TUTELA

Nordics

State of Mobile Experience

Analysts

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Annual Report

FEBRUARY 2021

www.tutela.com

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Introduction

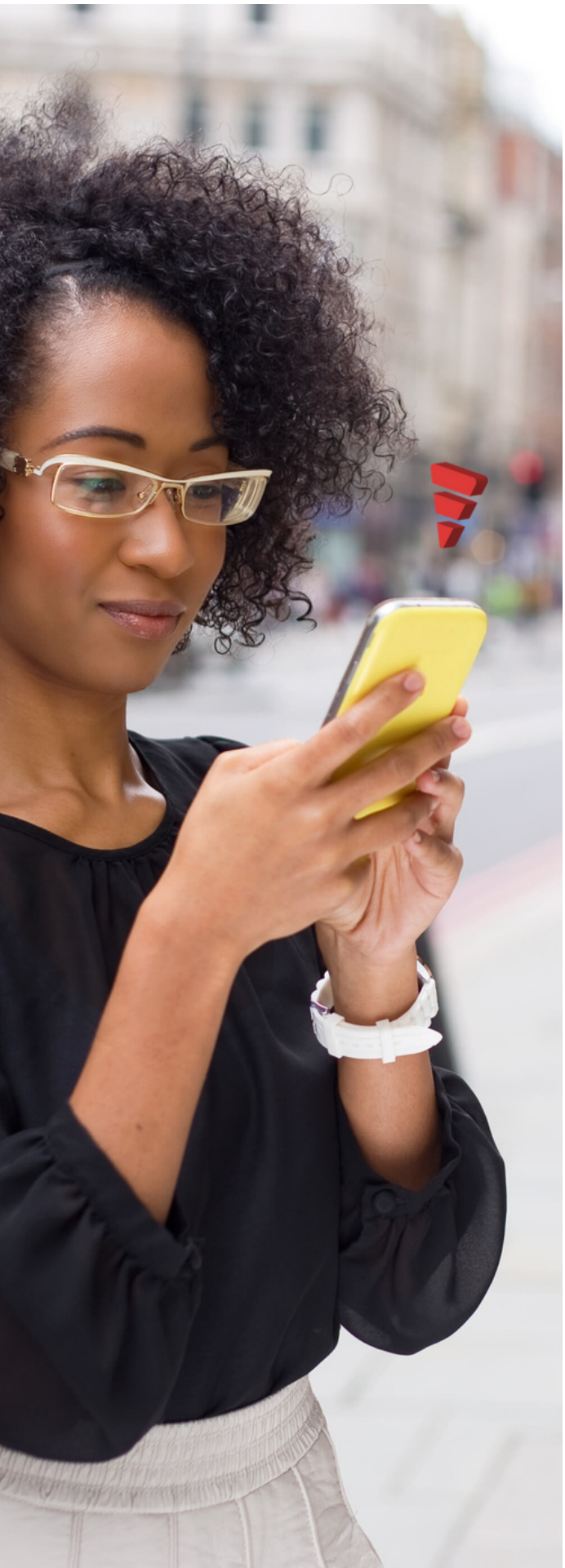
For the wireless industry, 2020 was supposed to be the year dominated by 5G rollouts. Instead, thanks to the changes to working and living brought about by the pandemic, the focus has been on providing unparalleled consistency for virtual meetings, socially distant hangouts, and all the streaming content the internet can provide.

As a result, wireless providers have been faced with a dual challenge: rolling out next-generation wireless technology, while maintaining and upgrading existing networks to handle unprecedented levels of data traffic. Nordic networks have a global reputation for being some of the best in the world, a reputation that was upheld in Tutela's recent Global Mobile Experience report, which saw all four Nordic countries finish in the top 20 countries in the world for mobile experience.

However, how the Nordics works to retain this position of international leadership, in an era where operators increasingly look to shift to 5G connections, remains the primary challenge of 2021. 5G networks and devices are becoming increasingly ubiquitous, with multiple operators having commercially available deployments in every country in the region. While 5G deployments are not yet making significant inroads in population-wide mobile experience, 5G rollouts can improve aspects of the LTE network — something some operators have stated[1].

In order to benchmark mobile experience over the last six months, Tutela has evaluated over 1.8 million speed and latency tests, conducted on the smartphones of real-world users of national mobile operators within Common Coverage Areas, between July 1st and December 31st, 2020.

[1] Telecompaper, TDC completes nationwide 5G deployment in Denmark
https://www.telecompaper.com/news/tdc-completes-nationwide-5g-deployment-in-denmark--1364015
Retrieved 02/02/21



Key findings

- All four Nordic countries in this report demonstrated outstanding mobile network experience, with several ties for the top spot at a regional level between the four. Denmark and Norway tied for best Excellent Consistent Quality, Norway and Finland demonstrated the fastest median download speeds, while Denmark had the highest Core Consistent Quality.

- In Denmark TDC was dominant, with wins for Excellent and Core Consistent Quality, as well as for median download and upload speeds. Meanwhile, Telenor led in Denmark for latency. However, in other countries, the results were much more distributed between the different providers, indicating the level of parity between providers in the region.

- 4G technology continues to be the dominant wireless technology in the Nordics, accounting for over 90% of connection time for the vast majority of operators. 5G is already beginning to show up for some operators on the connection-time metric, however, and as the proportion of 5G-compatible devices in use continues to increase, we expect to see the latest wireless technology become a more significant part of the end-user experience.

Results overview

TUTELA

Mobile experience results

Denmark, February 2021

	TDC	telenor	3	Telia
Excellent Consistent Quality	★ Winner			
Core Consistent Quality	★ Winner			
Download throughput	★ Winner			
Upload throughput	★ Winner			
Latency		★ Winner		

Results from over 1.8 million speed and latency tests, conducted on the smartphones of real-world users of national mobile operators within Common Coverage Areas, between July 1st and December 31st, 2020.

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

TUTELA
Best Mobile Network Experience
FEBRUARY 2021

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

Results overview

TUTELA

Mobile experience results

Finland, February 2021

	Telia	DNA	elisa
Excellent Consistent Quality	★ Winner		
Core Consistent Quality	★ Winner		
Download throughput		★ Winner	
Upload throughput		★ Winner	
Latency			★ Winner

Results from over 1.8 million speed and latency tests, conducted on the smartphones of real-world users of national mobile operators within Common Coverage Areas, between July 1st and December 31st, 2020.

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

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Results overview

TUTELA

Mobile experience results

Norway, February 2021

	telenor	Telia	ice
Excellent Consistent Quality	★ Winner		
Core Consistent Quality	★ Winner		
Download throughput	★ Winner		
Upload throughput		★ Winner	
Latency		★ Draw	★ Draw

Results from over 1.8 million speed and latency tests, conducted on the smartphones of real-world users of national mobile operators within Common Coverage Areas, between July 1st and December 31st, 2020.

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

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

Results overview

TUTELA

Mobile experience results

Sweden, February 2021

	3	telenor	TELE2	Telia
Excellent Consistent Quality	★ Winner			
Core Consistent Quality	★ Draw	★ Draw	★ Draw	
Download throughput				★ Winner
Upload throughput				★ Winner
Latency	★ Winner			

Results from over 1.8 million speed and latency tests, conducted on the smartphones of real-world users of national mobile operators within Common Coverage Areas, between July 1st and December 31st, 2020.

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

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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 connections networks are (and are not) enabling users to do almost everything that they want to do on their smartphones.

To best serve Tutela's goal to accurately measure and represent the real-world, end-to-end experience of actual users, our methodology is subject to ongoing improvements, which allow us to update the methodology in line with changes in network technology, measurement capabilities, and the realities of how people use their smartphones. As of this report, the methodology includes an updated version of Consistent Quality that better accounts for reliability, an area-based Coverage Score, a more granular Common Coverage Areas definition, and the separation out of users on MVNO or flanker brands. As a result, changes in the numeric values in this report compared to 2019 are not necessarily representative of year-on-year changes in the end-to-end user experience.

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.

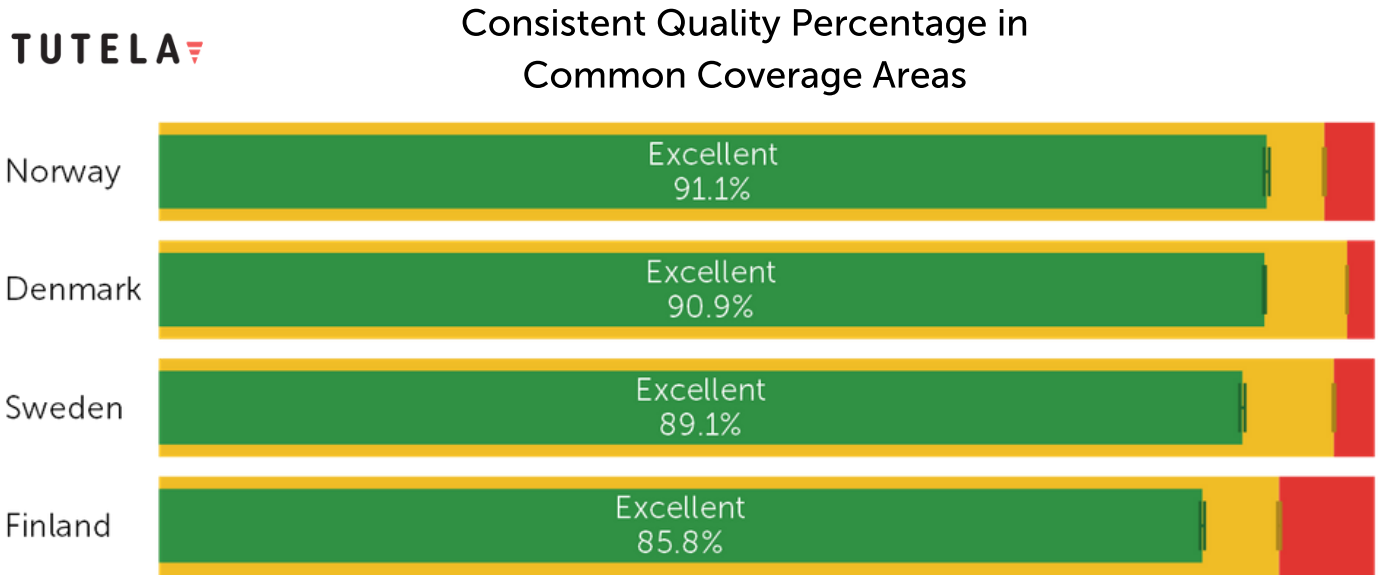
Common Coverage Areas are parts of the country where all national operators offer service, either on their own network or through a domestic roaming agreement. Comparing performance within common coverage areas ensures that user experience is being compared in places where networks are competing head-to-head, and ensures that operators with more diverse coverage are not being penalized. In this report, all performance metrics are taken from tests conducted in Common Coverage Areas only.

