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A Benchmark Study on Broadband Utilization in the Accommodation Sector of the Hardangerfjord Area in Norway

Project Assignment

Trondheim, December 20, 2010

Norwegian University of Science and Technology
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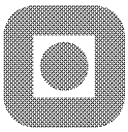

PROJECT ASSIGNMENT

Student's name:	Steffen André Stople
Course:	TTM4535
Title	A Benchmark Study on Broadband Utilization in the Accommodation Sector of the Hardangerfjord Area in Norway
Description:	In this project assignment I will undertake a grassroots research analysis of business uses and benefits of broadband services to assess the impacts of broadband for economic development. Research data will be collected directly from businesses and organizations within a defined geographic region. Research will focus on a specific industry or sector selected by myself. To collect data from these businesses, I will use an established online questionnaire provided by Strategic Networks Group (SNG). The goal of the research and analysis is to benchmark the selected industry/sector on the current state of uses of broadband services and the benefits derived from broadband use. Results will be compared to equivalent data - provided by SNG – from similar research already conducted in the US. By doing this, I will be able to conduct a comparative analysis with the selected region and hereby provide an opportunity to assess gaps and opportunities for increased adoption of broadband-enabled services and economic development. In addition to the collecting and analysing of research data, I am going to conduct research on how broadband is deployed in the Norwegian community today, and how the rapid evolvement in the field of broadband technology can affect the community in a socio-economic point of view.
Deadline:	20/12-2010
Submission date:	
Department:	**Department of Telematics**
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Trondheim, 22/09-2010

Harald Øverby
Professor

Abstract

Broadband technology has in recent years had a substantial growth, with the number of broadband subscribers in the OECD reaching 295 million in 2010, which is an increase of 250% from 2004. Norway is one of the most advanced countries for Internet connectivity, with high broadband penetration and excellent DSL coverage. When compared to the rest of Europe and to the US, Norway is also in the very elite when it comes to the deployment of the most advanced wireless technologies.

This increase in deployment of high-speed broadband can lead to apparent socioeconomic profits for individuals, businesses and for a society as a whole. A strong broadband connection provides the platform for many possibilities that the Internet can offer, and as consumers are constantly demanding more advanced online content, even faster bandwidth is essential for the further development of the information society.

This paper reviews some of the areas where enterprises can utilize broadband opportunities in order to achieve economic and social development. Also, a research study of a business sector in Norway has been carried out. A broadband utilization benchmark study was performed on the enterprises in this selected sector in order to determine the current state of uses of broadband services and also measure their benefits from broadband use.

By analyzing the results from this research, the paper identifies gaps and opportunities for the increased adaption of broadband enabled services and further economic development. The results from the Norwegian research population is compared to equivalent data from the US, and some of the similarities and differences regarding the utilization of the Internet are analyzed. Some important fields that are examined are broadband connectivity, the individual organizations' current utilization of broadband, barriers that can prevent effective broadband use and important areas of benefit the organizations feel that broadband can provide them.

Preface

This report serves as a specialization project in Telecommunications Economics in the 9th semester of the Master's Program in Communication Technology at The Norwegian University of Science and Technology, NTNU. As a topic given by Strategic Networks Group (SNG), this project has been planned and carried out during the fall of 2010 at NTNU Gløshaugen, Trondheim.

My appreciation is to be given to supervisor Thibaud Châtel. His guidance during this semester, by giving valuable input and regular feedback, has been of great value to this project. His experience has helped me form my perspective and develop the chain of thought that is needed to collect information when carrying out such a study. Thank you to SNG for lending me their online benchmarking-tools and supplying me with necessary information from their research database. During this semester, M. Châtel and I made several conference calls to Michael Curri and Gary Dunmore at the SNG headquarters in Ontario, Canada. Their knowledge was of great assistance to me, and they were always very helpful. To that I am grateful.

I would also like to thank Harald Øverby for his role as supporting supervisor. His presence here at NTNU has been of great help, being able to aid me on short notice as well as giving me ideas during the progression of my work.

Finally I would like to thank my fellow Communications-technology students in A-276 for creating a fun and helpful working environment this semester.

Trondheim, December 20, 2010

Steffen André Stople

Abbreviations

3GPP 3rd Generation Partnership Project

ADSL Asymmetric Digital Subscriber Line

AON Active Optical Network

DSL Digital Subscriber Line

FDD Frequency Division Duplex

FTTH Fiber To The Home

GPON Gigabit Passive Optical Network

GSM Global System for Mobile communications

HFC Hybrid Fibre-Coaxial

HSPA High Speed Packet Access

ICT Information and Communication Technologies

LTE Long Term Evolution

OECD Organization for Economic Co-operation and Development

OLT Optical Line Terminal

ONT Optical Network Terminal

ONU Optical Network Unit

PON Passive Optical Network

PSTN Public Switched Telephone Network

TDD Time Division Duplex

UMTS Universal Mobile Telecommunications System

VDSL Very-high-bitrate Digital Subscriber Line

VoIP Voice over Internet Protocol

WiMAX Worldwide Interoperability for Microwave Access

Definitions

3GPP The 3rd Generation Partnership Project (3GPP) is the standards organization that is responsible for the evolutionary planning of the 3GPP family of technologies.

Broadband Penetration refers to the amount of the Internet access market that high speed or broadband Internet has captured (Total subscribers / Total country population).

Capex, or capital expenditures, are expenditures that are made to create future benefits.

CDMA2000 is a family of 3G mobile technology standards, which use CDMA channel access, to send voice, data, and signaling data between mobile phones and cell sites.

FDD (Frequency division duplex) is a technique in which one frequency band is used to transmit and another used to receive. In other words, one block of the electromagnetic spectrum is allocated for the uplink carrying data from mobile phones to the base station, while a different block of spectrum is allocated to the downlink carrying data from the base station to the mobile phones.

OECD is an international economic organization of 34 countries founded in 1961 to stimulate economic progress and world trade. It defines itself as a forum of countries committed to democracy and the market economy, providing a setting to compare policy experiences, seeking answers to common problems, identifying good practices, and co-ordinating domestic and international policies of its members.

PT: Post- og Teletilsynet (in english: Norwegian Post and Telecommunications Authority) is a Norwegian government agency responsible for controlling and regulating the telecommunication and postal sector of Norway. The agencies main responsibilities are controlling the telecom market, issuing frequency concessions and telephone numbers.

TDM (Time-division multiplexing) is a method of putting multiple data streams in a single signal by separating the signal into many segments, each having a very short duration. Each individual data stream is reassembled at the receiving end based on the timing.

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Chapter 1

Introduction

The term broadband is normally used to describe almost any 'always on, high speed connection to the internet". Not only does it play a critical role in the workings of the economy, it also connects consumers, governments, businesses and promotes social interaction. Broadband growth has in recent years been quite substantial. In fact, since December 2004, the number of broadband subscribers in the OECD[1] has increased by 250%, reaching 295 million in June 2010 [12].

A very important and current topic in Norway is the development of broadband access, in both the population nucleuses as well as the more rural areas. Equal access to the digital infrastructure in all parts of the country is important for settlement and business life. Because of this, full broadband coverage of the nation has been the superior political goal in the Norwegian broadband discussions in recent years [Reg]. A study carried out by the Norwegian Ministry of Government Administration and Reform, dated mid-2009, showed that 99.9% of the countries' households had broadband coverage (including mobile broadband) [Nex10a]. However, only 50% of the households had access to downstream capacities above 25 Mbit/s.

With the evolution of broadband technology, there follow possibles a number of socioeconomic gains that can be achieved within a community. The latter years' upgrade to fiber-based access technologies can have an important role in modernizing existing operations - thereby securing existing workplaces. On the other hand, it is also an important premise for the establishment of new knowledge-based enterprises. The Fiber-network access builds the foundation for creating new competence-based workplaces throughout the country.

The introduction of fiber can effect a community in many more ways, for instance by modernizing a local society in terms of better Internet- and TV-offers. For businesses and enterprises, economic gains can be achieved by arranging effective videoconference meetings as an option to physical meetings, by using VoIP telephony (Voice over Inter-

[1]OECD is an international economic organization consisting of 34 countries, founded to stimulate economic progress and world trade.

net Protocol Telephony) rather than calling over the PSTN (public switched telephone network) and by giving employers the option of working from home using the high-speed Internet connection.

1.1 Objectives

This project consists of two main parts. First, a review of the various access technologies that are currently in use, is given - both wired- and wireless technologies. We will then look at how widespread these are on the Norwegian market today. Secondly, I am to perform a research study on an industry or sector in a geographically chosen sector. Both the sector and the location are to be decided by myself. The feedback that is received from this research is then to be analyzed and measured up against a database provided by SNG, containing data from similar research being performed in the United States of America.

With the results from this analysis, I should be able to assess potential gaps and opportunities for increased adoption of broadband-enabled services and economic development in the chosen area.

When looking at the results, several options and opportunities for profit realization that can be achieved from utilizing high-speed Internet (FTTH and HFC) will be discussed, as these are important for the growth and economic realization in a business perspective, as well as for the development and life quality in the society itself.

1.2 Method and choice of research areas

This research study has its basis in the Hardangerfjord-area, in the Norwegian county of Hordaland. The Hardangerfjord is a very-well known tourist destination, and with its length of 179 km (111 miles), it is the third largest fjord in the world and the second largest in Norway. After discussions and planning with Strategic Networks Group (SNG), the industry of choice selected became the Hotels- and accommodations sector. The reason for this is that tourism is an exiting area of where the use of broadband can come into effect and bring positive economic- and social gains, and accommodations are clearly a vital part of the tourism industry. In co-operation with SNG, I chose the following municipalities surrounding the Hardangerfjord, with the intent of benchmarking accommodation enterprises located here on their current broadband utilization:

- Eidfjord
- Jondal
- Kvam
- Odda

- Ullensvang
- Ulvik

In addition to these municipalities, I also decided to include hotels and bed & breakfasts' in two major cities in Norway, namely Bergen and Trondheim. The reason for this was to add more depth to the research, and the motive for choosing Bergen and Trondheim were their location close to the Hardangerfjord and the researcher, respectively.

The collection of data in this research has been done by using an online questionnaire provided by SNG. This survey has been sent to the hotels, bed & breakfasts' and camping cites by e-mail, addressing them to the enterprises' general managers or other employees with sufficient knowledge about the company's daily operations. For the ones that didn't reply on the first inquiry, a reminder e-mail was sent. Contacting the hotels and their managers by telephone was also done as a last instance.

1.3 Document Structure

The remainder of this report is organized as follows:

Introductorily, a brief account is given regarding the different access technologies that are used in todays market. The importance of describing these is simple: to be able to review economic and socio-economic benefits connected to broadband, knowing the terminology, characteristics and properties of the different technologies is essential to tell them apart and measure them up against each other. These properties are for instance up- and downstream capacity and range of operation. Information regarding the Norwegian market is included where it is seen relevant, and is considered important in order to improve the readers knowledge before discussing the results later in the report. Some examples of economic benefits that can be brought to a society, as a result of broadband, are also reviewed.

Following the background is a walkthrough of the research procedure. The process of localizing the industry sector and geographical area, the survey modeling and the fetching of information from the chosen enterprises, are all described. Then the results of the online questionnaire are reviewed, before discussing them thoroughly - looking at some of the socioeconomic gains that have been achieved in this sector. Other methods of profit- and social realization that can be achieved as a result of the growing broadband quality and coverage in Norway, will also be discussed.

After concluding the results of this study, a paragraph regarding future work on this project is given - revealing the author's thoughts and ideas regarding some aspects of interest surrounding this study.

Additionally, the following appendices are included:

Appendix A: List of Accommodations

Appendix B: E-mail to Accommodations (in Norwegian)

Chapter 2

Background

This chapter will introduce to the reader the position of broadband technologies in Norway today, and review it compared to European standards.

Theory related to access technology will also be presented. This includes the different technologies that are currently available in both wired- and wireless access technology. An insight in each of the technologies' capacity, scalability and limitations is also given. Where it is considered relevant, the unfolding of these technologies in the Norwegian market will be mentioned.

