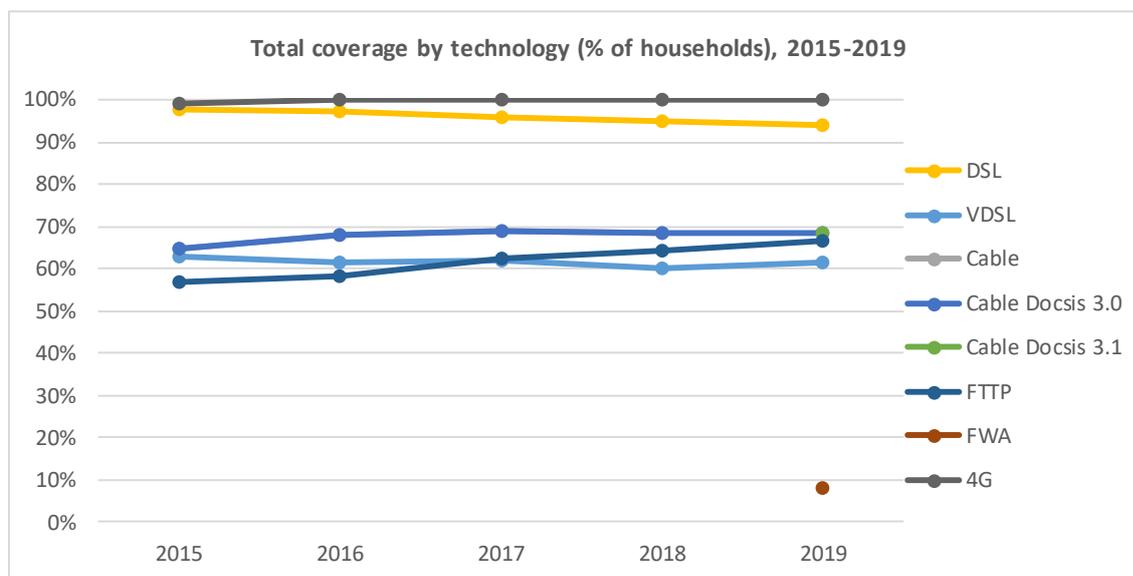
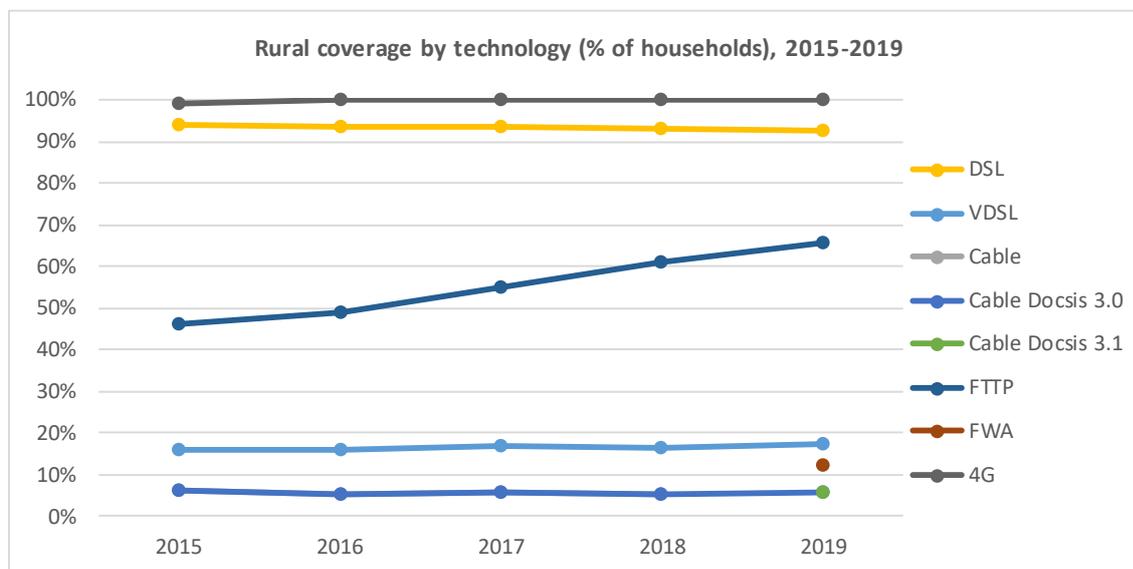


