



TUTELA 

Nordics

State of Mobile Networks

Analysts

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JANUARY 2020

Annual Report

www.tutela.com

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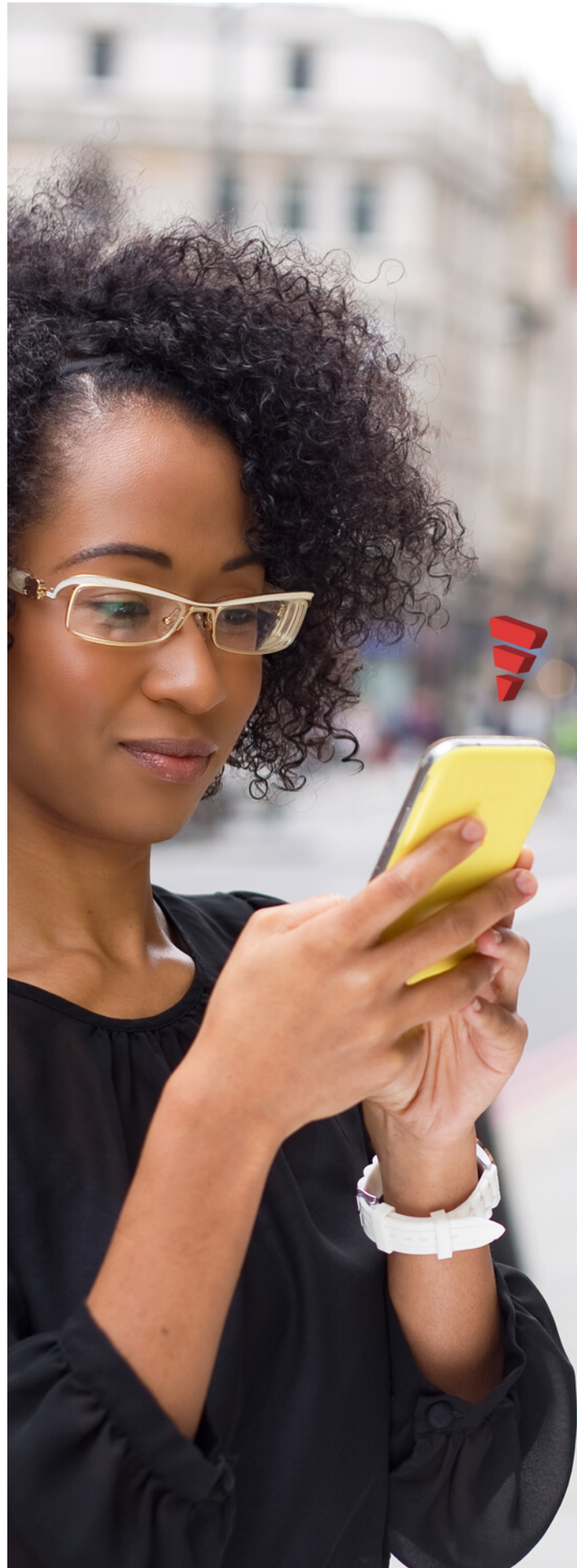
The Nordic region has long been a standard-bearer for high-quality wireless networks, and despite 2019 being a year of wireless disruption, the Nordics' place near the top of global standings remains unchanged.

Tutela's most recent [Global Report](#) put Norway, Sweden, Denmark, and Finland within the top 25 countries for mobile experience, as measured by Tutela's Excellent Consistent Quality metric. Whilst this report affirms the overall excellence of wireless experience across the region, it also highlights the differences that exist between some countries and operators.

In a year that has been dominated by news of 5G announcements and deployments, one critical observation is that early 5G action has not yet translated to widespread consumer benefits. Whilst some operators - notably Elisa in Finland - have commercially-available 5G service, Telenor Norway, the operator that performed best in almost every measured category, has not yet moved beyond the 5G pilot phase. This disconnect between 5G deployment and a measurable difference in performance is likely due to a relatively low 5G device penetration amongst users. As consumer and network adoption of 5G grows, some first-mover advantages may become apparent, but it is clear that in 2019, 5G hasn't moved the needle for network-wide mobile experience.

Key findings

- Norway's position as one of the best countries in the world for mobile experience remains, and Telenor Norway continues its dominance of the region.
- TDC was one of the few operators in the report (along with Telenor) to show a significant advantage over its competitors in Denmark, winning all nationwide categories and challenging Telenor for the fastest download speed across the region.
- Core Consistent Quality – Tutela's metric for how often users are able to do everyday use cases like SD video – is incredibly strong across the entire Nordic region, with 10 of 14 operators tested seeing more than 98% of tests pass this benchmark, and all but one exceeding 95%. However, the picture for Excellent Consistent Quality was more varied, with over 22% separating the first and last-ranked operators in the report.
- Latency was routinely excellent across all operators tested in the report. Nordic operators have been among some of the world leaders in using LTE as a replacement for fixed home broadband, where users are more likely to demand a stable and responsive connection for applications like online gaming.



Results overview

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Mobile experience results

Norway, January 2020



Excellent Consistent Quality	★ Winner		
Core Consistent Quality	★ Winner		
Download throughput	★ Winner		
Upload throughput	★ Draw		★ Draw
Latency			★ Winner

Results from 56,467,526,580 measurements taken in Common Coverage Areas across the Nordics between July 1st to December 31st 2019.

"Telenor delivered the highest percentage of Excellent Consistent Quality in Tutela's tests"



Based on the highest Excellent Consistent Quality in Common Coverage Areas.

Results overview

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Mobile experience results

Sweden, January 2020



Excellent Consistent Quality	★ Winner			
Core Consistent Quality	★ Winner			
Download throughput	★ Winner			
Upload throughput		★ Winner		
Latency			★ Winner	

Results from 56,467,526,580 measurements taken in Common Coverage Areas across the Nordics between July 1st to December 31st 2019.

"Three delivered the highest percentage of Excellent Consistent Quality in Tutela's tests"



Based on the highest Excellent Consistent Quality in Common Coverage Areas.

Results overview

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Mobile experience results

Finland, January 2020



Excellent Consistent Quality	 Winner		
Core Consistent Quality	 Winner		
Download throughput		 Winner	
Upload throughput	 Draw		 Draw
Latency			 Winner

Results from 56,467,526,580 measurements taken in Common Coverage Areas across the Nordics between July 1st to December 31st 2019.

"Telia delivered the highest percentage of Excellent Consistent Quality in Tutela's tests"



Based on the highest Excellent Consistent Quality in Common Coverage Areas.

Results overview

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Mobile experience results

Denmark, January 2020



Excellent Consistent Quality	★ Winner			
Core Consistent Quality	★ Winner			
Download throughput	★ Winner			
Upload throughput	★ Winner			
Latency	★ Winner			

Results from 56,467,526,580 measurements taken in Common Coverage Areas across the Nordics between July 1st to December 31st 2019.

