Making a success of FTTH learning from case studies in Europe

MAKING A SUCCESS OF FTTH

LEARNING FROM CASE STUDIES IN EUROPE

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While DSL and cable networks meet today's demands and services, they will be unable to support the simultaneous use of next-generation (video-based) applications; these need fibre in the access network. However, the investments to deploy fibre-based access networks, and more specifically Fibre-to-the-Home (FTTH) networks, are huge, and as the need for FTTH is not yet urgent, traditional telecoms players are deterred from investing in large-scale deployments. In some Western European regions, however, other parties are seizing the initiative.

This paper analyses the FTTH deployment in Stockholm, Sweden, and compares it to other successful initiatives, focusing on the initiators, their key drivers and strategies.

The next step in fixed access networks is the deployment of fibre from the Central Office (CO) to individual homes. Fibres with inherently high data-carrying capacity will revolutionise the way we communicate and exchange information.

Clearly it is hard to estimate in advance the demand for a FTTH network in comparison to existing offers on copper or cable networks. Still the evolutionary advantage of optical access networks is incontestable. Whether passive or active, they easily offer a dedicated upstream and downstream bandwidth of 100Mbit/s and an overlay broadcast channel for video (or other services) of 2.4Gbit/s or more.

Currently, the high-end offers of both copper and cable networks fall far short of this (typically limited to 100Mbit/s downstream and 5Mbit/s upstream). Pricing tariffs for existing FTTH connectivity show that these much higher bandwidths can be price competitive with existing high-end offers on copper or coax. Optical networks are also the only networks that will allow much more bandwidth in future upgrade scenarios at reasonable costs.

What does this higher bandwidth mean and what services will be using it? [1]. Recent developments in picture and video quality, social networks, the rise of networked storage and cloud computing require increasingly more bandwidth and benefit especially from higher upstream speeds. The trend to higher bandwidth applications (online gaming, remote desktop, video calling, etc) is to be expected and many of these applications are already technically feasible [2, 3]. While clearly none of those applications is the Killer App, the combination of all services would certainly benefit from higher bandwidth and lower latency and, as such, could greatly benefit from FTTH.

However, given the huge investments, traditional operators have generally delayed large-scale FTTH deployments. This has encouraged other parties (mainly public ones) to take the initiative.

Studies have analysed the different routes followed in the EU27 Member States by public and private investors to deploy fibre [4]. In the last few years, there has been an increasing effort from the research and business community to highlight the different means of interplay between public and private investors [5, 6].

This paper aims to identify critical success factors for FTTH in Western Europe based on the comparison of a selection of existing deployments. The analysis focuses on the different actors involved (both public and private) and the role each of them

plays in the deployment and operation. The next section introduces the framework used to describe and evaluate the cases. This is followed by two sections providing respectively details about the Stokab case in Stockholm and other regions in Europe. The paper concludes by summarising the similarities and differences between the cases and extracts some critical success factors.

IDENTIFICATION OF POSSIBLE BUSINESS MODELS BASED ON THE NETWORK MATRIX

To identify the best practices for the roll-out of FTTH, we devised a framework, the network matrix, to analyse existing deployments, focusing on the actors involved and their roles.