Denmark



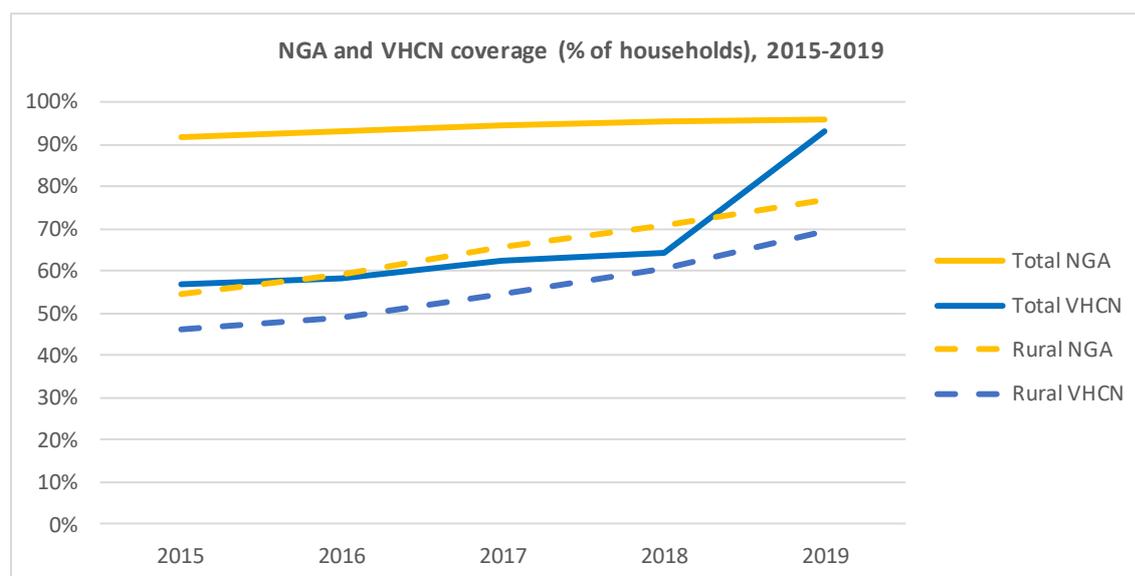
Source IHS and Point Topic, *Broadband coverage in Europe studies*

Denmark has among the best 4G and digital subscriber line (DSL) total coverage in the EU, at 100% and 94% of households respectively. As fibre roll-out continues, fibre-to-the premises (FTTP) coverage has reached 67%.



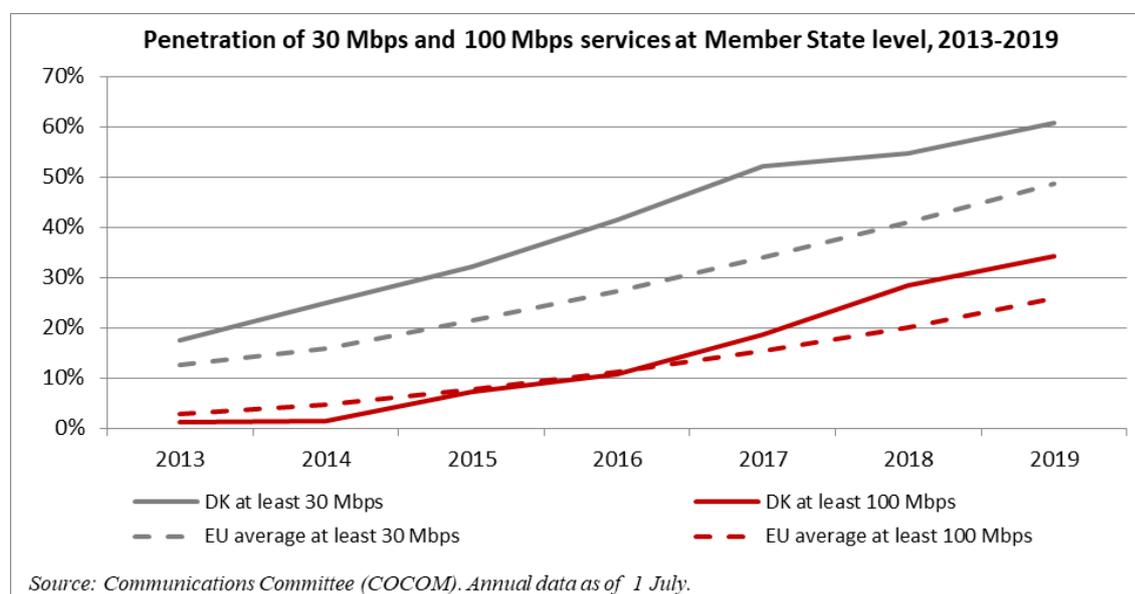
Source IHS and Point Topic, *Broadband coverage in Europe studies*

