Deployment Strategies For FTTH Networks

Case studies from fiber deployments around the world show a variety of strategies for succeeding with FTTH.

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Fiber to the home has been deployed in various regions by different companies and public institutions. To determine which strategies lead to successful deployments, we examined the approaches taken by several FTTH networks that vary in background, location, population density, type of entity initiating the deployment and, of course, deployment strategy (or the lack thereof).

UFB IN NEW ZEALAND
The government of New Zealand started a procurement for an FTTH deployment to 75 percent of the nation’s households. It chose four local fiber companies (LFCs) as private partners in the Ultra Fast Broadband (UFB) initiative. Each was granted a geographic area in which to operate on a wholesale-only basis, offering bitstream access to retail service providers (RSPs), which in turn offer services to customers. Chorus, the former DSL incumbent, was granted about 70 percent of the total coverage area, Enable 15 percent, UltraFast Fibre 13 percent and Northpower Fibre 1.5 percent.

Deployment started in 2011 and by June 2014 had passed 517,000 households, or 39 percent of targeted households. The two largest RSPs, Telecom and Vodafone, which own more than 75 percent of the retail market, are reluctant to invest in marketing for fiber services before a minimum market in terms of coverage is reached. Therefore, uptake still remains low, at 7.5 percent of homes passed as of June 2014.

The smaller LFCs (Enable, UltraFast and Northpower) can tackle this problem by using the advantage of local branding and local RSPs. They are subsidiaries of local utility companies and have the advantage of customers’ loyalty, and the local RSPs take a personal approach in marketing to customers.

Chorus, which not only deploys fiber but also owns the legacy DSL network, has a harder business case as it cannot incentivize the RSPs to set up offers on the FTTH network without cannibalizing its DSL network.

REGGEFIBER IN THE NETHERLANDS
Although municipalities launched the first FTTH initiatives in the Netherlands, deployment is now mainly driven by Reggefiber, a subsidiary of the private investment company Reggeborgh, founded in 2005. Originally, Reggefiber was involved as an investor in municipal networks such as Glasvezelnet Amsterdam and OnsNet Nuenen. After acquiring the backbone provider Eurofiber, Reggefiber linked the various isolated municipal initiatives. Now, Reggefiber is 60 percent owned by KPN, the DSL incumbent, and operates only the passive infrastructure. It leaves installing active equipment and offering services...
to other, competing providers on a nondiscriminatory basis.

Reggefiber uses a demand aggregation strategy to ensure sufficient revenues from the start of each deployment. The company determines the next deployment area based on a presubscription level: once a certain level (between 30 percent and 40 percent, depending on the area) is achieved, the company is assured of sufficient revenues to make a viable business case in that area and start deployment.

The company’s online platform allows households to check how close their area is to reaching this subscription level, stimulating families to persuade their neighbors to sign up. The latest statistics show 1.82 million households passed and 586,000 connected to a service provider on FTTH – which shows the positive effect of the demand aggregation strategy on uptake.

On the cost side, Reggefiber also uses several measures to ensure a positive business case. First, it deploys fiber in the streets using an innovative brush technique with rotating plastic brushes. This method is up to eight times faster than traditional deployment techniques and causes almost no damage. In addition, the company has set a maximum investment of 1,000 euros ($1,139) per home passed and seeks the support of local residents or the municipality in areas where costs exceed 1,000 euros.

**GOOGLE FIBER IN THE UNITED STATES**

Google, a well-known search engine company that gets its revenues primarily from advertising, started a new initiative in early 2010: Google Fiber. Its goal was to find an area in which to deploy a fiber access network under the best conditions possible, maximizing the value of every dollar spent, and to provide an outstanding broadband offer – a symmetrical 1 Gbps connection.

Municipalities from all around the United States answered a public request for information, providing data about their existing facilities and proof of engagement. Google received data from more than 1,100 communities and local governments, endorsed by more than 194,000 individuals, all of them applying to get fiber deployed in their towns and cities.

