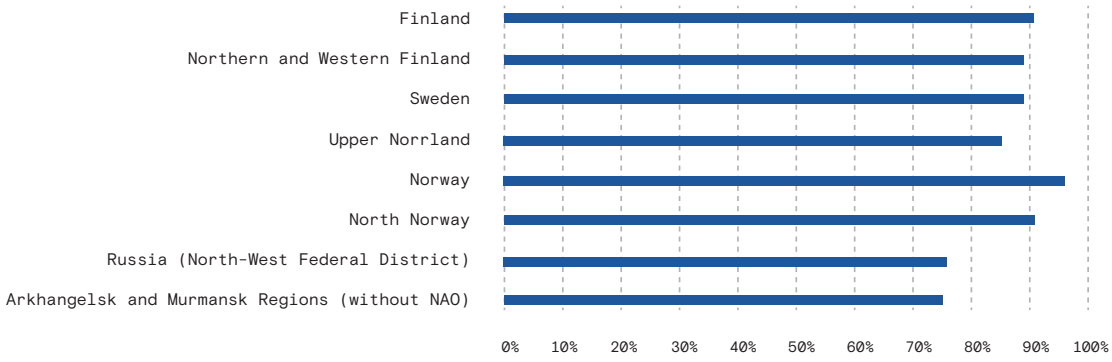
A prerequisite for economic development in the North.

(07)

Connectivity in the North

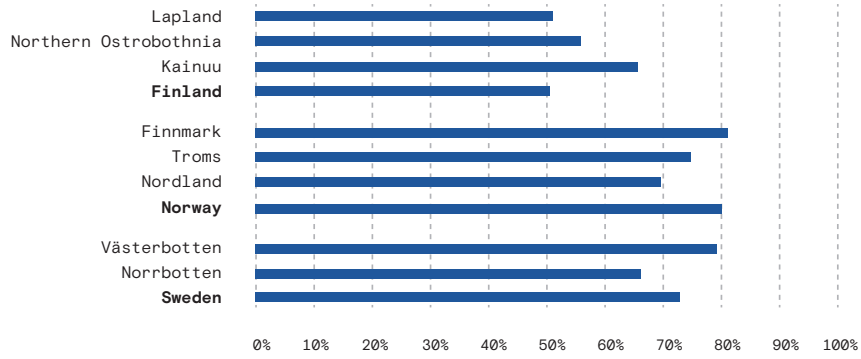
Households with broadband access, % (Basic Broadband)

2016



Availability of fixed broadband, % of households, at least 100Mbps (High speed Broadband)

2016



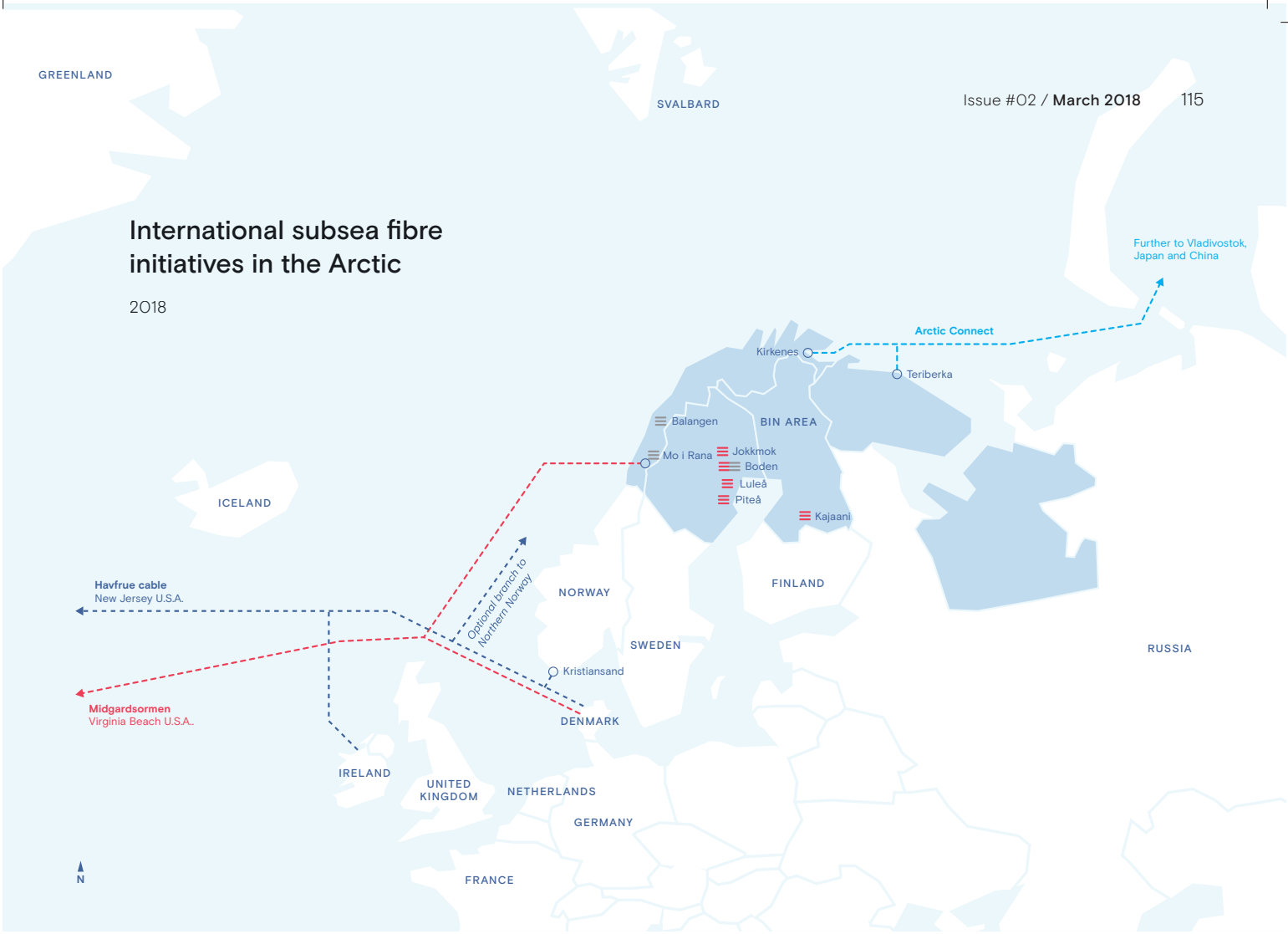
4G area coverage in the BIN regions, % of own territories