Measurement locations

Common Coverage Areas

Consistent Quality

Norway and Denmark tied for Excellent Consistent Quality in Tutela's testing - with the error bars for each overlapping at the 95% confidence level. Excellent Consistent Quality is Tutela's measure of how often a connection is good enough for intensive applications such as HD group video calls, 1080p video streaming and realtime gaming. This comparison includes only subscribers on the main networks in each country (those included in the per-country charts below), with comparisons made using results from within the Common Coverage Areas of each respective country. However, Denmark took the win for Core Consistent Quality, which Tutela uses to represent day-to-day activities like web browsing, social media sharing and SD video streaming. 97.7% of tests from subscribers from the main four networks in Denmark met the thresholds set for these uses.



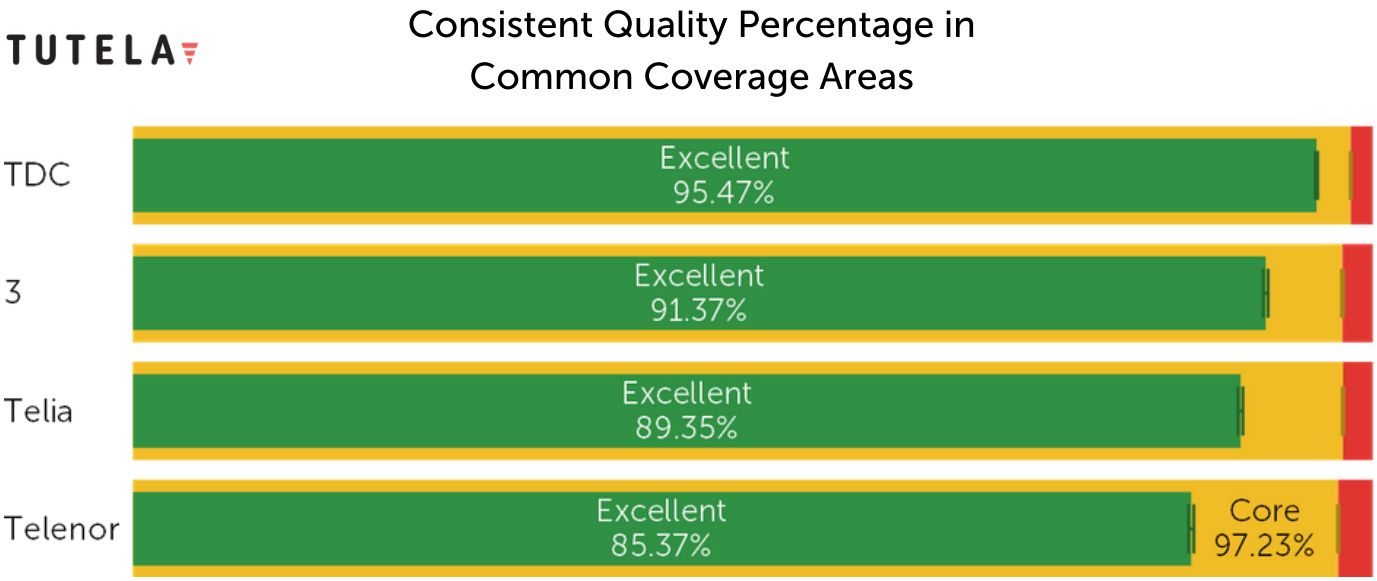
Consistent Quality

DENMARK

In Denmark, TDC maintained a lead over its competitors for both Excellent and Core Consistent Quality - indicating that, for the majority of common use cases, TDC subscribers get a reliable experience the most often. TDC Denmark's Excellent Consistent Quality was the highest for any operator in the Nordics.

However, the parity between all operators for day-to-day use cases like web browsing, SD video streaming, and social media usage, which Tutela measures with its Core Consistent Quality metric, is notable. Tests for all four networks met the Core Consistent Quality thresholds more than 97% of the time when users were in Common Coverage Areas. The differences are more noticeable for higher-intensity applications like 1080p video streaming or HD group video calling, which Tutela measures using Excellent Consistent Quality.

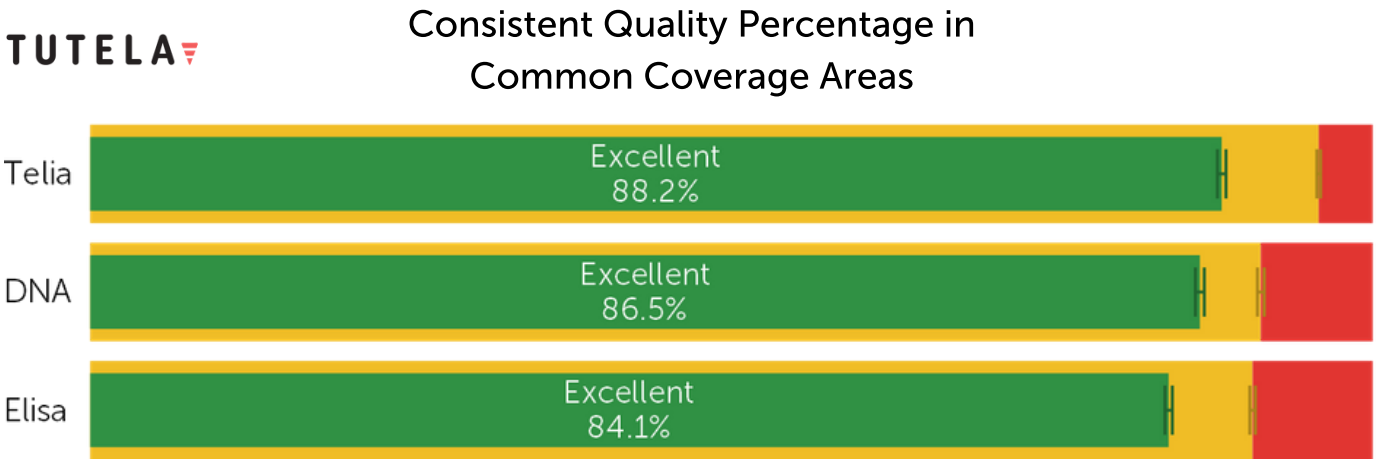
While subscribers of all four networks experienced connections good enough for these uses the majority of the time, there was a significant step between fourth-place Telenor and first-place TDC of nearly 10%.



Consistent Quality

FINLAND

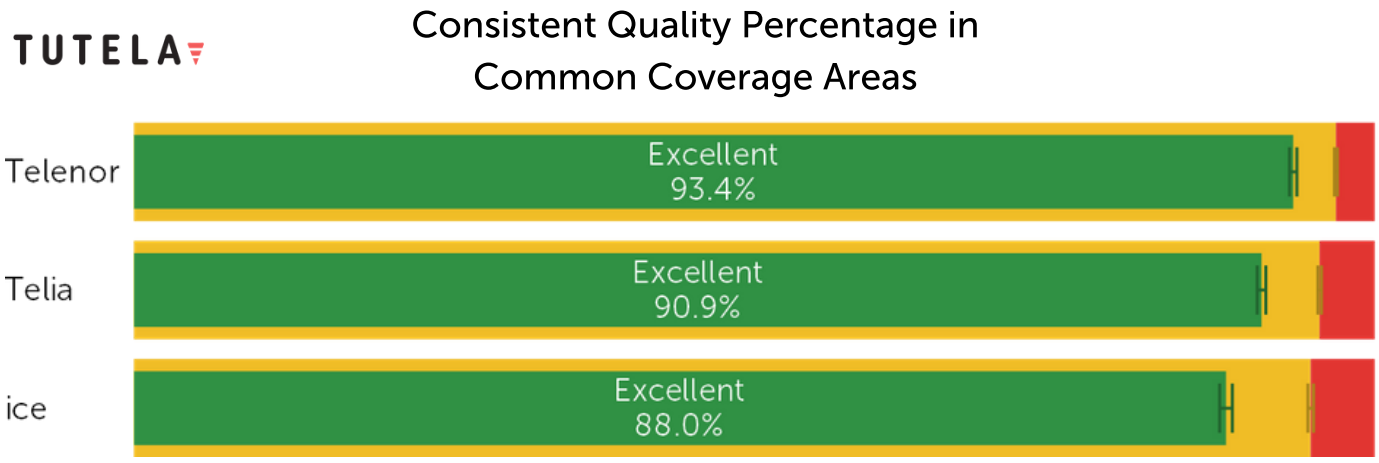
In Finland, Telia took the lead for both Excellent and Core Consistent Quality. However, unlike in Denmark, the leading operator had a greater edge over its competitors for Core Consistent Quality rather than Excellent Consistent Quality. All three operators finished within 5% of each other for Excellent Consistent Quality, Tutela's metric for how often a connection is good enough for applications like 1080p video streaming, HD video calling and realtime mobile gaming. This indicates that, in the Common Coverage Areas of Finland, users get a similar quality of experience for these applications. However, Telia had a compelling lead over second-place DNA when it came to Core Consistent Quality, Tutela's metric for when a connection is good enough for web browsing, social media sharing and SD video streaming. 95.8% of connections from Telia subscribers were good enough for these applications, compared to 91.3% of connections for DNA and 90.6% for Elisa.