From these applications, Google selected Kansas City, Kan., followed by other municipalities in the same metropolitan area. Google divided the city into fiberhoods, which are smaller than neighborhoods, and set pre-engagement goals before starting any deployment. If a fiberhood does not reach the minimum engagement needed, Google does not deploy fiber there. (This is similar to the demand aggregation model used by Reggefiber.)

Presubscription allows for better deployment planning (the company can pass and connect houses at the same time) and reduces investment risk. Google’s model seems to be exceeding the minimum presubscription goals. According to Sanford C. Bernstein, it could reach 50 to 60 percent of possible subscribers in two years after deployment.

The model, although not a true public-private partnership, benefits significantly from a strong commitment from the municipal government, which provides access to any existing telecom infrastructure (poles, dark fiber, conduits) and eases the provision of rights-of-way needed to deploy the network. In addition, the city council gets involved in the demand aggregation process by stimulating residents to subscribe, thereby reaching the minimum presubscription level, and in return gets free fiber connections to schools, hospitals and other public buildings in each fiberhood where Google deploys.

Combining both types of commitment – user and municipality – Google is seeking new deployment areas through public contests that ask local governments about their existing infrastructure and about the actions they will take to support participation in Google Fiber.

**GUIFI.NET IN SPAIN**

When a group of neighbors in a small rural community in Catalonia, Spain, decided in 2009 to deploy a fiber network, they realized they did not know enough about deployment methods and associated costs. They met with the Guifi.net Foundation, which was active in deploying community wireless networks, for help with the fiber deployment. This neutral operator calculated the costs and recommended that, to keep costs below 1,000 euros ($1,139) per household, the group needed more than 60 percent takeup.

This case thus follows a bottom-up scheme: The network is fully paid for by the final users. The fiber network itself belongs to the Guifi.net community, in which each user becomes an associate after paying for his or her own deployment. Volunteers carry out the installation, significantly decreasing the overall project installation costs. The presubscribers pay all the equipment and material to get connected. The deployment has been named Fiber From the Home to Farm to give special attention to the direction of its construction.

Though Guifi.net maintains the network and the network equipment, it does not interact with customers. Customers in Gurb village sign contracts with a separate service provider; Gurbtec was the first to offer broadband services.
In Guifi.net’s bottom-up deployment, users pay connection costs as well as service fees, so the network operator is assured of enough revenue to build and maintain the network.

With the unbundling of copper lines, competitors such as Softbank BB emerged and rapidly reached market shares similar to NTT’s. Driven by this threat and encouraged by favorable tax and interest treatments, NTT announced in 2004 that it would start to deploy fiber by replacing the copper lines to customers’ homes. That way, every line upgraded to fiber was removed from the legacy network.

This has made Japan a leading country in fiber deployment, with nearly 30 percent of the fiber deployed in the entire world. Currently Japan has more than 25 million homes connected with fiber solutions out of a total coverage of more than 36 million homes.

Soon, however, unbundling of the fiber lines became mandated as well, although not many alternative operators have succeeded in gaining significant market share on the fiber network (for example, Softbank reached 237,000 subscribers over NTT’s unbundled fiber in 2010). NTT is still the dominant operator on the fiber network, with a fiber market share above 70 percent in December 2009.

There are two important reasons for this low competitive entry in the fiber market. First, NTT offered a 100 Mbps connection on fiber for the same price as lower-speed xDSL, disrupting the market with a differentiated offer in peak speed. Second, it set the unbundling price for fiber at nearly five times the price for the copper unbundling as a way to increase facilities-based competition.

The business case for FTTH deployment in Japan currently has a positive outlook, as uptake and therefore ROI are very high (all DSL customers migrate to fiber). The threat of lowering the fiber unbundling price is imminent, however, and might drastically impact the business case for NTT.