County	Year	4G, %
Murmansk Region*	2017	5
Arkhangelsk Region (without NAO)*	2017	5
North-West Russia*	2017	26
Norrbotten	2016	45
Västerbotten	2016	61
Sweden total	2016	67
Troms	2016	75
Nordland	2016	83
Norway total	2016	87
Finnmark	2016	93

*3G-4G for the Russian territories

International subsea fibre initiatives in the Arctic

2018



Data centers

Active

Sweden: Piteå, Jokkmok, Luleå, Boden

Finland: Kajaani

Planned

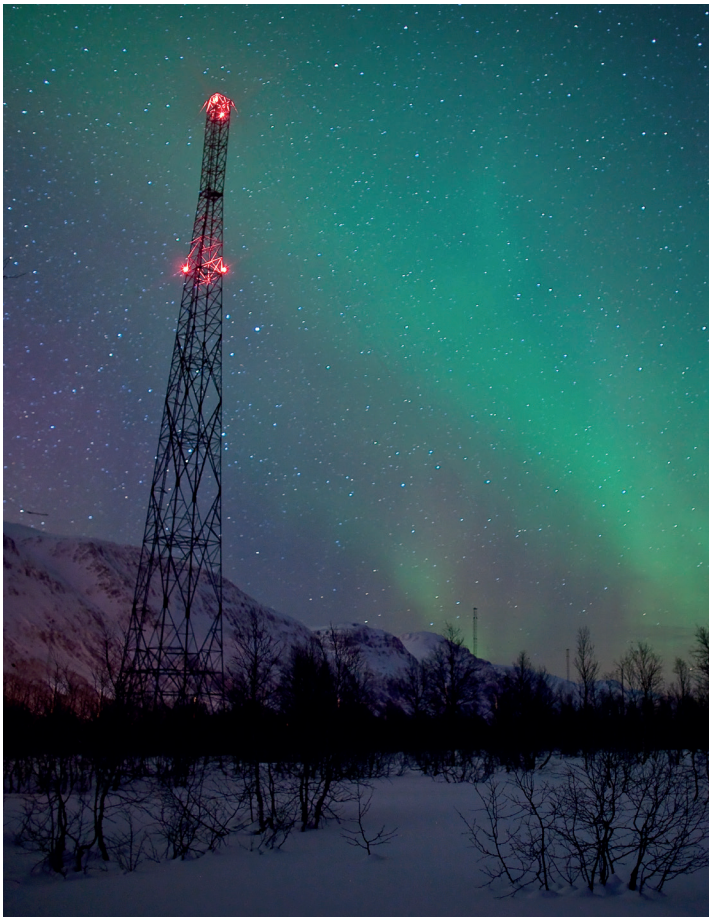
Norway: Mo i Rana, Balangen

Sweden: Boden

Section (07)

Connectivity in the North

Connectivity is recognized as a prerequisite for economic development in the Arctic. Finland's Chairmanship of the Arctic Council 2017-2019 sets connectivity as one of the priority areas. Access to broadband is essential for connectivity as it serves the needs of business, communities and research.



Telecommunication tower and Aurora Borealis.
Photo: shutterstock

Access to broadband facilitates the development of e-health and digital education. Business opportunities in the Arctic involving shipping, oil and gas, data centres, mining and service industries all need reliable connectivity solutions.

The Nordic BIN - countries Norway, Sweden and Finland - have developed broadband plans and digital agendas; however, connectivity in the Arctic regions requires separate attention. The Arctic Economic Council reports provide an overview of the challenges and ways forward to develop Arctic broadband infrastructure. In this chapter the focus is on the measurable and comparable development of connectivity in the Arctic in terms of the availability, quality and affordability of fixed broadband (including all the main fixed-line broadband access technologies). Furthermore, availability of mobile broadband is reported. Analysis of broadband development projects in the Arctic further highlights drivers and success factors for improving connectivity in the Arctic.

We address *connectivity for people* and *for business* in the BIN area. The indicators used in this chapter come from broadband statistics on households. The use of such statistics is well suited for purposes of highlighting people's universal access to basic infrastructure and Internet. The needs of businesses for Internet might vary, but basic household broadband offerings would suffice for small and medium enterprises (SMEs) as the speeds also satisfy the needs of these customers. Broadband speed is usually measured in Mbps (megabits per second), where a high number means faster downloads and uploads when using cloud services, rapid streaming of music or video and smoother video calls. A broadband speed of 100 Mbps would be considered sufficient for SMEs, but larger firms require higher speeds and bandwidths. Analysis of subsea cable projects explores new potential for increased connectivity for business in the BIN area. This chapter describes living conditions of people in the BIN area in terms of access to fixed and mobile broadband, identifies universal needs for broadband statistic information and presents implications for policy makers and investors.

Indicators used:

Availability of fixed broadband [1] shows the proportion of households with easy Internet access, whether they use it or not. It shows investments in basic infrastructure and people's universal Internet, without measuring actual usage.

Quality of fixed broadband is measured in terms of the availability of speeds of 30 Mbps [2] and 100 Mbps. This indicator demonstrates how well the BIN area meets the broadband coverage objectives of the EU Member States: universal broadband coverage with speeds of at least 30 Mbps by 2020 and broadband coverage of 50% of households with speeds of at least 100 Mbps by 2020.

Affordability of fixed broadband is measured by price level and by its percentage of average national income per capita. This indicator shows how well BIN area meets the targets of the UN Broadband Commission, namely that by 2025, entry-level broadband services should be made affordable in developing countries at less than 2% of monthly Gross National Income (GNI) per capita.

Availability of mobile broadband demonstrates mobile broadband availability in terms of population and area coverage.

Map of potential subsea cable projects illustrates subsea cable initiatives with a potential effect on the BIN area.

1. According to Eurostat, broadband refers to telecommunications in which a wide band of frequencies is available to send data. Broadband telecommunication lines or connections are defined as those transporting data at high speeds, with a speed of data transfer for uploading and downloading data (also called capacity) equal to or higher than 144 kbit/s (kilobits per second). In the Russian statistics minimum speed of broadband is 256 kbit/s.

2. Mbps and Mbit/s are used interchangeably

Findings:

AVAILABILITY

- Basic fixed broadband[3] was available to 95% of households in the Nordic BIN regions and in 75% of households in the Russian BIN regions.

