5G COUNTRY PROFILE

ICELAND

Version 1.1

Acknowledgements: This country profile was developed by the ITU Office for Europe within the framework of the ITU Regional Initiative for Europe on broadband infrastructure, broadcasting and spectrum management. It was elaborated by ITU Office for Europe team including Mr. Iago Bojczuk, Junior Policy Analyst, and Mr. Julian McNeill, Consultant, under the supervision and direction of Mr. Jaroslaw Ponder, Head of ITU Office for Europe. Moreover, important feedback has been provided to this report by the Post and Telecom Administration (PTA) of Iceland. The country profile was prepared as the background contribution to the ITU Regional Forum for Europe on 5G strategies, policies and implementation.

Note: Version 1.1 of this document is an advanced draft for possible additional inputs, comments, feedback. The final version of the document is planned to be released after the ITU Regional Forum for Europe.

1. ICT background and current status of broadband

Iceland is one of the world's most advanced and mature markets when it comes to the infrastructure, diffusion, and use of ICTs. The government first recognized the potential of ICTs as early as 1996 in the "Icelandic Government's Vision of the Information Society" document[1]. Moreover, the development of ICT-related policies such as the 2008-2012 "Iceland the e-Nation" (2008-2012)[2], the "Telecom Policy Statement" (2011-2014)[3], and the "Electronic Communications Plan" (2011-2022)[4] played an important role in paving the way for a country with a solid and advanced fibre-optic network infrastructure as well as a strong focus on e-governance.[5] Largely thanks to its low corporate tax incentives, its highly skilled IT labour force[6] and its geographical position, Iceland has also become a connecting global hub for the operation of large international Data Centres[7] and an important location for international submarine cable systems.[8]

With a small domestic telecom sector, Iceland is known for having a competitive and highly progressive market when it comes to ICTs. Iceland has also considerably harmonized[9] its electronic communications environment to the laws and regulatory framework of the European Union.[10] In the 2017 ITU ICT Development Index (IDI), Iceland replaced South Korea and topped the rank out of other 176 countries,[11] exceeding the European and world averages on all key indicators.[12] However, there are still areas that are not covered by private operators and that lack broadband services, which gained rapid popularity in Iceland the early 2000s due to the early use of IPTV technologies. More recently, Iceland has also encountered a decrease in investment in the telecommunication sector, which fell 5.5% in 2019 in comparison to the previous year.[13]

The Electronic Communications Plan (2011-2022)[14] contains ambitious objectives on quality, access, distribution and security of electronic communications services. The main objectives concerning the access to electronic communications services are:

- 90% of homes and places of work will have the option of a 30 Mbps fixed connection by 2014 and 100% by 2022;
- 70% of homes and places of work will have the option of a 100 Mbps fixed connection by 2014 and 99% by 2022;

[1] See: https://www.stjornarradid.is/efst-a-baugi/frettir/stok-frett/1996/10/01/Vision-of-the-Information-Society/
[2] See: https://www.government.is/media/forsaetisraduneyti-media/media/utgefidefni/Iceland_the_eNation.pdf
[3] See: https://www.broadbandcommission.org/Documents/ITU_BroadbandPlans_2019.pdf
[4] See: https://www.broadbandcommission.org/Documents/ITU_BroadbandPlans_2019.pdf
[5] See: https://www.researchgate.net/publication/256666996_Case_studies_on_e-participation_policy_Sweden_Estonia_and_Iceland
[6] See: https://www.iceland.is/trade-invest/ict#:~:text=Strong%20infrastructure%20for%20ICT&text=Icelanders%20have%20a%20solution%2Dfocused,in%20Europe%20and%20%234%20Worldwide.
[7] See: https://www.landsvirkjun.com/Media/international-data-connectivity-in-iceland-a-white-paper.pdf
[8] See: https://www.submarinecablemap.com/#/country/iceland
[9] See: https://www.pfs.is/library/Skrar/English/About-PTA/PTA_Annual_Report_2012_En_HIGHRES.pdf
[10] See: https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/pdf/key_documents/2012/package/is_rapport_2012_en.pdf
[11] See: https://www.itu.int/net4/ITU-D/idi/2017/index.html
[12] See: https://www.itu.int/en/ITU-D/Statistics/Documents/publications/misr2017/MISR2017_Volume2.pdf
[13] See: https://www.pfs.is/library/Skrar/Tolfraedi/Tolfraediskyrslur-PFS/T%c3%b6lfr%c3%a6%c3%b0isk%c3%bdrsla_%20PFS_2017_2019_me%c3%b0%20fors%c3%ad%c3%b0umynd.pdf
[14] See: https://www.althingi.is/altext/141/s/0593.html