Consistent Quality

NORWAY

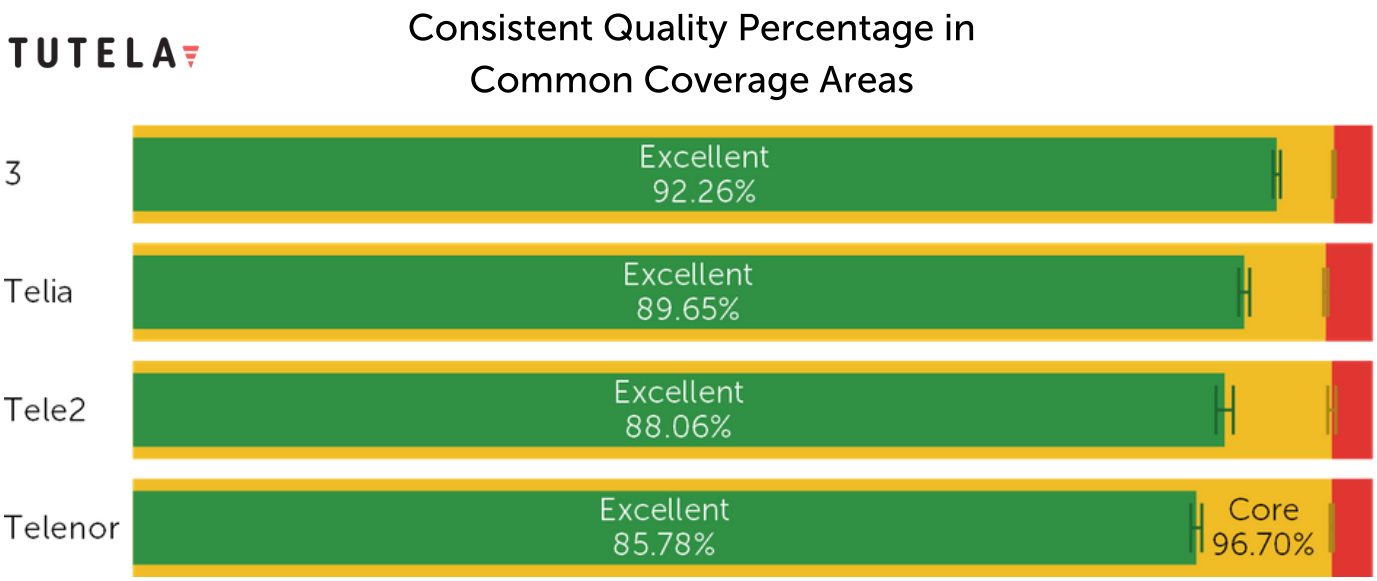
Telenor took the lead for both Excellent and Core Consistent Quality in Norway, although all three operators were relatively close. Telenor subscribers in Common Coverage Areas had 93.4% of connections meet Tutela's thresholds for group HD video calling, 1080p video streaming and realtime online gaming. This was compared to 90.9% of connections from Telia subscribers and 88.0% from ice subscribers. The rankings are the same for Core Consistent Quality – although here, just over 2% separated first and third place. However, with all three operators having more than 94% of connections meeting the thresholds Tutela uses to represent SD video streaming, web browsing and social media usage, users in Common Coverage areas in Norway can expect a decent connection the overwhelming majority of the time.



Consistent Quality

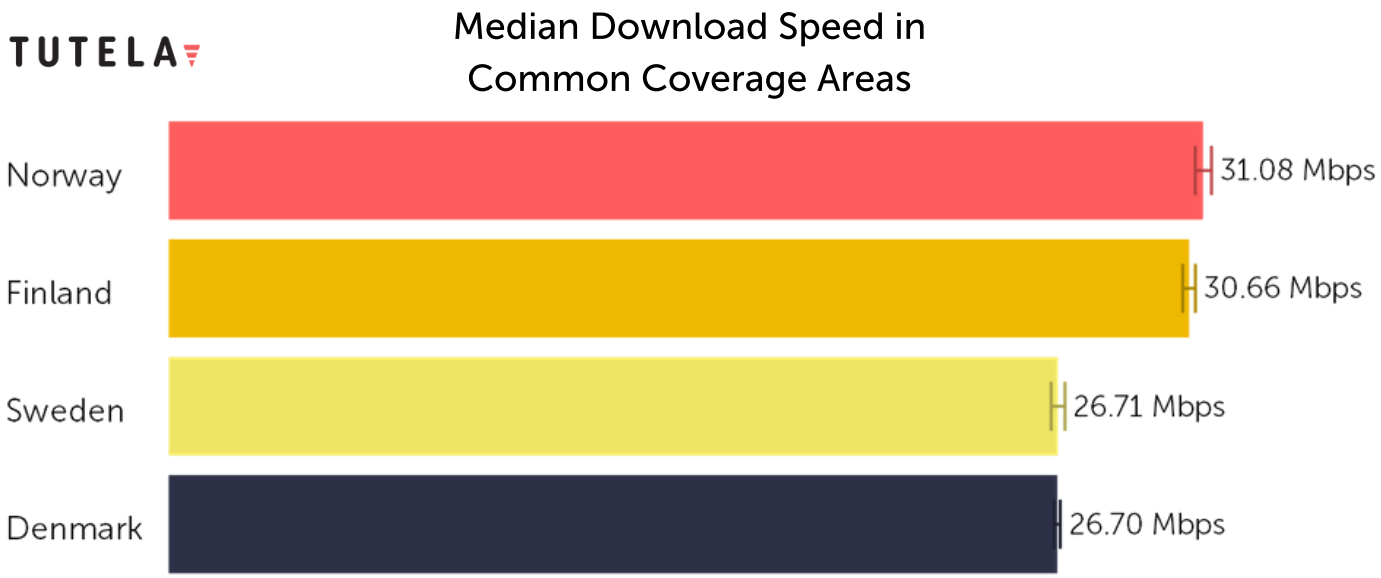
SWEDEN

In Sweden, 3 took first place for Excellent Consistent Quality, with 92.3% of tests meeting the thresholds that represent HD group video calls, 1080p video and realtime mobile gaming. However, Telia was close behind at 89.7%, with Tele2 and Telenor in quick succession after that. However, nowhere in the Nordics was the race tighter than for best Core Consistent Quality in Sweden. In fact, three of the four operators drew for the top spot for this metric, that represents user experience for web browsing, social media sharing and SD video streaming. 3, Tele2 and Telenor all scored above 96.7%, with overlapping error margins. Telia was just a whisker behind at 96.2%.



Download throughput

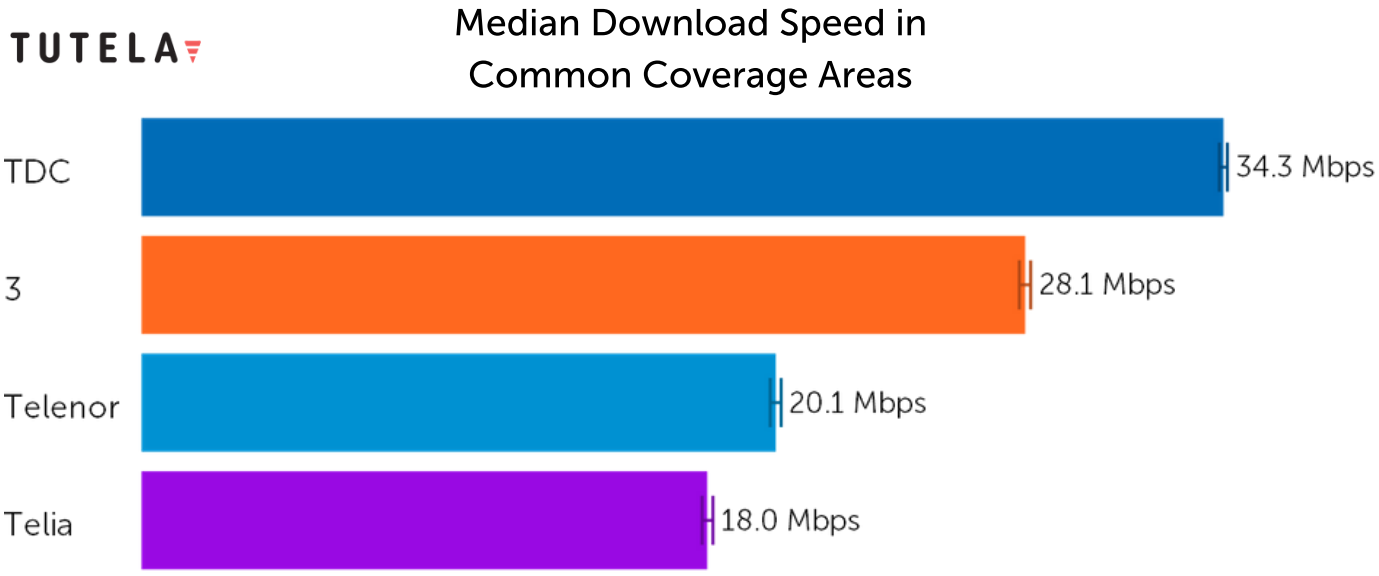
For download speed, the Nordic countries are divided into two tiers: Norway and Finland tied for first place, with subscribers on the main networks in Common Coverage Areas in each country experiencing equivalent median download speeds of approximately 31 Mbps. Meanwhile, Sweden and Denmark tied for third, with subscribers on the main networks in the Common Coverage Areas of their respective countries experiencing speeds of 26.7 Mbps. The median download speed for all four countries is among the best in the world – far above the requirements for many typical mobile services such as 1080p video streaming.



Download throughput

DENMARK

As one might expect given its wins for both Excellent and Core Consistent Quality, TDC had a compelling lead for median download throughput. Over 5 Mbps separated first and second place, with 3 achieving a median result of 28.1 Mbps. There was then another significant step down to third place of 8 Mbps, with third-place Telenor's median download speed in Common Coverage Areas coming in at 20.1 Mbps. All four providers offered speeds well in excess of the 5 Mbps threshold Tutela uses for Excellent Consistent Quality - not surprising given that earlier this year, Denmark placed joint 14th globally for median download throughput in Tutela's Global Mobile Experience report[2].