QUALITY

- The target of the EU Digital Agenda for broadband with at least 100 Mbps per second for at least 50% of households by 2020 was already achieved in the Nordic BIN regions in 2016. The target of 30 Mbps for all is yet to be achieved.
- The BIN regions in Norway and Sweden exhibit higher levels of quality fixed broadband availability than in Finland
- The regions of Troms, Nordland (Norway) and Norrbotten (Sweden) lag behind their country averages in 100 Mbps fixed broadband availability by 8 percentage points and 7 percentage points respectively, while the Finnish regions of Northern Ostrobothnia, Kainuu and Lapland outperform Finland's average by 8 percentage points.

AFFORDABILITY

- Fixed broadband is affordable in the BIN area, with broadband expenses constituting from 1.6 to 3% of annual disposable income. Norway has the most expensive broadband, followed by Sweden and Finland. There is no significant price disparity between the Finnish BIN regions and Finland as a whole.
- Murmansk Region has more expensive fixed broadband than the Northwestern Federal District in Russia.

MOBILE BROADBAND

- In 2016 the BIN regions in Norway had the best mobile broadband coverage lagging behind the national average by only 3 percentage points, Swedish BIN regions lagged behind by 14 percentage points and the Russian BIN regions lagged 21 percentage points behind their corresponding national averages.

SUBSEA CABLE INITIATIVES

- The BIN region requires improved connectivity with the USA and Asia by subsea fibre cable. Capital-intensive projects demand careful consortium building and secured financing from the initial stage outset. The role of the governments should be considered in securing connectivity in the Arctic BIN area.

3. In the Russian statistics, broadband is defined as access to internet with download speed of at least 256 kbit per second. In the statistics for the Nordic countries, according to Eurostat, the minimum broadband speed is 144 kbit per second.

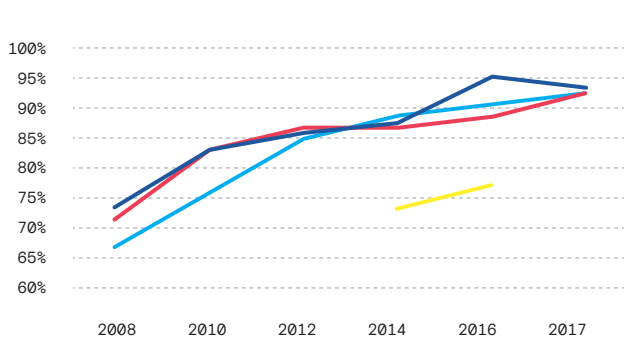
Availability of fixed broadband in the BIN area

Figure 1 shows the country specific shares of households with fixed broadband access. While Norway was the first to reach the 95% threshold in 2016, Sweden and Finland approached it in 2017. Russia is lagging behind by 20 percentage points as of 2016. Figure 2 shows that there is no disparity between BIN regions and their country averages (the share for both North-West Russia and the Murmansk and Arkhangelsk region is about 75%; for the Nordic countries and their corresponding BIN regions the shares are close to 95%). The development in North-West Russia in 2016 was at the 2009-10 level of the neighboring Nordic countries and their BIN regions. Today the difference in the share of households with broadband access between the Nordic BIN regions and North-West Russia is about 20 percentage points. In Russia, priority in extending Internet availability of at least 10 Mbps is given to settlements with a population of at least 250 people. When interpreting the results in Figures 1 and 2 one should remember that availability of fixed broadband meeting the minimum speed requirement is considered (access to internet with download speed at least 256 kbit per second in Russia and with minimum speed is 144 kbit per second in Nordic BIN area). See Table 1 for speed comparisons.

Figure 1

BIN countries-share of households with broadband access, %

2008–2017 [4]

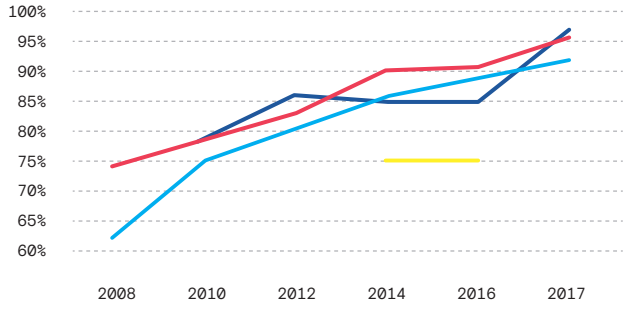


Data sources: Eurostat, Rosstat

Figure 2

BIN regions-share of households with broadband access, %

2008–2017



Data sources: Eurostat, Rosstat

4. In the Russian statistics, broadband is defined as access to internet with download speed of at least 256 kbit per second. In the statistics for the Nordic countries, according to Eurostat, the minimum broadband speed is 144 kbit per second.

The Digital Agenda presented by the European Commission proposes to better exploit the potential of information and communication technologies (ICTs) in order to foster innovation, economic growth and progress.

When it comes to broadband, the Digital Agenda has the following targets:

- All in Europe shall have access to internet with speed over 30Mbps per second by 2020 as the latest.
- 50% of all households in Europe shall have internet subscription with speed more than 100 Mbps by 2020.

In order to give some indication of what these speeds mean for the user, Table 1 compares the broadband speed required for downloading a 5-minnute video and a 2-hour movie over internet by using theoretical calculation. When using an internet connection with 100 Mbps it takes 1.5 min to download a 2-hour movie, while using 256 kbits it would take 9 h and 19 minutes.

Table 1

Broadband speed comparison

Content	Size	256 kbits	1Mbps	20 Mbps	100 Mbps
5 min video	30 MB	16 min	3 min	13 s	2.5 s
2 h movie	1-1.5 GB	9 h 19 min	2 h	10.5 min	1.5 min

(Source: fastmetrics.com)