- 98% of homes and places of work will have the option of high-speed mobile networks by 2014 and 99.9% by 2022;
- 80% of the country and the coastal waters will have the option of a high-speed mobile network in 2018.

Moreover, the government's approach has been to focus on strengthening the country's fibre-optic backbone network and also supporting fibre-optic cable-laying in rural areas—where distances are such that other technology cannot provide 100 Mb/s on a fixed network. The document also detailed a strong focus on mobile broadband services (4G/LTE), support to private stakeholders, networking sharing, the preservation and maintenance of the ever-growing maintenance of infrastructures, and a strong collaboration between telecom operators and municipalities as well as the federal government and other stakeholders.[15]

To achieve the above-mentioned targets, the government also approved a "Four-year electronic communications plan for the years 2011–2014"[16] which sets objectives for:

- accessible and easy communication;
- cost-effective and efficient communication;
- secure communications;
- environmentally friendly telecommunications.

Since 2016, government-led efforts have been in place to lay fibre-optical cables in Iceland's rural areas. For example, Iceland's Rural Fibre Project (Icel. *Ísland ljóstengt*)[17] is a short-term Government initiative to bring ≥100 Mb/s wired internet to 99.9% of households and businesses nationwide by year-end 2020, thereby accelerating the achievement of the objectives the Electronic Communications Plan (2011-2022) released in 2010. This project is overseen by the government-led Telecommunications Fund and originally included roughly 5,500 household and business[18], and has a strong emphasis on cost efficiency, synergies with other infrastructural projects, and cooperation with operators as much as possible.[19]

2. Broadband and mobile telecommunication sectors data

ITU data shows that 99.01% of individuals had access to the Internet in 2018.[20] In 2010, the ITU data for the country was 93.39% and in 2000 44.47%. In 2019, the number of fixed-broadband subscriptions per 100 inhabitants was 40.78.[21] xDSL use peaked in 2008 at 98% of connections and has been in constant decrease since 2013 as connections are being replaced by fibre, which corresponded to 62.8% of all

[15] See: https://www.pfs.is/library/Skrar/English/About-PTA/PTA_Annual_Report_2012_En_HIGHRES.pdf
[16] See: https://www.althingi.is/altext/141/s/0592.html
[17] See: https://www.stjornarradid.is/verkefni/samgongur-og-fjarskipti/island-ljostengt/
[18] See: https://joinup.ec.europa.eu/collection/egovernment/news/rural-fibre-100-mbs
[19] See: https://www.government.is/topics/transport-and-telecommunications/icelands-rural-fibre-project/#:~:text=The%20Iceland's%20Rural%20Fibre%20Project,nationwide%20by%20year%2Dend%202020.
[20] See: https://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2019/Individuals_Internet_2000-2018_Dec2019.xls
[21] See: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicator "i992b")

Internet connection in Iceland in 2019.[22] Due to the high penetration of FTTH access throughout the country, Internet average speeds in Iceland are faster when compared to most countries in Europe, with only 0.3% of connections registering a speed average below 10 Mbps.[23] As of 2019, about 75% of premises have Fibre-to-the-Home (FTTH)[24] access with all of the City of Reykjavik and towns areas connected through Gagnaveita Reykjavíkur's (GR) full fibre-network.[25] 54.8% of Internet subscribers benefited from more than 500 Mbps in 2019, while only 4.4% had average speed lower than 30 Mbps. Fibre-to-the-Premisses (FTTP) access has also been steadily growing, offering services to business, government, and other organizations.[26] From the regional perspective, Europe's average fixed-broadband basket cost was 1.5 per cent of the GNI per capita in 2019, while Iceland's corresponded to 1.6 per cent for a 50 GB cap per month in 2017.[27]