"TDC delivered the highest percentage of Excellent Consistent Quality in Tutela's tests"



Based on the highest Excellent Consistent Quality in Common Coverage Areas.

Understanding this report

Tutela uses two key methodological components to best compare user experience across operators: Consistent Quality and Common Coverage Areas. Consistent Quality is a set of metrics that Tutela has developed to objectively evaluate when networks are (and are not) enabling users to do almost everything that they want to do on their smartphones.

The methodology is covered in detail at the end of this report and [on our website](#), but simply put, there are two sets of thresholds, Excellent and Core. A connection that hits the Excellent threshold is sufficient for use-cases like 1080p video streaming or multiplayer gaming, while a Core connection will stream standard-definition video or handle things like web browsing or uploading photos to social media. The percentages you see in this report represent the percentage of tests on a given operator that were above the Excellent or Core thresholds. These were most recently re-assessed and updated September 1st, 2019.

Common Coverage Areas are parts of the country where the majority of operators offer service. In this report, we present results nationally and from Common Coverage Areas, which helps present both a full national picture, as well as highlighting network conditions wherever operators are directly in competition.

TUTELA Measurement Locations



TUTELA Common Coverage Areas



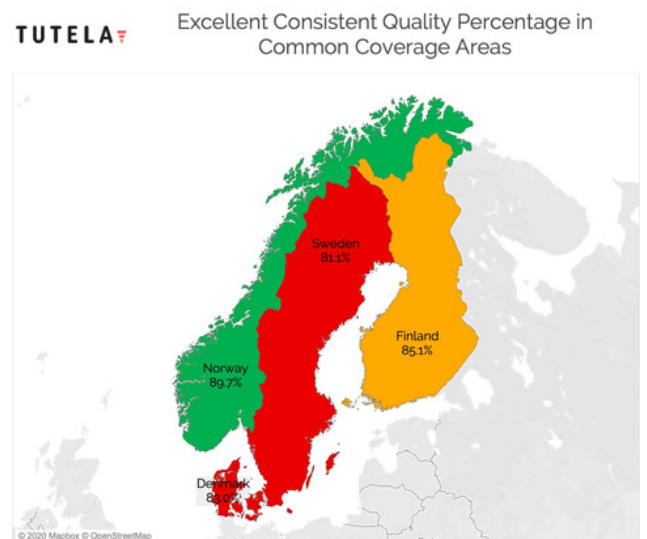
Consistent Quality

Country comparison

Norwegian mobile networks maintained a healthy advantage over the rest of the region in 2019, with an Excellent Consistent Quality percentage nearly 5% higher than second-place Finland. Norway's advantage indicates that Norwegian cellphone customers have a notably better experience when using their phones for the most demanding of use-cases, such as streaming HD video or mobile multiplayer gaming.

The difference between countries was much less pronounced when looking at Core Consistent Quality, Tutela's metric that is indicative of performance for less demanding use-cases, such as SD video streaming or web browsing. Norway still came out on top, but Sweden and Denmark were both within one percentage point. Finland was the only country to fall below 95% for Core Consistent Quality, which appears to be partially an artefact of the diversity of different mobile plans on offer.

The country has long been a world leader in innovation around mobile tariffs, with speed-tiered plans (rather than data volume-metered) particularly popular. As Tutela's testing is reflective of the throughput experienced by real-world users, Finland's greater-than-average proportion of speed-metered plans drives down its overall Consistent Quality results.



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Consistent Quality Percentage in Common Coverage Areas



Consistent Quality

Norway Common Coverage Areas (CCAs)

Telenor performed the best for both Excellent and Core Consistent Quality, both in Norway and across the Nordic region. Telenor's results are impressive in their own right - Telenor's Consistent Quality results are among the best of any operator in the world - but the relatively small gap between Core and Excellent Consistent Quality is also notable. A gap of just six percent between Core and Excellent Consistent Quality shows that wherever Telenor subscribers have cell signal, the connection is good enough for nearly every established use case. There are vanishingly few situations or locations where Telenor subscribers have a signal, but it's not "good enough" for what they want to do.

Telia and ice also perform well, compared to the Nordic and international average. Telia was the only operator in the report besides Telenor to achieve an Excellent Consistent Quality greater than 90%, putting it in second place in the region for Excellent Consistent Quality. Whilst ice's network was more significantly behind the competition for Excellent Consistent Quality, considering its position as a relatively new challenger, the quality of network it is able to offer its subscribers is impressive. Since Tutela's last report, ice has continued to grow its subscriber base(1), and recently claimed that it has acquired 10% of Norwegian mobile subscriber market share.

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Norway Consistent Quality Percentage in Common Coverage Areas



(1) Telecompaper, Ice Norway lifts smartphone subscriptions by 19,000 in Q4, claims 10% market share <https://www.telecompaper.com/news/ice-norway-lifts-smartphone-subscriptions-by-19000-in-q4-claims-10-market-share--1321858>

Retrieved 19 January 2020

Consistent Quality

Sweden Common Coverage Areas (CCAs)

3 has a commanding lead over other networks in Sweden when it comes to Excellent Consistent Quality. 6.3% more tests passed the most demanding set of thresholds for 3 customers, compared to second-place Tele2. The gap between first and last place was 18%, the most of any country in the report, showing some major differences in the performance of networks under a more demanding load. When it comes to Core Consistent Quality, the gap

between operators is much smaller. Just 0.8% separate first and last place - a difference that consumers are unlikely to notice - and the first place was a dead tie between 3 and Telia. In practice, that indicates that for consumers who spend most of their time doing things like web browsing or standard-definition video streaming, network quality is unlikely to be a differentiator between operators.

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Sweden Consistent Quality Percentage in Common Coverage Areas



Consistent Quality

Finland Common Coverage Areas (CCAs)

In Finland, there was minimal difference in Excellent Consistent Quality between the first and last-placed operators. Telia, DNA, and Elisa all saw results that were within 5% of each other, the smallest gap of any country.

Core Consistent Quality was more of a differentiator in this instance, with a 6% gap between Telia and Elisa. Although a difference of that size might seem surprising, it can be explained to some

extent by the use of speed-metered plans Finnish operators, and their relative popularity amongst the user base. For example, Elisa offers a “Tarkka Perus” plan⁽²⁾ that offers unlimited internet usage for €9.90 a month - an extremely competitive offer, but one that limits internet speed to 1 Mbps. Since Tutela’s Core Consistent Quality metric requires a minimum download throughput of 1.5 Mbps, tests from users of that plan will never meet the Core Consistent Quality requirements.