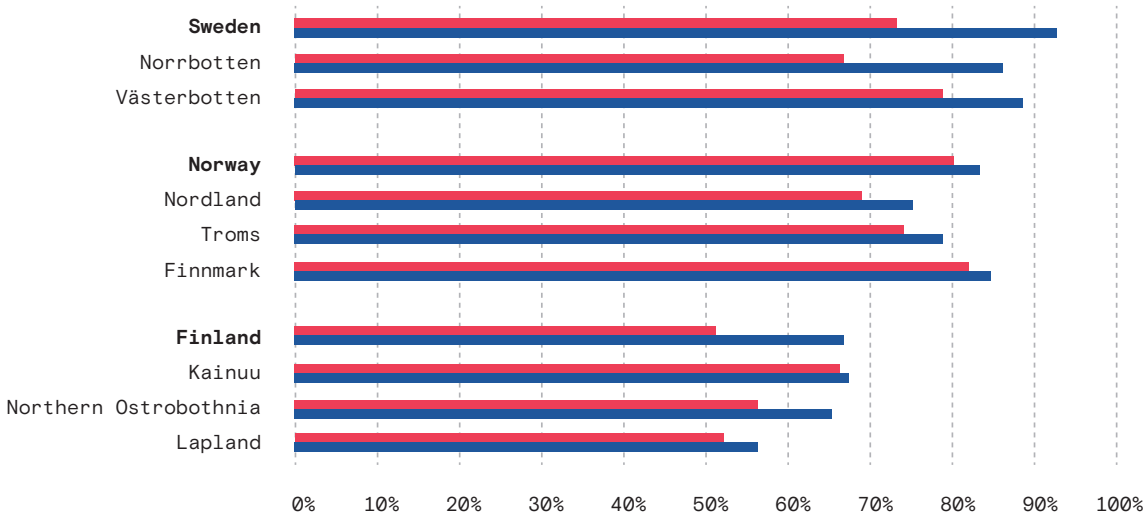
Figure 3.1

Availability of fixed broadband, % of households

2016

Figure 3.1 shows the quality of fixed broadband availability in the BIN area. The target of the EU Digital Agenda for broadband with at least 100 Mb per second for at least 50% of households by 2020 was already achieved in the BIN regions of Nordic countries in 2016. The target of 30 Mbps second for all was yet to be achieved. Percentages just represent the possibility to acquire broadband (infrastructure in place). The total level of broadband accessibility in Finland is significantly lower than in Sweden and Norway, lagging by 22% for 30 Mbps and 25.5% for 100 Mbps compared to the average for Norway and Sweden. The regions of Västerbotten, Finnmark and Kainuu are among the best performing regions in their respective countries in terms of access to internet with at least 100 Mbps. The differences across countries are explained by country-specific initiatives to support fibre enabled Internet availability. In Finland, the commercial bias has been more toward mobile network development. In Sweden state aid coupled with regional broadband co-ordinators acting as the link between the regional and municipal level and the market actors deploying broadband infrastructure proved to be efficient in achieving availability of high quality broadband. In Norway there have been more public financial support schemes available in order to cover the costs of the "last mile" of infrastructure in rural areas [5].
No comparable statistics are available for Russia.

Data sources: Finnish Communications Regulatory Authority, Norwegian Commnications Authority, Swedish Post and Telecom Authority



5. ACS Telecoms REPORT

Figure 3.2

100 Mbps 30 Mbps

Difference in fixed broadband availability by speed compared to country average, %

2016

Figure 3.2 shows that six out of the eight BIN regions underperform in 30 Mbps availability compared to their respective country averages, ranging from a 10 percentage points gap in availability in Lapland to a 1 percentage point gap in Northern Ostrobothnia. In Sweden, Norrbotten region underperforms in both 30 Mbps and 100 Mbps availability, while Västerbotten outperformed by 6 percentage points in 100 Mbps compared to the Swedish average (see Figure 3). In Norway, both regions of Nordland and Troms underperformed in fixed broadband availability, especially in 100 Mbps speed Nordland lags behind by 11 percentage points and Troms by 6 percentage points. Finnmark region performed slightly better than the Norwegian average. In Finland the BIN regions of Kainuu (15 percentage points), Northern Ostrobothnia (5 percentage points) and Lapland (10 percentage points) outperform Finland's average in 100 Mbps broadband availability equaling 51%, which is considerably lower than for the Swedish and Norwegian BIN regions. There is need to address fixed broadband disparities in the BIN regions.

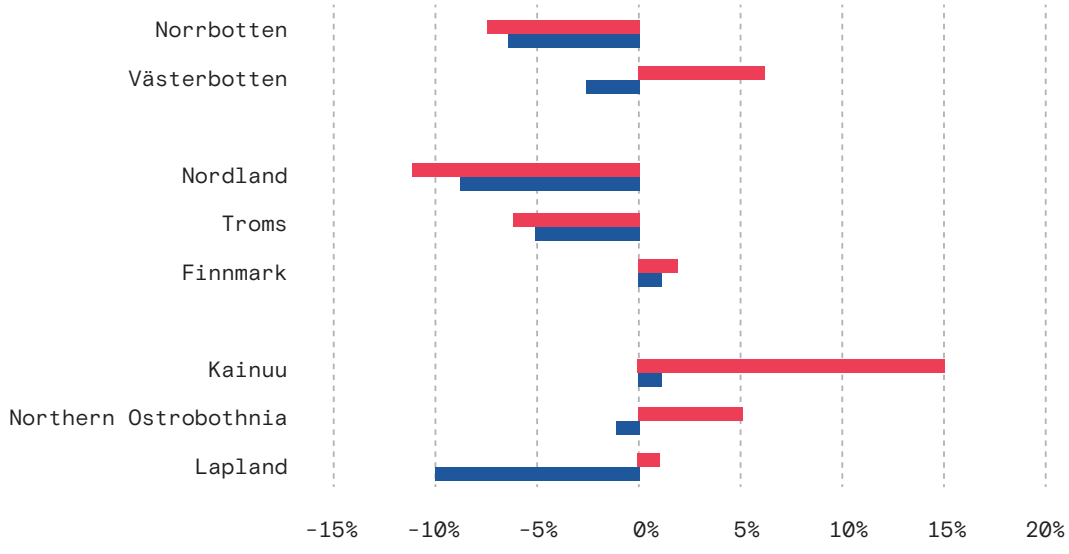


Figure 4

Subscription price per month, minimum 100 Mbps, lowest price offer in EUR

2017

Figure 4 demonstrates that subscription prices for fixed broadband with at least 100 Mbps second differ widely among the BIN countries. Norway has the highest price and Russia has the lowest. Prices in Sweden and Finland fall in between. Unfortunately, we could not find detailed statistics for the Norwegian and Swedish BIN regions. However, according to the experts, there is no significant difference between regions within the countries. In addition to the subscription price, users often have to pay an opening fee (not shown in the figure). The average level of the opening fee differs greatly between the countries. While in Norway the opening fee is around 564 EUR, in Sweden and in Finland, it is about 1,750 EUR. This means that for first-time users of high speed broadband (100 Mbps is available on fibre lines), the total cost in Norway is lower than in Sweden and Finland if considering a two-year plan. The opening fee in Russia can be up to 500 EUR if there is no fibre cable connected to a house. However, there is a connection to most of blocks, and if there is none people normally do not go for it but opt for a wireless connection plan.