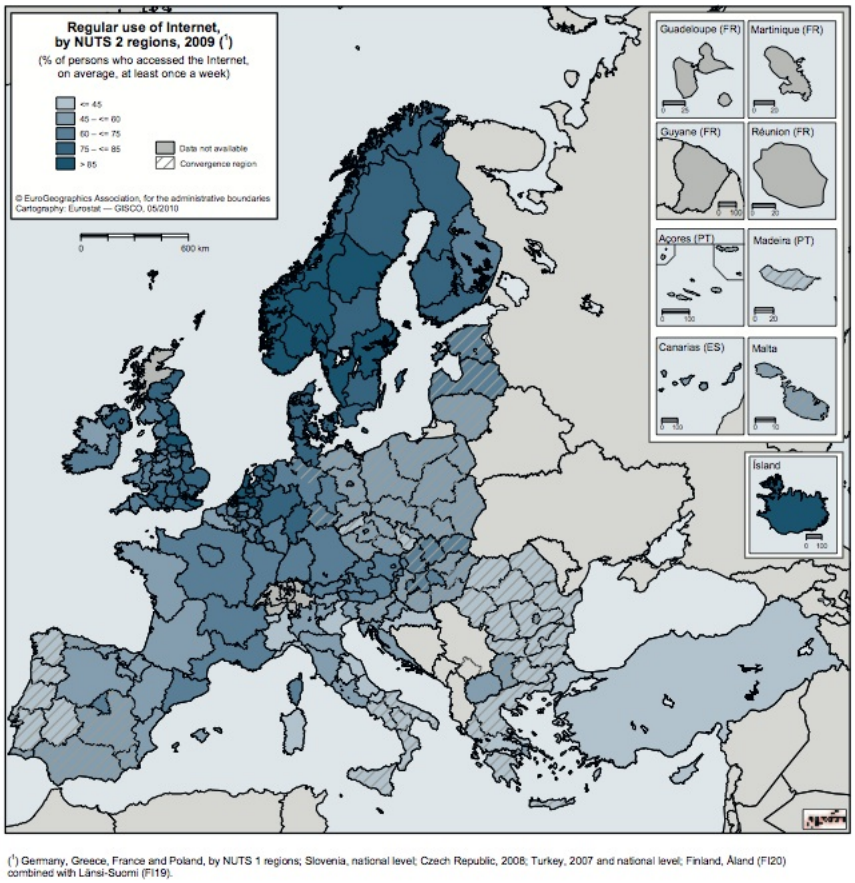
Finally, we will look at some of the benefits that can be acquired from the ongoing evolution of broadband technologies. More and more services and possibilities are offered online as the capacity of the broadband connections increase, leading to opportunities for economic- and socioeconomic benefits. The use of web-enabled devices and e-Solutions can significantly aid to these benefits.

2.1 Broadband in Norway

Norway is one of the most advanced countries for Internet connectivity, with high broadband penetration and excellent DSL coverage. According to Europe's Digital Competitiveness Report [Com10] published by the European Commission, the European Union is the largest broadband market in the world. Norway, although not an EU member, currently hold a third place over European countries when measuring broadband penetration[1] levels - scoring a percentage of 34.5. In comparison, the US penetration is 26.4%, and the average of the 27 countries currently in the European Union is 22.8%.

When looking at the number of users that use Internet on a regular basis, meaning at least once a week, Norway is definitely in the very top on the European scale, as can be seen in Figure 2.1. As many as 88% of the Norwegian population make use of the Internet and its services at least once a week, and 75% use it every day.

[1]The term "broadband penetration" refers to the amount of the Internet access market that high speed or broadband Internet has captured (Total subscribers / Total country population).



(1) Germany, Greece, France and Poland, by NUTS 1 regions; Slovenia, national level; Czech Republic, 2008; Turkey, 2007 and national level; Finland, Åland (FI20) combined with Länsi-Suomi (FI19).

Figure 2.1: Regular Internet use in EU regions (2009). [Com10].

At a global level, the growth in the broadband market has been driven by strong increases in developing countries. The total number of broadband subscriptors across the globe was, according to the European Commission, estimated to be 440 million in July 2009. Most of the broadband lines in Europe are based on xDSL technologies, and Norway is no different. As of June 2010, there were 1,65 million fixed (wired) broadband subscriptions in Norway, and the majority of the connections were DSL - approximately 60%. However, fiber-optic cables are constantly gaining ground, and has recently reached a market share of 14%, or 230,000 subscribers, making Norway one of the pioneers on the European fiber market. This can be seen in Figure 2.2.

Figure 2.3 displays the distribution of wired access technologies in Norway as of June, 2010. It can be seen that DSL still holds the largest share, followed by cable and fiber. Other technologies are limited to a mere 2.9%.

Not only is Norway in the very elite when it comes to deploying fiber-to-the-home connections, but they are also taking a lead in European LTE[2] developments [9]. Norway has one of the smallest mobile markets in Europe, as is appropriate for the country's

[2]LTE (Long Term Evolution) is the project name of a new high performance air interface for cellular mobile communication systems. LTE is further described in section 2.2.2.3

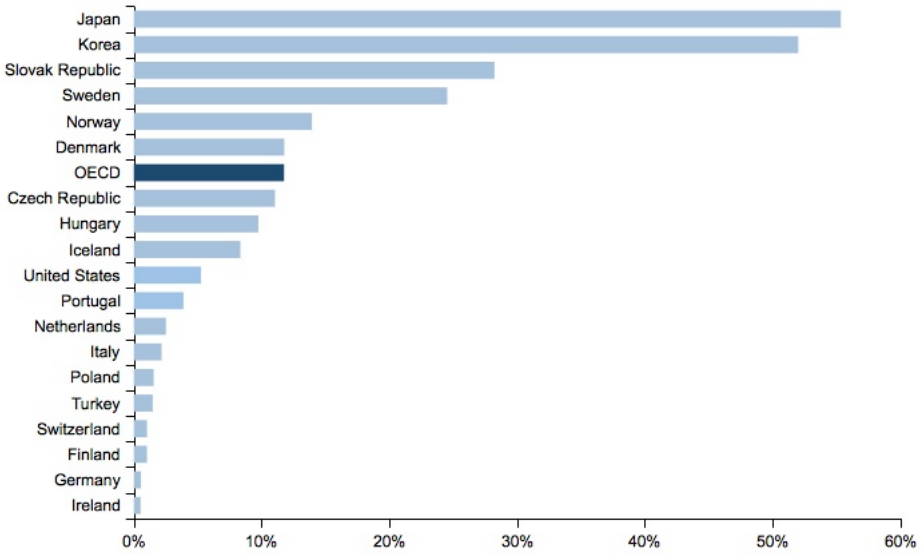


Figure 2.2: Percentage of fibre connections in total broadband among countries reporting fiber subscribers, June 2010. [12].

population. Nevertheless, by mid-2010, mobile penetration reached almost 115% (98% when disacknowledging the use of multiple SIM cards), and has since 2007 had a subscriber growth driven by the 3G sector. During this same period the number of GSM subscriptions has diminished steadily.

The world's first commercial LTE network was launched in Oslo, December 2009 by TeliaSonera, and demonstrated download peak rates of up to 150 Mbit/s. As the Norwegian government has committed itself to broadband expansion in regards to capacity, coverage and speed, the further development of services based on LTE will be essential. This area will significantly enhance network capabilities and allow operators to extend their services to rural areas with lower capex[3].

The Norwegian telecommunications company Telenor, which is currently ranked as the sixth largest mobile phone operator in the world - with more than 195 million subscribers, aims to be one of the driving forces in this area and has a strategy to incorporate some 6.500 LTE sites by the end of 2010 [9]. This undermines Norway's goal to maintain itself in the very elite when it comes to broadband communications in the years to come.

To be able to look more into the advantages, both economically and socially, that can be actualized by the investment in the expansion of broadband technology, we will in the following section take a brief look into different access technologies that are available and utilized today.

[3]Capex, or Capital expenditures, are expenditures that are made to create future benefits

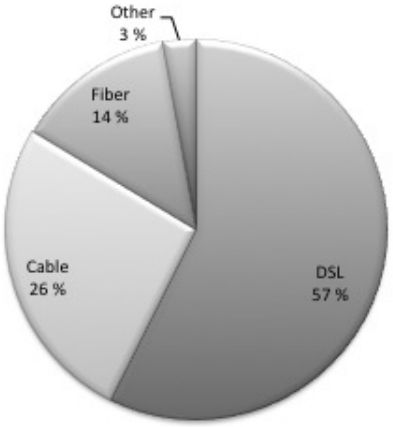


Figure 2.3: Distribution of wired access technologies in Norway (June 2010). [Stople, 2010].

2.2 Access Technology in General

The final segment of an information transfer over a broadband network, takes place through a channel between a unit placed at the customer and the broadband operators' closest node. These two components both contain senders and receivers, and information can be sent between them using different technologies. Radio-waves are sent through the air for all wireless solutions, while threads of copper, coax or fiber are used for the cable-based technologies.

Common for all transfer technologies is that there exists physical limitations in the shape of a certain frequency spectrum where the data can be transmitted. The size of the spectrum, *the bandwidth*, is decisive to the amount of information that can be transferred in a given space of time - i.e. *the capacity*. Issues also worth mentioning that can affect the bandwidth, is the distance between the sender and receiver and noise on the transmitting channel.

When it comes to the architecture of the network, it is normal to separate this into two categories: shared mediums and point-to-point. A shared medium is a network where multiple customers communicate with the broadband operator through one common node. If instead each customer has its own dedicated line to the broadband operator, the medium is viewed as point-to-point.

We can divide access technologies into two categories: Wired- and wireless access technologies. Each of them have their own advantages and serve different purposes, and will be reviewed in the following subsections.

2.2.1 Wired Access Technologies

As the evolvement of telecommunications has rapidly put on speed in recent years, several wired access technologies have seen the light of day. A short overview of the most used ones are mentioned in this section.

2.2.1.1 Fiber-Optic Access Network

Fiberoptic communication is a method of transferring information from one place to another by sending impulses of light through cables of optical fibre. Although the idea of using fibers in telecommunications was considered in 1966, the first optical fibre capable of transmitting over substantial distances was developed in 1970. Only in the 1990's did the demand of these cables, that could carry heavy loads of digital data, become significant - as this was the time when the use of the Internet exploded. Optical fibers today serve as the backbone for our communication services, with copper wire, cell phones or other technologies serving only the very ends of the network [11].

Fiber-To-The-Home (FTTH) is an expression for the network architectures where fiber is used as an access medium all the way to the customers at the end-points. As briefly mentioned in the above section, some installations use a different medium the last few meters when connecting an end-user, i.e. copper wire. We will not take note of this in the remainder of the report, as but the difference this may cause in terms of offered capacity is near neglectable.

Another point worth mentioning about fiber optic cable is its scalability. There are no limitations when it comes to fiber optic cables as an information transport medium. It is, however, the electronics surrounding the cables that set the limits. The scalability is in other words dependent on the upgrade of electrical senders and receivers at the end-points.

In Norway, FTTH has been deployed greatly the last year, and of late 2010, the number of FTTH subscribers approached 200,000.

There are two basic architectures that are used in the deployment of fibre optic cables: Active optical networks (point-to-point) and Passive optical networks (point-to-multipoint).

Active optical networks

Most fiber-network distributors in the Norwegian fiber market, except for Telenor, has chosen to deploy Active optical networks. This means that each customer receives a dedicated fiber - not shared with their neighbors - that offers a transmission rate of up to 100 Mbit/s in both directions. An overview of the AON architecture can be seen in Figure 2.4.

This is a network where the network operator has to use some sort of electrically powered equipment in the ODN (Optical Distribution Network) to distribute the signal in dedicated fibers to each user unit (ONT - Optical Network Terminal). From the ODN the signal coming from the operator can be routed to as many as 500 ONT's.

Passive optical networks

A passive optical network has a point-to-multipoint solution, which means that several households share access to one fiber. As many as 64 end-users can share one such fiber

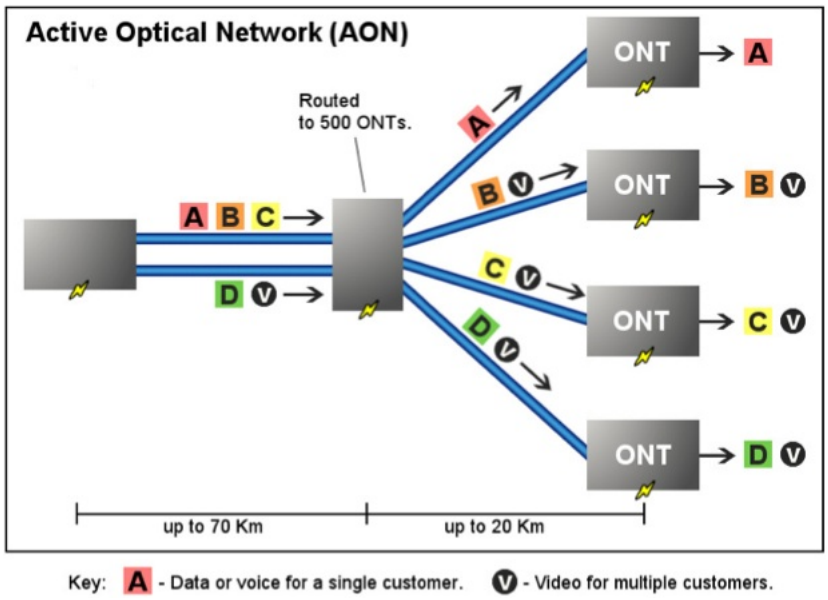


Figure 2.4: Active optical network (AON) [5].

cable. The most used solution today is GPON (Gigabit Passive Optical Network), and offers, according to Telenor, a total down- and upstream of 2.5 Gbit/s and 1.25 Gbit/s respectively [oT10]. Telenor is the only network distributor in Norway that has chosen this architecture when deploying fiber optic networks, claiming that an important factor for this decision is that a PON-solution has less working expenses. Active components can be centralized easier than what is possible in a point-to-point network. Figure 2.5 shows the architecture of a PON network.