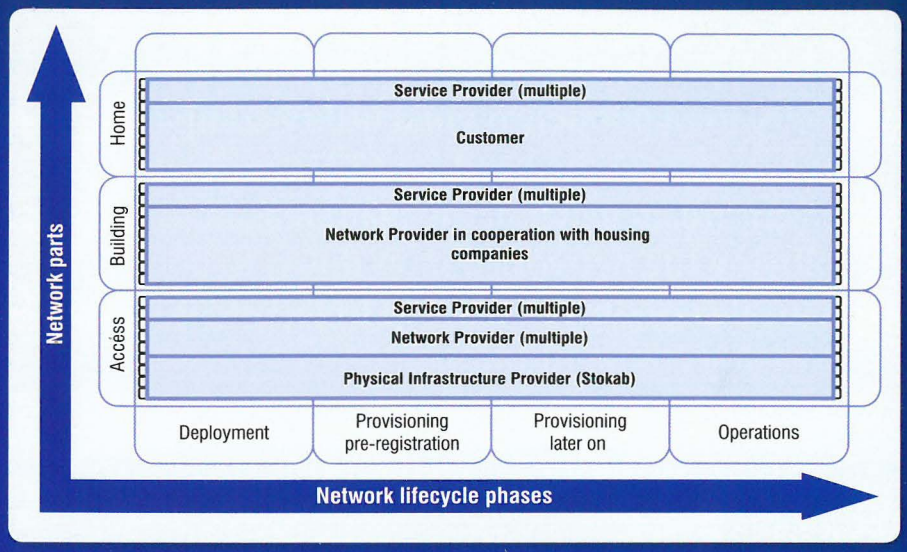

Figure 1: *Focusing on the different network layers within each cell allows us to identify three important roles and to identify the possible business models.*

NETWORK MATRIX

The network matrix describes the different deployment and operations roles within a FTTH network (Figure 1 based on [7]). The life-cycle phases of the network (deployment, provisioning of the early subscribers together with deployment, provisioning later on and operations) are mapped against the different parts of the network (backbone, access, building and home). Within each cell, several boxes represent the different network layers, which can be considered as an extension of the classical OSI-model [8] towards fibre-based networks.

- **Physical Infrastructure Provider (PIP)** - responsible for obtaining rights of way, digging, duct and fibre installation. The PIP can also take care of other passive infrastructure, such as the housing of the Central Office (CO), installation of empty racks, provisioning of man- and hand-holes.
- **Network Provider (NP)** - deploys and operates all the active equipment necessary to provide end-to-end connectivity between the customers and the CO. They install optical equipment at the CO and at the customer's premises and are responsible for the other equipment (like switches, splitters...) in between.
- **Service Provider (SP)** - uses the end-to-end connectivity to offer services. They install service-specific equipment (e.g. set-top box for DTV) and send the right content and applications to their subscribers. Only local service providers that receive direct revenues from their customers through subscriptions are considered here (not players like Google that derive their main income from advertising).

BUSINESS MODELS

An important issue when analyzing FTTH deployment is the identification of the business model: who is responsible for what and does this allow for competition? The different business models encountered while analysing the deployment cases are given below.

Based on theoretical studies and experience from experts, there are two possibilities for opening up a network to competition: on network level and service level [9]. From these, several business models can be extracted, but we will only focus here on the three encountered in analysing the cases.

- **Vertically Integrated** - one actor (or its subsidiaries) takes up all the roles.
- **Open Access model with competition on service level** - characterised by one single PIP, one NP and several SPs. End-customers are then able to subscribe to services from different SPs whilst the provisioning of end-to-end connectivity is a monopoly.

> "In all four urban cases under study, it was the city (or a publicly owned utility company) that recognized the need for FTTH and initiated the venture. In general, the main reason for deploying the network comes down to boosting the local economy and the ICT market, as well as increasing competition."

- **Equal Open Access** - allows for competition on both network and service level, since multiple NPs and multiple SPs are operating on top of one passive network. In this case, price competition can be combined with speed differentiation because NPs are responsible for the offered bandwidth.

The framework described above was used for a detailed analysis of the Stokab case in Stockholm and to identify which business model was used in the other Western European cases.

THE STOKAB CASE

In order to create competition in the telecoms sector, the City of Stockholm founded a public company in 1994: Stokab. By rolling out a dark fibre, operator-neutral network, the goal of Stokab was (and still is) to stimulate the telecoms market and ICT development in the region and thereby promote economic growth.

GENERAL INFORMATION AND BACKGROUND

The Stockholm region consists of both mainland and several thousands of islands. It covers an area of about 216 km^2 , residing 840,000 residents in about 450, 000 buildings; 45% of these are multi-dwelling units (MDU), 19% is municipality owned. Economically, Stockholm is dominated by the service sector and has the highest concentration of knowledge-intensive jobs in Europe (74% of working population).