Data sources: Finnish Communications Regulatory Authority, Swedish Post and Telecom Authority, Internet providers.

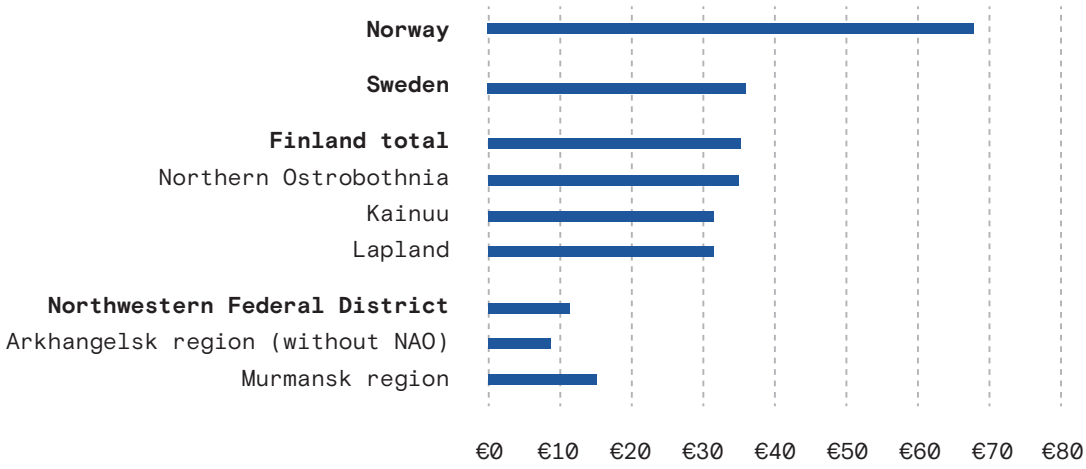


Figure 5

Affordability 100 Mbps Affordability 30 Mbps

Affordability of fixed broadband by speed: annual subscription price as % of annual net income

Figure 5 shows affordability of fixed broadband as percentage of annual net income. Broadband of 100 mbps is most affordable in Finland, and amounting to 1.9 % of annual net income, followed by Sweden (2%). The most expensive high-speed broadband is in Norway, 3% of annual net income. Affordability of 30 Mbps broadband was under 2% in all BIN regions and their corresponding countries. The greatest affordability disparities are in the Murmansk region.

Data sources: Finnish Communications Regulatory Authority, Swedish Post and Telecom Authority, Internet providers, Statistics offices in Norway, Sweden, Finland, Russia.

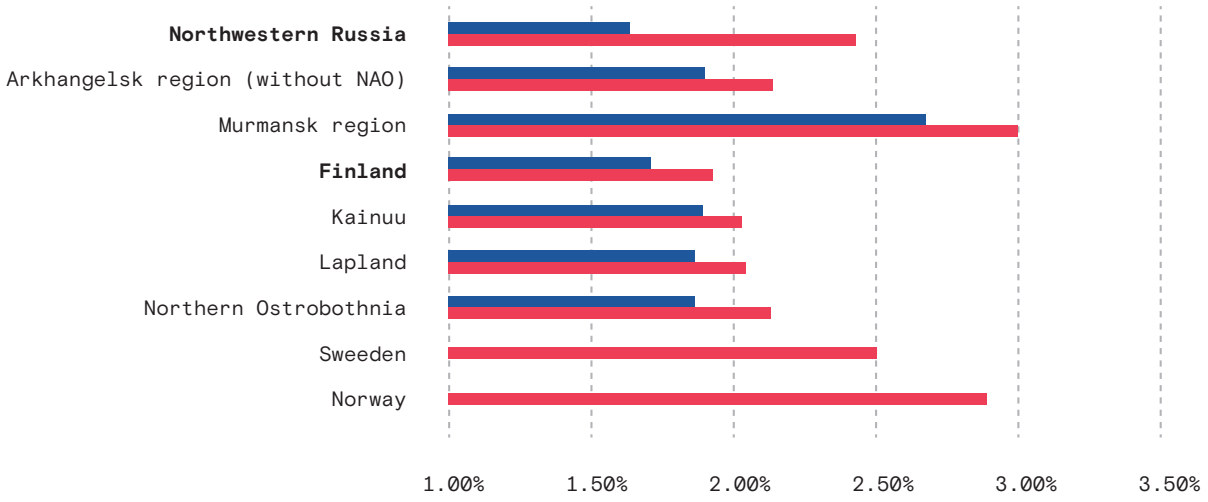
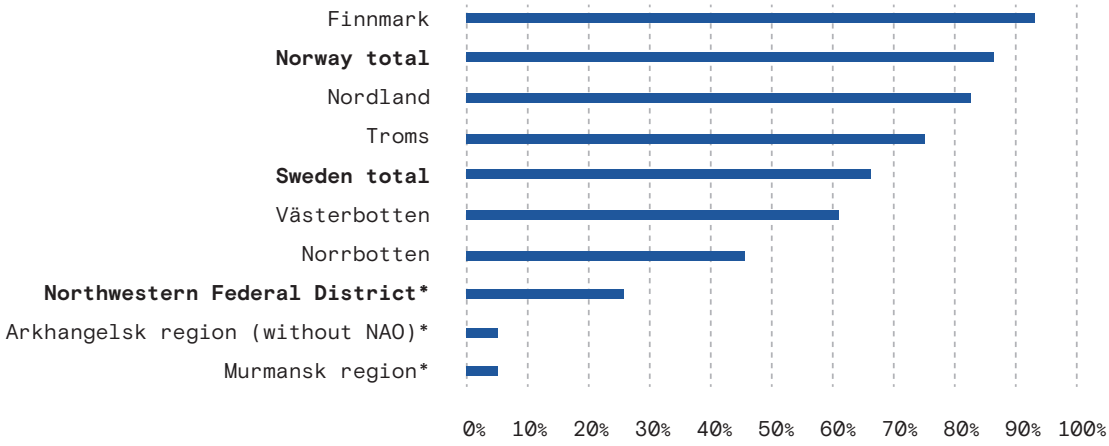