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Finland Consistent Quality Percentage in Common Coverage Areas



(2) Elisa, Telephone access product page

<https://elisa.fi/kauppa/puhelinliittymat>

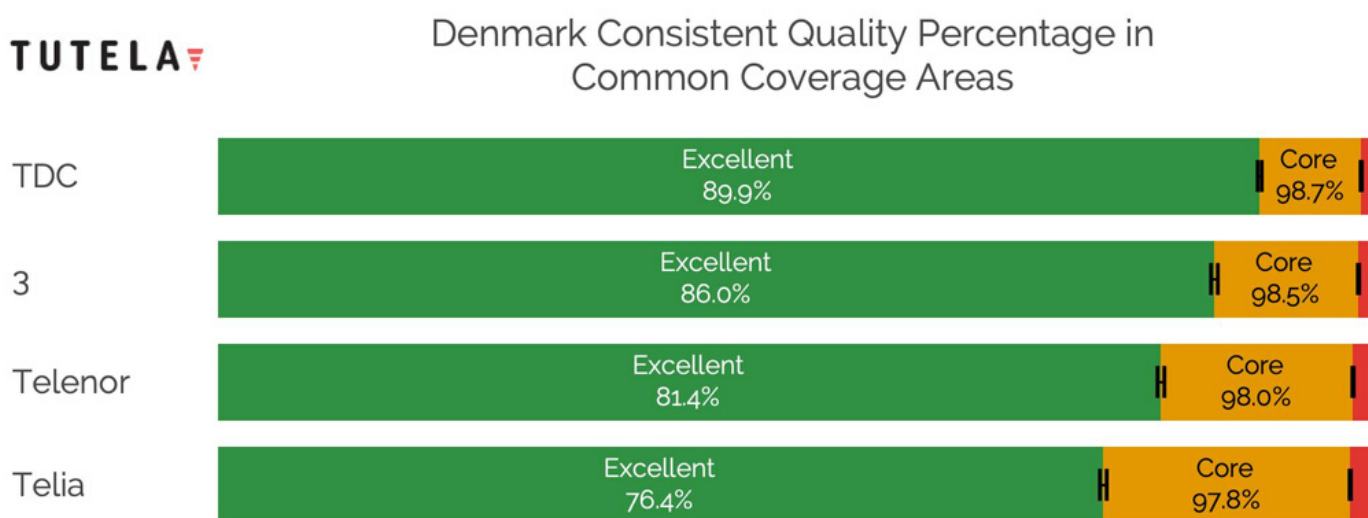
Retrieved 19 January 2020

Consistent Quality

Denmark Common Coverage Areas (CCAs)

TDC took first place for Excellent Consistent Quality in Denmark, very nearly cracking the 90% barrier. It was almost 4% better than second-place 3, and over 14% better than Telia. The placing of operators for Core Consistent Quality was the same - TDC first, 3 2nd, then Telenor and Telia - but the gaps between operators were far smaller, and just 0.9% separated first and last place.

Results indicate near-parity between operators for base-level mobile experience, but much more of a difference for demanding use-cases.



Download throughput

Country comparison

Norway took first place for download throughput, with a median download speed of 25.5 Mbps. In particular, Telenor and Telia in Norway recorded extremely fast median download speeds, while ice's lower download throughput (relative to the other Norwegian operators) brought the average

down. A consistent download throughput across Finland saw the country in second place, whilst a strong result for TDC in Denmark saw the Danes come in third. Sweden was the only country in the region to see its median download throughput fall below 20 Mbps.

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Median Download Speed in Common Coverage Areas



Download throughput

Norway Common Coverage Areas (CCAs)

Telenor retains its first-overall position for download throughput, recording a median of nearly 30 Mbps in Common Coverage Areas. That was the fastest median download speed of any operator in the Nordics, and more than 5 Mbps faster than Telia.

Although there was a relatively minor difference between Norwegian operators for Consistent Quality, the gap in download

performance was much greater - Telenor's download throughput was nearly double that of ice. However, it's worth noting that this performance difference will rarely be noticeable to users, as the median download throughput for all operators was well in excess of what's required for common use cases like streaming HD video. Only users who regularly do things like download large applications over a cellular connection are likely to notice a performance difference.

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Norway Median Download Speed in Common Coverage Areas



Download throughput

Sweden Common Coverage Areas (CCAs)

Download throughput performance was relatively similar across all four Swedish operators, with just 5.5 Mbps separating first and last place. 3, which placed first and tied-first for Excellent and Core Consistent Quality respectively, also came first for

download throughput, 0.9 Mbps faster than second-place Telia. The rankings remain relatively similar for other operators, with a switch between Telia and Tele2 for second and third place, compared to Excellent Consistent Quality.

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Sweden Median Download Speed in Common Coverage Areas



Download throughput

Finland Common Coverage Areas (CCAs)

Whilst there was a minimal difference between operators for Excellent Consistent Quality in Finland, there was virtually no difference in median download throughput. DNA was in first place with a median of 24.9 Mbps, just 0.5 Mbps ahead of Elisa and Telia, which were tied for second place. Near-

parity for download throughput may reflect Finland's embrace of speed-tiered plans more than the network performance, as the median download throughput is driven by the mix of tariffs chosen by subscribers, as well as by the maximum possible throughput the LTE networks are capable of.

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Finland Median Download Speed in Common Coverage Areas

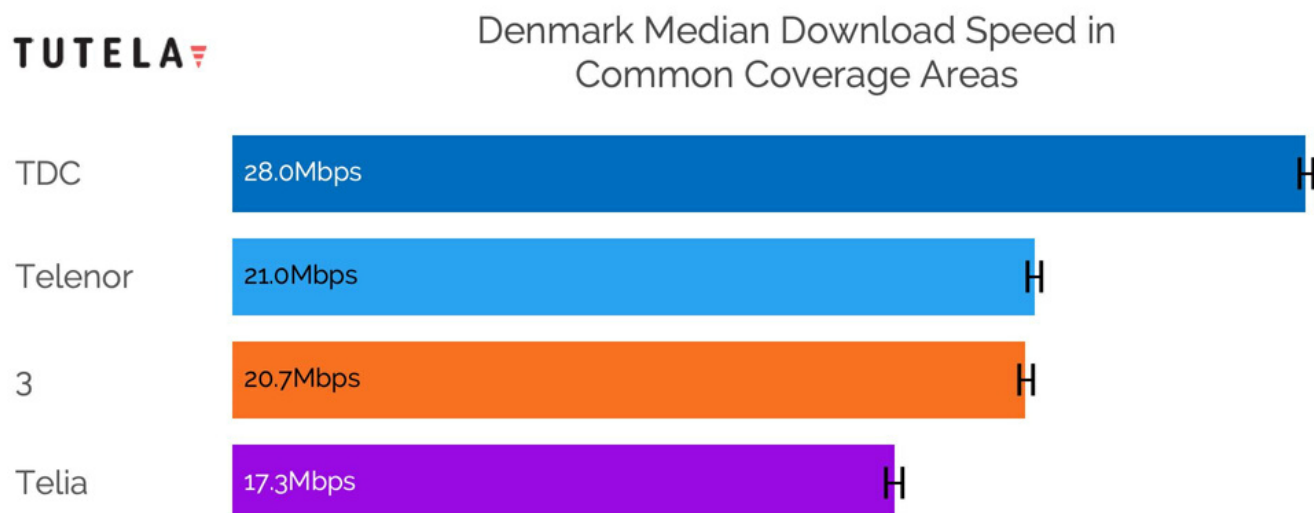


Download throughput

Denmark Common Coverage Areas (CCAs)

Denmark saw the greatest difference in download throughput between first and second place, as TDC was head and shoulders above the competition with a median download throughput of 28.0 Mbps,

fast enough for second place across the Nordics region. Telenor and 3 tied for 2nd place in median download speed, whilst Telia rounded out the operators with a still-impressive 17.3 Mbps.