The point-to-point FTTH network in Stockholm covered 175,000 households at the end of 2010 and the goal of Stokab is to reach 90% (about 400,000 households) and 100% of companies by the end of 2012 [10].

THE ACTORS INVOLVED

The FTTH network in Stockholm is provided by three types of actors: one PIP (Stokab), multiple NPs and over 90 SPs [9]. Apart from these telecoms-oriented actors, the influence of housing companies and enterprises is vital for the success of this case. Figure 2 gives a visual representation of the different actors. Because the focus is on the "last mile", the backbone part of the network is not shown. Also, in Stockholm, all the actors are responsible for the entire life-cycle of the different parts of the network.

- **One single PIP: Stokab** - responsible for the passive infrastructure between the CO and the basements of the MDUs, as well as between the different COs (redundant connection). It does not own active equipment. Stokab buys or rents accommodation from the land owner (e.g. in the basement of the MDU) to install empty racks. It leases dark fibre and rack space for the active equipment to all NPs for less than it would cost NPs to build their own network. This ensures that the disruption from digging works is kept to the minimum. Moreover, the public nature of Stokab facilitates coordination and cost sharing of the digging works with other utilities.
- **Multiple NPs** - provide transmission capacity to end-users or to SPs by installing active equipment and using dark fibres rented from Stokab. Within the Stockholm region, both public and private NPs co-exist, each connecting different buildings. The public NP that operates the city's internal networks is a subsidiary of Stokab: S:t Erik Kommunikation. It also provides in-house wiring in the city's own buildings. They only offer transmission capacity, the offering of services is granted to other companies (SPs) through the use of open tenders. Several private NPs use Stokab's network, e.g. OpenNet [11], Zitius [12]. They connect the end-customer to the active fibre network and let the end-customer decide to which services they would like to subscribe. A NP typically has contracts with different SPs so that competition exists between SPs serving the same customer.
- **Tens of SPs** - Currently, there are more than 90 SPs. They do not have their own network or active end-to-end connectivity equipment but are responsible for the service-specific equipment (like a set-top box)

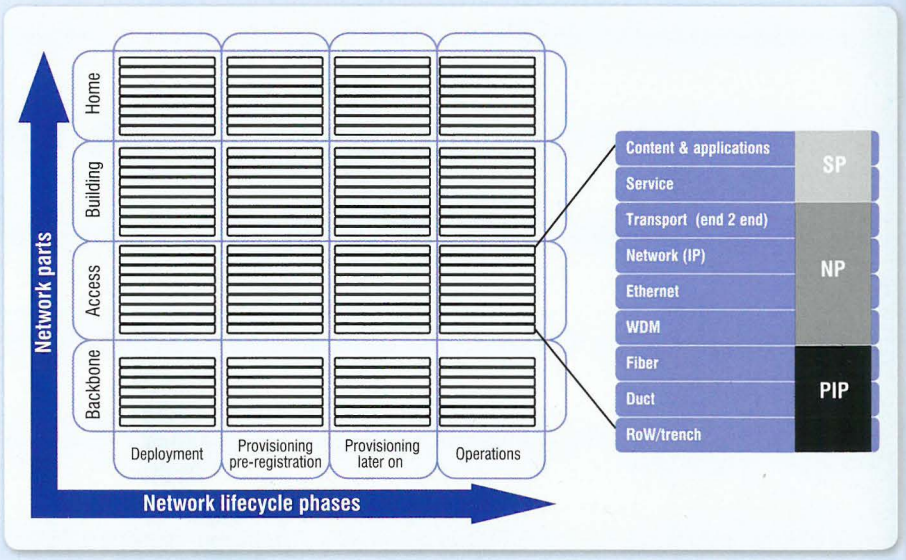

Figure 2: Network matrix for Stockholm

and the applications and content of the services. Some examples of SPs active in the Stockholm region are: Canal Digital (digital television), Viasat (digital television), All Tele (broadband, telephony), Tele 2 (broadband, telephony, digital television, triple play) and Bredband Bahnhof (broadband, telephony, digital television, triple play).