Rural FTTP coverage has improved significantly, and with 66% coverage there is almost no difference with overall coverage. Also in DSL coverage, the difference between the total coverage of 94% and rural coverage of 92% is only very small. As coverage for both cable (6%) and very high speed digital subscriber line (17%) is low in rural areas, rural fibre roll-out will play a crucial role in closing the small remaining rural-urban divide.



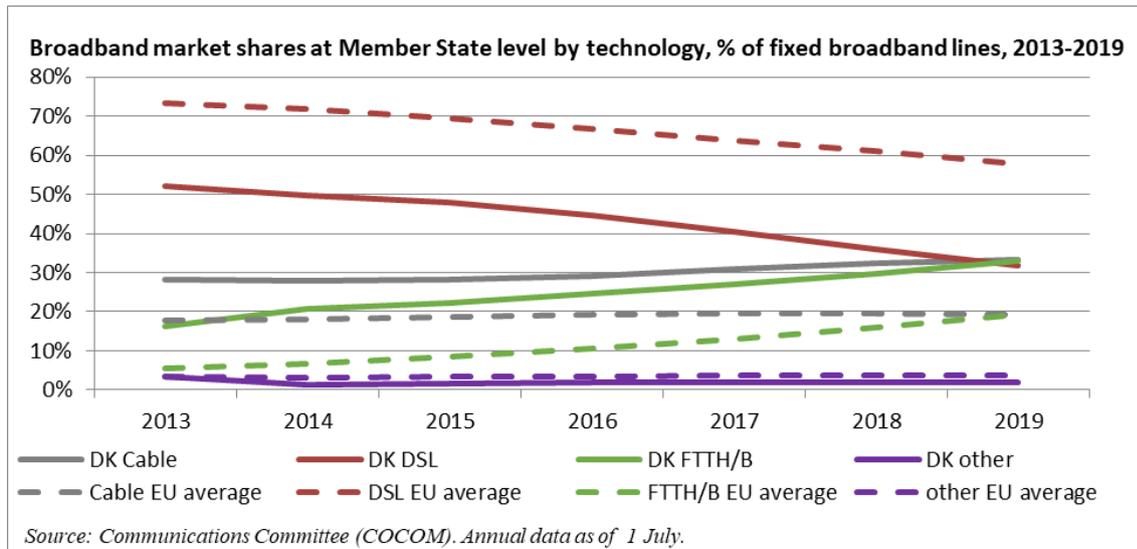
Source IHS and Point Topic, *Broadband coverage in Europe studies*

Total fast broadband next generation access (NGA) coverage is at a very high level (96% of households), compared to the EU average of 86%. Rural NGA coverage has continued to increase significantly, rising by 6 percentage points in 2019 to a level of 77%, significantly above the EU level of 59%. Fixed very high capacity network (VHCN) coverage - including FTTP and DOCSIS 3.1 - is also very high (93% total and 69% rural, compared with EU averages of 44% total and 20% rural). As VHCN figures for 2019 include DOCSIS 3.1 for the first time, they are not directly comparable to figures for previous years.