Upload throughput

Country comparison

Although Norway took first place for Consistent Quality and download speed, Finland took a decisive victory when it comes to median upload speed, with its result of 9.2 Mbps a full 1.5 Mbps better than

Denmark and Norway, which were tied for second place. Sweden came in third at 6.9 Mbps, despite a strong showing from Telia Sweden.

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Median Upload Speed in Common Coverage Areas



Upload throughput

Norway Common Coverage Areas (CCAs)

Unlike the results for Consistent Quality and download throughput, Telenor didn't take outright first place for upload speed, instead tying with ice for the overall win. Telia was in third place, just over 1 Mbps behind. All three operators were more than three times faster than the 1.5 Mbps threshold required

for upload throughput in Tutela's Excellent Consistent Quality standard, meaning that there will be little noticeable difference between operators when uploading a video to social media or taking part in a live video call.

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Norway Median Upload Speed in Common Coverage Areas



Upload throughput

Sweden Common Coverage Areas (CCAs)

Telia took first place for upload throughput in Sweden, despite finishing second and third for download throughput and Excellent Consistent Quality respectively. Telia's lead over the other operators was relatively

commanding, with a 1.6 Mbps gap to second-place 3. The results for the other operators were much closer, and all four operators recorded a median upload throughput greater than 6 Mbps.

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Sweden Median Upload Speed in Common Coverage Areas



Upload throughput

Finland Common Coverage Areas (CCAs)

The parity between operators in Finland continues in upload throughput, with less than 0.2 Mbps separating all three operators, when taking error margins into account. Telia and Elisa tie for first place, with DNA just behind. Functionally, there is little

difference in the user experience when considering these median upload speeds, as just milliseconds will separate the time it takes to upload typical files over the different networks.

TUTELA

Finland Median Upload Speed in Common Coverage Areas

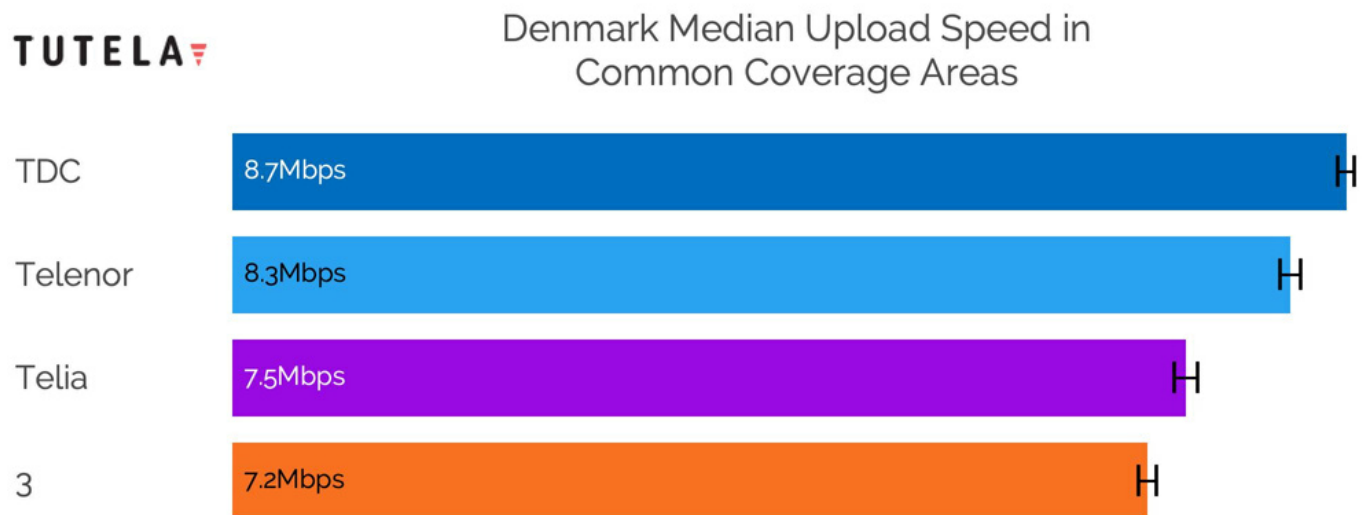


Upload throughput

Denmark Common Coverage Areas (CCAs)

TDC continued the winning streak that it established in Consistent Quality and download throughput, as it provided the fastest median upload speed to its

subscribers. Once again, there was relatively little difference between all the operators tested, with just 1.5 Mbps separating first and last place.



Latency

Country comparison

Latency was notably excellent across almost all mobile networks in the Nordic region, with just one operator seeing a median latency greater than 20 milliseconds. Finland took the crown for the lowest overall latency, with a median of just 13.8

milliseconds. Norway had the highest latency, despite the fact that its users spent the greatest proportion of time on 4G, which is typically a strong indicator of a low median latency.

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Median Latency in Common Coverage Areas



Latency

Norway Common Coverage Areas (CCAs)

Ice was in first place amongst Norwegian operators for latency, with a median of 15.6 milliseconds. Telenor and Telia were in second and third place respectively, although it should be noted that the median

for all three operators was well below the maximum allowed for latency-sensitive applications, such as cloud gaming or real-time voice or video calls.

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Norway Median Latency in Common Coverage Areas



Latency

Sweden Common Coverage Areas (CCAs)

Tele2 edged out the other operators to provide the lowest-latency mobile network in Sweden, with a median latency of just 13.2 milliseconds - the lowest of any operator in the Nordic region. Telenor and

Telia were barely one millisecond behind, whilst 3 had a substantially less responsive network, with a median latency of 20.5 milliseconds.

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Sweden Median Latency in Common Coverage Areas



Latency

Finland Common Coverage Areas (CCAs)

Once again, the story for Finnish operators was one of parity, as the median latency for all three operators was within 0.8 milliseconds. Although Elisa narrowly missed out for the most responsive mobile network

in the Nordics region, the consistently responsive results from all three Finnish operators helped Finland achieve first place for latency in the inter-country rankings.