- **Network and Service Providers**- Apart from companies that are only NPs or SPs, there are also companies that offer both connectivity and services. One example is an NP, Ownit [13], that also offers broadband and telephony services. Additionally, they have an agreement with a SP, Canal Digital, for digital television. The Swedish incumbent operator, Telia Sonera, and the cable operator, ComHem, also offer both connectivity and services.

In the early days, it was thought that Stokab would become a competitor to those traditional operators. However, we now find these operators also using Stokab's network. As a consequence, Stokab is not a competitor on its own, but provides a competitive playing field for all other operators.

- **500 enterprises as customer** - Alongside these telecoms-oriented actors, over 500 enterprises (banks, media, security and more) make use of Stokab's network renting point-to-point fibres directly from Stokab and providing their own equipment (or via outsourcing to an NP) to have their own (security-sensitive) services.
- **Housing companies** - Housing companies play an important commercial role given that it is their decision as to which NP connects to their premises. Some examples of both public and private housing companies in Stockholm are: Familjebostäder, Svenska Bostäder (public), Stena fastigheter, E.M, Wallenstam, Akelius Fastigheter AB (private) and Micasa (service homes for elderly). Svenska Bostäder is especially worth mentioning because it deployed an in-house fibre network (and acts as a kind of in-building PIP). It has contracts with different NPs (OpenNet, Zitius, Itux) for the operation of the network and contract SPs for the offering of services.

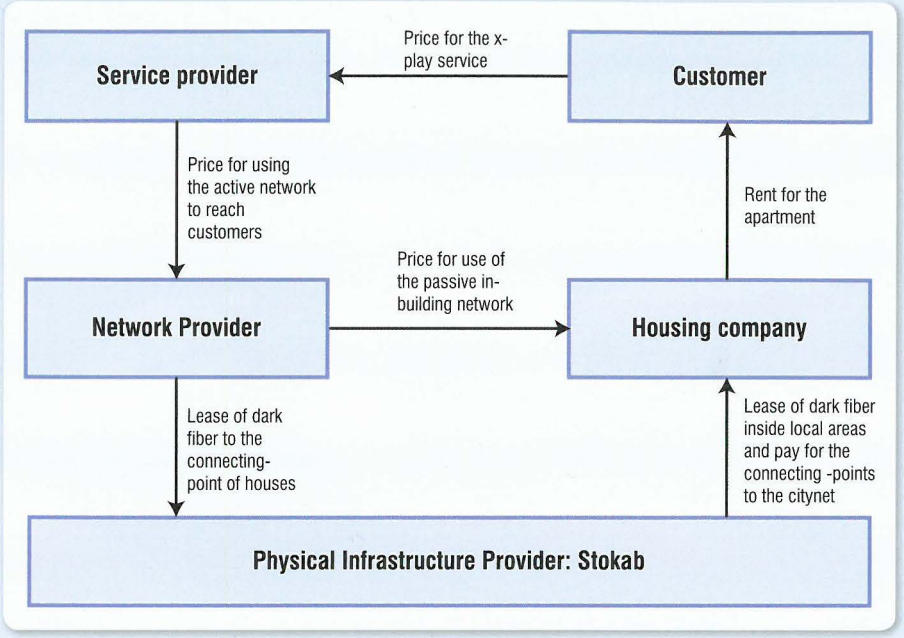

Figure 3: *Value network for Stockholm's FTTH network*

VALUE NETWORK

How does the money flow in between the actors? Figure 3 gives a visual representation of the value network.