In 2019, the number of active mobile network subscriptions per 100 inhabitants was of 121.95.[28] Moreover, the, the number of active mobile-broadband subscriptions per 100 inhabitants was 128.63 in the same year.[29] There are four major mobile network operators (MNOs) that dominate the market in Iceland: Síminn (formerly Landssíminn), Nova, and Vodafone (Formerly Og Vodafone, Íslandssími). The country's mobile-data basket cost corresponded to 0.5 per cent of the GNI per capita in 2017 for a monthly allowance of 5.0 Gb, while the European region's average was 0.8 per cent in 2019.[30] Over the past years, significant investment has been made in extending 4G infrastructure, and the major operators now provide 4G services to 98.90% of the population in the country,[31] above Europe region average of 97.58%, though 2G and 3G are still being used by a small percentage of the population.[32] Domestic mobile data traffic for 2019 stands at 0.05 exabytes per year, more than a 20% increase on a yearly basis.[33]

3. Current progress on 5G: consultations and national strategies

In May 2018, Iceland signed a declaration of intent for a cooperation on 5G with other Nordic countries within the framework of the Nordic Council of Ministers.[34] In addition to accelerating the development of 5G, this declaration outlines the collective vision for the Nordic region becoming the first interconnected 5G region in the world and identifies areas in which Nordic cooperation needs to be strengthened. The document also acknowledges the deployment of 5G will require substantial investments as well an appropriate regulatory framework both in national contexts as well as in forging a common Nordic 5G

[22] See: https://www.pfs.is/library/Skrar/Tolfraedi/Tolfraediskyrslur-PFS/T%c3%b6lfr%c3%a6%c3%b0isk%c3%bdrsla_%20PFS_2017_2019_me%c3%b0%20fors%c3%ad%c3%b0umynd.pdf
[23] See: https://www.pfs.is/library/Skrar/Tolfraedi/Tolfraediskyrslur-PFS/T%C3%B6lfr%C3%A6%C3%B0isk%C3%BDrsla_%202018_me%C3%B0Fors%C3%AD%C3%B0u.pdf
[24] See: https://genexis.eu/news/iceland-number-one-country-worldwide-in-homes-connected-to-fiber/
[25] See: https://www.ljosleidarinn.is/gagnaveita-reykjavikur
[26] See: http://www.reykjavikfibrenetwork.is/smart-communities
[27] See: https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU_ICTpriceTrends_2019.pdf
[28] See: https://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2019/Mobile_cellular_2000-2018_Dec2019.xls
[29] See: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicators "i911")
[30] See: https://www.itu.int/en/ITU-D/Statistics/Documents/publications/prices2019/ITU_ICTpriceTrends_2019.pdf
[31] See: ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicator "i911mw")
[32] See: https://www.pfs.is/library/Skrar/Tolfraedi/Tolfraediskyrslur-PFS/T%c3%b6lfr%c3%a6%c3%b0isk%c3%bdrsla_%20PFS_2017_2019_me%c3%b0%20fors%c3%ad%c3%b0umynd.pdf
[33] ITU World Telecommunication/ICT Indicators Database online (2020): http://handle.itu.int/11.1002/pub/81550f97-en (indicator "i136mwi")
[34] See: https://ec.europa.eu/digital-single-market/en/news/nordic-countries-sign-letter-intent-be-forefront-5g-development

space.[35] This agreement is also aligned with other Nordic areas of cooperation dealing with the adoption of IoT and other emerging technologies such as the Nordic Smart City Network,[36] which helps governments create best practices for smart city projects and urban development.[37]

To achieve this goal, in June 2018 Iceland agreed to cooperate closely with other Nordic countries to set up a common action plan for early adoption of 5G technology across the Nordic region. The action plan will:[38,39]

- Encourage the development of new testing facilities, including testbeds;
- Ensure the technical coordination of 5G frequency bands within the region;
- Remove obstacles to the expansion of 5G network, in particular, the deployment of base stations and antennas; and
- Encourage and monitor the development of 5G, specifically for certain sectors such as transport, mission-critical communications, and advanced automation in the manufacturing industry, and the energy sector.