Figure 6

4G area coverage in the BIN regions, % of own territories

Russian BIN regions year 2017, Nordic BIN regions year 2016



*3-4G coverage for Russian regions

Mobile broadband in the BIN area

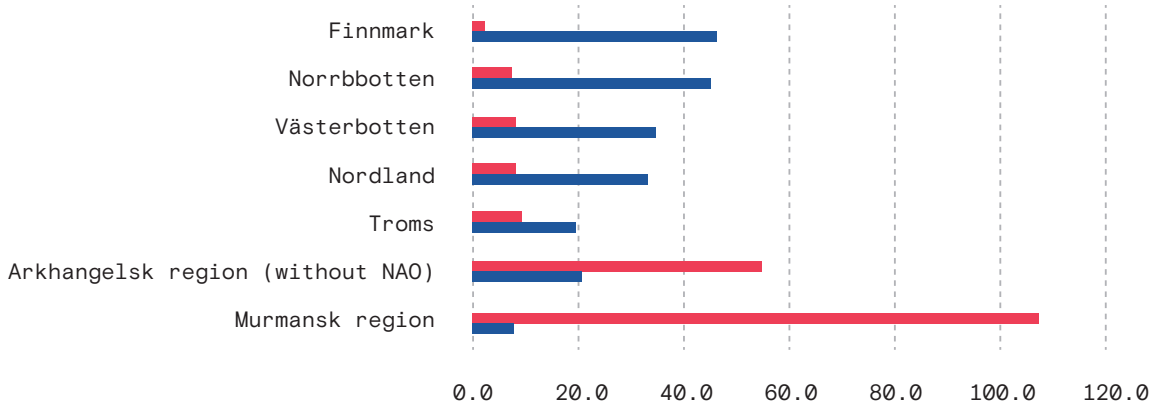
The estimated share of the population with access to mobile data based on 4G (all mobile networks, outdoor coverage) is close to 100% in all BIN regions in Norway, Sweden and Finland. In the Russian BIN regions of Murmansk, Arkhangelsk and Northwestern District in Russia as a whole most households are covered with 3G and some have 4G. While population coverage with mobile broadband is nearly complete, the area coverage in the BIN regions is much less (Figure 6). The northern territories of Norway, Sweden, Finland are much less covered with 2G, 3G, 4G than the southern parts of these countries. The situation on the Russian side is even more dramatic – most of the Northwestern Federal District Territory remains uncovered. On the Nordic side, most of the territory covered has 4G and a secure 3G back-up. In Russia most of the territory covered has 2-3G, while 4G is available only in more densely populated places. Mobile networks are developed first in populated areas (see Figure 7). The higher percentage of territory covered – the more dispersed the population in the region is and vice versa. Finnmark in northern Norway has the largest share of own territory covered with 4G – 93%. In general, regions in Norway have a higher share of own territory covered than do Swedish regions. The Russian regions have the lowest share. No comparable Finnish data available

[6] Industry 4.0 is the comprehensive transformation of the whole sphere of industrial production through the merging of digital technology and the internet with conventional industry (EU definition)

Figure 7

Area covered with 4G (in 1000s km2) and number of citizens per 1 km2 of this area

Figure 7 shows that Finnmark has the largest area covered with 4G – 45.2 thousand square kilometers. At the same time, the region has the lowest number of people per square kilometer of the area covered with 4G – 2. Figure 7 clearly shows that the BIN regions with the largest 4G covered areas have the lowest number of population per square kilometer of this covered area, and vice-versa. Murmansk region has 105 people per square kilometer of the area covered with 3-4G, while this area is only 7. 2 thousand square kilometers. No comparable Finnish data available.



3-4G coverage for Russian regions

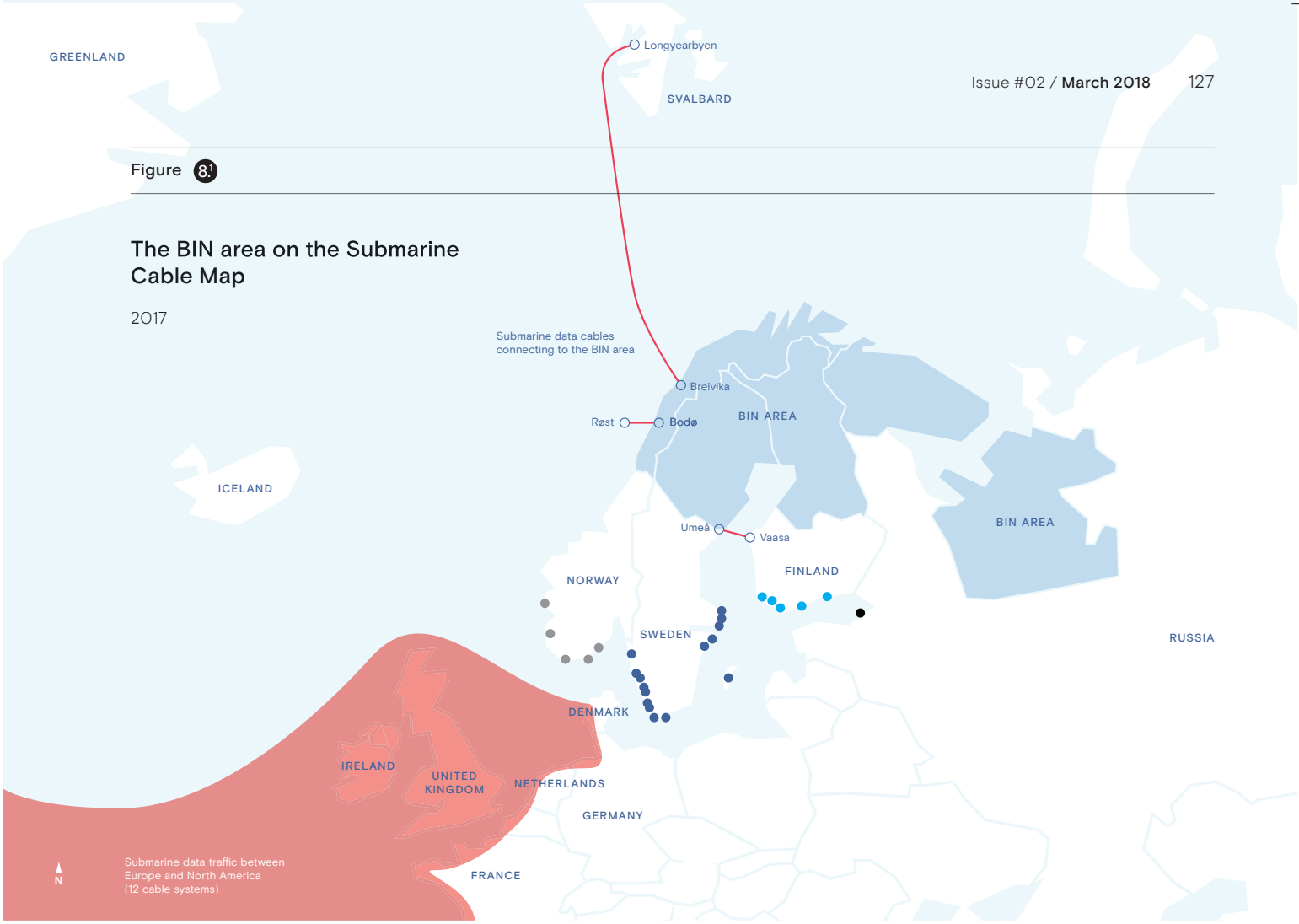
International subsea fibre initiatives in the Arctic