TUTELA

Finland Median Latency in Common Coverage Areas

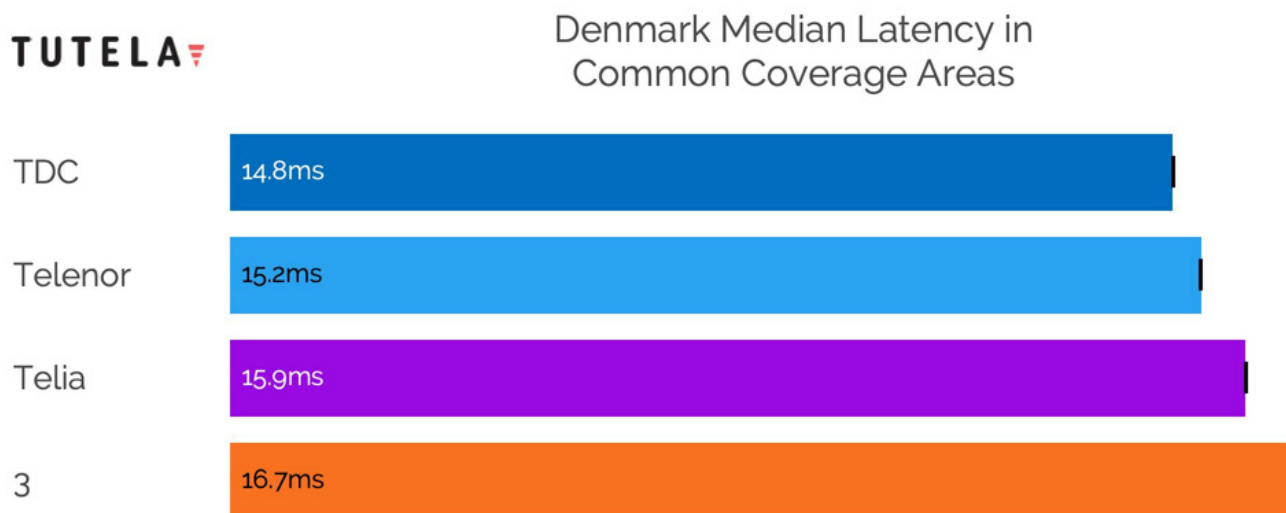


Latency

Denmark Common Coverage Areas (CCAs)

TDC continued its clean sweep of first places across key performance indicators, as its median latency of 14.8 milliseconds was the fastest of all Danish operators. Telenor, Telia, and 3 were all within 1.9 milliseconds of TDC, however, showing that Danish

consumers overwhelmingly have access to responsive networks that should give no issues for demanding use-cases like cloud gaming, or even VR and AR applications under development.



Radio technology usage

Country comparison

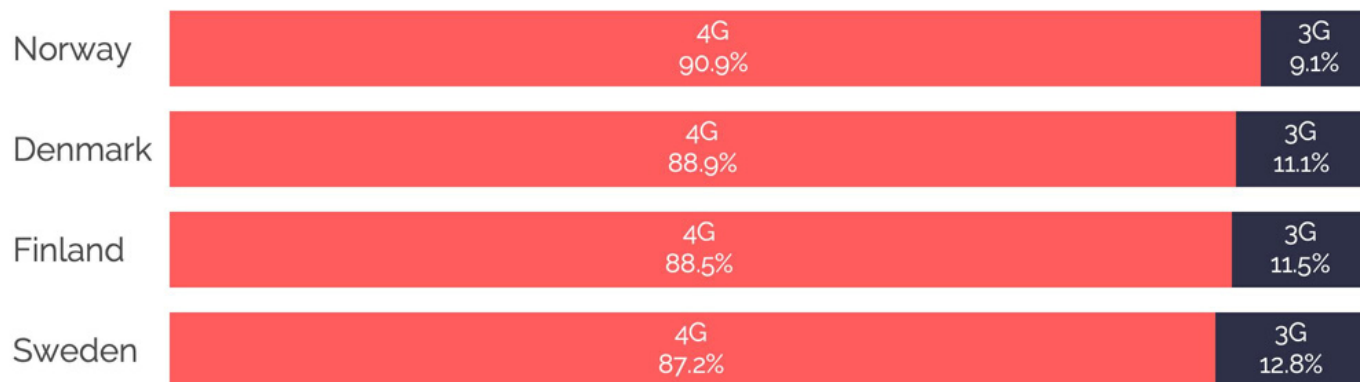
Norway has a 2% lead over other countries when it comes to the amount of time users spend on 4G, and was the only country in which subscribers spent more than 90% of their time on a 4G network.

The amount of time spent on 4G, combined with data that suggests Norwegian users

use the smallest amount of cellular data in the region(3), go some way to explaining Norway's lead in most network experience measurements - Norwegian users spend most of their time on lightly-loaded LTE networks, and therefore have the best experience when they are using data on those networks.

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Percent of Time by Mobile Connection Type Nationwide



(3) Nordic-Baltic Telecom Statistics, Telecommunications Markets in the Nordic and Baltic Countries

<https://statistik.pts.se/media/1460/presentation-nbtm-2018.pdf>

Retrieved 19 January 2020

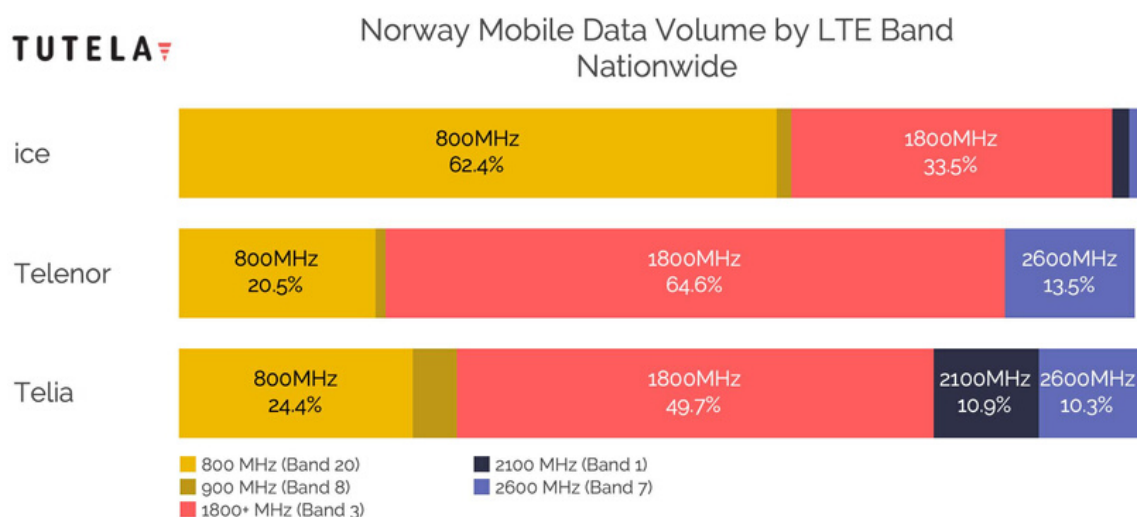
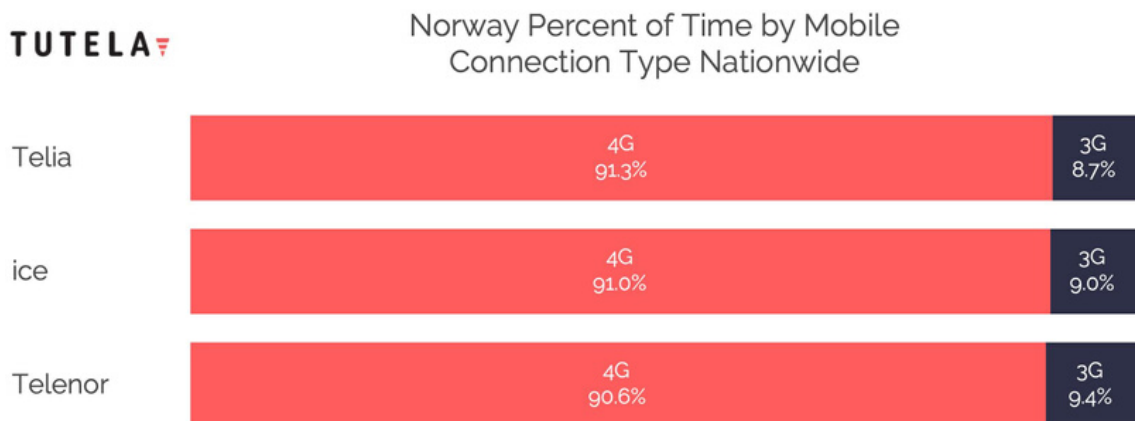
Note: Data usage and spectrum information is gathered when subscribers are on their own network as well as domestically roaming.