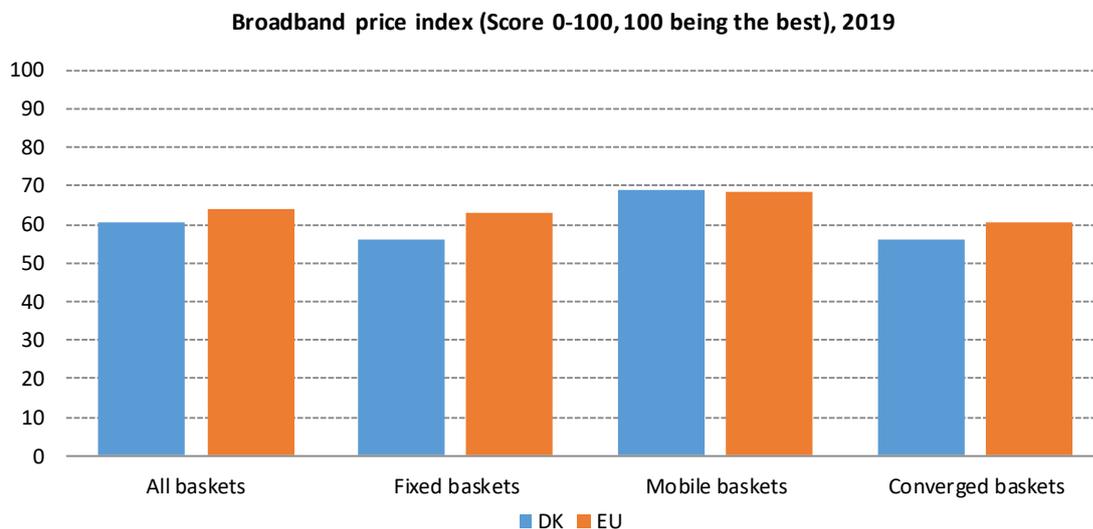


Source: Communications Committee (COCOM). Annual data as of 1 July.

Broadband take-up for households at 1 July 2019, both for capacities of at least 30 Mbps and for capacities of at least 100 Mbps continues to increase and is well above the EU average (61% compared to an EU average of 49% for at least 30 Mbps; 34% versus an EU average of 26% for capacities of at least 100 Mbps). In 2019, there were 139 subscriptions to mobile broadband services per 100 people, against an EU average of 100. The high digitalisation of Danish society and the low price level are contributing factors to the high take-up of broadband. The main drivers of demand for high-speed access, including in rural areas, are video-based services and potentially in the future also smart society solutions, supported by facilities such as sensors.



In terms of broadband market shares, DSL, cable and fibre are now on a par, with both cable and fibre significantly above the EU average and DSL significantly below.



Source Commission services based on Empirica (Retail broadband prices studies)

Price index levels (taking account of purchasing power parity) for broadband access (both mobile and fixed) are (slightly) higher than the EU average, in particular for fixed baskets and for converged baskets. Converged baskets include fixed and mobile calls, fixed and mobile data and TV. Prices for mobile baskets are slightly below the EU average.

1. Progress towards a Gigabit Society¹

The national broadband target for 2020 is for all households and businesses to have coverage with speeds of minimum 100 Mbps download / 30 Mbps upload. By 2019, this had been achieved for 93% of all households and businesses. Work on a new broadband strategy started in early 2020, and focusses mainly on rolling-out fast broadband to the remaining 7% of households and businesses and preparing Denmark for the internet services of the future. The investment climate in Denmark has

¹ It is noted that statements regarding planned or potential State aid measures record intentions declared by Member States and do not pre-judge or pre-empt the assessment of such measures by the Commission under the relevant state aid rules. The DESI report is not meant to provide any assessment of the compliance of such measures with state aid rules and procedures.

improved, with actual investment both in fibre and 5G increasing and more being announced. Fibre roll-out by (regional) energy utilities (typically owned by their users) continues, with the aim of first connecting all co-owners and then entire regions. One consortium alone has announced investment of an additional DKK 4.6 billion (€0.62 billion) in fibre between 2019 and 2023. The incumbent telecoms operator, TDC Group, increased its investment budget in 2019 from DKK 3.5 billion to DKK 4.5 billion (€0.47 billion to €0.6 billion) and announced an ambitious investment programme for its network company (TDC NET) to connect one million addresses to fibre by 2025. The current roll-out of fibre and the roll-out plans of the utilities mean that there will be overlap, so a number of households will have the choice between different fibre infrastructures.