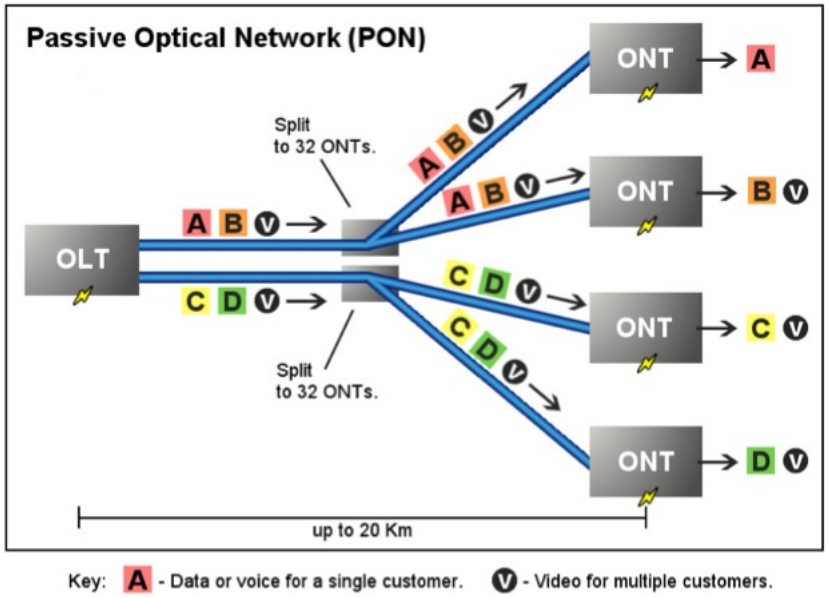


Figure 2.5: Passive optical network (PON) [5].

As can be seen in the figure above, the information stream along *one* fiber cable going

from the operators' node (OLT) is forwarded to several customers through the use of passive splitters. In the ONT, any information that is not intended for a specific user is simply filtered out.

2.2.1.2 Cable / HFC

A Hybrid Fiber Coaxial (HFC) network is a broadband technology that utilizes both coaxial cable and optical fiber cable in different portions of a network to be able to carry the data content. The HFC-operators use fiber-cables in the core of their networks, but put to use the already existing coax-network, previously built for cable-TV, in order to reach all the way out to the customers. This means that the HFC operator have the advantage of bringing fiber cable (high bandwidth and low noise- and interference susceptibility) close to the users, as well as saving the costs of replacing the coax cable that is already installed all the way to the home and businesses. Below is a figure (2.6) showing the architecture of an HFC network:

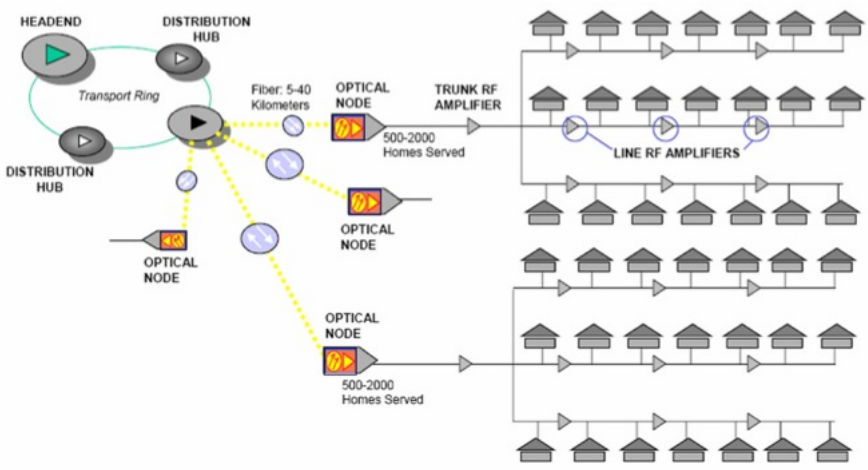


Figure 2.6: Architecture in an HFC network [6].

In the figure we see that the HFC-network exploits the coax cable from the operator's node, the optical node, and uses it as a shared medium. Several thousand customers can be attached to each of these segments of the network - all sharing the available network capacity. Each of these network segments would typically hold between 250 and 1000 customers.

As mentioned earlier, the fiber-optic cable has near to unlimited capacity, which means that - in a HFC network - the coax part of the network is what limits the bandwidth.

HFC networks in Norway are currently implementing the standard EuroDOCSIS 3.0 [8], which is the newest standard for data transmissions for HFC networks [3]. This standard specifies the frequency area between 5 and 65 MHz for upstream traffic, while it dedicates all frequencies from 87,5 MHz and upwards to downstream traffic. The top

barrier in the frequency area varies from 300 to 867 MHz depending on how the network is set up [Nex10b].

The cable-TV operators in Norway currently occupy a significant portion of the above-mentioned spectrum. Channels of 8 MHz make up this entire frequency spectrum, where one analog TV-channel, sent in the European PAL-Standard, fills one such channel. However, it is expected that these channels will be abandoned in the next few years, and that the whole frequency spectrum from 87,5 MHz to 867 MHz can be made available for transportation of digital video and other broadband services by the year 2015. This equals a potential capacity of 5 500 Mbit/s.

2.2.1.3 DSL

Digital Subscriber Line (DSL) is a family of technologies that provides digital data transmissions over the ordinary telephone network. The most commonly installed technical variety of DSL is Asymmetric DSL (ADSL) - which in telecommunications marketing is what DSL is understood to mean. ADSL service is delivered side by side with regular telephone service on the same telephone line, and is possible because ADSL uses a higher frequency. The lower frequencies on the network are used by analog telephony or ISDN, while the higher ones are used both upstream and downstream data transmission. Splitters and filters are used to separate these frequency-areas at the customer-end.

Figure 2.7 shows the principle of the Digital Subscriber Line.

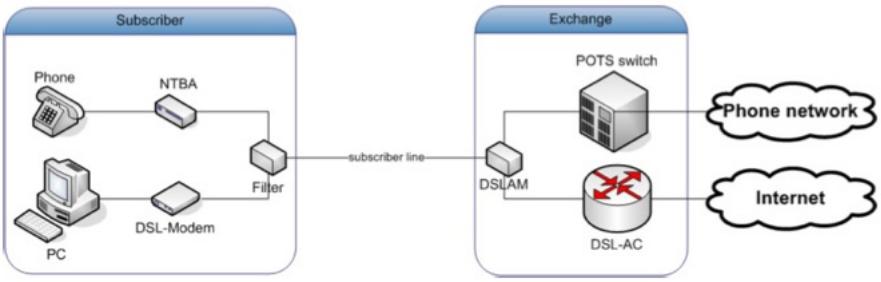


Figure 2.7: DSL (Digital Subscriber Line) principle [7].

Here we can easily see the concept of sending both Internet and telephone services over the same subscriber line, and how the line is split at the subscriber end by the use of a filter.

Several variants of the DSL standard have been released in order to deliver the best possible capacity based on different line-length limitations. The following versions can be regarded as the most relevant for the Norwegian market [Nex10b]:

- **ADSL** was the first DSL to be set up in Norway, and is still widespread. Using the available frequencies in the Norwegian market, ADSL has a capacity of 6 Mbit/s downstream- and 1 Mbit/s upstream. The maximal line-length using this technology is 5.5 km.

- **ADSL2+** is an evolvement of ADSL that utilizes higher frequencies in order to get an increase in data transmission capacity. ADSL2+ can offer capacities of 20 Mbit/s downstream and 1,2 Mbit/s upstream.

- **VDSL/VDSL2+** is the most advanced DSL technology to date, with the possibility of transmission speeds of up to 50 Mbit/s. However, this technology is only available over very short distances - normally up to 1 km.

- **SHDSL** is a variant of the DSL technology that is primarily used by companies. In addition to the frequencies used in ADSL, SHDSL also utilizes the frequencies set aside to telephony. The transfer capacity is symmetric and offers 2,3 Mbit/s in both directions on line-lengths up to 3 km. As SHDSL actually can run over four parallel channels between the network operator and the customer, the total transfer rate that can be offered is 9,2 Mbit/s.

2.2.2 Wireless Access Technologies

When it comes to wireless access, there has for a while been two competing technologies:

- The GSM-standard and the technologies evolving from it (EDGE, UMTS, HSPA, LTE), all standardized by 3GPP[4].

- The CDMA2000[5]-standard and the technologies evolving from it (EV-DO, UMB), standardized by the organization 3GPP2.

Of these two, the GSM-standard is the dominating one in the market as it currently has close to 80% [14] of the market on a worldwide basis.

A new standard, based on the standards from IEEE, is WiMAX. Being a fairly new competitor, it's certified by WiMAX Forum and developed for both fixed and mobile broadband. Its deployment is currently very limited.

An increase in the domination of GSM's 3G technologies is expected in the next few years. According to 4G Americas, by 2014, UMTS-HSPA and LTE 3G technologies are expected to account for 84 percent of global 3G subscriptions or 2.8 billion subscribers, compared to 528 million CDMA EV-DO (to be discussed in 2.2.2.5) subscriptions and 89 million WiMAX subscriptions [1]. Figure 2.8 gives an image of the distribution of these three technologies as of today.

In Figure 2.9 we see an overview of the most relevant wireless broadband technologies currently in use. Framed in the figure is the expected number of 3G subscribers by the year 2013. This figure describes the maximal capacity that can theoretically be offered. In

[4]The 3rd Generation Partnership Project (3GPP) is the standards organization that is responsible for the evolutionary planning of the 3GPP family of technologies

[5]CDMA2000 is a family of 3G mobile technology standards, which use CDMA channel access, to send voice, data, and signaling data between mobile phones and cell sites.

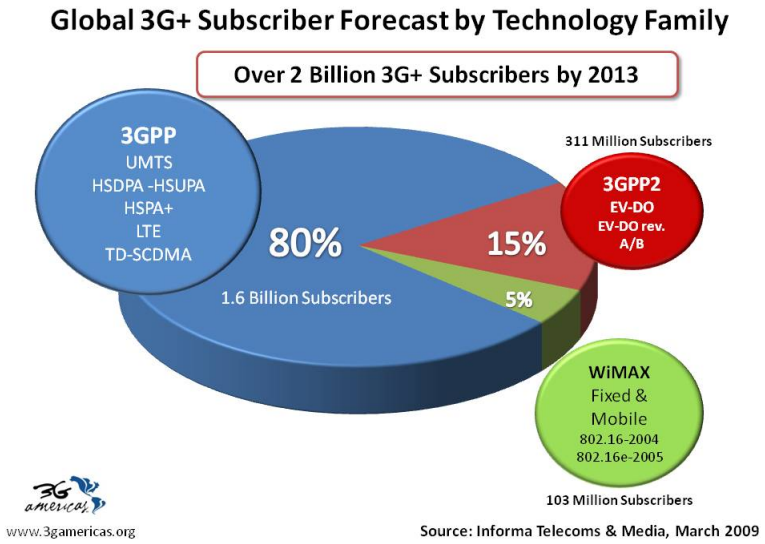


Figure 2.8: Global 3G Subscriber Forecast by Technology Family.[1].

the following subchapters, most of these technologies will be described, along with their capacities and assumed potential.

2.2.2.1 GSM / UMTS / HSPA

This technology family uses FDD (Frequency Division Duplex) as its access method. This means that the two directions of transmission - to and from the base station - each uses its own frequency band. In Europe, the following frequency bands are used by the GSM-family:

- *GSM*: The 900- and 1800 MHz bands. In Norway, the 900 MHz is fully occupied by existing operators, while the 1800 MHz band still has free resources.
- *UMTS / HSPA*: The 2,1 GHz band. The Norwegian operators Telenor, NetCom, HI3G and Mobile Norway each have a 3G-license in this spectrum.

Over time, the GSM bands will get reallocated in order to get used by UMTS and LTE. This is an ongoing tendency in the EU, which is followed in Norway by PT (Post- og Teletilsynet). There are currently negotiations being held between Norwegian telecommunication operators regarding the allocating of the 900 MHz band, so that this can be used by UMTS as well [Nex10b].