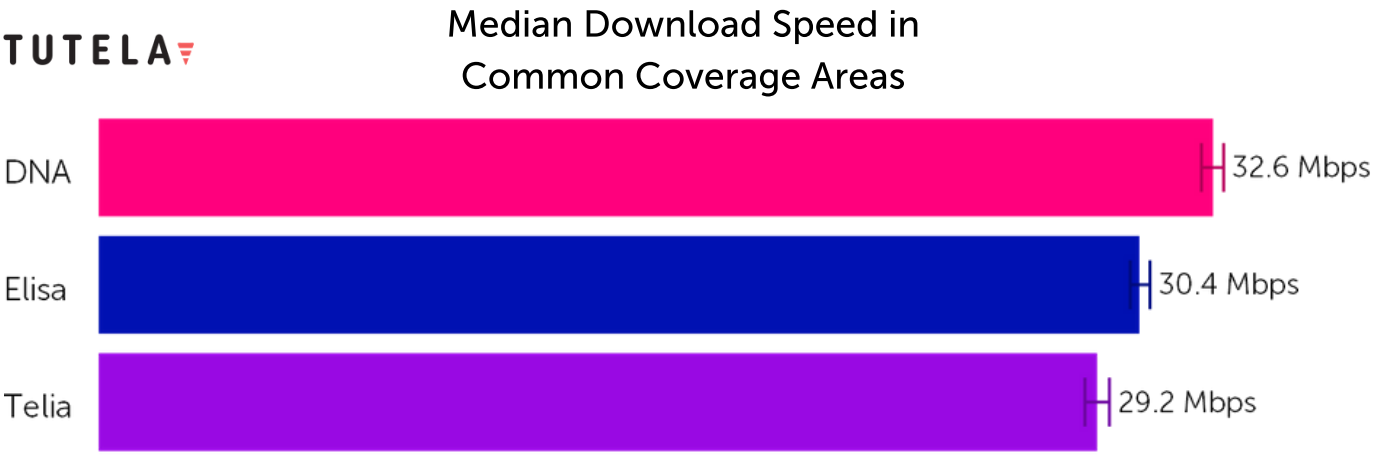


[2] Tutela, Global Mobile Experience
https://www.tutela.com/blog/global-mobile-experience-2020
Retrieved 02/02/21

Download throughput

FINLAND

For median download throughput in Finland, DNA took first place, with Telia - who led for both of Tutela's metrics – falling into third place. All three operators were separated by just 3.4 Mbps, with speeds well in excess of those needed for the majority of popular mobile applications. Indeed, Finland's slowest network, Telia, achieved a speed of 29.2 Mbps, which would have been enough to net it second place in Denmark or Sweden.

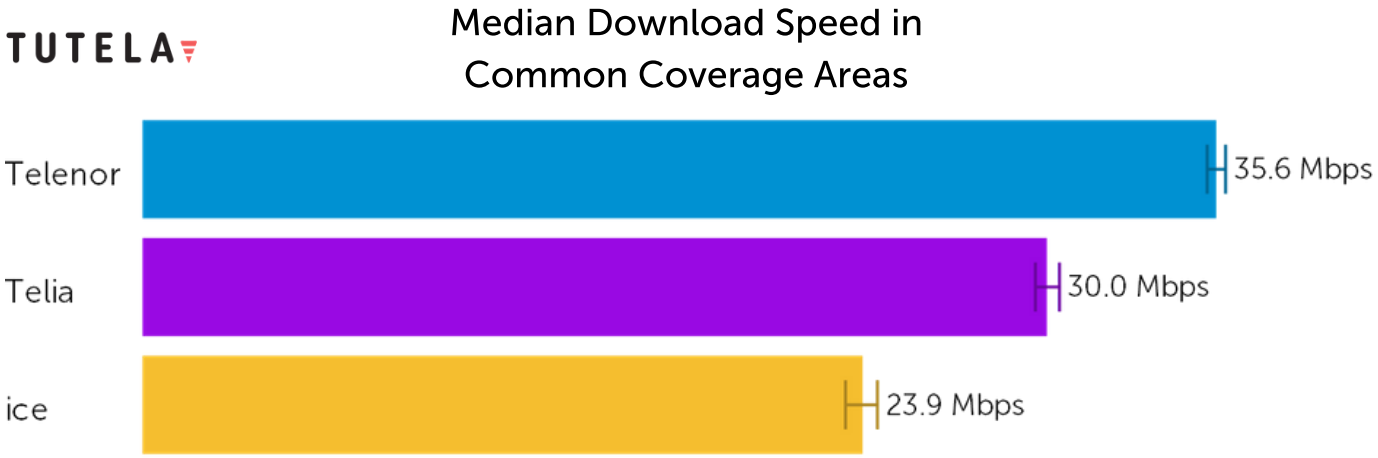


Download throughput

NORWAY

In Norway, Telenor came a clear first for median download speed, at 35.6 Mbps. This performance was enough to also position Telenor Norway as the fastest operator in the Nordics. Telia was then second at 30.0 Mbps, with ice in last place at 23.9 Mbps.

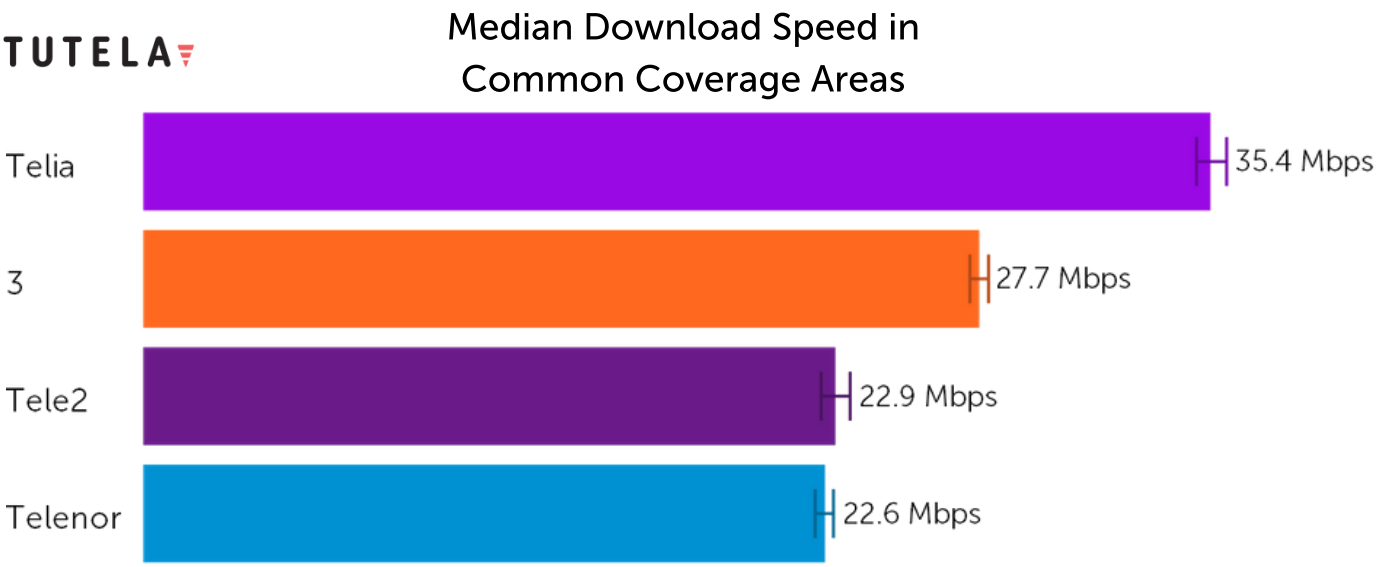
These echo the rankings each operator achieved for Excellent Consistent Quality, indicating that download speed are seldom a limiting factor for subscribers' mobile experiences in Norway.



Download throughput

SWEDEN

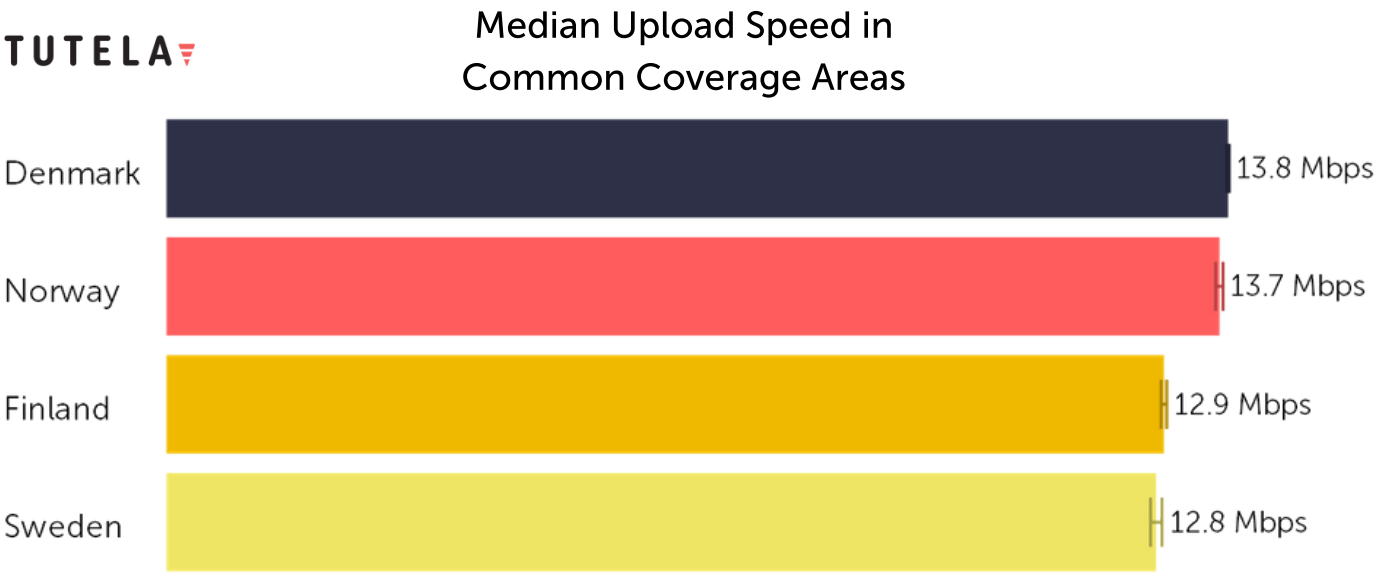
Telia Sweden outperformed its three competitors for median download speed with a result of 35.4 Mbps – more than 7 Mbps faster than second-place 3. This was despite Telia placing second for Excellent Consistent Quality, which highlights an important distinction in customer experience measurement – that speed is only a part of the picture. This is especially the case in a country like Sweden, where even the slowest operator achieve median speeds far in excess of common application requirements - such as the 5Mbps that Netflix recommends for HD video streaming[3]. 3, despite its slower median download speed (second at 27.7 Mbps), was still able to deliver a more reliable "Excellent" connection, more of the time. This can be down to differences in the test distribution (for example, if an operator has the highest median download speed, but also a high percentage of tests below 5Mbps), or down to performance in other metrics such as latency or packet loss – as is the case in this instance.