Developments will be monitored and followed up by the Nordic Council of Ministers, facilitating implementation in cooperation with the Nordic governments, national telecommunication and digital regulatory bodies, and stakeholders from the ICT and telecom industries.[40]

The 5G Action Plan 2018-2020[41] was released in late October 2018 establishing 23 deliverables grouped under the following policy goals:

- Encourage the development of new testing facilities, including test beds;
- Ensure the technical coordination of 5G frequency bands within the region;
- Remove obstacles to expansion of the 5G network, in particular deployment of base stations and antennas;
- Encourage and monitor the development of 5G, specifically for certain sectors including transport, critical communications, manufacturing, energy and the environment, health and welfare, stakeholder dialogue on 5G application.

Nordic telecoms companies in support of the region include Ericsson, Nokia, Iceland Telecom, TDC Group, Telenor Group, Tele2 Group, Telia Company and Vodafone Iceland. Representatives of these operators issued a statement welcoming the new deal between the countries and expressed their visions for

[35] See: https://www.government.se/press-releases/2018/05/new-nordic-cooperation-on-5g/
[36] See: https://nscn.eu/
[37] See: https://aithority.com/news/nordic-enterprises-see-5g-networking-as-boost-for-internet-of-things/
[38] See: https://www.government.se/49b8be/globalassets/government/dokument/statsradsberedningen/letter-of-intent--development-of-5g-in-the-nordic-region-.pdf
[39] See: https://techblog.comsoc.org/2018/06/06/5-nordic-countries-agree-to-accelerate-5g/
[40] See: https://www.government.se/49b8be/globalassets/government/dokument/statsradsberedningen/letter-of-intent--development-of-5g-in-the-nordic-region-.pdf
[41] See: http://norden.diva-portal.org/smash/get/diva2:1259977/FULLTEXT01.pdf

appropriate spectrum assignment rules and the removal of the obstacles around the deployment of 5G infrastructure.[42]

Aside from the recent 5G spectrum allocation, cooperation with other Nordic countries, and work on 5G-related EMF concerns, Iceland does not have a national strategy document on 5G as of October 2020.[43]

4. Spectrum assignment for 5G & market development

The current generations of mobile network transmitters in Iceland (GSM, 3G and 4G) use frequencies between 700 MHz - 2.6 GHz.[44] In April 2020, Iceland's Post and Telecom Administration (PTA) allocated 5G frequency licenses in the 3.6 GHz frequency band to Síminn[45], Nova[46], and Syn (Vodafone Iceland) [47], which are MNOs that are already operating 4G networks. The spectrum in the 3.6 GHz band is allocated as follows:[48]

- Siminn: block B3600 (3500MHz-3600MHz);
- Nova: block C3600 (3600MHz-3700MHz);
- Vodafone Iceland (Syn): block D3600 (3700MHz-3800MHz).

In the frequency authorization for these MNOs, it is stated that thee 3.6 GHz frequency band shall be used for high-speed mobile network through technology neutrality. The service shall be in accordance with the standards and definitions set out in the data from ETSI, 3GPP and current conditions from CEPT (e.g. ECC Decision (11) 06).[49] Due to the uncertainties concerning the various ways in which 5G can develop in the country and worldwide and its impact on communication law, the licenses are valid only through the end of 2021. Future amendments in terms around the legislation as well as spectrum assignment may occur.

Through the license, PTA informs that frequencies at 3.6 GHz, as well as other and other higher frequency (e.g. 24.25 - 27.5 GHz bands), are yet to be allocated and likely to be the mainstay for 5G in Iceland. With that, the regulator expects that 5G will be implemented in different stages, with the first being intended to support normal technological upgrades and the capacity of existing high-speed mobile networks in the companies' operations. Allocation of higher 5G frequencies will also include the development of IoT and other secure high-speed mobile network services, as well as cloud services, data centres and other technologies such as artificial intelligence.