5G roll-out starts with installation of macro cells on existing sites, and will then be extended to 10-15% more sites. Small cell roll-out is not part of the current schedule. By the end of 2020 TDC NET is expected to have rolled out a nationwide 5G network.

In general, Denmark has a good coverage with high-speed broadband, also in rural areas. However, there are still white spots with poor coverage. Most of these white spots are in the rural areas.

The national regulatory authority responsible for this, the Danish Energy Agency (DEA) expects most postal addresses in Denmark to receive access to very high-speed broadband through commercial rollout. Some white spots (notably in rural areas) may remain, at least within the foreseeable future. The National Broadband Fund, which was established in 2016, and has been more strictly focused on less populated areas since 2018, offers grants for rolling-out broadband with at least 100/30 Mbps in areas which only have access to maximum 10/2 Mbps. For 2019 the fund had a volume of DKK 100 million (€13.5 million). In 2020, the DEA is planning a state aid scheme, establishing a more concise framework for financial grants from municipalities to support the local roll-out of digital infrastructure.

As part of ensuring that only addresses with maximum 10/2 Mbps are funded the DEA collects information in order to provide very detailed mapping of broadband coverage (at postal address level). As collecting these data may require significant resources on the side of the operators, the DEA has introduced processes to reduce the data collections and thereby reducing the administrative burden that such a detailed mapping creates. Furthermore, some operators consider the open access requirements as an administrative burden preventing them from participating in funding projects, in particular where projects are small (50-100 addresses, or fewer). In the parts of Denmark covered by such operators it is therefore more difficult to use state aid to ensure coverage for white spots.

The DEA published the 5G action plan for Denmark in February 2019. It focuses on four topics (frequencies, roll-out, use cases and regulation) and presents a series of measures to increase demand for 5G, facilitate network roll-out and access to spectrum by 2020, and ensure that Denmark ranks amongst the countries that make the best use of 5G technology. A DEA workshop in October 2019 explored how companies can make use of 5G networks, focussing on concrete use cases. A similar workshop addressing the public sector is planned for 2020. Collaboration projects between industry, business organisations and the public sector aim at identifying and testing 5G use cases. This is in addition to TDC's and Telia's own tests and demonstrations. Trial spectrum licenses can now be obtained for 600 DKK (81 €) under criteria set out by DEA. A 5G award was presented on 23 October 2019 calling for projects and pioneering examples showing how 5G can help remove barriers in society, increase welfare and fight climate change.

TDC announced plans to roll out 5G nationwide by the end of 2020. Telenor and Telia have already activated several 5G sites.

To enable further network roll-out, it is important for industry to have the necessary contracts with landowners for the use of existing and new sites, and the aim is to have contracts with full flexibility regarding technology. Using street furniture will also be important. Many Danish municipalities see 5G as an opportunity.

2. Market developments

In the course of 2019, TDC completed the separation (functionally and legally), into TDC NET and a retail company (Nuuday). Both companies are 100% owned by TDC group which handles some central activities including strategy, communication, HR, public affairs and legal affairs. The investors (50% Macquarie and 50% Danish pension funds) are interested in keeping the TDC NET, as its assets are considered to be long-term and low-risk. TDC's revenues are concentrated in retail, whereas investment is concentrated in the network. TDC still has the largest market share in fixed telephony (56%), mobile telephony (39%) and broadband connections (52%).

2.1. Fixed markets

A new operator, Fastspeed entered the Danish broadband market as a new service provider on TDC's coaxial network in May 2019 and reported 10,000 broadband customers in October 2019 and 20,000 in January 2020². Two of the largest (energy) utility companies, South Energy and Eniig, have merged after receiving clearance from the Danish Competition Authority in June 2019. The merged company Norlys provides more than 40 % of Danish households with fibre or coaxial networks.