Telenor and NetCom have both upgraded their UMTS-networks to HSPA (High Packet Speed Access), and mobile-operators in Norway are (as of December 2010) currently deploying their upgrades. 3G HSPA provides a number of significant benefits that enables this new service to provide a far better performance for the user. In addition to increased speeds of data transfer rates, shorter transmission time intervals, the use of shared channel

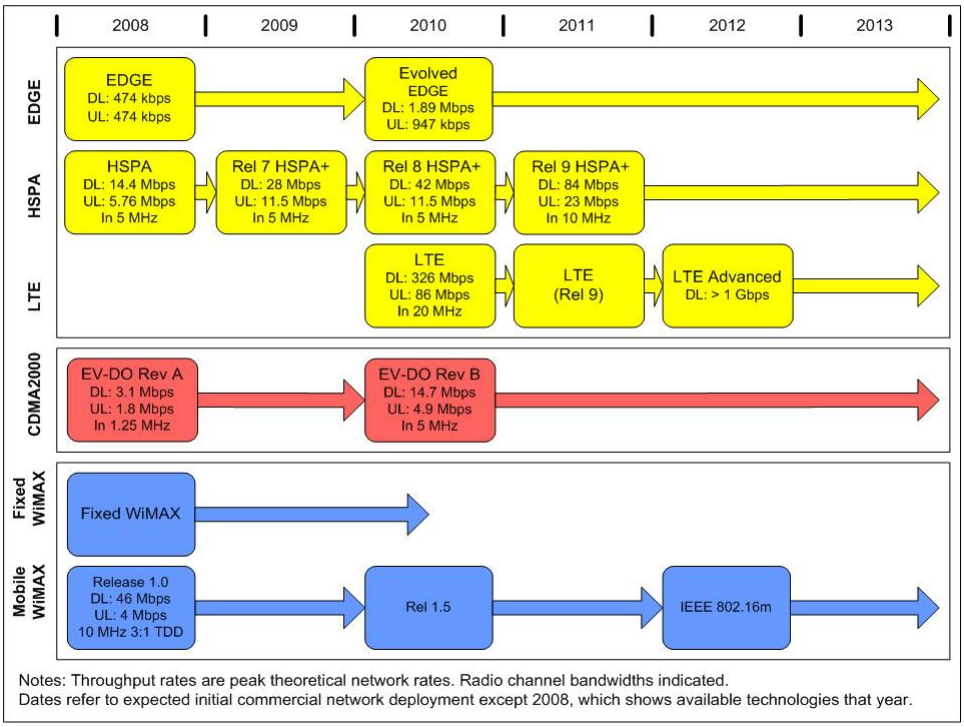


Figure 2.9: Technology families for mobile broadband technology. [1].

transmission and the use of link adaptation is now possible [13]. Theoretically, HSPA can offer the customer data rates of 14,4 Mbit/s downstream. However, the versions of HSPA that have been implemented in Norway so far, can only offer data rates of 3,6 and 7,2 Mbit/s.

The practical data-rate experience of HSPA will depend on the amount of simultaneous users on the network, as the radio spectrum is shared between all customers that access it. The distance to the base station will also play an important factor.

For UMTS and HSPA, the user bandwidth experience will be:

- UMTS: 70 - 130 kbit/s both down- and upstream.
- HSPA: 1 - 4 Mbit/s downstream and 0,5 - 2 Mbit/s upstream.

HSPA+ is currently being deployed in Norway by Telenor (December, 2010). HSPA+ (High Speed Packet Access Plus) is also known as HSPA Evolution and Evolved HSPA, and will apply some of the techniques developed for Long Term Evolution (LTE) - allowing operators to extend the life of their HSPA networks.

2.2.2.2 Fixed Wireless Broadband

Fixed wireless broadband is a type of high-speed Internet access where connections to service providers use radio signals rather than cables. This is a way for areas that lack fiber optic cable, DSL or cable television lines to still enjoy broadband Internet access via a fixed

wireless service. For rural areas in any country, this technology is a welcoming option, as it can easily overcome geographical obstacles and still deliver proficient broadband service. The Hardangerfjord area in Norway is an example of an area where fixed wireless broadband is deployed. Although they tend to offer lower speeds than other types of broadband Internet, fixed wireless services generally support between 1 and 10Mbit/s of network bandwidth.

Internet providers maintain the transmission towers, also called ground stations, that the fixed wireless broadband uses. These ground stations communicate with each other and with the subscriber's location. To be able to communicate with the ground stations, the subscribers have to install transceiver equipment on their building or property.

This service often requires line of sight access between the subscriber and a ground station. Rain or fog can sometimes adversely affect the quality of the service. It neither supports roaming, as fixed wireless broadband is tied to one physical access point per subscriber.

2.2.2.3 LTE

The upgrade of todays 3G to HSPA, and especially the implementing of the next generations mobile network LTE (Long Term Evolution), will give mobile broadband services a significantly higher capacity. LTE is by some called 4G, and has a theoretical capacity of over 100 Mbit/s downstream and 50 Mbit/s upstream, which is much higher than what can be offered in todays 3G network. However, the bandwidth experienced by the customer will depend on several factors, like available frequencies, the number of simultaneous users and local conditions.

By utilizing the frequencies better than 3G, as well as having an easier architecture, the use of LTE will lead to lower operating costs. When introduced, it can be expected that many cell phones and computers will get LTE built into their system, leading them to be able to achieve high-speed mobile broadband almost everywhere.

LTE was taken into use in Norway in December, 2009, on the 2.6 GHz frequency band by the network operator Netcom/Telia Sonera. As of December 2010, the only operator that has followed is Telenor, although their LTE service is still at the trial stage [2].

2.2.2.4 WiMAX

WiMAX a 4G technology, and is a wireless system that is commercially available both for fixed and mobile broadband. The two systems aren't compatible, and utilize partially different frequency spectrums. Common for all available versions of WiMAX is that they all use time-division duplex (TDD) as method of access, i.e. that the same frequency band is applied to both transmission directions.

Fixed WiMAX (802.16d) has a certain deployment in Norway, and is often used to cover areas that previously have been without broadband coverage. This technology works in

the same way as Fixed Wireless Access, described in section 2.2.2.2 - only now it utilizes 4G technology. For customers situated close to the base station, a symmetric capacity of 11,3 Mbit/s can be achieved. The range is dependent on the kind of equipment placed at the customer-end. With so-called line-of-sight applications, an antenna is assembled outside of the household with a free view to the operators base station. With standard equipment, this setup results in a range of 10-15 km. With a fully equipped base station, the range can be extended to 30-50 km.

For installations where the end-user equipment is placed on the inside of the household, the range is considered to be reduced to as little as 1-2 km.

Telenor and NexGenTel deliver fixed WiMAX-services in Norway, with up to 3 Mbit/s down- and 1 Mbit/s upstream.

Mobile WiMAX (802.16e) is not yet taken into use in Norway, despite of the technology having the necessary frequency spectrums assigned. The performance of this system is - as for all other wireless broadband technologies - dependent the amount of spectrum that the operator can utilize. The 802.16e standard, which is the standard used by mobile WiMAX today, is developed for bandwidths ranging from 1,25 - 20 MHz.

The next release of 802.16e (release 1.5) is expected to have a capacity similar to HSPA+. The future of WiMAX is, as the case is for CDMA2000, very uncertain - as the continuos work and investment in LTE and LTE Advanced are making waves in the world of telecommunications.

2.2.2.5 CDMA2000

On a global basis, CDMA2000 utilizes a number of frequency bands. In Norway, the only bands that are relevant for use by this service are the 410 MHz and the 450MHz. These bands are currently owned by ICE/Nordisk Mobiltelefon. As there's no more room for additional operators in these bands, there probably won't be more than this one CDMA-operator in Norway. Also, the GSM-family has already built a strong market position in Norway, which makes it less likely for operators be willing to invest largely in CDMA in the coming years. The technology used by CDMA in the 450MHz band is in Norway called CDMA450.

ICE covers today 70% of the Norwegian soil and 90% of Norway's households [Nex10b]. At this point in time, ICE is only used for mobile broadband, and has just recently upgraded to the version EV-DO Rev A. Maximal capacity for this version is in theory 3,1 Mbit/s downstream and 1,8 Mbit/s upstream. The next step in this development is the introduction of EV-DO revision B, which will give downstream speeds somewhere between 4,9 - 14,7 Mbit/s and upstream speeds in the range 1,8 - 5,4 Mbit/s. This upgrade is expected to be completed by the end of 2010 [10].

However, at the time of writing, the future of CDMA isn't among the brightest in regards to their 4G-solution - the UMB-standard. Leading CDMA-operators, like Verizon

Wireless (USA), KDDI (Japan) and SK Telecom (Korea) have all declared that they will migrate to LTE instead of upgrading to UMB.

2.2.2.6 Broadband via Satellite

In May 2009, EU granted a European License for satellite-based broadband access. This license concerns a frequency area of 2 x 15 MHz in the so-called S-band, with an available broadband capacity corresponding to that in one LTE-cell.

Satellite Internet is, in most cases, one of the more expensive methods of gaining broadband Internet access. Nevertheless, the importance of this technology is genuine as it may be the only choice other than cellular broadband in rural areas. Costs following the use of this system have in recent years come down to a point where it is starting to become more competitive with other broadband options.

2.3 Economic Benefits of Broadband in the Society

Many changes are undergone in enterprises that choose to introduce ICT (Information and Communication Technologies). They may explicitly involve employees, but will in any event affect their way of working, the skill they use, their professional identity and the relations between different functions and profiles inside the enterprise. Technological change in the work-domain has been dramatic and very widespread during the last two decades, and has gained great importance in information- and knowledge-intensive areas of work. ICT has also been gaining increasing importance in sectors that, at first sight, don't seem very focused on technology, like in construction, manufacturing and mining.

The use of broadband is an essential part of the market transformation that ICT has induced, and the recent increase of investment in high-speed broadband has lead to more activities and services - both business and personal - being performed "online". For businesses and organizations it is essential to have in place a solid broadband infrastructure in order to have an effective participation in today's economy. For private individuals, the introduction of broadband has lead to many everyday activities being done on the Internet. In Norway, the most popular activities (for the average population) are: looking up information about goods and services, Internet banking, reading online newspapers and ordering goods and services online.

Before, separate systems - like telephone, television and video and individual computer systems - stored and transmitted voice video and data independently. Now, all of these systems are converging onto the Internet - giving new and exiting possibilities in terms of innovation and communication for 21st century communities and their citizens. A strong broadband connection provides the platform for these possibilities, and because new kinds of Internet activity and content-rich applications emerge, the continuing evolution of broadband capacities is of grave importance.

The introduction of high-speed Internet can lead to apparent socioeconomic profits for a whole society, as well as for the individual itself. The following subsections will review some of the areas where fiber-based broadband can have major impacts, describing some of the impacts e-Solutions has set forth.

2.3.1 Creation of New Enterprises and Workplaces

The creation of new enterprises is especially visible in areas that are considered as rural, i.e areas that earlier may have suffered from little or no Internet at all. Web shops can for instance have their base pretty much anywhere, by importing goods from foreign countries and selling them across the country. Utilizing high-speed broadband may be a premise for such a business, as video-based online marketing can be an important way to reach out to existing and potential customer groups.

Being able to carry large loads of data over long distances using FTTH, as compared to earlier, makes it possible for ICT enterprises to be suited in rural areas. Fiber technology makes it possible to offer services like server-hotels, databases and storage to customers, even if the data-transportation distances are significant. In other words, small enterprises can arise anywhere, as long as there is a thorough FTTH-network in place.

2.3.2 Preservation of Existing Workplaces

For companies that already existed before the networks were upgraded to high-speed Internet, the network access can be regarded as important for the companies' development and continued operation. Both time and money can be saved as a result of lesser work-related traveling, as more of the interaction with customers, suppliers and collaborating partners can be done electronically, i.e. using videoconferencing. Reduced telephone-expenses can also easily be accomplished, with new solutions like IP-telephony and videoconferencing replacing traditional, more expensive telephone services.

2.3.3 Better Home Offices

When private and leisure homes are connected to a high-speed broadband network, the possibility of setting up more effective home offices arises by establishing electronic interaction with the ordinary workplace as well as external business connections.

Working from a home office leads to a reduced need of traveling back and forth to the ordinary workplace. Hence, both use of time and travel costs are reduced. Additionally, environmental gains for the society are increased because of reduced pollution. High capacity broadband increases the opportunity for remote work like this. For small societies without a large local labour market, this kind of work can also have a direct effect on settlement.

District areas are also more attractive for people that might be choosing where to have their leisure homes, if they have a fiber infrastructure deployed. A larger leisure-population

in an area leads to increased activity for the local economic life.

2.3.4 Effects for Settlement and Improved Life Quality

The fiber infrastructure helps modernizing the local society, and the introduction of this technology can be said to have a direct influence on residential environments. FTTH-networks have given better Internet- and TV-offers in both cities and rural areas. Especially important is this for young people who look at digital communication and entertainment as a vital part of everyday life. The TV-services, in terms of quality and channels offered, are subject of much improvement with high-speed Internet, as opposed to previous satellite- and cable-network technologies. Geographical topologies can now also be overcome in offering such services to rural areas.

The willingness to live in rural areas is also increased by the introduction of a stable, high capacity Internet connection. The transition from a possible unstable ISDN connection to a symmetric 50 - 100 Mbit/s connection surely increases both the willingness to settle in rural areas, as well as it most likely will increase the quality of life.

The possibility of joining social networks are also important in rural areas, as they can help creating a local unity, identity and attachment to an area. Especially important may the Internet connection be for younger generation. They may be separated from friends because of spread-out settlement in an area and therefore have limited possibilities of visiting each other after school-hours. Using social networks, they can socialize with their friends without physical presence. This can be an integral reason for families with young children to remain living in a rural area.

2.3.5 Education & e-Learning

The evolvement of high-speed Internet has lead to an increase in the use of digital learning platforms, like Fronter and It'slearning. A larger amount of student-work can be performed and documented through these platform because of the fiber penetration. This is especially the case in less central areas.