Radio technology usage

Norway nationwide

The percentage of time spent on 3G and 4G (including domestic roaming) was nearly identical across all three operators in Norway, but the spectrum usage across LTE bands was much more different. In particular, ice relies on low-band 800 MHz spectrum for almost two-thirds of its subscriber data usage, whilst using the mid-band 1800 MHz spectrum much less. Bandwidth is limited in the 800 MHz band,

all three operators own 10 MHz of uplink and downlink spectrum, which means that the maximum potential speeds achievable (without aggregation) are much lower on 800 MHz compared to mid-band and high-band spectrum bands, where more bandwidth is available. Given that, ice's relatively slow median download throughput compared to Telia and Telenor makes more sense.

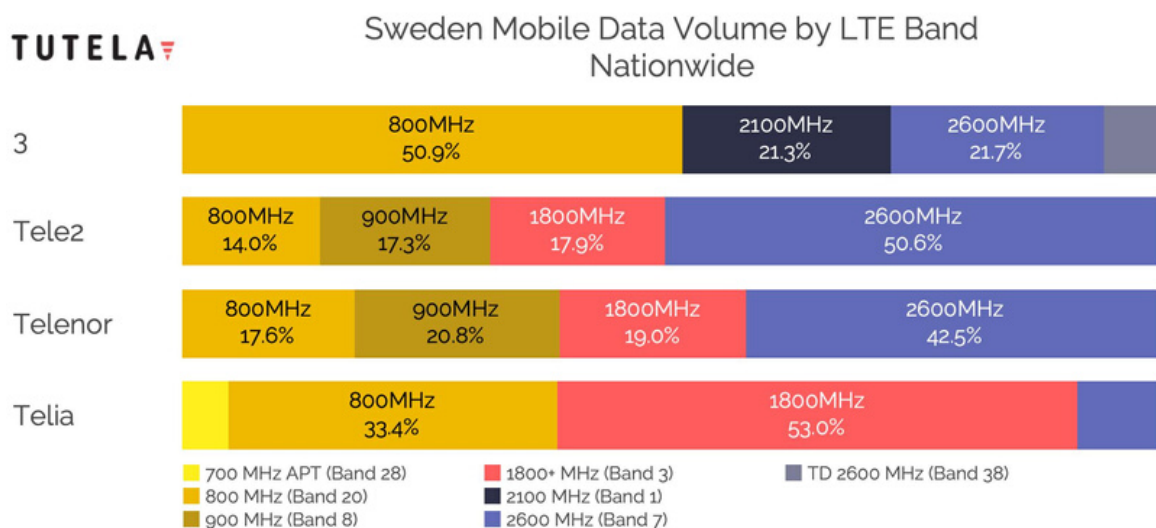
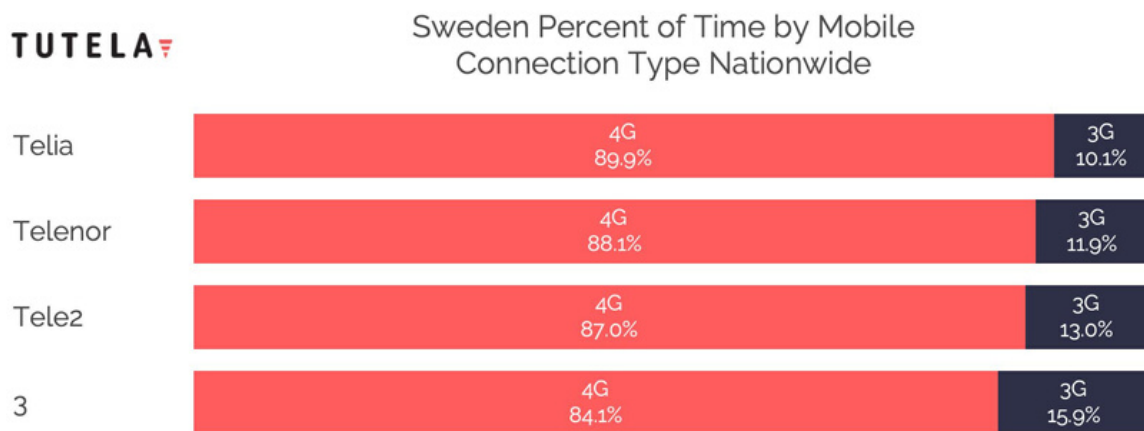


Radio technology usage

Sweden nationwide

There is a nearly 6% spread in the amount of time spent on 4G amongst different operators in Sweden, with 3 coming in last place at 84.1%, well below the Swedish average of 87.2%. 3's performance does not seem adversely affected by this - it has the best Excellent Consistent Quality and fastest download speed - but it does go some way to explaining why 3's latency in Sweden is the highest of any operator

across the region, as high latency is a known artefact of 3G networks. 3 is also an outlier on its spectrum usage, as it exclusively relies on low-band and high-band networks, with no mid-band 1800 MHz spectrum, which is popular amongst other operators. 3 is also the only operator in Sweden to use TDD spectrum, as it owns a 50 MHz block of Band 38 spectrum.