Norlys runs the wholesale platform OpenNet, on which a limited number of wholesale fibre access agreements are executed, including one giving TDC access to parts of Norlys' fibre network. Further agreements have been concluded on the platform but are not actively used so far. Market shares have not shown significant changes since last year except from Norlys now being the second biggest actor on the fixed broadband market with a market share of 19 % at the end of 2019. Fixed voice subscriptions (VoIP, PSTN and ISDN) continue to decrease. From mid 2018 to mid 2019 the number of fixed subscriptions fell by 11% to approx. 900,000. Fixed internet usage (up- and download) has increased from 2,968,000 Terabyte (TB) in the second half of 2018 to 3,580,588 TB in mid 2019 (plus 21%). It is 7.4 times higher than data traffic in mobile networks.

2.2. Mobile markets

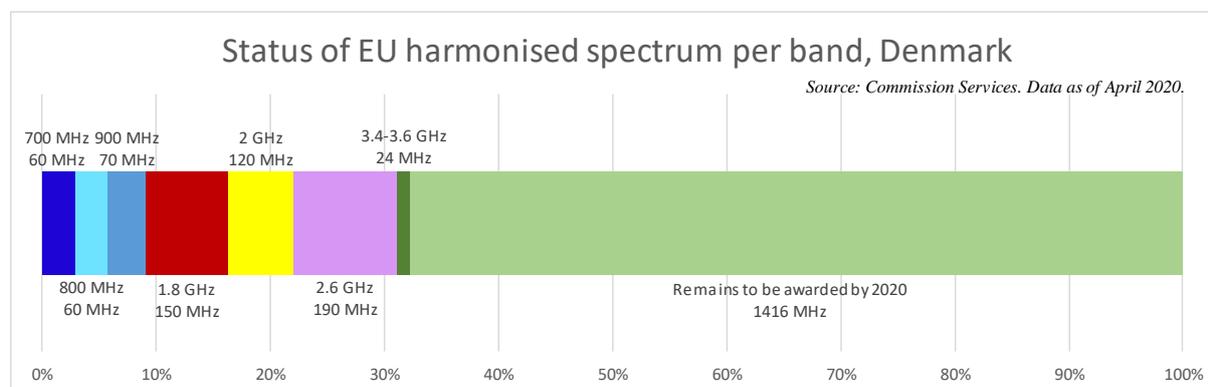
According to the DEA, most mobile subscriptions are sold as bundles with call minutes, SMS, MMS and data allowances included in a single tariff. The wide range of different plans/bundles offered in the past has narrowed. According to the DEA, each operator typically offers three to six plans/bundles with different volumes and prices. Bundles including OTT services like film and music streaming services and bundles with unlimited minutes, SMS/MMS and data are still offered. OTT services generate significant traffic in the mobile networks. OTT services such as Netflix, Spotify, TV2 Play, Viasat and HBO generate substantial revenues, to which a few operators react by including third party OTT services in their service offerings or in some cases equivalent own services. In one year, data traffic volumes have increased by 31.1%, reaching 484,000 TB in mid-2019. The data growth rate in the mobile network is 11% higher than in the fixed network. Mobile call volumes (calls originated) have increased by 6.9% to 7.8 billion minutes in the second half of 2019. However, SMS services continue to decrease slightly. From the second half of 2018 to the second half of 2019, SMS services fell by 1.6%, from 2.74 billion to 2.69 billion units.

² The announced goal is to have 40,000 broadband customers by end 2020.

The network sharing agreement between Telenor and Telia has been in place since 2012 and covers the companies' radio access networks (2G, 3G and 4G). In February 2019, Hi3G entered into a commercial agreement with TDC on national roaming covering mobile voice and mobile data on 2G, 3G and 4G.

3. Regulatory developments

3.1. Spectrum assignment



Denmark ranks 4th in the 5G readiness indicator³. It has assigned 32%⁴ of the total 2090 MHz spectrum harmonised at EU level for wireless broadband.

The roll-out of 5G has started with the installation of macro cells on existing sites, and is due to be extended to 10-15% more sites. Small cell roll-out is not part of the current schedule. The 700 MHz, 900 MHz and 2300-2400 MHz bands were auctioned in March 2019. All Danish operators, TDC, Hi3G and TT-Netvaerket, were awarded spectrum, raising a total of €296 million. The 700 MHz and 900 MHz licences are valid from April 2020, while the 2300-2400 MHz band licenses are valid from April 2019. The next 5G spectrum auction is planned for the fourth quarter of 2020 and will include the 1.5 GHz, 2.1 GHz, 3.5 GHz, 26 GHz bands and the remaining part of the 2.3 GHz band. This will be an important auction since it will include the last wireless broadband spectrum bands to be made available for the next 8 years.