Expenses on books, paper and ink for printers can be reduced as a direct result of increased use of digital solutions in schools. The fiber-connection also makes it possible to use Internet better as a learning resource, since the high capacity broadband is able to carry the data-loads that are necessary when using both sound- and videoclips in online learning programs.

In rural areas, the use of fiber can increase the educational opportunities for students, by offering lectures held at other schools and universities online using videoconferencing. Also, students that are heavily involved in school-related organizations or with a sports-program, may be traveling quite a bit during school hours. If the broadband access is good, these students would be able to log onto their school network at a remote location and follow classes and submit schoolwork online.

2.3.6 Health care

So called e-Health is an exiting aspect that has come to life because of the introduction of high-capacity broadband in the health sector. Through telemedicine, checkups and diagnosing based on virtual data or data from instruments, can be done digitally without the patient and health personnel being at the same physical location. Examples of this are digital transfers of pictures, videos and X-ray images. Patient consultations and assistance of clinical patient treatment can also be done over videoconference calls. Videoconferencing is also used for meetings, guidance and teaching within the health sector.

In addition to better health services, especially in the district areas, telemedicine can lead to a reduced need of transport of patients to and from the hospital, leading to considerable savings in respect to both time and costs.

FTTH and other high-speed alternatives may also lead to a positive impact in the respect to surveillance and immediate help to the elders in a community. Having a reliable network connection makes the health sector able to respond quickly to distress calls, that are registered by the computer system, if anything were to happen. To be able to monitor a great number of "always-on"-monitors at the customer end would require a large capacity network. The fiber technology fits that bill.

Chapter 3

Research Procedure

3.1 Outline

This chapter describes the research procedure for carrying out the survey. First an outline of the procedure is given, before giving a short introduction to SNG - the company aiding me in my research during this project. Then a short recap on the choosing of geographical area and why we selected the industry sector we ended up analyzing. Finally, section 3.4 describes how the information was retrieved from the selected enterprises. This includes both how the online questionnaire was put together, as well as describing the communication method that was used between the researcher and the businesses.

An overview of the phases of this research procedure can bee seen in table 3.1. The three first phases are described in this chapter, while phase 4 is thoroughly explained and investigated in Chapter 4.

Table 3.1: Phases in the research procedure.

Phase 1:	Localize geographical area and choose industry/sector for survey. Identify enterprises of interest.
Phase 2:	Construct online questionnaire for information collection.
Phase 3:	Contact enterprises by email & telephone for participation.
Phase 4:	Retrieve results from database and perform analysis.

3.2 About SNG

Strategic Networks Group was formed in 1998, bringing together industry specialists with large experience in helping communities evaluate their technology investment options. Their headquarter is situated in Ottawa, Canada, but they also have offices in the United States, in France and in Australia.

As of today, SNG's team consists of 15 specialists, who all look to enable the most broad-reaching and transformational impacts that broadband can bring to businesses,

communities and regions. Their experience includes providing support in the areas of strategic planning, business and economic analysis, network architecture, and project implementation.

3.3 Localizing Geographical Area & Sector

The selection of geographical area for this research project was closely related to the sector of industry that was eventually chosen. When initiating this project, the researcher was interested in identifying a sector that was widespread, so as to create a diversity in the survey feedback. Another important aspect was to choose a sector with enterprises that are fairly easy to get in contact with. Of course, the sector would have to have a potential for broadband usage in its daily operations. The hotel- and accommodations-sector fitted the bill agreeably, as hotels are unique in the way that their size, owners and locations influence their customer basis and daily operations differently. The fact that hotels carry a huge potential for opportunities brought by high-speed broadband made them very interesting subjects for research.

As they already had made similar studies in the US, SNG were mutually interested in this choice of sector. SNG has over the years built up a solid database of research information collected from broadband readiness and usage studies in the US, covering a number of different sectors. In fact, as of December 2010, SNG is regrouping data on 14.000 organizations, households and businesses - meaning that they currently own the world largest database on broadband utilization. The tourism industry, within that the hotel- and accommodations sector, is one of the areas where they have built up a profound foundation for performing a comparative analyses.

Norway advertises itself as a country of great nature, and the tourism industry lays this as its basis for attracting foreign tourist. When selecting an area where it could be interesting to perform the survey, we looked at what tourists come to Norway to see, and how this could be connected with our chosen sector. The choice fell on finding a fjord, and selecting hotels, bed & breakfasts' and cabin/camping cites surrounding the fjord. Although only being the second largest in Norway, the Hardangerfjord in the county of Hordaland is the most famous, along with the Geirangerfjord in the county of Møre og Romsdal. The Hardangerfjord has a length of 179 km (111 miles) and the surrounding areas have a total of 23,000 inhabitants. Albeit the small population, the area has many visiting tourists every year, and hence the tourism industry is since long introduced. A list of hotels, bed &breakfasts' and cabin/camping cites in the Hardangerfjord area was drawn up as possible enterprises to enquire regarding the survey (see Appendix A).

In addition to performing the research study in the Hardangerfjord area, a number of hotels were also picked out in the cities of Bergen and Trondheim. Bergen is Norway's second largest city, and is situated one hour by car from the Hardangerfjord. Trondheim is the city where the researcher currently resides and was added with the thought that

the compliance from the enterprises situated here would be greater since the research was performed by a student from the city's prominent science university, NTNU.

The table 3.2 shows an overview of the counties that were finally chosen for participation in this broadband analysis project. Along with the municipal is the number of hotels, enterprises and camping cites in each of these. In total, 79 accommodation enterprises were picked out as potential participators.

Table 3.2: Municipals chosen for the survey.

Municipal	***Number of enterprises***
Eidfjord	9
Jondal	2
Kvam	5
Odda	4
Ullensvang	9
Ulvik	5
Bergen	22
Trondheim	23
Total	**79**

3.4 Collecting the Information

In able to collect information from the hotels and B&B's, several things had to be prepared beforehand. First, the goal of the research had to be formed and confirmed, with both the author and SNG as parties in regards to what kind of information we wished to ask for. Then contact had to made with the enterprises of interest. These two processes are described in the following subsections.

3.4.1 Constructing the Questionnaire

SNG offered their established online questionnaire for use in this project. Since their full-version questionnaire is quite substantial in size, it was agreed to adjust the survey and thereby reduce the number of questions that were to be posed. An important reason for shortening the questionnaire was to make it more attractive for the enterprises to answer it, as long surveys often act discouraging.

The necessary adjustments were made utilizing IP-telephone conferencing along with supervisor Thibaud Chatel in France and the SNG headquarters in Canada. This resulted in the questionnaire that got deployed in this project.

The questionnaire used is a property of Strategic Networks Group, and is not available for representation in this paper.

3.4.2 Making Contact

The first step of attempting to make contact with the hotels was to send out an email to the chosen enterprises, where a link to the online survey was given (this email written in Norwegian, and can be viewed in Appendix B). As a sign of gratitude for participating in this project, SNG offered to calculate and return to each of them a personal DEi-scorecard [1], hoping that the survey response rate would rise as a result of this.

A deadline for the completion of the survey was set to November 19th. In an attempt to remind about the survey, in case the selected hotels and B&B's had forgotten about it, a follow up email was sent, kindly reminding them of the interesting benefits they could learn about if they took the time to go through the questionnaire.

After sending a follow up e-mail, the third step was to contact the enterprises by telephone, reminding them about the deadline and explaining the purpose of the survey more in detail. If interested, the possibility was offered for the researcher to fill out the questionnaire for them by reading the questions out loud, and filling the answers in manually.

3.5 Bringing in the Results

After hitting the deadline for submission, and closing the online questionnaire, the results were generated by SNG. They were then sent to the researcher along with similar data from benchmarking SNG has performed on a large number of accommodation-enterprises in the United States (in the states of Kentucky, Louisiana, North Carolina and Virginia). A total of 169 hotels and bed- and breakfast's were selected from the selected US states, and comparative studies were then performed between the US and the Norwegian market on selected areas that were questioned about in the survey. These comparisons are shown in the results in Chapter 4.

3.6 Method review

The response rate from the enterprises on this survey can be seen in Figure 3.1.

After several attempts to persuade the businesses into participating, including several e-mails and large number of phone calls, the response rate for this survey landed at 22%. This has to be seen on as a very good result - considering the limited time this survey was available for answering. However, not all of these survey submissions were fully completed, but the ones who were only partially implemented still generated a lot of useful information that could be used in the analysis.

The geographical differences, both of the American and Norwegian enterprises, have been disregarded in the results and analysis phase. Both markets are hence viewed as a

[1] SNG's Digital Economy Index is a composite indicator of the utilization of Internet enabled applications by organizations

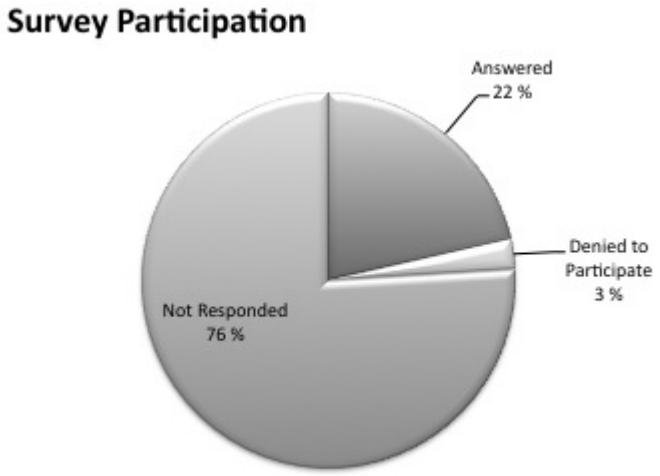


Figure 3.1: Overview of survey participation [Stople, 2010].

unison representation of all its accommodation facilities. This does, for example, result in the non-separation rural- and non-rural areas.

In this paper it is predicted that the population that has been collected in this survey is identical as the real population in Norway. This sample set is not very large, and if it turns out to be inaccurate as opposed to the real population, the results put forward in this paper may be somewhat imbalanced.

Chapter 4

Results

This chapter presents the results that were obtained from the survey that was performed. The responses from the research on the accommodation-organizations in the Hardangerfjord-area, Bergen and Trondheim have been added together to form a bundle, representing the "Norwegian market". In the United States, SNG has recently performed e-solutions benchmarking on a great number of organizations and businesses in the states of Kentucky, Louisiana, North Carolina and Virginia. The organizations fitted under the category "Accommodations" in their well-constructed database have been extracted, and their values have been bundled to form a representative for the accommodations-sector in the US-market.

The reader will be presented some of the information regarding broadband utilization that was retrieved in this project. Some important fields that are represented are broadband connectivity, the individual organizations' current utilization of broadband, barriers to effective broadband use and important benefit areas the organizations feel that their broadband can provide. In the following sections, the Norwegian and the US market are compared to each other, showing similarities and differences that there might be in different aspects of broadband utilization.

It is important to note that these results are discussed further in Chapter 5.

4.1 Type of Internet Connection

Both markets currently use a number of different access technologies, most of which are described in Section 2.2. Figure 4.1 shows the organizations' primary type of Internet connections, both in Norway and in the US.

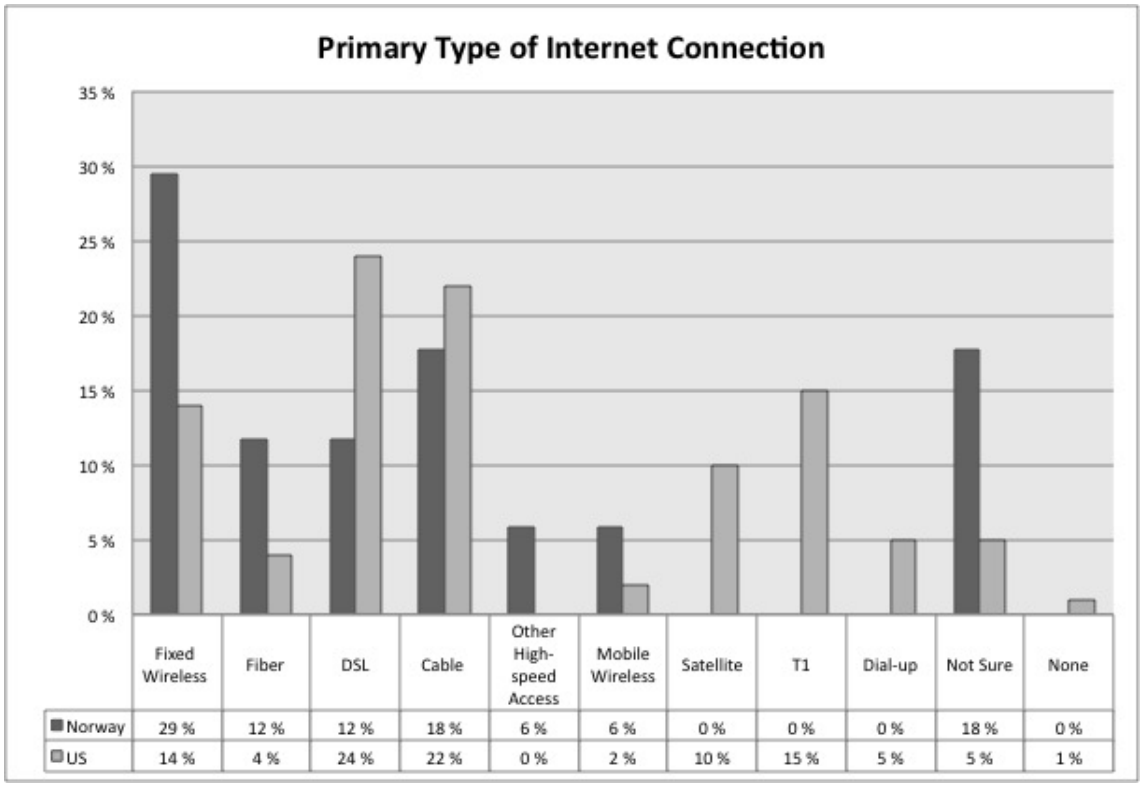


Figure 4.1: The organizations' primary type of Internet connection [Stople, 2010].