The end-customer pays a monthly subscription per service (or bundle of services) to the SP and they pay rent to the housing company. Fees range from €20 per month for basic broadband (1Mbit/s downstream and upstream) to about €50 per month for very fast broadband (100Mbit/s down and up). End-customers do not pay directly the NP for end-to-end connectivity. NPs receive revenues from the SP and in return offer the use of the active network and marketing through their websites. The NPs pays Stokab for the use of the dark fibre and the housing companies for the use of the in-building network. Stokab receives money from the NPs and/or housing companies for using the fibre. Stokab charges NPs about €200 per km or €5-7 per customer (dependent on the number of customers the NP serves) for the customers living in the inner city (regardless of distance). These revenues are sufficient to make a viable business case. Stokab, for example, had a turnover of €63 million in 2010.

SUCCESS RATE FOR THE STOCKHOLM CASE

Stockholm was one of the first cities to look at the telecoms network from a broader perspective: it considered dark fibre as a public utility (next to water, gas and electricity) that should be available to everyone on equal terms. It also foresaw the indirect benefits such a network could have in terms of the economic and social situation in the city.

The business model allows for competition at the network and service layers which has a positive effect on the efficiency of the business actors (mainly SMEs) and on the prices

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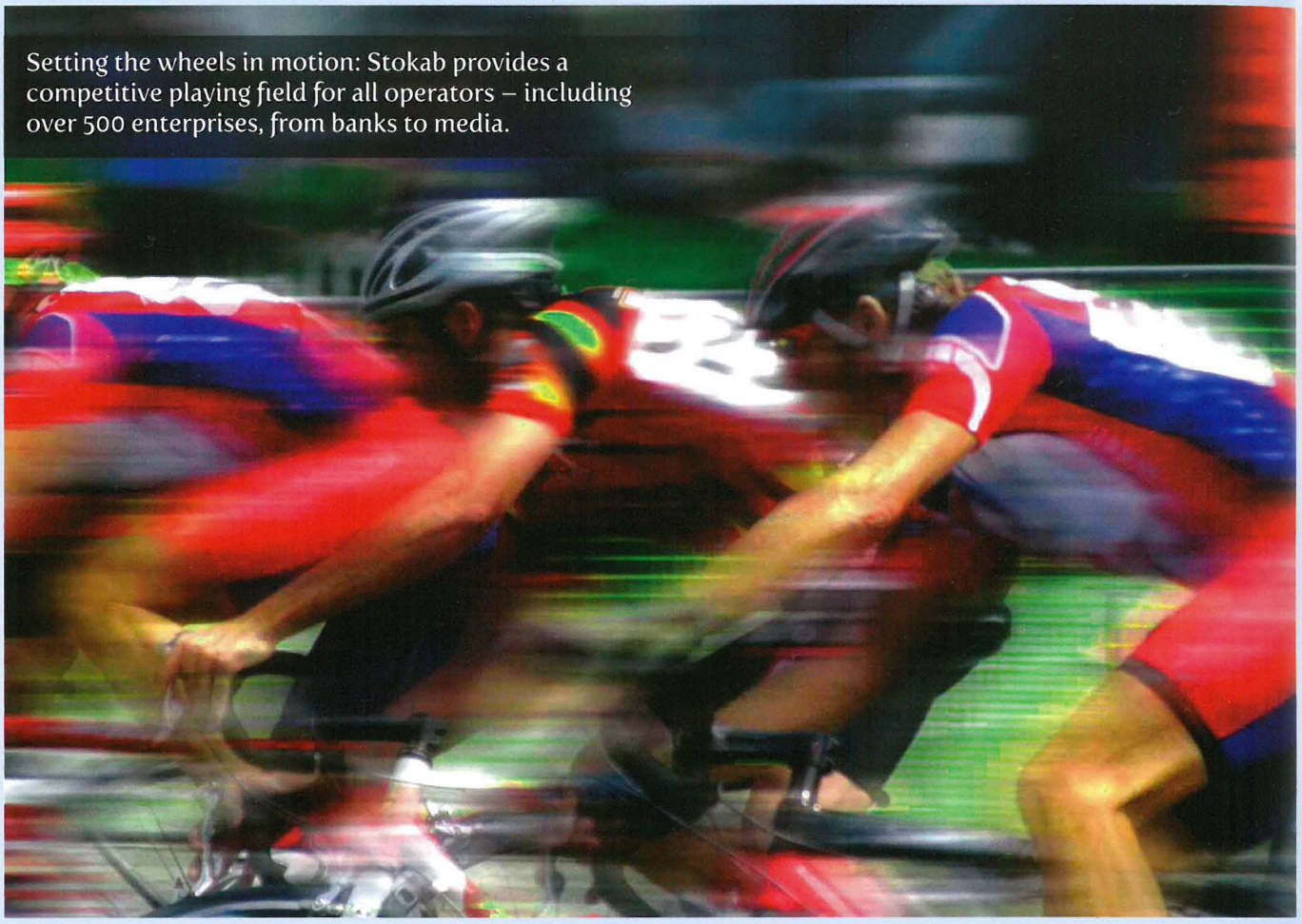