3.2. Regulated access (both asymmetric and symmetric)

TDC has not yet contacted the Danish Business Authority as to the regulatory treatment of a wholesale-only company. Opening up utilities' fibre network has been discussed for years but it now seems like a growing number of utilities are moving forward by announcing dates for when they expect to open up for access. Market analysis for wholesale broadband (market 3 of the 2014 recommendation on relevant markets) is planned to be conducted during 2020. As a first step, geographically specified submarkets – instead of a national market defined today – are suggested in order to assess the situation of regional players.

Effective from 1 April 2019, TDC's wholesale prices for services on the fixed network had been revised, due to minor errors in the long-run average incremental cost model. In 2020 it is planned to analyse

³ The 5G spectrum readiness indicator is based on the amount of spectrum already assigned and available for 5G use by 2020 within the 5G pioneer bands in each EU Member State. For the 3.4-3.8 GHz band, this means that only licences aligned with the technical conditions in the Annex to Commission Decision (EU) 2019/235, are considered 5G-ready. For the 26 GHz band, only assignments aligned with the technical conditions in the Annex to Commission Implementing Decision (EU) 2019/784 are taken into account. By contrast, the percentage of harmonised spectrum takes into account all assignments in all harmonised bands for electronic communications services (including 5G pioneer bands), even if this does not meet the conditions of the 5G readiness indicator.

⁴ This figure does not take into account an assignment of 20 MHz of supplementary downlink spectrum in the 700 MHz band.

the wholesale markets for fixed and mobile voice call termination, wholesale local access provided at a fixed location/physical network infrastructure access and wholesale central access for mass-market products provided at a fixed location/wholesale broadband access (markets 1, 2, 3a and 3b of the 2014 recommendation on relevant markets).

4. End-user matters

a. Complaints

Consumers complained increasingly about issues when roaming outside the European Economic Area. Marketing promises like 'livelong/forever prices' were challenged in court and the verdicts found that such prices would be applicable for a period of 3 to 5 years. There has been an increase in complaints regarding misuse of 'NemID', a common secure login on the Internet used in Denmark for online banking, finding information from public authorities or engaging with a business.

b. Open Internet

A minority of operators in Denmark offer zero-rated products. Operators generally include large amounts of data in the subscription plans which makes zero-rated products a lesser-used strategy among operators. The categories of zero-rated products offered are music streaming services, video streaming/IPTV services and social media services. However, many operators have informed that several of these products are no longer being advertised as they are being phased out.

In the area of 5G services, DEA is currently working together with a television broadcasting company on testing potential use cases of specialised services for TV broadcasting.

c. Roaming

In February 2019, the DEA reopened a case of non-compliance with the roam-like-at-home rules. The case concerned the same operator which the DEA had monitored in 2018. The main issue related to the operator's general terms which limited the customers to making calls only within the Member State where the customer was located, and to Denmark. On 19 March 2019, the operator had made the necessary changes and the DEA closed the case.

d. 112 Emergency calls

The public service answering points (PSAPs) have changed their provider of 112 interconnection services from TDC to LinkMobility, an SMS operator. Advanced mobile location services are implemented in the Danish network and work on Android, but not yet on Apple. In the context of transposing of the European Electronic Communications Code, the legislator is considering clarifying if and how the requirement for the service to be free for end users and PSAPs would relate to interconnection charges across networks.

5. Conclusion

Fixed broadband and mobile network coverage are significantly above the EU average. As Denmark overwhelmingly relies on private investment, decisions about regulated access to fibre networks resulting from the market reviews under preparation will be significant for investors. The new investment patterns implemented in TDC are relevant also in other Nordic countries, since they focus on long term, relatively safe returns from network investment. The fact that VHCNs are owned by their customers in the case of the utilities and by public pension funds in the case of TDC is specific to Denmark, as a way how citizens can take ownership – directly or indirectly - of their own technological future.