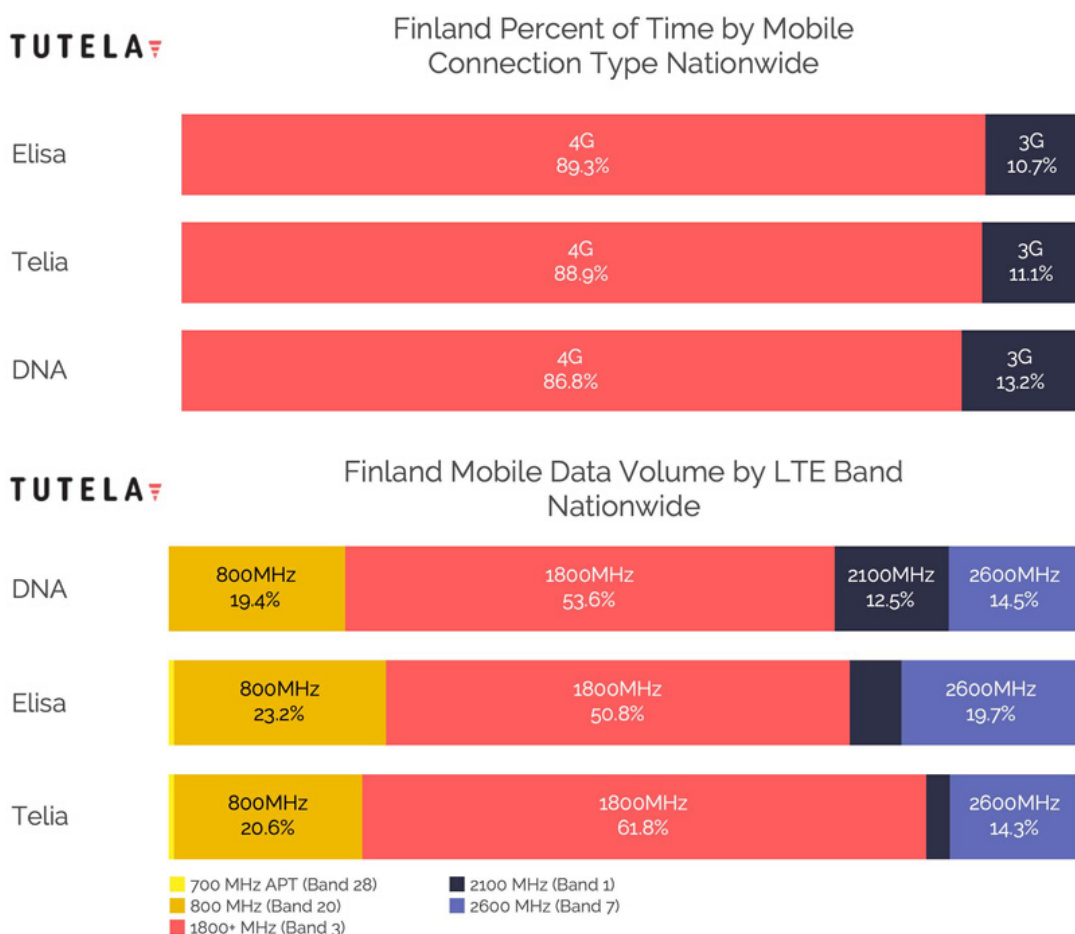


Radio technology usage

Finland nationwide

Finnish operators all use 1800 MHz for the majority of their smartphone data traffic, although some operators (Telia) rely on the mid-band spectrum more heavily than others. Mid-band spectrum is playing an increasingly large role in data traffic for all

three operators, and as fixed wireless offerings become increasingly popular (especially with fixed 5G services) the capacity offered by those higher spectrum bands will become ever more important to alleviate congestion.(4)



(4) Tutela, Can operators offer Fixed Wireless Access without degrading mobile performance?

<https://www.tutela.com/blog/can-operators-offer-fixed-wireless-access-without-degrading-mobile-performance>

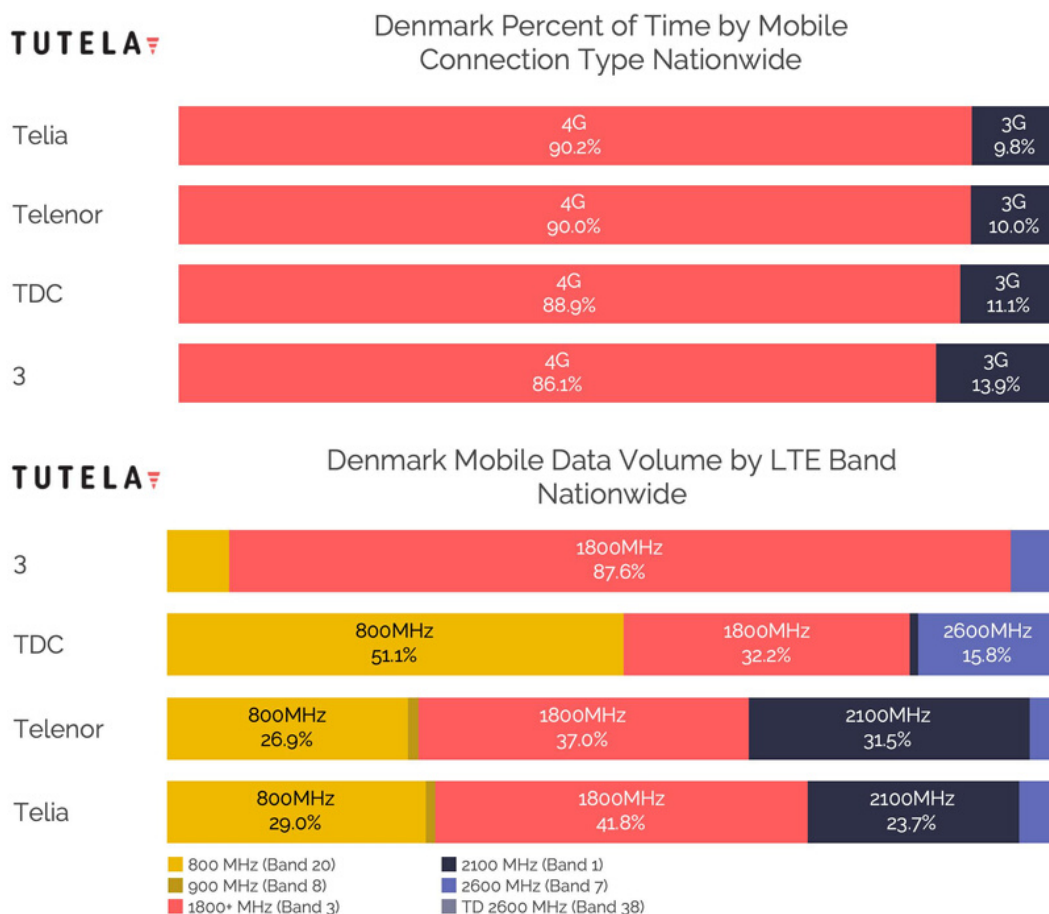
Retrieved 19 January 2020

Radio technology usage

Denmark nationwide

3, which claims to have the highest per-capita data usage of all operators in Denmark(5), relies overwhelmingly on 1800 MHz spectrum - of which it owns 60 MHz - for the majority of its mobile data traffic. 3 users also spend the lowest proportion of time on 4G, compared to other operators.