[3] Netflix, Internet Connection Speed Recommendations
https://help.netflix.com/en/node/306
Retrieved 02/02/21

Upload throughput

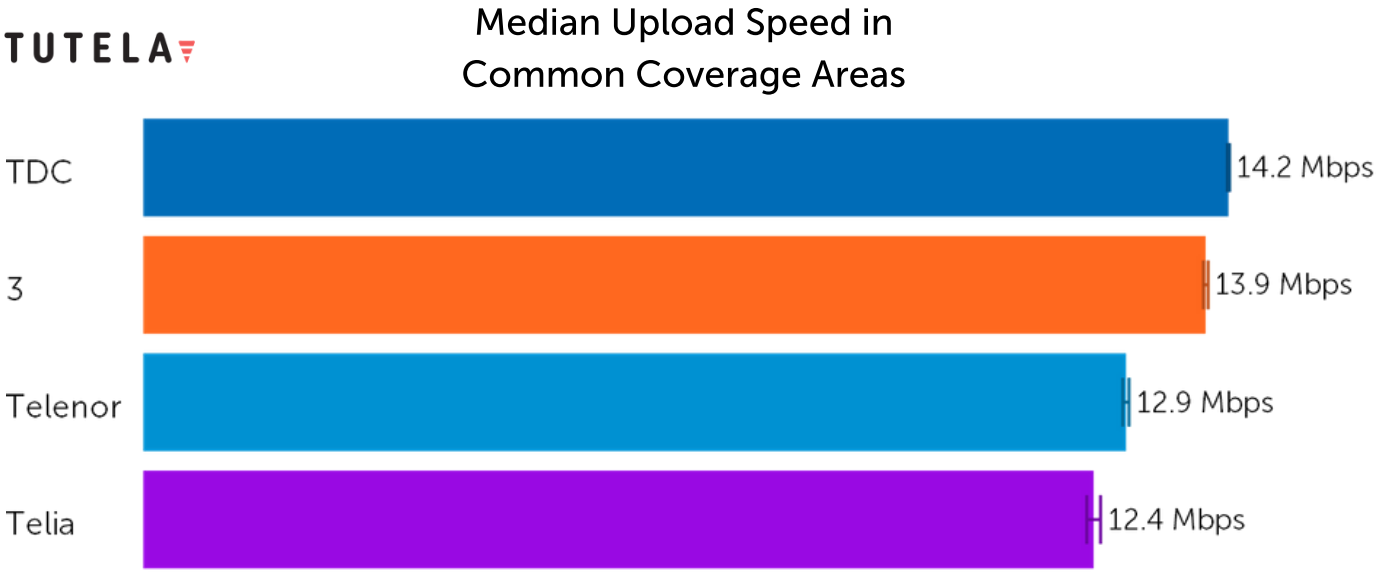
Denmark took the lead for median upload speed, with subscribers on the main networks experiencing a median upload throughput of 13.8 Mbps in Common Coverage Areas. This was closely followed by Norway, where users experienced speeds of 13.7 Mbps. Finland and Sweden then tied for third place, with a median upload speed of approximately 12.8 Mbps.



Upload throughput

DENMARK

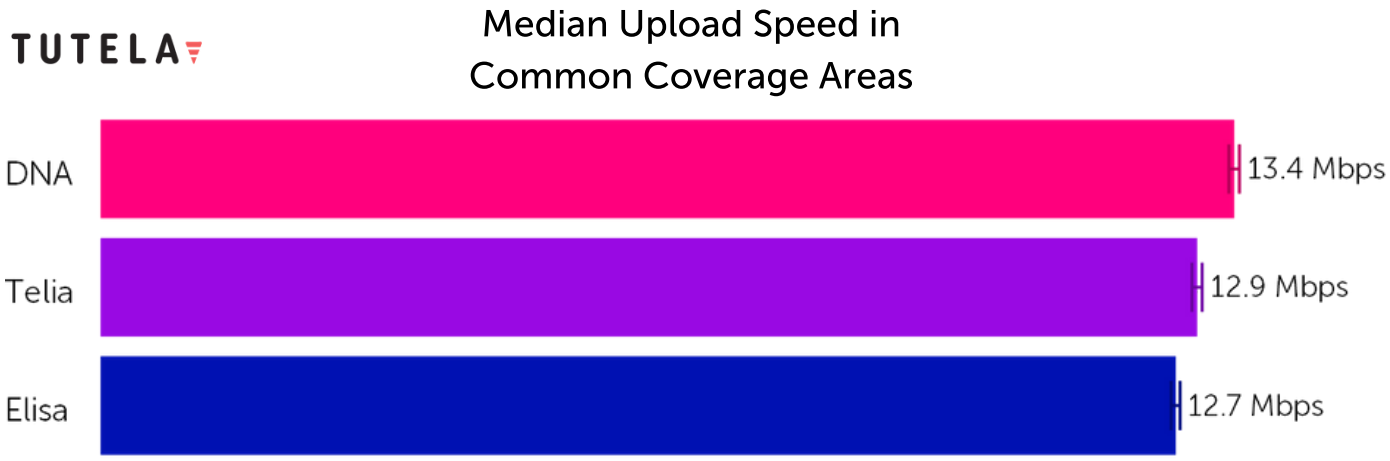
TDC led in Denmark at 14.2 Mbps, making this the fourth quality of experience metric where TDC has achieved a win in Denmark. However, 3 was again just behind at 13.9 Mbps for median upload speed. All four operators had upload speeds over 10 Mbps, with less than 2 Mbps separating first and last place.



Upload throughput

FINLAND

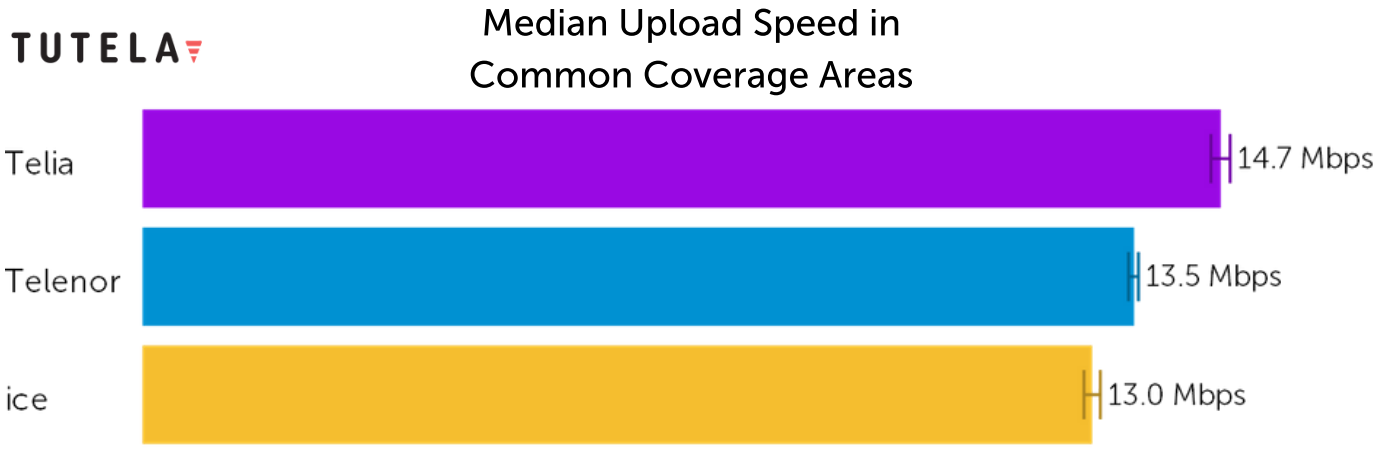
DNA eked out a first-place finish again for upload speed. Unlike for download throughput, Telia came in second at 12.9 Mbps. However, all three operators achieved results within a single Mbps of each other, showing just how closely fought the race is in Finland's Common Coverage Areas – and what a high quality of experience users on all three of the main networks can expect.



Upload throughput

NORWAY

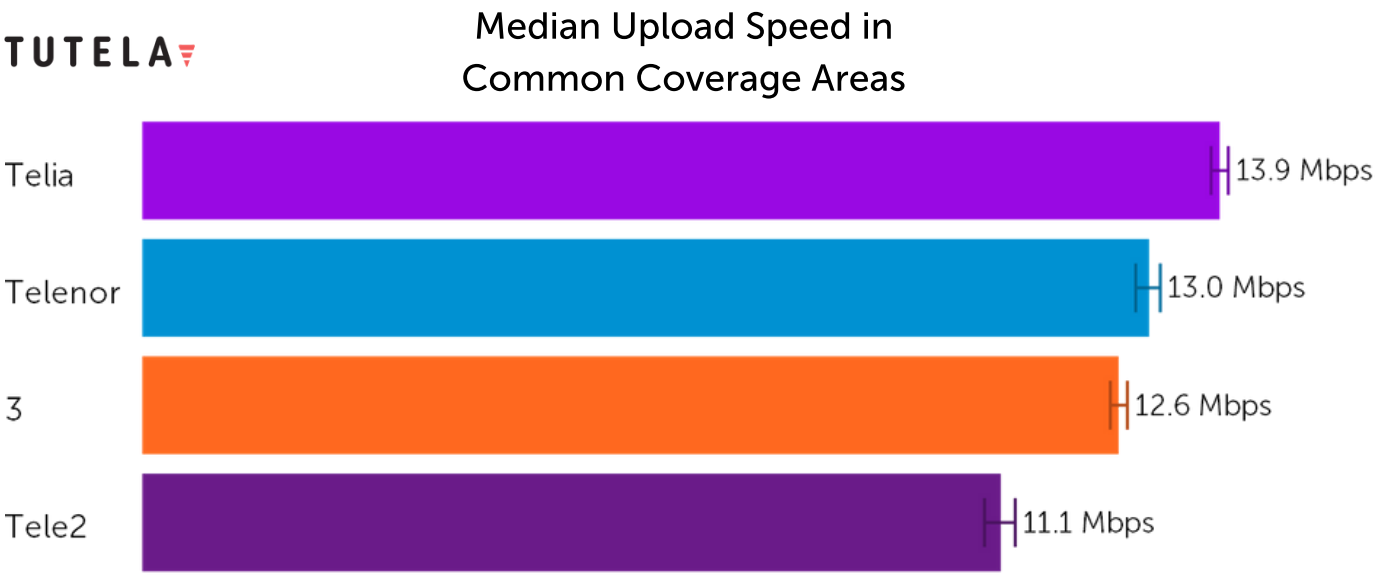
While Telenor had won for both Consistent Qualities, as well as download throughput, it fell into second place in Norway for upload speed, behind Telia – who came top at 14.7 Mbps. Telia's performance was enough to secure it the title of fastest median upload speed in the Nordic region, beating TDC in Denmark which placed second at a regional level. In Norway, ice again finished last, although the scale of difference was much smaller than for download throughput, with less than 2 Mbps between first and last.



Upload throughput

SWEDEN

In Sweden, Telia placed first again for upload throughput at 13.9 Mbps. Telenor surged from fourth place in the download throughput rankings to overtake 3, knocking it into third place. Tele2 was a notable step down from the other operators, 1.5 Mbps behind third-place 3, and 2.8 Mbps behind first-place Telia. This placed Tele2 in Sweden last among the Nordic operators for median uploaded throughput.