Setting the wheels in motion: Stokab provides a competitive playing field for all operators – including over 500 enterprises, from banks to media.

for the end-customers. However, the viability of Stokab is not assured by revenues from the residential market alone. An important part of its revenues comes from private companies leasing point-to-point fibre to have their own, secure networks.

The authors see two main drawbacks in applying this model to other European regions. First, the current regulatory framework does not allow for public funding in regions where a network is already in place. It may be funding could be permitted for the deployment of "an infrastructure", as is done for the deployment of roads, sewerage systems and so on. Secondly, the business case is only viable for MDUs; Stokab has yet to connect to single homes.

OTHER SUCCESSFUL EUROPEAN REGIONS

Although the Stockholm has one of the most evolved fibre-based networks in Europe, initiatives elsewhere in Europe have led to fully operational fibre-based networks with high subscription rates. In this section, we compare the case of Stokab with other deployments to see if there are generic drivers for success.

IDENTIFICATION OF CHARACTERISTICS FOR COMPARISON

Using the network matrix and the results obtained from analysing the Stockholm case, seven characteristics for comparing the case studies were identified.

- **Region** - population density, type of residence (MDUs, single houses, large villas etc.), geo-type (urban, rural).
- **Competitive infrastructure** - presence of other broadband networks and operators, like DSL networks (frequently owned by the incumbent) and cable networks.
- **Business model** - Equal Open Access, Vertically Integrated, and other models that lie in between those extremes: e.g. when the installation and operations of the active equipment is granted to one party with the use of a public tender procedure.
- **Initiator** - who started the project and has the main responsibility for its execution.
- **Other important actors** - e.g. a partner in a Public Private Partnership, by sharing ducts, by aggregating demand etc. Their roles can be quite diverse: from facilitation of deployment, over assuring a certain start-up take rate, to financial aid.
- **Scale of deployment** - the magnitude of deployment: does the project cover an entire country, a certain region or city?
- **Key drivers** - what drove the initiator to deploy the network? An incumbent driven by competition from the cable operator, a city handling out of public interest, a private company hoping to make useful returns from their investment, etc.

These characteristics were used as a basis for comparing 10 case studies selected according to geographical location and region, a mix of urban and rural cases, and a spread across Western Europe. The authors decided to exclude cases from Eastern Europe because of the strong differences in economic situation and historical development of