TDC, which had impressive results across every category in Denmark, has an advantage in low-band spectrum - it owns a total of 40 MHz of 800 MHz, double the amount of every operator required - which it puts to good use, as 800 MHz carries over half of TDC's smartphone data traffic.



(5) Telecompaper, 3 Denmark average monthly data use 12.4 GB vs 9.0 GB for rest of country in H1
<https://www.telecompaper.com/news/3-denmark-average-monthly-data-use-124-gb-vs-90-gb-for-rest-of-country-in-h1--1320629>

Retrieved 19 January 2020



Methodology

Tutela is an independent crowdsourced data company with a global panel of over 300 million smartphone users. We gather information on mobile infrastructure and test wireless experience, helping organisations in the mobile industry to understand and improve the world's networks.

Tutela collects data and runs network tests via software embedded in a diverse range of over 3000 consumer applications, which enable the measurement of real-world quality of experience for mobile users, 24/7. For this report, we gathered 1.6 billion records, including over 19 million speed tests and 240 million latency measurements, from over 760,000 devices (iOS and Android smartphones) between July 1st and December 31st 2019.

Tutela measures network quality based on the real-world performance of actual network subscribers, inclusive of occasions when a network or tariff may be throttled or congested. Results in this report are based on a testing configuration designed to represent the typical (rather than maximum) performance that users experience. We use a 2 MB file to perform our download testing and a 1 MB file to perform our upload testing. Latency performance in this report reflects one-way UDP latency. Tests are conducted against the same content delivery networks that power many of the world's most popular consumer applications, and as such reflect the end-to-end performance of the network.

Consistent Quality

Download speed is most often used as a proxy for network quality, but while download throughput is important, it's just one of several crucial requirements for a "good" connection.

As operators have upgraded 3G networks to LTE-Advanced technology, theoretical (and even real-world) peak throughput speeds have increased to where they vastly outstrip the maximum needed for any current use-case. Real-world speeds above 100 Mbps are now common in parts of the world, and with a 4K video stream — which itself is rarely something smartphone users need — using a fifth of that, average download speed has lost some of its relevance as the dominant statistic used to measure the quality of wireless networks.

At its most basic, a good connection is one that doesn't get in the way of users doing what they want to do. In the real world, smartphone users aren't running speed tests all day — they're browsing the web, using apps, voice calling their friends, streaming Netflix and YouTube, or making video calls.



Consistent Quality

To more objectively evaluate when networks are (and are not) enabling users to do those things, Tutela has developed a standard called consistent quality. Simply put, it's two sets of thresholds, called Excellent and Core. If a connection hits the Excellent standard, it's sufficient for the most demanding mobile use-cases, like HD group video calling or 1080p video streaming. A Core connection is good enough for SD video streaming, web browsing, emails, and VOIP calling, but users are more likely to experience delays or

buffering when trying to use more demanding apps. Tutela bases the threshold values on the minimum performance requirements published by popular apps. We most recently updated our Consistent Quality thresholds on [September 1st, 2019](#).

Tutela's consistent quality metric, as used in our reports, simply measures the percentage of time that users can hit the thresholds. The higher the number, the more often users have a Core or Excellent quality connection.

Excellent Quality

KPI	Download throughput	Upload throughput	Latency	Jitter	Packet loss
Minimum acceptable value	5 Mbps	1.5 Mbps	50 ms	30 ms	1%

Core Quality

KPI	Download throughput	Upload throughput	Latency	Jitter	Packet loss
Minimum acceptable value	1.5 Mbps	500 Kbps	100 ms	50 ms	5%

Meet Tutela at MWC

Tutela invites executives from telecoms operators to meet with our management team for an executive briefing where you can:

- Learn how Tutela's crowdsourced data solutions can be applied to Benchmarking, Planning, Quality Assurance and Optimisation
- Discover our latest new features and developments for 2020
- See a live demonstration for your markets
- Discuss your objectives and requirements

Visit www.tutela.com/meet-at-mwc-exec-2020 to learn more and schedule a meeting.

Schedule a meeting



24-27 February 2020

Appendix

TUTELA

Common Coverage Areas Results Overview

		Median Download (Mbps)	Download Error Margin (Mbps)	Median Upload (Mbps)	Upload Error (Mbps)	Median Latency (ms)	Latency Error Margin (ms)	Excellent CQ (%)	Excellent CQ Error Margin (%)	Core CQ (%)	Core CQ Error Margin (%)
Denmark	3	20.7	0.18	7.2	0.07	16.7	0.01	86.0	±0.26	98.5	±0.09
	TDC	28.0	0.19	8.7	0.07	14.8	0.00	89.9	±0.19	98.7	±0.07
	Telenor	21.0	0.19	8.3	0.09	15.2	0.00	81.4	±0.25	98.0	±0.09
	Telia	17.3	0.22	7.5	0.09	15.9	0.00	76.4	±0.29	97.8	±0.10
Finland	DNA	24.9	0.23	9.1	0.08	14.3	0.00	84.9	±0.27	95.1	±0.16
	Elisa	24.4	0.16	9.2	0.05	13.5	0.00	83.2	±0.22	92.5	±0.15
	Telia	24.4	0.19	9.3	0.07	13.8	0.00	88.4	±0.24	98.5	±0.09
Norway	ice	16.6	0.27	8.5	0.12	15.6	0.01	85.7	±0.46	98.3	±0.17
	Telenor	29.6	0.13	8.4	0.07	16.9	0.00	93.3	±0.17	99.4	±0.05
	Telia	24.8	0.19	7.2	0.07	17.3	0.01	91.2	±0.20	99.0	±0.07
Sweden	3	21.6	0.12	6.9	0.04	20.5	0.02	88.8	±0.16	98.7	±0.06
	Tele2	17.1	0.07	6.7	0.03	13.2	0.00	82.5	±0.11	98.2	±0.04
	Telenor	16.1	0.15	6.1	0.05	13.9	0.00	70.8	±0.25	97.9	±0.08
	Telia	20.7	0.21	8.5	0.05	14.3	0.00	78.7	±0.22	98.7	±0.06

About Tutela

Tutela Technologies, Ltd., is an independent crowdsourced data company with a global panel of over 300 million smartphone users. It gathers information on mobile infrastructure and tests wireless experience, helping organizations in the mobile industry to understand and improve the world's networks. Data and insights provided by Tutela are trusted by the engineering teams at mobile network operators and network equipment manufacturers around the world and used to compare operators as well as inform decisions in network and infrastructure planning and optimisation. The organization is headquartered in Victoria, British Columbia.

Tutela does not collect any sensitive personal data and is compliant with international privacy regulations including GDPR.

For further information about the methodology, data and tools used to create this report, please contact analysis@tutela.com or visit www.tutela.com.

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