Latency

Finland took the lead in the regional latency comparison, with subscribers on the main networks getting a median one-way latency of 13.4ms in Common Coverage Areas. Sweden was a fraction behind at 13.8 ms. Norway placed third at 16.1 ms, with Denmark falling into last place at 17.5 ms.

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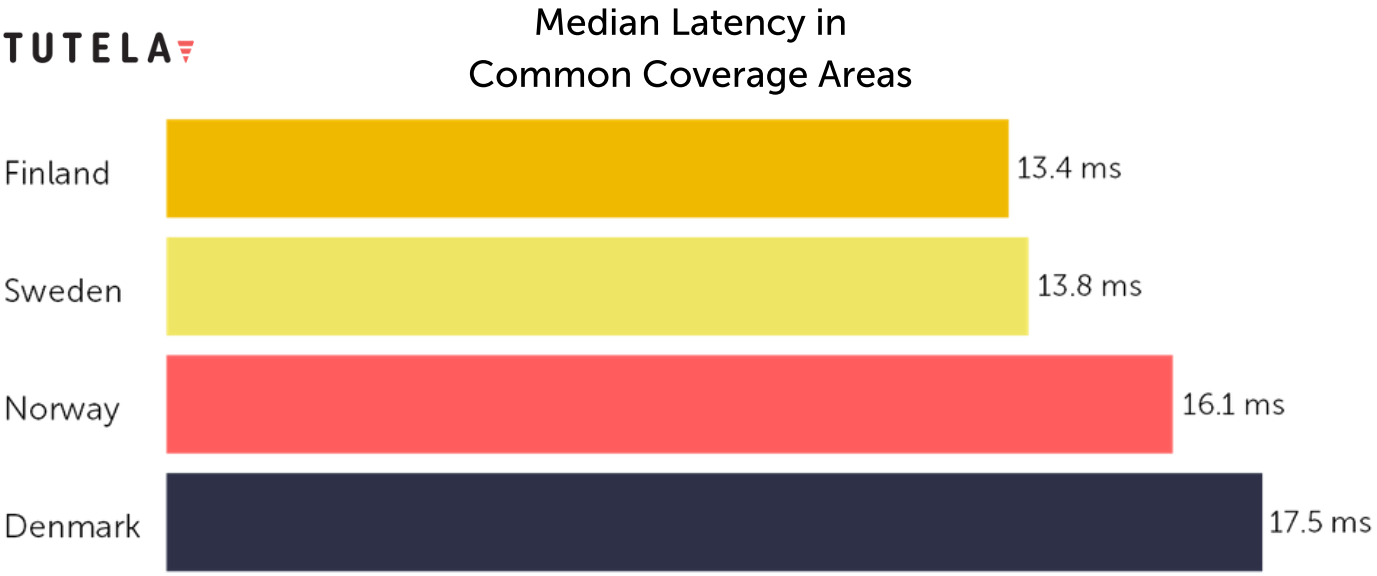
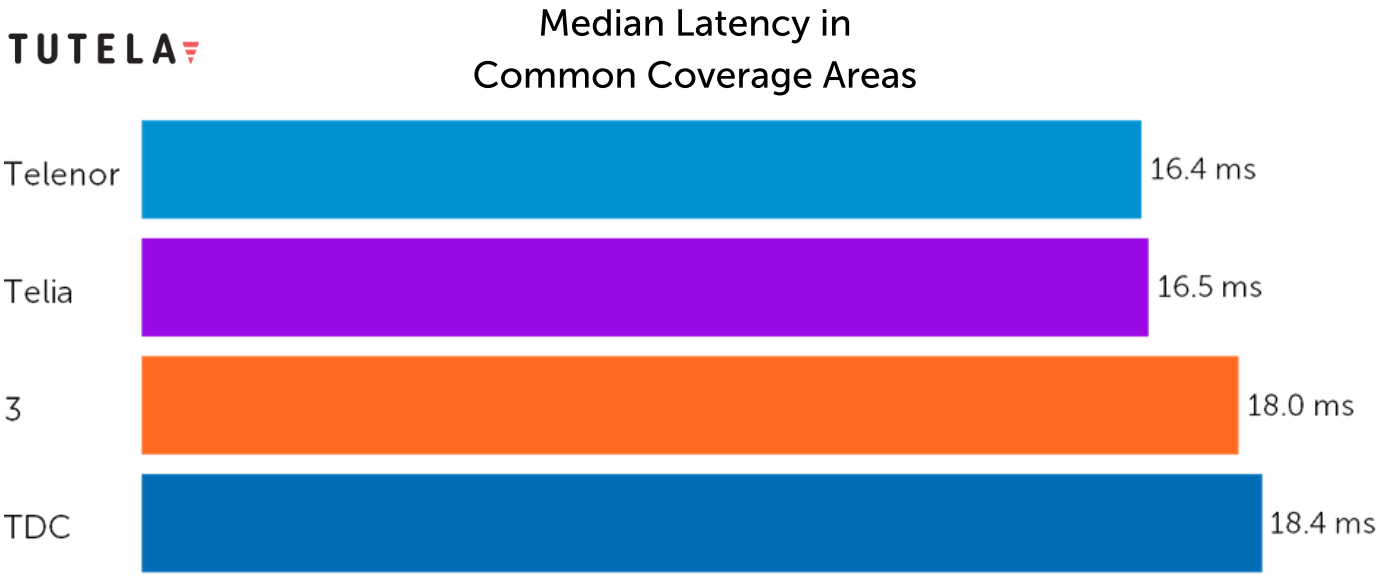


Latency

DENMARK

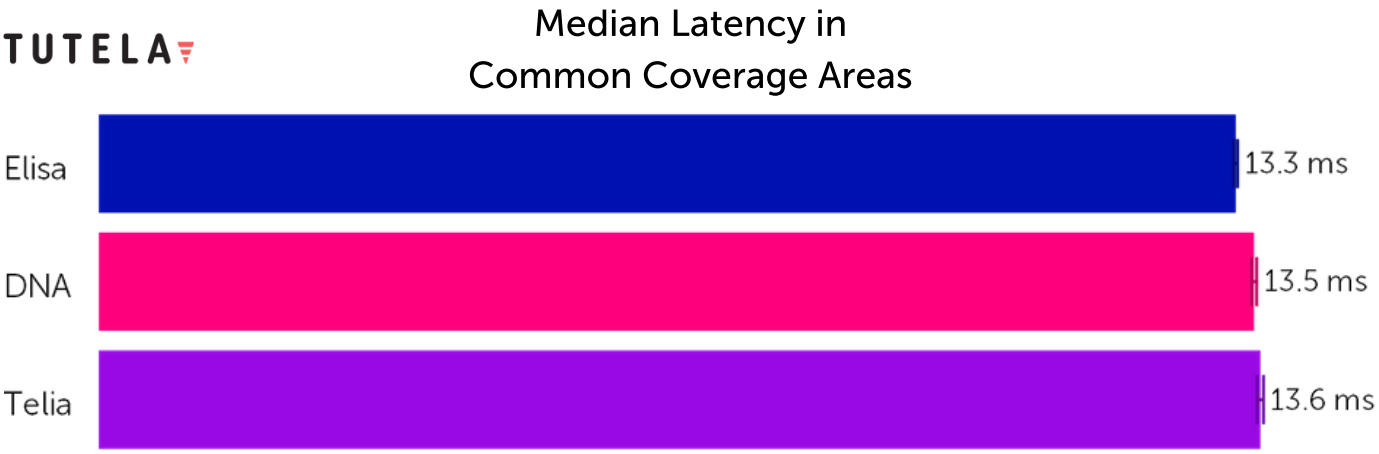
Telenor in Denmark offered its subscribers the most responsive network, eking out a win over Telia by just 0.1 ms, to finish with a one-way UDP latency of 16.4 ms. There was then a notable step down between second and third place of 1.5 ms, with 3 coming in third at 18.0 ms and TDC coming last at 18.4 ms.



Latency

FINLAND

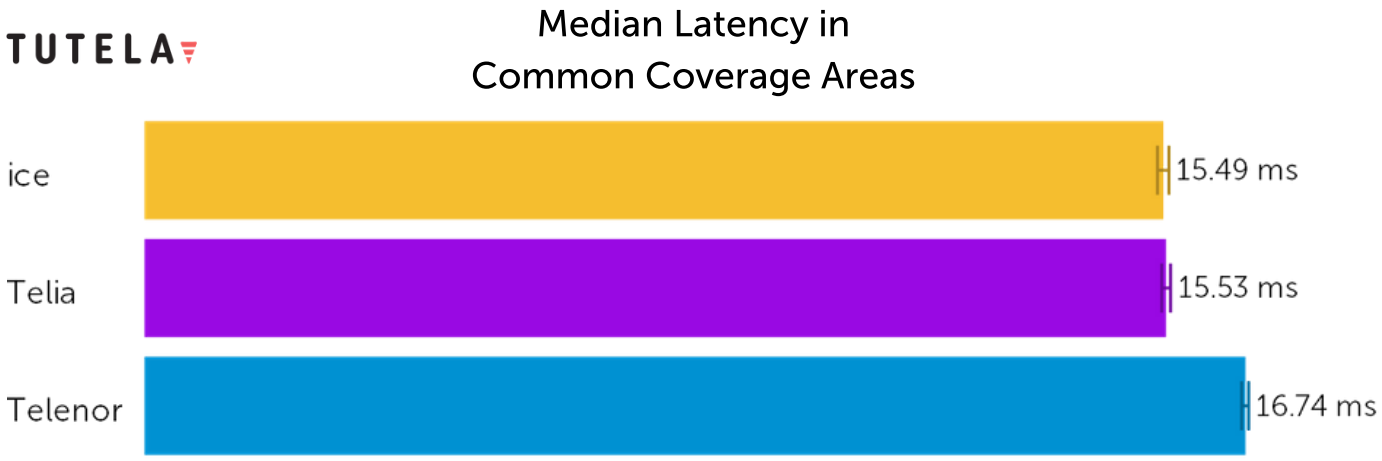
All three Finnish operators finished within a single millisecond of each other, however Elisa took the top spot at 13.3 ms. DNA was in second at 13.5 ms, and Telia was just in third at 13.6.