### STOKAB IN SWEDEN

In 1994, the city of Stockholm founded a public company, Stokab, to deploy a passive fiber infrastructure to all households and businesses in the region. The goal was to enhance the economic attractiveness of the region, especially the knowledge-intensive business area of Kista for high-tech companies. Stokab only deploys and maintains the passive, dark fiber

<table>
<thead>
<tr>
<th>Public involvement</th>
<th>Google, USA</th>
<th>Reggefiber, the Netherlands</th>
<th>UFB, New Zealand</th>
<th>Guifi, Barcelona</th>
<th>NTT, Japan</th>
<th>Stokab, Stockholm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public support</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Private involvement</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>End user as a stakeholder</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>Pre-subscription</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>Wholesale only</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

(*) NTT Japan was mandated to unbundle its fiber and provide wholesale offer service.

Table 1: Case study overview
infrastructure; it leaves lighting the fiber and offering services to other operators that lease fiber links from Stokab (a business model similar to that of Reggefiber).

As a trial phase, the first connections targeted public and educational institutions, after which private businesses were connected on point-to-point dark fiber, thereby ensuring a revenue stream and hence a viable business case. Later, Stokab started to deploy fiber to all households, relying on contracts with housing organizations that wanted to increase their property values. These contracts allowed Stokab to deploy fiber to the basements of multiple-dwelling-unit properties. The first phase of the network deployment was funded using publicly backed loans, but soon customer revenues provided the funds necessary to expand the network. Stokab reached break-even in 2001 and now is a profitable company, although it spends much of the profit maintaining, upgrading and expanding the network.

Stokab’s network now covers 100 percent of businesses and more than 90 percent of households. There are about 90 active operators and more than 500 direct business customers, the latter providing about 50 percent of Stokab’s revenues. Stokab does not contract with small customers but interacts only with service providers or large businesses that install their own active equipment. It does not charge these operators and businesses on a per-premises basis but calculates its fees based on meters of fiber leased.

Table 1 shows that all these companies except Reggefiber have some type of support from the public sector, whether that is easing bureaucratic processes, leasing public infrastructure or educating citizens about the network. Direct public funding is used only in networks whose goals are broader than connecting profitable customers. Private involvement, on the other hand, is observed in all cases except for Stokab and helps explain why Stokab needs a technically skilled operator to manage the network.

Some projects follow a presubscription model; those using this model aim to involve users as stakeholders of the fiber network (way beyond being a subscriber). Wholesale service is also another characteristic these projects have in common. Only Google deploys a private network without a wholesale service.

### A COST-BENEFIT MODEL

To compare the economic success of the FTTH cases in this paper, we developed a model that calculates costs and revenues over time, taking into account the takeup rate and deployment strategy used. The costs are calculated as the sum of a fixed cost per home passed (the cost to deploy the fiber in the street, which is fully taken up front) and a cost per home connected (which is included in the equation at the moment of subscription).

![Figure 1: The adoption curves used in the cost-benefit model](image)

<table>
<thead>
<tr>
<th></th>
<th>Google (US)</th>
<th>Reggefiber (Netherlands)</th>
<th>UFB (New Zealand)</th>
<th>Guifi, Gurb (Spain)</th>
<th>NTT (Japan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per home passed</td>
<td>616</td>
<td>1,300</td>
<td>2,348</td>
<td>700</td>
<td>344</td>
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<tr>
<td>Cost per home connected</td>
<td>250</td>
<td>NA</td>
<td>1,104</td>
<td>250</td>
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</tr>
<tr>
<td>Monthly fee per subscriber</td>
<td>36</td>
<td>19.5</td>
<td>30</td>
<td>10</td>
<td>9.1</td>
</tr>
<tr>
<td>Demand aggregation %</td>
<td>28%</td>
<td>30%</td>
<td>0%</td>
<td>60%</td>
<td>35%</td>
</tr>
<tr>
<td>Total homes passed</td>
<td>150,000</td>
<td>1.8M</td>
<td>517,000</td>
<td>300</td>
<td>36M</td>
</tr>
<tr>
<td>Adoption curve</td>
<td>Aggressive</td>
<td>Aggressive</td>
<td>Likely</td>
<td>Aggressive</td>
<td>Conservative</td>
</tr>
</tbody>
</table>

Table 2: Input parameters (prices in USD)
These costs vary as they take into account the local economic environment (for example, manual labor is cheaper in Asia than Europe) as well as possible savings from deployment strategies (such as reusing existing ducts).

