cover the whole of the EU. EuroQCI implementation announced in January 2023; but

- EU trailing China in quantum comm progress – quantum link between Beijing and Shanghai – 20 links to cover 1,000km

Supporting innovation "over the top"

Broadcasting and media

- Broadcasting and media is one application that has benefited from the availability of dark fibre in Stockholm.

- Providing connectivity for events such as the Stockholm Marathon and UEFA matches requires dedicated connections offering very high bandwidths, low latency and packet loss. Just one high definition video signal requires 1.5 Gbit/s. Ultra-high-definition requires 12 Gbit/s if

"We are spoiled in Stockholm. It is quite unique to have one supplier which can provide connectivity at short notice at what can be odd locations like the middle of the street, as we needed for the Stockholm marathon. With fibre, all the communications work as if the camera were in the studio"

Andreas Langell, CEO of Mobile Links

- Mobile Links notes that dark fibre is its preferred solutions as with 16 wavelengths it can easily achieve 1.6 Tbit/s.

- Other technical solutions are used when fibre is not available, but have limitations: microwave is less reliable, satellite works well for line of sight and simultaneous broadcasting, but has limited bandwidth, 4G mobile suffers from packet loss / delay, while quality-assured 5G could be costly

- Mobile Links also notes potential discrimination concerns when telecom companies active in media control the fibre

Supporting innovation "over the top"

Digital healthcare

- The Stockholm Region provides healthcare to 2.2m inhabitants

- Since 2021, the Region has been trialling quality-assured 5G services, which rely on fibre backhaul

- A key element of the trial is to provide support at the site of a disaster or accident using 5G to stream video from cameras installed inside the ambulance and on ambulance personnel

- Images are transmitted to the Emergency Room to enable doctors to advise on intervention

- 5G has also been installed inside Karolinska Hospital, which acts as an Innovation Hub for training for the Region.

"Fibre connections to households support other digital healthcare initiatives in Stockholm such as "home care" and remote monitoring for chronic conditions, as well as video consultations."

Fredrik Engströmer, Head of Innovation, Stockholm Region

Supporting innovation "over the top"

Traffic and environmental management

- The Stockholm Region and Stokab are collaborating with industry e.g. Edeva and research institutes incl. RI.SE to support trials of traffic and emissions management

- In Hornsgatan Street, considered the most polluted in Stockholm, Stokab has provided fibre backhaul at 14 locations for the installation of sensors (incl. radar and cameras) which capture information about traffic patterns and behaviour, enabling enforcement of environmental and traffic management rules.

- License plate recognition software coupled with the license-plate register enables identification of the class of vehicle and fuel type, while radar captures location (e.g. wrt bus lanes) and speeds

- Edeva's CEO notes that 20,000 vehicles pass each site every day. Edge processing limits bandwidth requirements today, but dark fibre could support future applications involving processing of data on sound, video and vibrations in the cloud

Lessons from the Stockholm case

- The example of Stokab shows that dark fibre can provide an important platform to support the innovation ecosystem, both for connectivity and applications

- Point to point fibre is an important input for Quantum communications, which will be essential to guarantee security in a quantum environment

- Although it is not the only possible solution, the Stockholm example shows that public ownership of dark fibre networks can help to ensure that research facilities and centres of public interest including schools and hospitals are effectively served with open and future-proof infrastructure

- The wide and growing range of applications for dark fibre (from creative industries to smart cities and connections for homes and businesses) show that fibre is fast becoming an essential platform for society and the economy

Should the next Digital Decade focus more on future-proof networks (dark fibre) to support the needs of citizens, businesses and public services in the post-2030 era?

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