CASE	Region	Competitive Infrastructure	Business Model	Initiator	Other important actors	Scale of deployment	Key drivers
Stokab Stockholm (Sweden) [9-10]	Urban	DSL and cable	Equal Open Access	City of Stockholm	Housing corporations, enterprises	City-level	Creation of competition in telecom
Amsterdam CityNet (the Netherlands) [14-15]	Urban	DSL and cable	Equal Open Access	City of Amsterdam	Housing corporations, private investors	City-level	Promote local economy and integration
Reykjavik Fiber Network (Iceland) [16]	Urban	DSL	Open Access with competition on service level	Reykjavik Energy, public utility company	Municipalities	City-level	Increase Quality of Life and competition and synergies with other utilities
OnsNet Neunen (the Netherlands) [17]	Urban	DSL and cable	Vertically integrated (although not meant to be)	Cooperative OnsNet, founded by the residents	€800 subsidy per resident from the government, Reggefiber (later)	City-level	Stimulate development of ICT-services and BB infrastructure
Fastweb (Italy) [18]	Mainly urban	Dial-up internet, some DSL, no cable	Vertically integrated	Fastweb, a private company	Partnership with electricity firm in Milan	Seven cities (e.g. Rome, Milan etc.)	Improve Internet access conditions in Italy
Portugal Telecom (Portugal) [19]	Mainly urban	Cable operators	Vertically integrated	Portugal Telecom, the incumbent	NA	Country-wide (1mil homes passed as of 2009)	Competition from cable on Pay-TV market
Altibox, subsidiary of Lyse Energi (Norway) [20]	Both urban & rural	Seven telecom operators across the country	Vertically integrated multi-utility (different roles in subsidiaries)	Lyse Energi (regional energy supplier)	NA	Country-wide (360k homes passed as of 2011)	Interesting investment, horizontal integration
Pau-Pyrenées (France) [21]	Rural	DSL, but not everywhere	Open Access with competition on service level	Municipal authority of Pau-Pyrenées	NA	Pau + 13 neighbouring municipalities	Promote local economy
SEIPC, Pays Chartrain (France) [22]	Rural	Not everywhere alternative infrastructure	Equal Open Access	SEIPC, the regional electricity provider	NA	Regional (71 municipalities)	Meet the needs of the digital age
Ruhrnet, subsidiary of Stadtwerke Schwerte (Germany) [23]	Rural	DSL, but not everywhere	Vertically integrated	Stadtwerke Schwerte	NA	Municipality-level	Horizontal integration, Multi-utility; "one face to the customer"

Table 1: *Overview of Western European cases (NA denotes Not Available)*

the telecoms sector. Table 1 summarises the findings and details of the different deployments.

COMPARING THE CASE STUDIES AND DEDUCTION OF SUCCESS FACTORS

Urban regions are characterised by the presence of alternative networks, like DSL and cable networks, that were already in place long before deployment of FTTH. In rural areas, on the other hand, FTTH networks can be the first broadband networks to be installed which can result in the application of different marketing strategies. There is a strong difference in who initiated the project and their strategies used, as well as what drove them to start deploying FTTH. Furthermore, three of the cases described deal with country-wide level deployments (Portugal, Italy and Norway) which makes it harder to categorise the case in purely urban or purely rural terms. We have therefore divided our analysis into three parts: urban cases, rural cases and large-scale deployments.

URBAN REGIONS

Urban regions are characterised by the presence of other broadband networks, like DSL or cable. This might be one of the reasons why we see here a clear preference towards the (Equal) Open Access business model, allowing room for competition resulting in a reduction of prices charged.

In all four urban cases under study, it was the city (or a publicly owned utility company) that recognised the need for FTTH and initiated the venture. In general, the main reason for deploying the network comes down to boosting the local economy and the ICT market, as well as increasing competition. Apart from the public entity, housing corporations and private investors have a notable influence, both financially and in aggregation of demand. For instance, in Amsterdam the housing companies took up a third of the initial investment (the rest being taken up by the city of Amsterdam and by private banks), thereby ensuring a certain take-up rate from the start as all their homes got connected. Key motivations for the housing companies to invest were the ability to offer a fast and reliable FTTH connections to their residents which in turn increased the value of their properties.

LARGE-SCALE DEPLOYMENTS

Three examples are given here: Portugal, Italy and Norway.