On the revenue side, the model uses three main parameters: monthly average revenue per user (ARPU), an estimated adoption curve and a level of demand aggregation. Monthly ARPU is based on the fees charged by operators in their commercial offers, and demand aggregation is applied only for those cases that use it (Google, Reggefiber, Guifi). The adoption curves shown in Figure 1 are based on forecasts for representative countries. These adoption curves were matched to the respective cases based on historic and current available uptake rates, with the goal of respecting reality as closely as possible.

Table 2 shows the input parameters used (all values in U.S. dollars). Stokab is not included in this table because of its different business model concerning revenues charged.

The first striking fact is the large range in cost per home passed, from a few hundred dollars in Japan to more than $2,000 in New Zealand. NTT’s aggressive deployment clearly has the lowest cost, mainly because of the high population density but also because multiple-dwelling-unit buildings are connected with fiber to the basement rather than fiber to the unit. Finally, NTT uses aerial deployment (along poles or facades), which significantly reduces deployment cost.

Google’s fiber deployment cost is higher but still very low compared with other cases. Google obtained favorable prices for the use of existing public infrastructure such as poles and conduits and obtained rights-of-way directly from the city council.

Guifi.net benefits from a symbiosis between the company and the final users. Users want to deploy fiber connections to their homes and mainly install them by themselves. Guifi.net helps them obtain the material and machinery and connects this network to the local interconnection point. This collaboration model allows for an inexpensive budget for deployment.

On the other end of the deployment cost range is the UFB initiative in New Zealand. Costs there are relatively high because of low population density, high trenching cost in volcanic soil and the right-of-way issues that follow from shared driveways (multiple owners have to give permission to trench).

**COST PER HOME CONNECTED**

Cost per home connected also varies widely. It is rather high for the UFB in New Zealand, probably because connecting a home there requires interaction with multiple parties (RSP, LFC). For Reggefiber, the cost per home connected is set to zero, as Reggefiber is not involved in installing the active equipment. (In reality, there is a cost for connecting homes, but as it is not the responsibility of Reggefiber, it is not included in the business case analysis here.) NTT has a rather low cost per home connected because of the large number of MDUs.

**MONTHLY FEE TO SUBSCRIBERS**

There is a significant difference in the average revenue received per user. Reggefiber, Guifi.net and the UFB receive wholesale prices because they do not interact with the end users. The fees are also low for NTT because of the unbundling obligation and the company’s model of charging per fiber, not per number of subscribers. NTT’s desire to migrate all customers to the new fiber deployment and remove the copper cabling also drives it toward a cheaper retail offer.
Government ownership or partial ownership allowed FTTH deployers in some countries to use riskier business models, such as building out without considering demand.

**ECONOMIC VIABILITY**

Figure 2 shows a forecast of net present value (NPV) for each network. Comparing these results with published data about the economic health of the companies suggests that the results are realistic.

The deployment by Google reaches break-even after five to six years, but profit is still limited because the number of homes passed is small. NTT, whose NPV exceeds the other cases, may show a different result if the unbundling price for fiber is decreased. The Guifi case, with a flat line, confirms that the aim of this operator is charging its users only to sustain the network and not making profit from it. Reggefiber turns positive after some years as it accomplishes its deployment phase and still has users and stakeholders connected to it. The outlook for UFB looks rather bad, but it may have a different projection if it reaches better penetration or creates a plan to incentivize fiber usage and adoption.

There are three categories of business cases in this study: NTT, which is outperforming all the others; the three “median” cases of Reggefiber, Guifi and Google; and UFB, whose outlook is rather negative.

As mentioned before, the most probable reason for NTT’s positive outlook is its assurance of keeping its subscribers as it moves them from DSL to fiber. However, although it has the best takeup rate of the carriers analyzed, it also assumed the highest risk in its first three years. The government’s 36.5 percent ownership may have some effect on the outcome.