Radio frequencies are expected to be used efficiently and the PTA has defined certain requirements for

[42] See: https://www.siliconrepublic.com/comms/nordic-5g-deal-partnership
[43] See: https://www.pfs.is/fjarskipti/5g-a-islandi/
[44] See: https://gr.is/fraedsluefni_um_5g/
[45] See: https://www.pfs.is/library/Skrar/Skraningar-og-leyfi/Tidniheimildir/T%c3%ad%c3%b0niheimild%20S%c3%admans%20%c3%a1%2036%20GHz.pdf
[46] See: https://www.pfs.is/library/Skrar/Skraningar-og-leyfi/Tidniheimildir/T%c3%ad%c3%b0niheimild%20Nova%20%c3%a1%2036%20GHz.pdf
[47] See: https://www.pfs.is/library/Skrar/Skraningar-og-leyfi/Tidniheimildir/T%c3%ad%c3%b0niheimild%20S%c3%bdn%20%c3%a1%2036%20GHz.pdf
[48] See: https://www.commsupdate.com/articles/2020/05/01/pta-awards-5g-spectrum-in-3-6ghz-band-until-december-2021/
[49] See: https://docdb.cept.org/download/34f57e2a-1c04/ECCDEC1106.PDF

network development for each MNO, with the intention of improving service dissemination. Each license receives a general and a special requirement detailing a percentage of the population to be covered (25% each) alongside a list of 30 mobile sites across the country where 5G network shall be built with the average speed goal of 200 Mbps to be reached by December 31, 2021. In particular, Síminn is required to provide 5G services with a minimum downlink of 200Mbps to 90% of the population in Blonduos, Thorlakshofn and Egilsstadir; Nova has the same requirement for Hellu, Sandgerdi and Vestmannaeyjum; and Vodafone Iceland has it for Hvolsvelli, Siglufirdi and Grindavik.[50]

The renewal of the frequency authorizations for the MNOs will depend on whether they have used the frequencies effectively in accordance with the relevant PTA criteria. With the renewal of the 5G frequency licenses, it can be expected that the data transfer speed will be increased, and more urban areas will be added to the group of those who will have access to 5G services in the future.[51]

5. Electromagnetic fields levels and the implementation dynamics

In 2002, a new government act on radiation protected added non-ionizing radiation to the tasks of the Icelandic Radiation Safety Authority (IRSA).[52] For work-related situations, protection measures dealing with the effects of non-ionizing radiation are subject to an Act on Working Environment, and Health and Safety in the Workplace and fall under the auspices of the Administration of Occupation Safety and Health in Iceland (AOSH). Both of the above-mentioned authorities refer to the ICNIRP Guidelines and no national deviation from these are expected.

IRSA And PTA established a collaborative project in parallel with the introduction of 5G. The project involves monitoring the development of 5G technology in Iceland as well as various measurements. IRSA is closely monitoring the development of 5G issues around the world, including the active participation in co-operation between the Nordic Radiation Protection Institutions and international cooperation with the World Health Organization (WHO). In order to keep the Icelandic public informed of the recent developments, IRSA monitors information from reliable sources such as WHO, ICNIRP, IARC, and SCENIHR on health risks due to EMF and publishes it on its website. More specifically, several recent informative notes on 5G and EMF have been published supporting the ICNIRP guidelines (both the 1988 and most recent versions),[53] highlighting the limit value for the intensity of the electromagnetic field in the frequency range 100 kHz - 300 GHz limits.

In the spectrum allocation approved by PTA in April 2020, Article 9 stipulates the conditions to radiation and environment for MNOs using the 3.6 GHz band. The document establishes that the MNO shall ensure that the electromagnetic radiation from their equipment is within the limits specified in the ICNIRP guidelines for EMF or in accordance with criteria that are in Icelandic rules and laws. Moreover, the MNO

[50] See: https://www.commsupdate.com/articles/2020/05/01/pta-awards-5g-spectrum-in-3-6ghz-band-until-december-2021/
[51] See: https://www.pfs.is/?PageId=3a034dad-e97b-11e2-b5a5-005056864800&newsid=4b565d0a-8ae5-11ea-945d-005056bc2afe
[52] See: https://gr.is/
[53] See: https://gr.is/5g-og-heilsa-spurt-og-svarad-a-vef-who/

shall ensure that the installation and use of the MNO's equipment shall be in accordance with the recommendation from the International Telecommunication Union (ITU-K.52).[54]