The Norwegian market has a much larger percentage of Fixed Wireless connections as their primary broadband access, as well as a much larger share of fiber connections. In contrast, the US has a larger share of both DSL and Cable connections in its home-market. The US bundle also uses Satellite- and T1[1]-connections in 10% and 15% of the market, respectively. The test area in Norway have no representations with these technologies at all (0%).

4.2 Current Utilization of the Internet

In this area the organizations were to answer how their current use of the Internet is, i.e. if they are using the Internet to sell goods and services, host a website, access government information or for staff training. Two fields are chosen here for closer examination: Figure 4.2 takes a look at the organizations' use of the Internet for online banking and financial services, so-called e-Banking, while Figure 4.3 represents the organizations' use of rich media or service creation.

[1]T1 is a dedicated phone connection supporting data rates of 1,544Mbit/s per second.

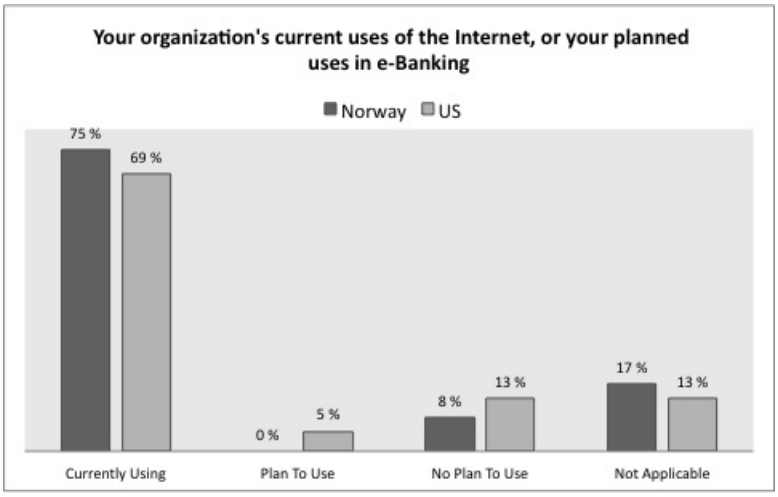


Figure 4.2: The organization's current uses of the Internet, or planned uses, in terms of e-Banking [Stople, 2010].

The chart represented in the figure above shows that both Norway and the US have quite similar use of the Internet for e-Banking services.

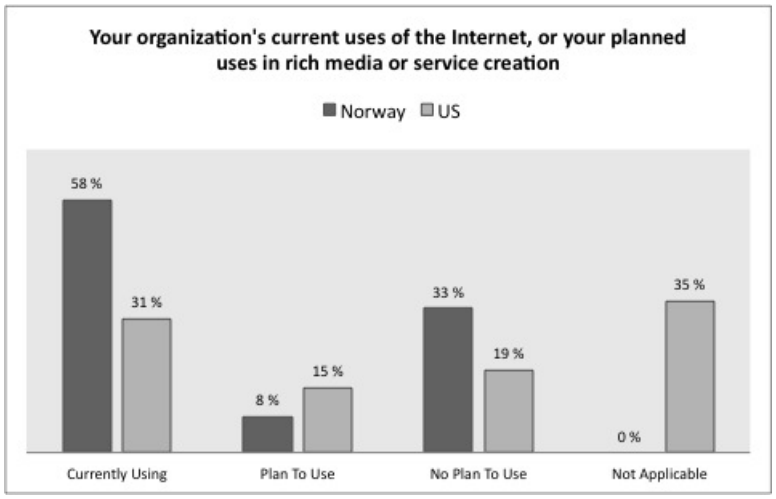


Figure 4.3: The organizations' current uses of the Internet, or planned uses, in terms of rich media or service creation [Stople, 2010].

Figure 4.3 describes current or planned uses in terms of rich media or service creation (e.g. use of multimedia content and interactive tools), and shows clear differences between the accommodation sectors in the two countries. In Norway, more than half of the enterprises inquired said that they were currently using the Internet for this, and 8% said that they were planning on introducing it. In the United States, only 31% were currently using, although 15% of the accommodations said that they were planning to. An interesting point is the 35% share in the American sector that claimed that this type of Internet use was not applicable for their business, while not a single Norwegian enterprise claimed the same.

4.3 Barriers preventing the efficient use of Broadband

Barriers are any factors that limit or prevent the effective implementation or use of broadband capabilities. The enterprises were asked as to what degree different scenarios regarding barriers could be related to themselves. Such barriers can include the lack of internal expertise and knowledge, uncertainty about benefits, privacy concerns and the possibility of losing personal contact with clients. The Norwegian enterprises were generally neutral as to naming possible barriers to effective broadband usage. However, when it comes to security concerns, the Norwegian bundle reveals a high significancy result, as shown in Figure 4.4. The American enterprises share the Norwegian concern, even feeling that this is a more significant barrier than what the Norwegians do.

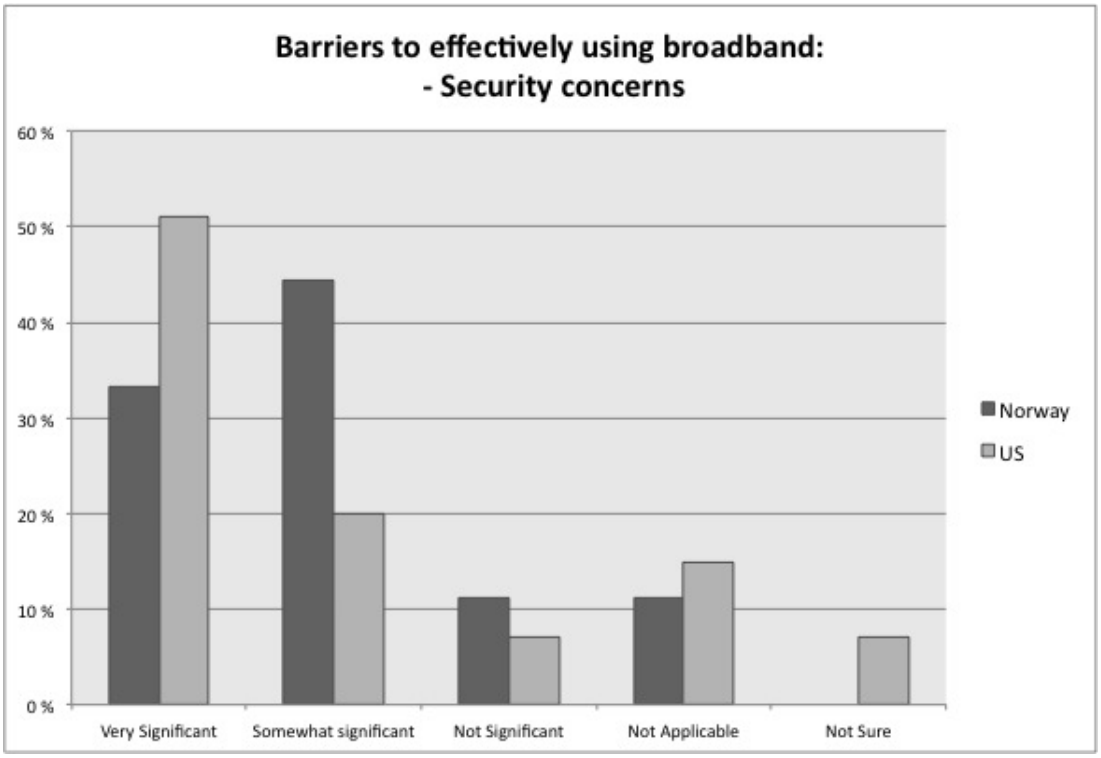


Figure 4.4: Barriers to effectively using broadband: Security [Stople, 2010].

4.4 The Use of Web-Enabled Devices

The use of web-enabled mobile devices allows for flexibility of work location for employees performing their work functions, enabling them to remain productive when away from their normal work location. This may include business travel, access from other organization locations or client locations, or any other requirement for worker access when away from their office. This may also include the use of specialty devices, e.g. for remote data entry or remote monitoring. Figure 4.5 shows the the similarities in the Norwegian and

American accommodation enterprises when it comes to using laptop computers, equipped with wireless network cards, in their daily operations.

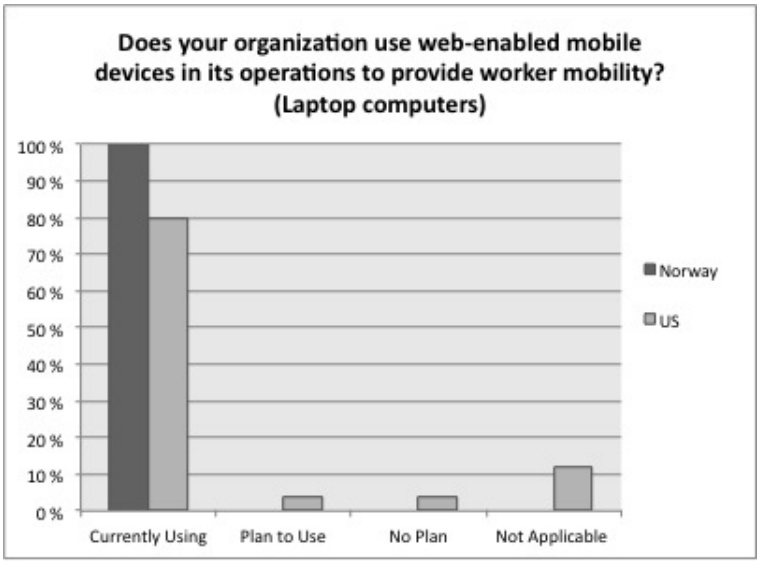


Figure 4.5: Use of laptop computers in the organizations' operations to provide worker mobility [Stople, 2010].

The comparison of web-enabled mobile phone-use is shown in Figure 4.6. Worth noticing here is the high amount of enterprises (more than 30%) in the US market that don't believe that these devices are applicable in their daily operations.

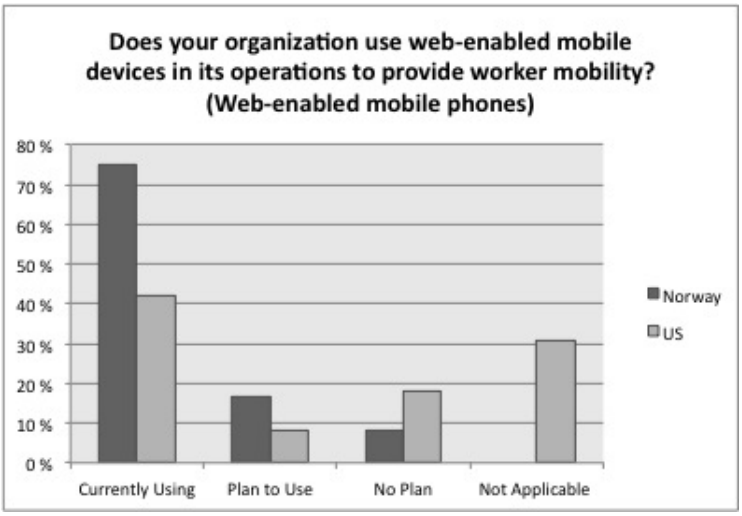


Figure 4.6: Use of web-enabled mobile phones the organizations' operations to provide worker mobility [Stople, 2010].

The organizations that answered that they were either currently using web-enabled mobile devices, or were planning in doing so, were asked how important the use of these devices were "for increasing the productivity and efficiency" of their own organization. Figure 4.7 shows the two countries' markets compared to each other.