Latency

NORWAY

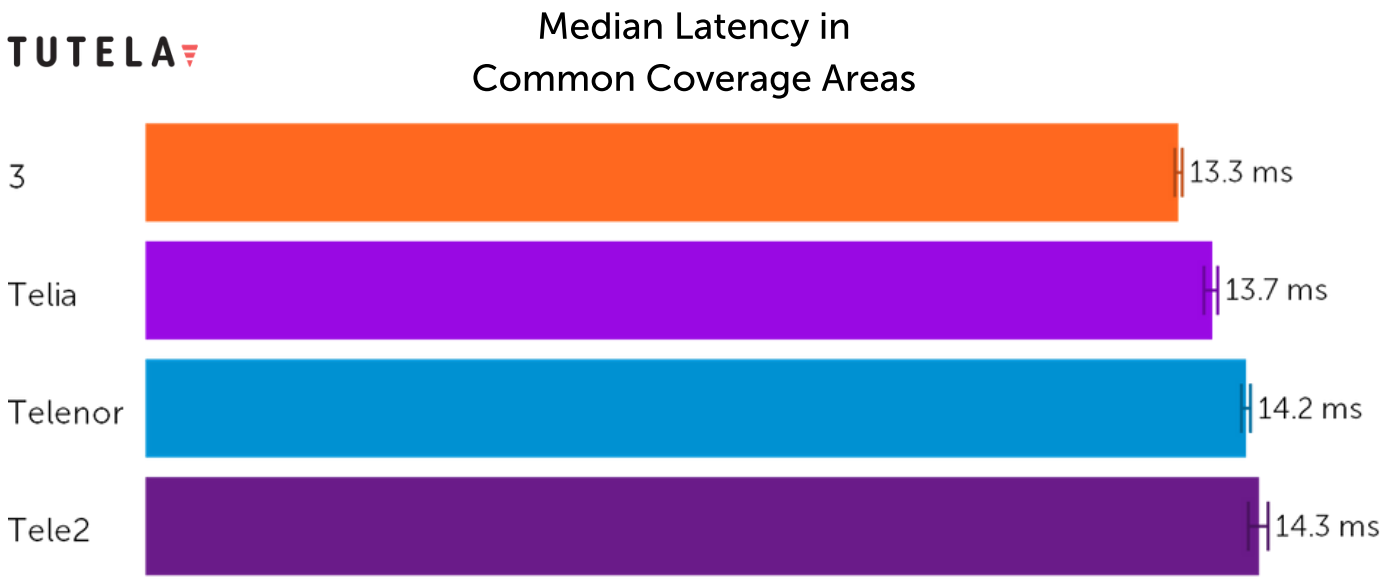
In Norway, ICE and Telia drew for the best latency, at 15.5 ms. Telenor was slightly behind the two with a one-way UDP latency of 16.7 ms. The medians for all three operators were well below the maximums allowed for latency-sensitive applications such as real-time voice or video calls.



Latency

SWEDEN

The latency results in Sweden were exceptionally close, with just a single millisecond separating first and last place. 3 had the best median latency at 13.3 ms, with Telia second at 13.7. Despite its close margins, this win for latency is significant for 3 in helping it achieve the highest Excellent Consistent Quality, and tie for first for Core Consistent Quality – as a more responsive network can help ensure reliable performance for real-time applications such as video calling, where any lapse in network responsiveness can be especially noticeable.



Technology usage

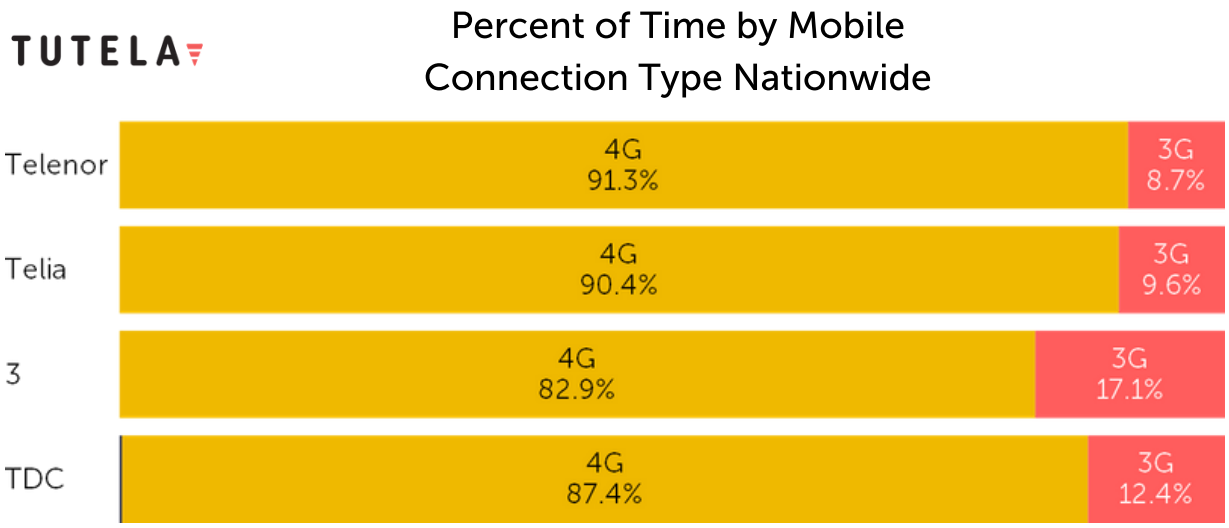
DENMARK

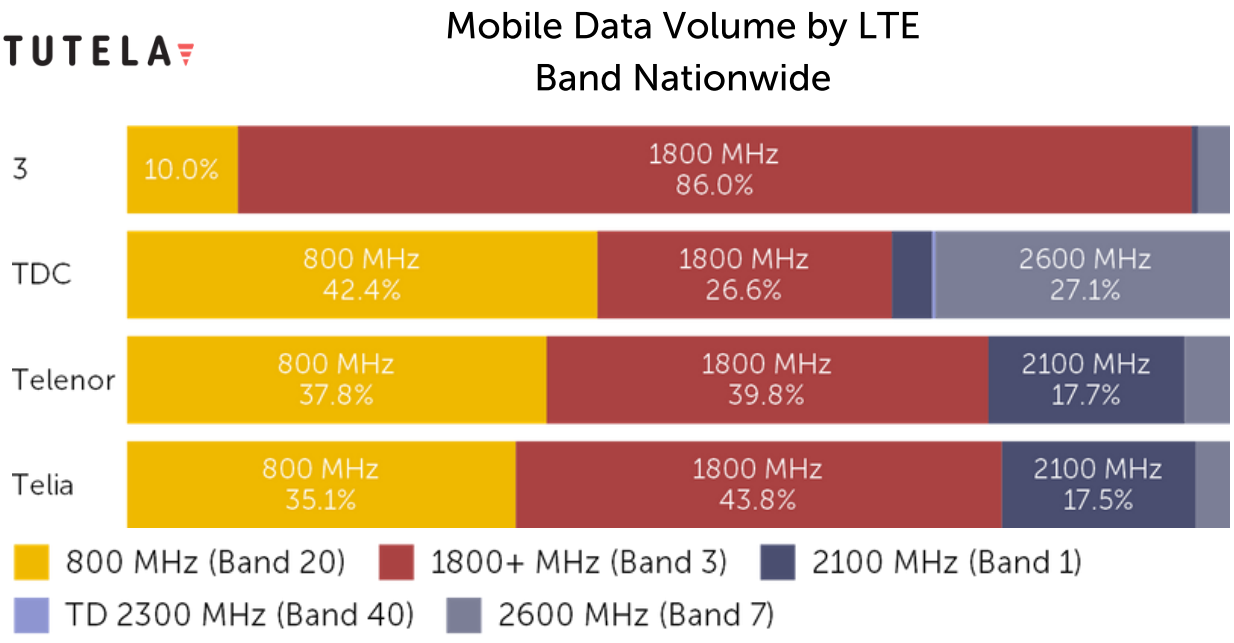
In Denmark, disparities in spectrum holdings show up in the form of different capacity strategies for the operators. The bulk of 3's LTE-available holdings are in the 1800 MHz band, and that band accounts for over 80% of 3's observed data volume. Around 10% of 3's data volume is accounted for by high-band 2600 MHz spectrum, with a further 10.0% transferred over 800 MHz — in this case, TDC's network, via a roaming agreement[4] that 3 has in place with TDC.

As expected with infrastructure sharing, Telenor and Telia's customers transceive their data over a similar range of LTE spectrum, and with similar spectrum holdings, TDC's spectrum usage is similar to Telenor/Telia's spectrum usage in the 800 MHz and 1800 MHz bands. The only difference is observable in higher-band spectrum, where TDC uses 2600 MHz most heavily, while Telenor/Telia utilize 2100 MHz.

[4] Telecompaper, 3 Denmark signs national roaming agreement with TDC, replacing deal with Telia
https://www.telecompaper.com/news/3-denmark-signs-national-roaming-agreement-with-tdc-replacing-deal-with-telia--1279184
Retrieved 02/02/21

For the percent of time connected to 4G, there was a significant difference between operators: Telenor led the way, with subscribers spending 91.3% of time connected to 4G. Telia was less than one percent behind, but both TDC (87.4%) and 3 (82.9%) had subscribers spend much more time connected to 3G. This shows up particularly in the latency results, where Telia and Telenor recorded a much lower median latency than 3 or TDC. Going forwards, however, TDC has a clear path for improvement: a sliver of 5G connectivity shows up, making TDC the only operator to have enough 5G connections (bearing in mind the six-month time period of the report, as well as the relatively low number of 5G-compatible devices in circulation) to show up in this report.