The needs of modern internet users require fast internet with low latency, meaning short delays in data transmissions. The driving factors behind the need for higher bandwidth are among others increasing cloud driven traffic, IoT developments, Industry 4.0[6], autonomous vehicles, emergence of 5G technology which offers data transfer up to 150 times faster than the current 4G networks. Subsea fibre cables carry close to 100% of transoceanic voice and data communication.

Figure 8.1

The BIN area on the Submarine Cable Map

2017



Data source: https://www.submarinecablemap.com/ The Submarine Cable Map is a free and regularly updated resource from TeleGeography.

Landing points to submarine cables to Europe	
Norway	
Sweden	
Finland	
Russia	

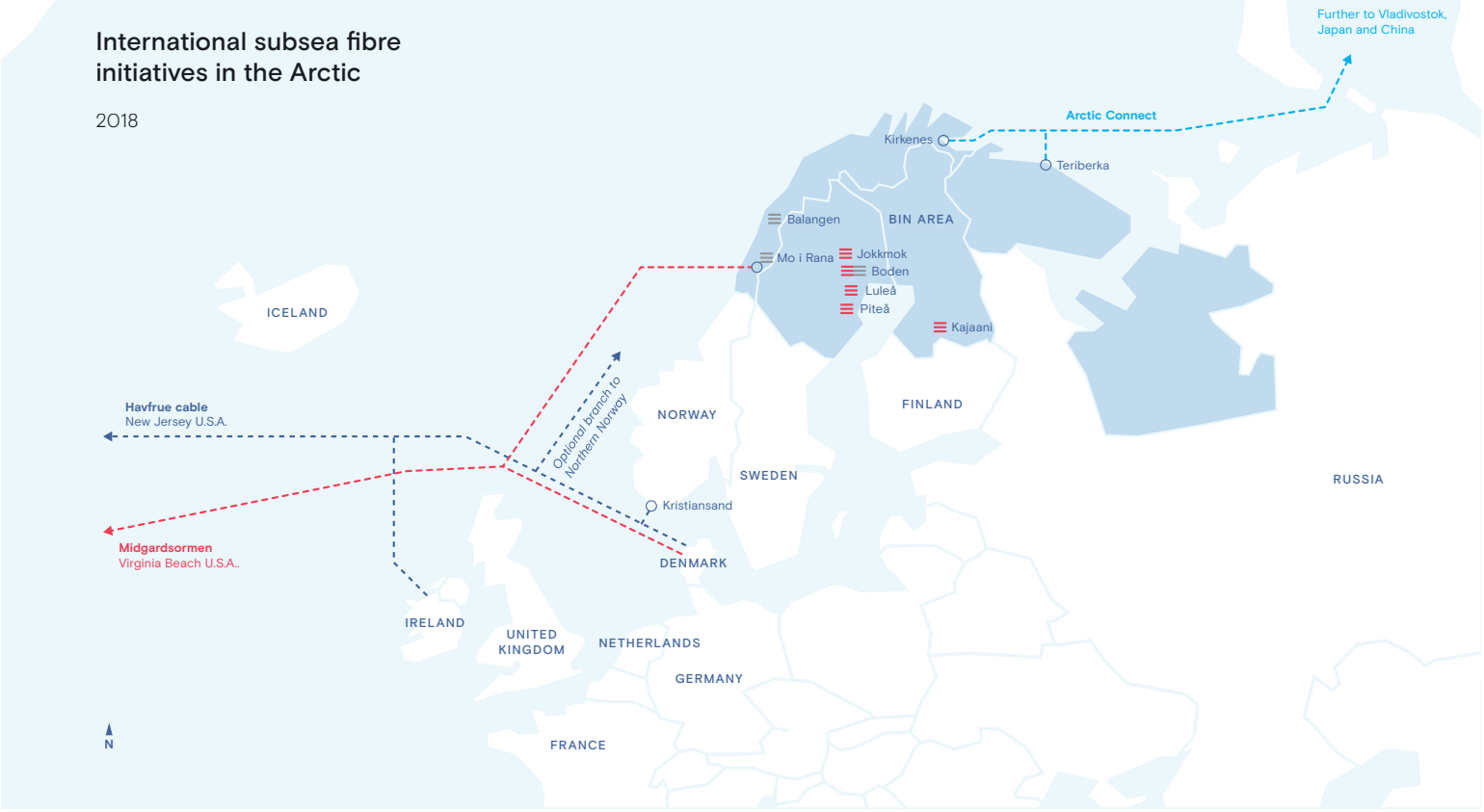
Figure 8.1 shows that on the global scale the BIN area has no direct international subsea fibre cables connecting it to the USA or Asia. The lines on the map show the routes of the cables and territories they connect. As of early 2017, there are approximately 428 submarine cables in service around the world [7]. The total number of cables is constantly changing as new cables enter service and older cables are decommissioned. Historically, these cables were built as commercial projects financed by private enterprises rather than governments. The BIN area has no direct subsea cables to the USA or Asia; Direct transatlantic data traffic proceeds through 12 cable systems connecting regions in North America to Denmark, Netherlands, Germany, United Kingdom, Ireland, France, Spain and Portugal. Major subsea cables that connect Finland, Sweden and Norway with the rest of the world have interconnects in continental Europe, which introduces latency into data traffic. All landing points for these cables are in the south of Norway, Sweden, Finland and none in the BIN area; South Sweden has the highest number of landing points for these cables to continental Europe.