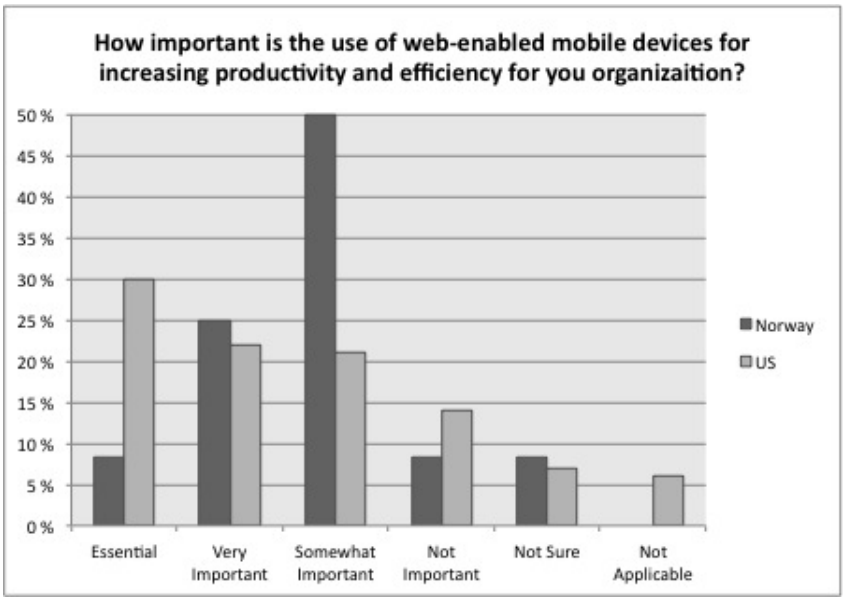


Figure 4.7: Importance of the use of web-enabled devices for increased productivity and efficiency [Stople, 2010].

Standing out are the Americans' feeling that the use of broadband on web-enabled devices is a lot more essential than what is believed in the Norwegian research pool. Fifty percent of Norwegian enterprises believe their use to only be "somewhat important" in regards to increased productivity and efficiency.

4.5 Importance of Internet to Provide Benefits

As mentioned in section 2.3, broadband can bring many benefits to enterprises as well as to a society as a whole, as compared to not having Internet access at all. One of the views on benefits that both the Norwegian and the US market seem to share, however, is the importance of Internet when reaching out to new customers and clients. As seen in Figure 4.8, both countries' sectors find the utilization of Internet very important in this matter.

When it comes to the Internet performing benefits by increasing the possibility of implementing tele-working for the business (Figure 4.9), there are differences in the two countries' results. While the accommodation sector in Norway mostly find this possibility very- or somewhat important, the American accommodations are less enthused, even having 34% claiming that tele-working is not applicable to their business. It can be noted that this looks like an occurrence happening in several of the scenarios in this chapter. Often where the Norwegian enterprises have few or none claiming that a given scenario is "not applicable", the US accommodation-sector scores a fairly high value. Some thoughts surrounding these scenarios will be discussed in Chapter 5.

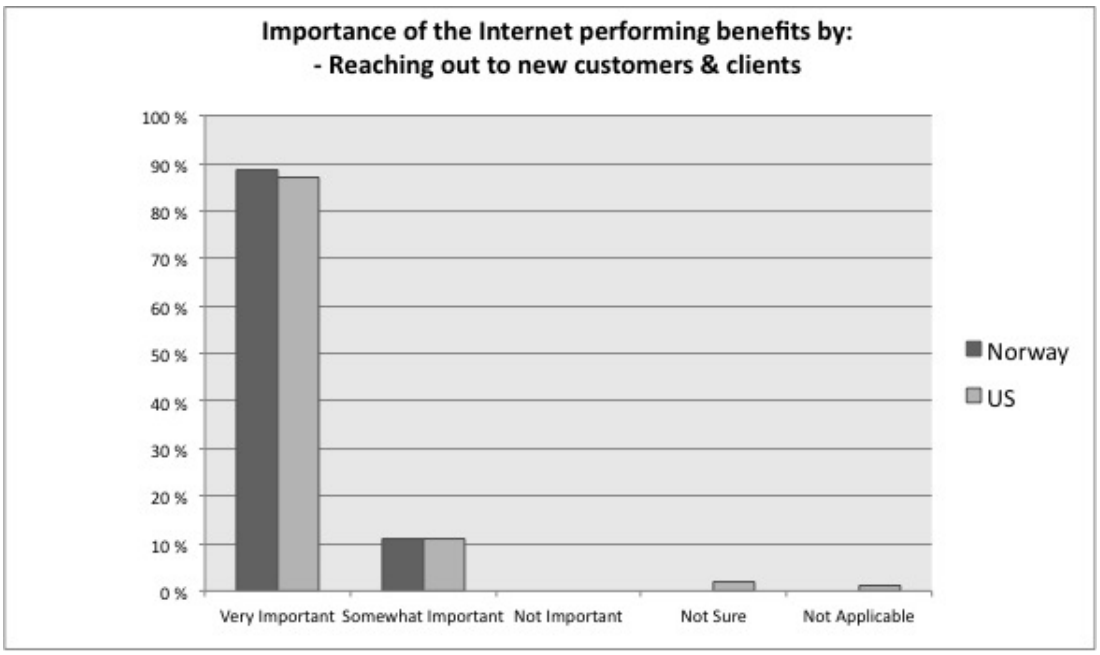


Figure 4.8: Importance of Internet in reaching out to new customers [Stople, 2010].

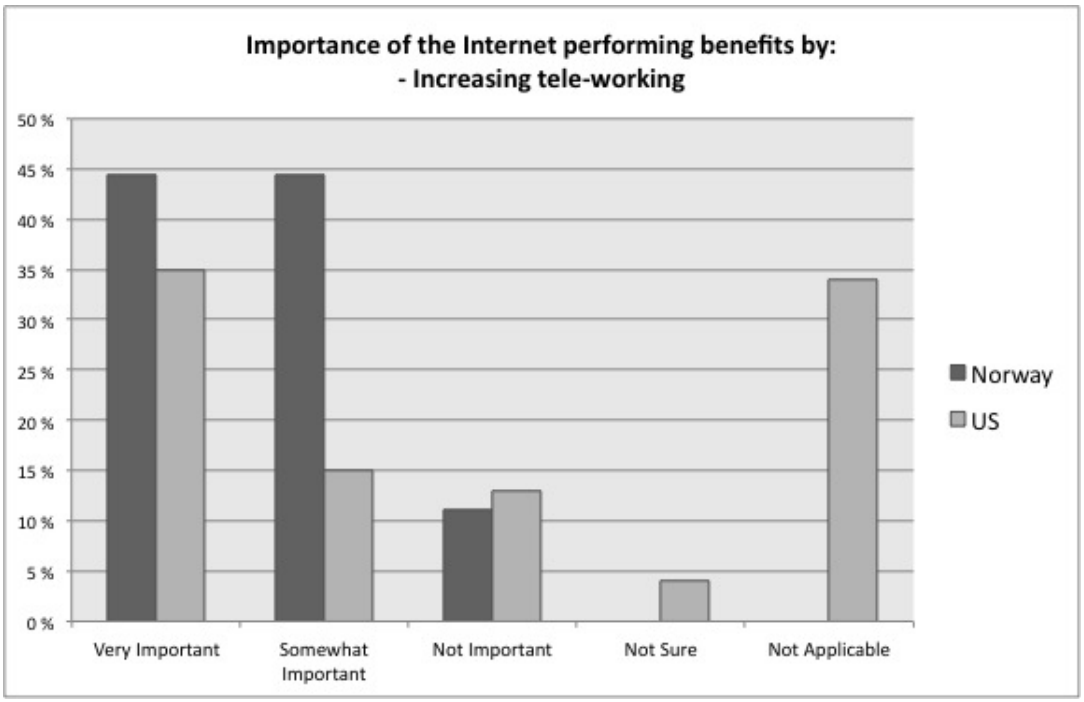


Figure 4.9: Importance of Internet to provide benefits - the increase of Tele-working [Stople, 2010].

Chapter 5

Discussion

In this chapter we will perform a more comprehensive discussion, based on the findings presented in *Results*, Section 4. The sections below describe different scenarios surrounding the accommodation enterprises' utilization of the Internet.

5.1 How Are They Connected?

The natural place to begin the discussion of broadband usage, is the organizations' primary type of access technology. Noticeable is the high percentage of fixed wireless connections in Norway compared to the US. The fixed wireless broadband technology was explained in section 2.2.2.2. 29% of the Norwegian enterprises revealed that they used this technology. The reason for this can be related to the geographical area that was chosen for this study. The Hardangerfjord-area can be defined as a rural area, where the number of potential subscribers has limited the expansion of fixed broadband technologies. The anticipated income that follows from the development and upgrade of fixed broadband network, needs to exceed the initial deployment costs to make a network provider want to invest in the area. Fixed wireless broadband is therefore a great option for areas like the Hardangerfjord, where water, trees, valleys and distances are easily surpassed by radio-waves. The American market also has a fair share of enterprises with this technology (14%), which is probably because a fair share of lodging units evaluated by SNG are situated in rural areas.

Another point worth mentioning is the use of fiber technology. As we can see in Figure 4.1, the Norwegian research population has a very similar usage percentage as to what was reported by OECD to be Norway's total share of fiber connections, as of June 2010 (14%). The share of fiber network connections is only 4% in the US. Looking at the figure we notice that US enterprises uses the "older" technologies DSL and cable instead. Also, 15% of the sector still uses the T1 technology - a technology that utilizes channels in a phone connection, and actually was released as early as 1984.

The United States also has a fair share of Satellite connections, 1 in 10 to be exact.

This may be a substitute for fixed wireless access in remote areas, where the infrastructure is so underdeveloped that the only possible option to get sufficient broadband capacity is to use satellite.

Overall, it looks like the Norwegian market is more developed on average than the American market, which is similar to calculations published by OECD [12]. Still, 5% of the research population in the US used dial-up technology, which is a technology that is close to obsolete in Norway.

Finally, a comment has to be made on the "Not Sure" column in Figure 2.2.2.2. The high percentage of businesses that answered this in Norway, compared to the US, is assumed to be somewhat coincidental as a result of the limited number of enterprises that make out the Norwegian bundle.

5.2 How do they Utilize of the Internet?

The introduction of Internet over high-speed broadband has brought many new possibilities for organizations and businesses to enhance operating functions and processes. E-solutions can enable an enterprise to integrate the use of computers and systems to perform both simple and sophisticated tasks online. Basic things may be to do online research or to put up an information website, while the more complicated e-Solutions can be to offer the processing of online orders, or to utilize rich media content on websites. Two examples of the organizations' use of Internet is presented in Section 4.2: e-Banking and the use of rich media or service creation.

Figure 4.2 shows the results when it comes to the current (or planned future-) use of the Internet for online banking and financial services. This is called e-Banking, and as we can see in the figure, is something that both the American and the Norwegian research bundle already focuses a great deal on.

When it comes to the use of rich media or service creation, we see that the accommodation sector in Norway almost twice as often say that they use the Internet for this purpose. Rich media, or interactive media as it is also called, can enable a web site to use technology advanced applets and interactive programs embedded in the webpage, which can respond to the user's actions without loading a new page. Interestingly, Figure 4.3 shows that 35% of the enterprises in the US don't feel that this kind of Internet use is applicable for their business. Undoubtedly, web-pages have the possibility to become more attractive, user-friendly and effective using rich media services. An important factor for this, however, is that the company has a broadband connection that is strong enough to handle the extra load that this service generates. The high agreement of it not being applicable may be a result of ignorance on the subject, or may be a misinterpretation of the question when filling out the survey. Clearly, rich media is something that can be used on any website, and any enterprise with an interest in expanding itself and reaching out to customers uses a website to market itself.

5.3 What is Preventing Effective Broadband Utilization?

Barriers for broadband utilizations can vary greatly. In fact they can be described as any factors that limit or prevent the effective implementation or use of broadband capabilities. The Norwegian enterprises that answered the survey seem to have a rather neutral opinion about these kind of barriers, not really singling anything out as a major significance in preventing their use of the Internet. However, in one area there were some concerns: namely regarding security. A chart displaying this concern can be seen in Figure 4.4.

Comparing to Norway, the US share the same concerns. The introduction and deployment of stronger broadband, accompanied by the possibility of new and innovative Internet services, is exiting in many ways. On the other hand, the feeling of "not being safe" is certainly viable for almost all enterprises. The importance of accompanying the new access technologies with the necessary firewalls is essential, and encrypting the data that is being sent should be a matter of course if the information is delicate and in relation to the company's operations. The fact that that most people see this as a concern is in fact a good thing, as it means that they are aware of the consequences that may come. However, it is even more important to ensure the education of these people in how to overcome these issues in order to fully utilize the available broadband connection.

5.4 The Internet provides mobility - do the Enterprises?

The use of web-enabled mobile devices allows for flexibility of work location for employees performing their work functions, and leads the employees to remain productive even though they might be away from their normal work location. This may include business travel, the ability to get access while at other organization- or client locations, or any other situation when the worker might be away from their office. The field of worker mobility also includes the ability to perform remote data entry or remote monitoring.

As can be seen in Figure 4.5, both the Norwegian and US accommodations-sectors make use of laptop computers to ensure mobility for their employees. It is interesting to see that 100% of the inquired enterprises in Norway use laptops. The US-based hotels also have a very high percentage-rate, although 1 in 10 don't feel this kind of equipment is applicable for ensuring their workers' mobility.