- **Portugal** - the incumbent rolled out FTTH to stay competitive vis-à-vis the cable operator in the DTV market. This case leads to interesting conclusions as it is often said that the only application that

truly needs FTTH is video. Cable operators are ahead because their networks are built to transmit video-services and they can more cost-efficiently upgrade their network bandwidth as well. Clearly this illustrates that there is no such thing as a "killer app" but the use of multiple high-quality video-related services simultaneously is a good motivation to begin to deploy FTTH. The case in Portugal is similar to that in many Eastern European countries where incumbents are starting with FTTH due to a lack of good infrastructure.

- **Italy** - a new company was set up: Fastweb. It saw opportunities in connecting the residents in seven municipalities (cities like Milan, Rome, etc. and their environments) where the Internet access was rather rudimentary. Formulating a partnership with AEM, the electricity company in Milan, it was able to save digging costs and in turn gained additional subscribers for the network.
- **Norway** - Altibox, a subsidiary of the regional Norwegian energy supplier Lyse Energi, initiated and fully deployed a FTTH network. This again is a completely different case, with a utility company opting for a "multi-utility" strategy, offering both energy and broadband.

Although the initiators for these large-scale deployments are very diverse, the same Vertically Integrated business model is used.

RURAL REGIONS

As mentioned before, rural areas are characterised by rudimentary access to the Internet, and broadband DSL or cable networks are not available everywhere. One could conclude that rural areas form good markets to start deploying FTTH apart from the fact that the upfront costs are much higher than in urban areas. Because of this, and lack of interest from the incumbents to invest, the initiative to deploy the network was always taken by a public institution: a public utility or the municipality itself. Furthermore, rural areas with no other broadband infrastructure are the only areas where public funding is allowed (the so-called white areas, as defined in the European Regulatory framework [24]). This again discourages private firms to invest in FTTH in rural regions.

GENERAL REMARKS

Looking across all case studies, a relationship can be found between the key drivers and the business model applied. If the goal of the initiator is to promote the local economy, encourage competition or a similar reason related to public interest and the advantage for the end-customer, the business model used is more open. On the other hand, if the initiative is taken by a private company that aims at maximising its return, the business model is Vertically Integrated.

AUTHORS' CONCLUSIONS

In almost all cases there is a clear influence from public parties. There are exceptions, e.g. Portugal, where the incumbent was motivated to deploy FTTH as a result of competitive pressure from the cable operator. This competitive pressure was not found elsewhere as deployed DSL networks generally meet the needs of current offer of TV-services. The public actor is the municipality itself or a utility firm, and its role varies among the cases: from active deployment of the network, to investment of public money where the municipality acts as a genuine market player or to the aggregation of demand where the municipality ensures a certain take up rate from the start of the project (public administrative buildings, schools, hospitals and so on).

A second conclusion involves the relationship between the actor who takes the initiative and the business model applied. A public actor tends to opt for a more open business model (Open Access with competition on service level or even Equal Open Access), while a private actor will try to minimise the threat of entry by applying a Vertically Integrated model. A similar link can be found between the initiator and the key driver: a public actor will deploy the network because of the advantages for the end-users (both in the matter of public interest – access for all – as to force a reduction of prices stimulated by enhanced competition), while a private actor will try to maximise return on investment.

In general, we can conclude that public actors can and will be involved in deploying fibre-based access networks. The regulatory framework in Europe means that state aid is only allowed in white areas where no next generation access network exists or is likely to be built within the next three years. Future work should therefore investigate this path further to make sure that public involvement does not distort competition.

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ABBREVIATIONS

CO	Central Office	NP	Network Provider
DTV	Digital television	PIP	Physical Infrastructure Provider
MDU	Multi-Dwelling Units	SP	Service Provider

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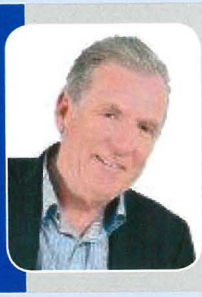

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