[7] TeleGeography

Figure 8.2

International subsea fibre initiatives in the Arctic

2018



Data centers

Active
Sweden: Piteå, Jokkmok, Luleå, Boden
Finland: Kajaani
Planned
Norway: Mo i Rana, Balangen
Sweden: Boden

The opening of the Arctic sea and operational Northern Sea Route create preconditions for northern subsea cables (see Figure 8.2). The growing business potential of the Arctic requires new subsea cable solutions to improve Arctic connectivity with the rest of the world. In the BIN area, the need for fast connectivity is driven especially by:

- Interest in the BIN area as an attractive place for opening data centres (see datacenters on the map) [8] running on low cost green energy, benefitting from cold climate and taxation incentives
- Offshore wind industry
- Mining
- Oil and gas industries
- Increased demands of local businesses in cloud computing services
- Tourism and transport industry connectivity needs
- BIN area being a frontrunner in 5G research [9]

In our analysis we investigate three BIN area related subsea cable initiatives originating in different countries and at different stages of completion. Attention is paid to how projects are organized and their sources of investment. As a benchmark we investigate two reference projects with potential impact on the BIN area. The main development and success drivers are identified.

8. There are datacenter initiatives at initial stage in North-West Russia that are not displayed on the map

9. The University of Oulu has a 5G Test Network https://5gtn.fi/

BIN area subsea fibre cable projects

Arctic Connect is a cooperative opportunity for PolarNet and Cinia Group Oy to relaunch Polar Net's Russian Optic Trans Arctic Submarine Cable System (Arctic Connect). The Russian Optical Trans-Arctic Submarine Cable System ("R.O.T.A.C.S.") is a Russian-led project that began in the year 2000 and was developed by PolarNet.

Midgårdsormen Norwegian-led project seeking to design, build and operate a Norway-centric transatlantic 7,500 kilometre cable system to connect Norway and Sweden to the East Coast of the United States. Specifically, Midgårdsormen proposes to connect Virginia Beach, Virginia to Blaabjerget, Denmark, with a possible connection to Mo i Rana, Norway.

NXTVN´S Oulu Nordic Express Europe proposes a cross-border, Nordic-centric, Gulf of Bothnia bridge connecting cities in the Nordic regions of Finland and Sweden to Norway with onward connections to mainland Europe via submarine and terrestrial networks. NXTVN specializes in Data Center Parks solutions.

Project name	Initiated by	Technology	Vol. of Investments	Source of investments	Expected completion date
Arctic Connect	Russia and Finland	A capacity of 100 Gbit/s. 6-8 fibrer pairs with PFE [10] station and off-shore branching units	Development costs $6mil, and total cost of the project is estimated to be around $700 mill	Equity – debt ratio is expected to be 50/50 percent; EIB, Asian Infrastructure Funds, private investors	Development phase 2017-2018/2019 Implementation phase 2019-2020
Midgårdsormen	Norway	6 or 8 fibre pairs	Total costs estimated at = 2,5 bill NOK ($322 mill)	Equity – debt ratio is expected to be 60/40 percent	Passed market analysis and vendor negotiations phases in 2017. Status: The project is on hold due to competing Havfrue Cable System that announced its plans in January 2018
NXTVN´S Oulu Nordic Express	Finland, NxtVn HQ is in Amsterdam	Subsea cable project at concept phase	Approximately $80 million dollars (depending upon the number of landings)	N/A	Acquired 31,000 square metres of ready-to-use buildings in Halli (Finland) for a data centre facility

10. PFE-power feeding equipment

Reference subsea fibre cable initiatives

For reference, we use two projects that are in the operational stage and that are likely to affect connectivity in the BIN area.

Quintillion brings high-speed Internet access to the North American Arctic through subsea cable. Quintillion is a private operator that contracts to sell capacity on a wholesale basis on its network.

Havfrue subsea cable will run through the North Atlantic connecting mainland Northern Europe to the USA. Optional branch extensions to northern and southern Norway are also included in the design. The first new transatlantic cable in almost two decades.

Project name	Initiated by	Technology	Vol. of Investments	Source of investments	Expected completion date
Quintillion	USA, HQ in Anchorage	9,500 - 9,700 miles subsea and terrestrial fibre optic network (1,400 mile segment completed 2017)	Not disclosed Estimates for predecessor Arctic Fiber $620 million in 2013	100% private investment, funded by U.S. private investment firm Cooper Investment Partners	Phase I (Alaska) completed 2017 Phase II Asia Phase III Canada - U.K
Havfrue	Consortium partners (US, Norway, Ireland)	a cross-sectional cable capacity of 108Tbps	N/A	Consortium of owner/operators including Aqua Comms, Bulk Infrastructure, Facebook, Google and others	Route survey operations for the system have begun and system ready-for-service (RFS) is expected in Q4 2019

The analysis served to identify the following success drivers of subsea cable projects:

- Secured finances
- Strong consortia
- Growing role of OTT players (over-the-top), e.g. Facebook, Google and Amazon as initiators of subsea cable investments

Challenges and findings

Recommendations

Overall, connectivity of the BIN area should be addressed at the government level, including the interests of different stakeholders such as communities, businesses and academia.

For Policy

- A Providing all households with access to internet with speeds over 30 Mb per second by 2020
- B Improving mobile broadband availability in the BIN area
- C Decreasing discrepancies in broadband affordability in the Russian BIN regions
- D Addressing the needs for increased connectivity by means of subsea cables connecting the BIN area with the USA and Asia
- E Addressing the needs for increased connectivity using the mix of technologies including satellite solutions

Business Index North (BIN) is a project that contributes to sustainable development and value creation in the Arctic. The overall goal is to set up a recurring, knowledge-based, systematic information tool for stakeholders. This is the second issue of the “Business Index North” analytical report that focuses on the BIN area, including ten northern regions of Norway (Finnmark, Troms, Nordland), Sweden (Norrbotten and Västerbotten), Finland (Lapland, Northern Ostrobothnia and Kainuu), and North-West Russia (Murmansk Region and Arkhangelsk Region without the Nenets Autonomous Okrug). For the third issue of the report we would like to include more territories of the Russian High North, as well as Alaska and the Northern territories of Canada.

The main implementing partner is the High North Center for Business and Governance at Nord University Business School. Nordland County Council and The Norwegian Ministry of Foreign Affairs provide basic funding for the BIN project.

www.businessindexnorth.com

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