When looking at the use of web-enabled mobile phones we see a much clearer difference between the two. The Norwegian sector can combine the "Currently using" and "Plan to use" percentages to form a solid 92% answer regarding their willingness to use phones like this to increase their workers' mobility. The US sector can display an answer of 50% to the similar question. As many as 31% actually said that the use of web-enabled phones weren't relevant for their line of business.

The trend in the last couple of scenarios, regarding the use of web-enabled laptops and phones, may show that the US hasn't come quite as long of a way in the broadband

development process as the Norwegian market. It can even be interpreted as to that the staff currently working at the enterprises don't have enough knowledge about the possibilities ICT and broadband can introduce. Although the technical elite in both countries may very well offer all there is of top-notch Internet-services, far too many seem to not know what they can really benefit from using the Internet in an effective way. This includes the use of mobile-phones to do business related work while on the move. Of course, the use of these devices requires a wireless broadband connection not only at the workplace, but around it as well. This means that a wireless infrastructure also has to be in place in the local community as well.

If we take a look at Figure 4.7, we can see that both research populations feel that the use of web-enabled devices is important for the increased efficiency and productivity for the enterprise's daily operations. It should be noted, however, that these values are calculated only from the enterprises that were either currently using or planning to use such devices.

5.5 What Benefits do they Seek from Broadband Use?

The last issue that was reviewed in the Results (Chapter 4) was the rate of importance the organization felt that the Internet could have in providing them benefits. Two scenarios regarding such benefits were asked about: the reaching out to new customers and clients, and the potential increase in tele-working. Figures 4.8 and 4.9 show the views on how beneficial these two areas.

Both the American and Norwegian accommodations-sectors believe that the Internet is very important in helping them reach out to new customers and clients, and most of the remaining respondents feel that its impact is somewhat important. Most people that are traveling use the Internet when browsing for suitable lodging, and all hotels and B&B's with a nose for business would want to make themselves available for this purpose.

Differences between the two countries' sectors can be seen in the case of wanting to increase tele-working. The Norwegian share of enterprises were mostly positive to the importance of this beneficial possibility. The US-based enterprises were, however more split in their opinion. Tele-working can bring great benefits to an enterprise when it comes to employe satisfaction, but also to a society in terms of environmental benefits. This was talked about in Section 2.3.

When reviewing these values, there may be an understandable reason for this split view. The Accommodations-sector is a service sector, meaning that the daily operations are based on the handling of customers in person, and offering them presence at all times. These ideas may very well be dominant for many enterprises, meaning that they don't believe that performing the work anywhere else is even possible. For many small enterprises, those with few employees, this is probably the case as well. However, for larger enterprises, being able to perform tele-working if needed, can be a great addition in terms

of cost-saving possibilities.

Chapter 6

Conclusion

Since the spread of broadband, traditional Internet activities, like obtaining information has intensified. In addition, new kinds of Internet activities and content-rich broadband applications have also been on the rise. On the horizon are even higher data-intensive applications - like high-definition streaming video and TV, new peer-to-peer applications, virtual conferencing, health- and education applications and virtual reality applications.

As consumers are constantly demanding more advanced content, faster upstream bandwidth is essential for the further development of the information society. Norway has over the recent years, as one of the leading OECD countries, focused on this by increasing the uptake of installed capacity, electronic business, digital delivery and broadband applications.

In this research project some of the broadband utilization aspects of enterprises in the accommodations-sector in selected areas, in both Norway and in the US, have been reviewed. Common for both countries is that the drive for broadband evolvement is already in place. The difference, with reference to both the results from this survey as well as numbers released by OECD, seems to be that Norway is, on average, further along the path to a fully upgraded broadband society. A large number of enterprises in the American sector still uses old access technologies, like T1 and dial-up, implying that there are a lot of services and possibilities that these enterprises are missing out on. Of course, they might feel have enough broadband capacity to "get around", but still they are missing out on many economic benefits that can be brought to them by upgrading their network connections.

It is important to mention that the use of broadband for tele-work, e-government services, health and transport is still in its infancy. The use of web-enabled applications has almost exploded over the last few years, especially in regards to web-enabled mobile phones. In Norway today, more often than not, people have phones they can use to access high-speed Internet. This may be the reason why a much larger number of Norwegian enterprises, as seen in the figures in Chapter 4, use web-enabled devices in daily operations, as opposed to their American colleagues. Norway is, as of 2010, one of the most advanced

countries in the world in regards to Internet connectivity, as it has high broadband penetration and excellent DSL coverage. It has also a very good 3G coverage, high above the average of countries currently in the EU [12]. The mere fact that this coverage is so good, can itself make the population aware of the possibilities that can be carried out.

For the reasons just mentioned, it may not be that enterprises don't want to achieve benefits of broadband utilization. They should neither be blamed for, maybe incorrectly, assuming that certain Internet applications don't apply to them. Companies and enterprises may not have the required skills or knowledge to effectively make use of broadband in every possible way. This can especially be the case for small business firms. It's as easy to say as "you don't know what you don't know". In these cases, bringing in external resources to spread awareness can be the solution.

The importance of utilizing the available broadband capacity in the best possible way is, in any case, the underlying issue. To quote SNG: "Broadband today is as vital as electrification was in the 1930's". This may very well be, as the constant introduction of new, innovative services seek to make our society more efficient and our lives easier. It is only a question of being able to see these opportunities when they arise and being able to utilize them properly.

Chapter 7

Future Work

The first suggestion for future work is to *perform a new and wider survey.* Even though the response rate that was achieved in this project was quite respectable, it would still be a good idea to repeat the survey. The results that were used in the discussion were based on the responses that was received, However, the numbers received could very well turn out to be a somewhat inaccurate representation of the selected sector - as a number of hotels that could have substantial influence on the result didn't wish to participate at the time the survey was deployed. It would be important to reconsider the initial approach to the enterprises of interest - like how to make contact and the importance of persuading governing bodies and persons in the research area.

An interesting aspect for future work would also be to *follow up the enterprises that have submitted the survey*, giving them feedback on their results, seeing how they respond and look at what decisions - with regarding broadband use - they might undertake as a result of this.

Relations between relevant business models and the results of this research study is also something that could be looked more into. As an example of this, one can try to identify if there are any relevant business models that can help *preventing rebound effects* that the broadband efficiency and potential cost reduction may lead to.

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Appendix A

List of Accommodations

Appendix A:

List Of Accomodations

(Hotels, Bed & Breakfast's, Cabins and Camping Sites

Municipal	Name
Bergen	Bergen Travel Hotel
Bergen	Best Western Hotel Hordaheimen
Bergen	Clarion Collection Hotel Havnekontoret
Bergen	Clarion Hotel Admiral Bergen
Bergen	Clarion Hotel Bergen Airport
Bergen	Comfort Hotel Holberg
Bergen	First Hotel Marin
Bergen	Grand Hotel Terminus
Bergen	Hanseatic Hotel Bergen
Bergen	Hotel Augustin
Bergen	Neptun Hotel
Bergen	P-Hotels Bergen
Bergen	Radisson Blu Hotel Norge
Bergen	Radisson Blu Royal Hotel, Bryggen
Bergen	Rica Hotel Bergen
Bergen	Scandic Hotel Bergen City
Bergen	Steens Hotel
Bergen	Strand Hotel
Bergen	Thon Hotel Bergen Airport
Bergen	Thon Hotel Bergen Brygge
Bergen	Thon Hotel Bristol Bergen
Bergen	Thon Hotel Rosenkrantz
Eidfjord	Dyranut Fjellstove
Eidfjord	Eidfjord Fjell & Fjord Hotel
Eidfjord	Eidfjord Gjestgiveri
Eidfjord	Eidfjord Hyttegrend
Eidfjord	Fossli Hotel AS (Eidfjord)
Eidfjord	Garen Gaard og Hyttesenter
Eidfjord	Liseth Pensjonat og Hyttetun
Eidfjord	Quality Hotel & Resort Vøringfoss
Eidfjord	Vik Pensjonat og Hytter
Jondal	Folgefonn Guest House
Jondal	Jondal Hotel og Gjestgjevarstad
Kvam	Bråthun Hyttetun
Kvam	Hardangerfjord Hotel
Kvam	Hardingasete Accomodation
Kvam	Oddland Camping
Kvam	Strandebarm Fjordhotel (Kvam)
Odda	Hardanger Hotel
Odda	Skysstasjonen Cabins / Camping
Odda	Tyssedal Hotel
Odda	Vasstun Guest House
Trondheim	Best Western Chesterfield Hotel

Municipal	Name
Trondheim	Britannia Hotel
Trondheim	City Living Schøller Hotel
Trondheim	Clarion Collection Hotel Bakeriet
Trondheim	Clarion Collection Hotel Grand Olav
Trondheim	Comfort Hotel Lipp
Trondheim	Comfort Hotel Trondheim
Trondheim	Hotel St. Olav
Trondheim	P-Hotels
Trondheim	Prinsen Hotell
Trondheim	Quality Hotel Augustin
Trondheim	Quality Hotel Panorama
Trondheim	Radison BLU Royal Garden Hotel
Trondheim	Rica Nidelven Hotel
Trondheim	Scandic Solsiden
Trondheim	Thon Hotel Gildevangen
Trondheim	Trondheim Leilighetshotell
Trondheim	Best Western Stav Hotel
Trondheim	Botellet
Trondheim	Sandmoen Bed & Breakfast
Trondheim	Singsaker Sommerhotell
Trondheim	Trondheim InterRail Center
Trondheim	Trondheim Vandrerhjem/Hostel
Ullensvang	Agahytter
Ullensvang	Best Western Kinsarvik Fjord Hotel
Ullensvang	Bråvoll Camping
Ullensvang	Hardanger Hostel
Ullensvang	Hardangertun Hytter og Familiepark AS
Ullensvang	Hotell Ullensvang
Ullensvang	Kinsarvik Camping
Ullensvang	Ullensvang Gjesteheim
Ullensvang	Utne Hotel
Ulvik	Brakanes Hotel
Ulvik	Finse 1222 AS
Ulvik	Strand Fjordhotel
Ulvik	Ulvik Fjord Hotel
Ulvik	Ulvik Hotel

Appendix B

E-mail to Accomodations

E-mail to Accommodations

(this e-mail is written in Norwegian and included for special interest only).

Til daglig leder v/:

Hei,

Jeg er en 25 år gammel master-student fra linjen Kommunikasjonsteknologi ved NTNU i Trondheim, som for tiden holder på å skrive en prosjektoppgave om **bruken av bredbånd** i utvalgte regioner i Norge. I samarbeid med **det kanadiske selskapet Strategic Networks Group (SNG), kjent som en verdensleder innenfor bredbåndøkonomi**, **ønsker jeg å kartlegge utnyttelsen og de sosioøkonomiske innvirkningene av bredbånd** i turisme-sektoren i Bergen, Hardangerfjorden og Trondheim – og sammenligne resultatene opp mot liknende informasjon fra USA.

Utviklingen av høyhastighets bredbåndsnett har skutt fart i Norge de siste årene. Mulighetene for gevinstrealisering i bedrifter og det lokale næringsliv, som en følge av økt bredbåndutbygging, er derfor enormt.

Måten jeg ønsker å samle inn informasjon på, er å linke dere til **en nettbasert undersøkelse**. Svarene på disse spørsmålene vil hjelpe både meg og SNG til å forstå hvordan husstander og bedrifter bruker bredbånd – og hvordan de gagner fra det. Undersøkelsen bør ikke ta mer enn 15-20 minutter å gjennomføre, og vil være til stor hjelp til mitt arbeid.

Som en takk for hjelpen vil SNG generere et personlig DEI-Scorecard om deres bedrift som vil bli tilsendt i ettertid. Kalkulert med svarene dere avgir i undersøkelsen, er DEI (Digital Economy Index) en én-sides rapport som tilbyr en kjapp oversikt over hvor deres bedrift står med tanke bruken av bredbånd og Internett-baserte applikasjoner. Videre vil den identifisere muligheter for å utnytte bruken av Internett på en bedre måte – og derav kunne forbedre sluttresultatet. DEI'en vil også sammenligne din bedrift med andre i hotellnæringindustrien i ditt område, samt i USA.

For å utføre undersøkelsen kan du klikke på linken som er gitt under. Den er ikke tidsbasert, og kan aksesseres gjentatte ganger til den er gjennomført. Den er utviklet av SNG og er (selv om den er på engelsk) ukomplisert og gjennomførelsen er intuitiv.

LINK: http://sngroup.qualtrics.com/…/

Dette er i mine øyne en vinn-vinn-undersøkelse for både meg og dere, og jeg setter stor pris på deres deltakelse. For å få en best mulig tilbakemelding på DEI-Scorecard'et anbefales dere å svare så presist som mulig på spørsmålene. Svarene sendes og lagres til SNG sin database og behandles hele veien konfidensielt.

For at arbeidet videre, og tilbakemeldingen til dere, skal kunne gå så fort som mulig, ønsker vi at dere gjennomfører undersøkelsen *innen 19. november*.

Dersom du skulle ha noen spørsmål er jeg tilgjengelig både på epost og mobiltelefon

(informasjon er gitt under). Det kan også være av interesse å besøke www.sngroup.com om dere lurer på noe.

Med vennlig hilsen,

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