The UFB also shows the effect of the state’s subsidizing networks and taking risks. In this case, however, the forecast does not show profitability, although that may change if the UFB reduces prices to ADSL levels, as NTT did to accelerate the shift to fiber.

The median cases show the influence of demand aggregation, whether on the city level in

![Figure 3: Yearly profits for Stokab (in million SEK; currently, 1 SEK = $0.12)](image-url)
FTTH deployers should provide incentives for customers to switch to fiber – or, if they are wholesalers, they should make sure their retail service providers can offer such incentives.

The riskier deployments in this category are the UFB deployments, whether the deployment is by a group (Japan and New Zealand) or a single firm (the Netherlands or on smaller neighborhoods in the U.S. For Google Fiber, dividing a city into small neighborhoods that rally to compete and obtain fiber first is a new way to incentivize the demand for fiber and its deployment. Its success can be explained by the combination of this rally with the power of Google’s well-known brand and its highly competitive retail offer for 1 Gbps broadband.

Google is the only private facilities-based competitor that starts to be profitable five to six years after its implementation. Only the Guifi.net project is in the same category, as the project also starts to be deployed after reaching 60 percent presubscription. Reggefiber has a slightly lower business case outlook but also reaches break-even within 11 to 12 years. In conclusion, all three median cases, Reggefiber, Guifi and Google, do not deploy an entire network to an entire community; they deploy the network only where demand is.

The third category is the UFB deployment in New Zealand, which is very ambitious but only supply-driven. It is more than reaching its coverage targets but is not meeting uptake targets. As the project is still in its rather early stages, this observed uptake rate might increase over time. However, at the moment, there is a mismatch between the RSPs’ promotion of the UFB offer and the LFCs’ deployment. The former have no real incentive to start offering services over fiber, which is costly in terms of software and marketing, before they can reach the entire population.

The riskier deployments in this group (Japan and New Zealand) have government participation.

NTT’s case seems to have a better projection, but competition will be gradually introduced by lowering the fiber unbundling price. The smaller initiatives are private and all demand-driven; these operators avoid areas where there is not a high demand. In the case of Guifi, in which users pay for the deployment, the network may reach some remote areas, as long as users cover the cost of the deployment with their initial investment. In the case of Reggefiber, more expensive areas are targeted only if supported by government aid.

Finally, although not included in the quantitative analysis above (because it does not charge per household), the case of Stokab in Stockholm should also be tackled. Publicly available data about its financial situation (Figure 3) clearly shows that the company is performing well. The main reasons for success are the involvement of the city in the deployment stage (rights-of-way and reuse of existing ducts) as well as the two-sided business model: Stokab targets large business users directly and connects residential homes by leasing dark fiber to communications operators and signing contracts with housing organizations.

DO’S AND DON’TS FOR FTTH

The following recommendations are based on conclusions reached from the case studies. Because the selection covers a range of different deployments with different socioeconomic and political backgrounds, the cases may help shed light on any new fiber network deployment, whether the deployer is a big firm or a group of users that join together for a common network deployment.

Demand-side measures

• Ensure the economic viability of the business case by securing sufficient return on investment up front. This can be done through demand aggregation (mainly for private initiatives), direct subscriber investment (for bottom-up projects) or access to public funds (publicly led deployments).

• Ensure sufficient revenues by incentivizing households to switch to the fiber offer. Make sure the offer is competitive in both speed and price.

• Target both residential and business customers, and differentiate these offers significantly.

• If not allowed to directly interact with subscribers, ensure incentives for service providers to start fiber offerings.

Among the analyzed cases, those deployers that achieved enough demand before starting to deploy are the ones that were profitable eight years after deploying the first phase of the network.

Supply-side measures

• Try to reduce costs by getting access to installed public infrastructure (ducts, poles, colocation space) and by negotiating rights-of-way.

• Try to minimize costs by opting for aerial deployment if possible and legally allowed.

• If upfront investment for FTTH is too high or too risky, then first target FTTB installation, but prepare the FTTB with enough fibers to later evolve to FTTH.

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