If it is found that electromagnetic radiation from electronic communications installations exceeds the specified limit values are in ICNRIP recommendations, rules or relevant Icelandic standards, the frequency holder shall make amendments without delay or otherwise discontinue use of the relevant electronic communications infrastructure. If the combined electromagnetic radiation from electronic communications installations located close to each other passes limit, without any individual equipment exceeding the limit, the frequency holder shall replace the equipment while ensuring that the public does not have access to the area or stop using it.[55]

6. 5G commercial launches: announcements, trail cities, and digital cross-border corridors

In February 2019, after receiving authorization from the Post and Telecom Administration, Nova announced it started 5G tests by launching the first 5G transmitter in Iceland, which was manufactured by Huawei. Through a Memorandum of Understanding signed in the same month, the two parties also announced their intention of extending the cooperation on 5G technology to realize the best telecommunications network in Iceland in terms of radio coverage, stability and bandwidth to ensure the reliable service quality and the enhanced experience.[56]

Within the framework of the Memorandum, Huawei installed 5G base stations and routers at Nova's facilities and will be supplying 200 sites of 5G Massive MIMO technology. The agreement states that Huawei will be responsible for planning, design, rollout, and optimization to ensure the overall network quality and user experience. It will supply approximately 2000 units of 5G CPE (Customer-Premises Equipment). [57] Nova was also the first operator to deploy 3G in 2006, 4G in 2013, and 4.5G in 2017.[58] In 2018 and 2019, Nova invested around a billion krónur (6.2 million EUR) per year in the development of its network.[59] On May 5, Nova commercially launched the first 5G network in Iceland and are to date providing 5G service in Reykjavik, Hella, Sandgerdi and Vestmannaeyjar.

In May 2019, Siminn (Iceland Telecom), which has the largest market share of data subscriptions in Iceland, and Ericsson have signed an agreement for the modernisation of the operator's radio access and core networks by deploying Ericsson Cloud Packet Core portfolio upgrades to support the transition from 4G to 5G in Iceland. Enabled by Ericsson 5G New Radio and Ericsson Spectrum Sharing, the two companies plan to conduct 5G trials.

[54] See: https://www.pfs.is/library/Skrar/Skraningar-og-leyfi/Tidniheimildir/T%c3%ad%c3%b0niheimild%20S%c3%admans%20%c3%a1%2036%20GHz.pdf
[55] See: https://www.pfs.is/library/Skrar/Skraningar-og-leyfi/Tidniheimildir/T%c3%ad%c3%b0niheimild%20S%c3%admans%20%c3%a1%2036%20GHz.pdf
[56] See: https://www.telecomlead.com/mwc/huawei-signs-5g-agreements-with-viva-bahrain-and-nova-iceland-89363
[57] See: https://www.huawei.com/en/news/2019/2/huawei-icelandic-operator-nova-agreement-5g-testing
[58] See: https://www.nova.is/dansgolfid/5g-i-loftid-hja-nova
[59] See: https://www.ruv.is/frett/5g-comes-to-iceland

Furthermore, the agreement also aims to accelerate the growth of the Internet of Things ecosystem (IoT) across Iceland's commercial sectors through Narrowband IoT (NB-IoT) and Category M1 (Cat-M1).[60] Accordingly, the Siminn-Ericsson agreement includes geo-redundant Ericsson Network Functions Virtualisation Infrastructure operated on Ericsson's Blade Server Platform with Ericsson Virtual User Data Consolidation, and Ericsson Fast VoLTE. Ericsson Fast VoLTE enables HD voice services with simultaneous LTE-speed surfing, which is likely to pave the way for more advanced communication services.[61]

In September 2020, Vodafone Iceland activated its first 5G transmitter with the intention of building a 5G network in the capital area over the next 2 years.[62]

[60] See: https://operatorwatch.3g4g.co.uk/2020/02/
[61] See: https://www.ericsson.com/en/news/2019/5/5g-and-massive-iot-in-iceland
[62] See: https://vodafone.is/5g/?childTab=0&question=question-2