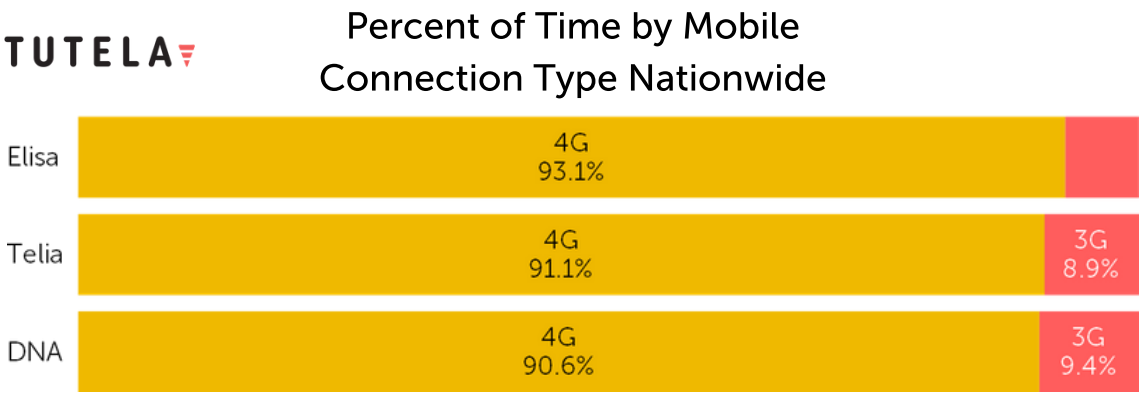
Technology usage

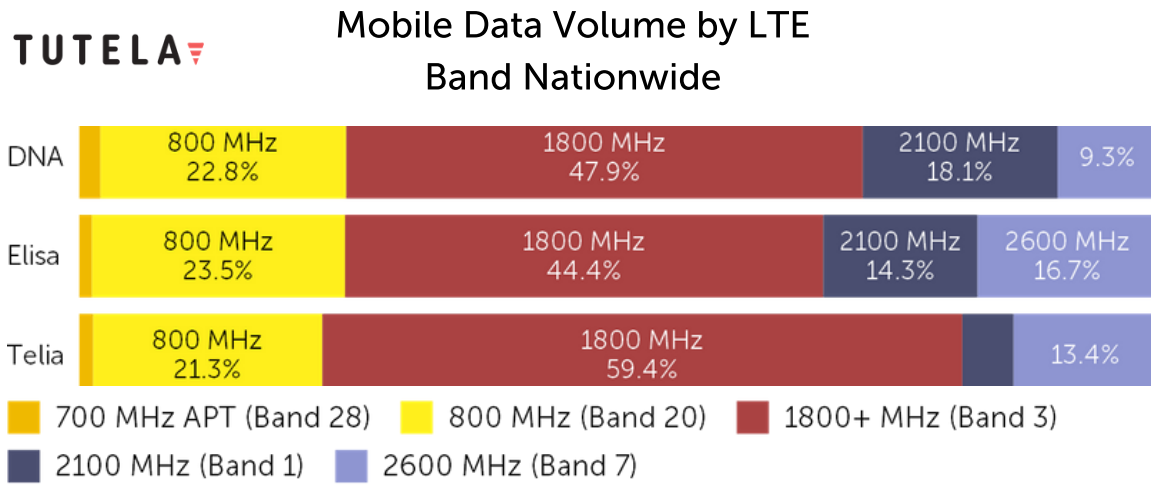
FINLAND

When it comes to LTE spectrum, all three Finnish operators have very similar spectrum holdings, so differences in spectrum usage are attributable to differences in network configuration and user behavior. Elisa uses high-band spectrum the most heavily, with 2100 MHz and 2600 MHz accounting for a little over 30% of Elisa customers' data volume.

Looking ahead, the parity between operators for spectrum holdings is not set to change significantly in initial 5G deployments.

All three operators have 130 MHz of TDD spectrum in the 3.5-3.7 GHz range available for use. For Finnish operators, tower density and network configuration are likely to be the difference-makers in the long run when it comes to 5G performance. Elisa leads the pack in terms of time that subscribers spent connected to 4G: at 93.1%, its subscribers spend the greatest proportion of time connected to 4G of any operator in the region. However, the results were also good for Telia and DNA, with all three operators finishing over 90%.

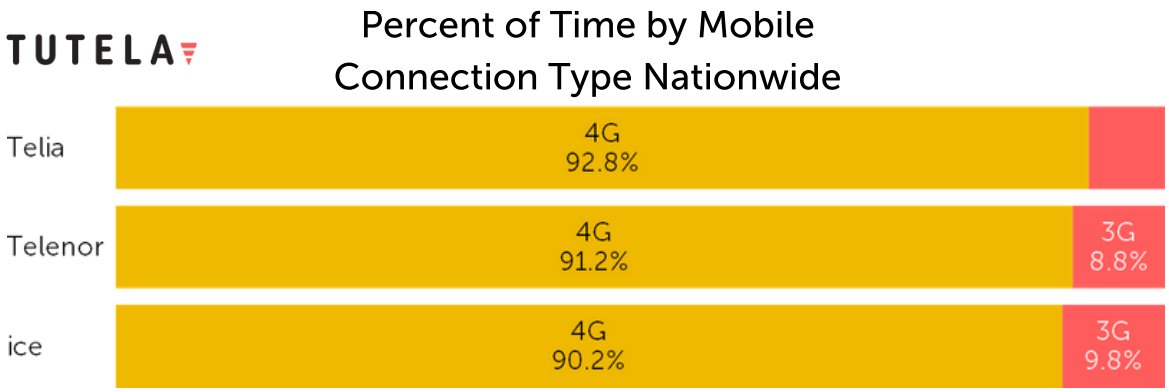


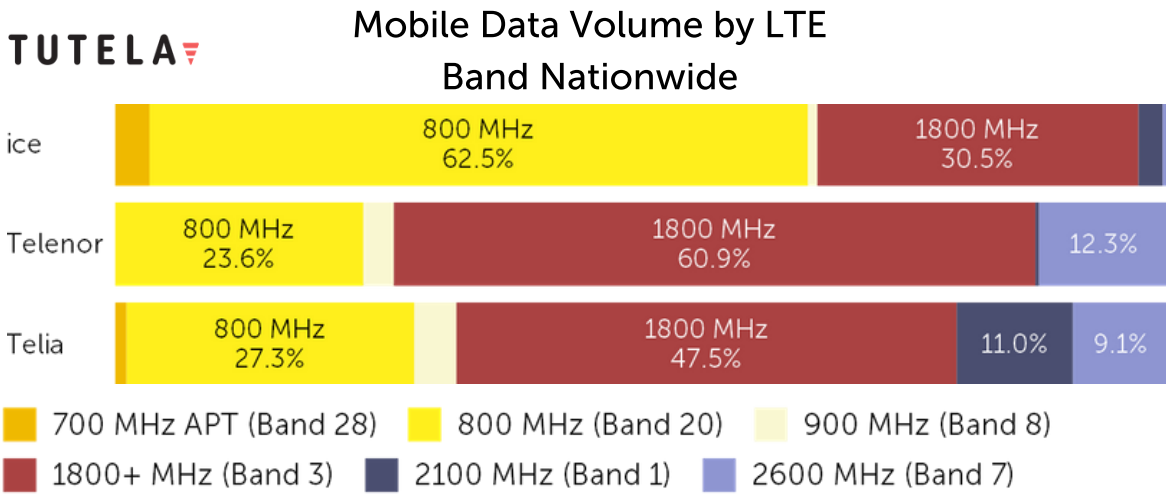


Technology usage

NORWAY

While all three networks in Norway use the 1800 MHz spectrum to some extent, the level of reliance on the mid-band spectrum varies between operators. Nearly 60% of Telenor customers' data traffic uses the 1800 MHz band, and it uses the lower-band 800 MHz (where all three operators own just 20 MHz) for less than a quarter of data traffic. Ice, meanwhile, is virtually the inverse: 800 MHz accounts for 62.5% of ice subscribers' data volume, with 1800 MHz at nearly 30%, and high-band spectrum less than 10%. When it comes to the time spent on 3G/4G, the split is much more even between operators. Telia is in first place, with subscribers spending 92.8% of time connected to 4G networks. Ice was in third place, but subscribers still spent more than 90% of time connected to a 4G connection.





Technology usage

SWEDEN

Three different network strategies are clearly evident in Sweden: Telenor and Tele2, thanks to their joint infrastructure deal, have a nearly-identical distribution of LTE data traffic, spread relatively evenly across low-band, mid-band, and high-band spectrum.

If anything, the low utilization of 1800 MHz — accounting for less than 20% of subscribers' data traffic for each network — is atypical for European operators, which tend to use the 1800 MHz band heavily for capacity. 3, on the other hand, has no 1800 MHz LTE deployment, so instead splits its data volume relatively equally between 800 MHz and 2100/2600 MHz high-band deployments. Although this means that 3 is leaning relatively heavily on just 20 MHz of spectrum for nearly half of its data volume, it still managed to take first place in Excellent Consistent Quality for Sweden.

For the percentage of time connected to 3G/4G, Telia came out on top, with subscribers spending 92.7% of time connected to a 4G network. Telenor was a close second, on 90.5%, while Tele2 and 3 lagged slightly behind.

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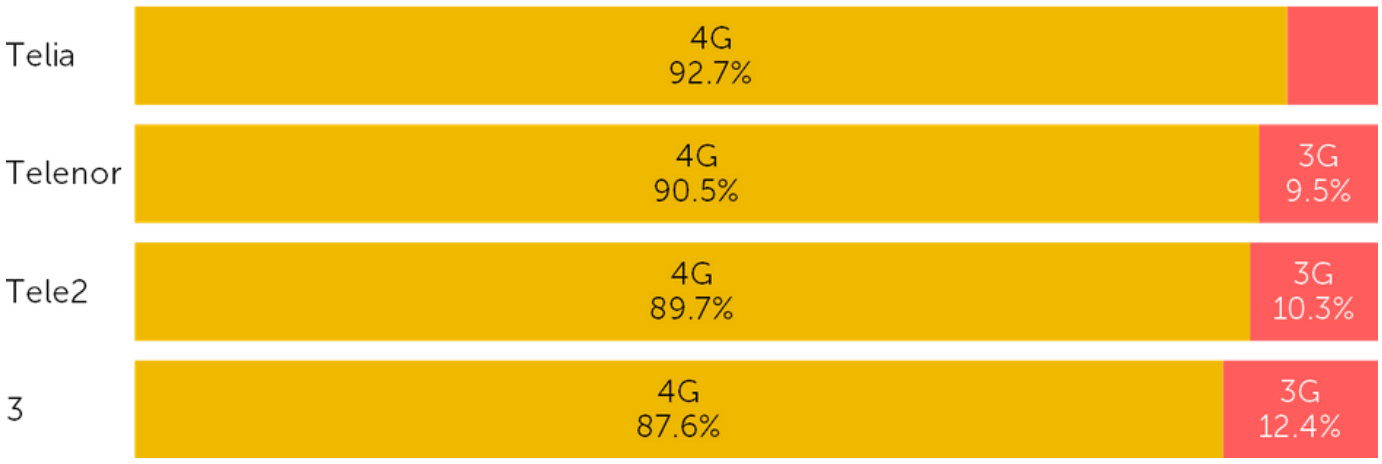
Percent of Time by Mobile Connection Type Nationwide



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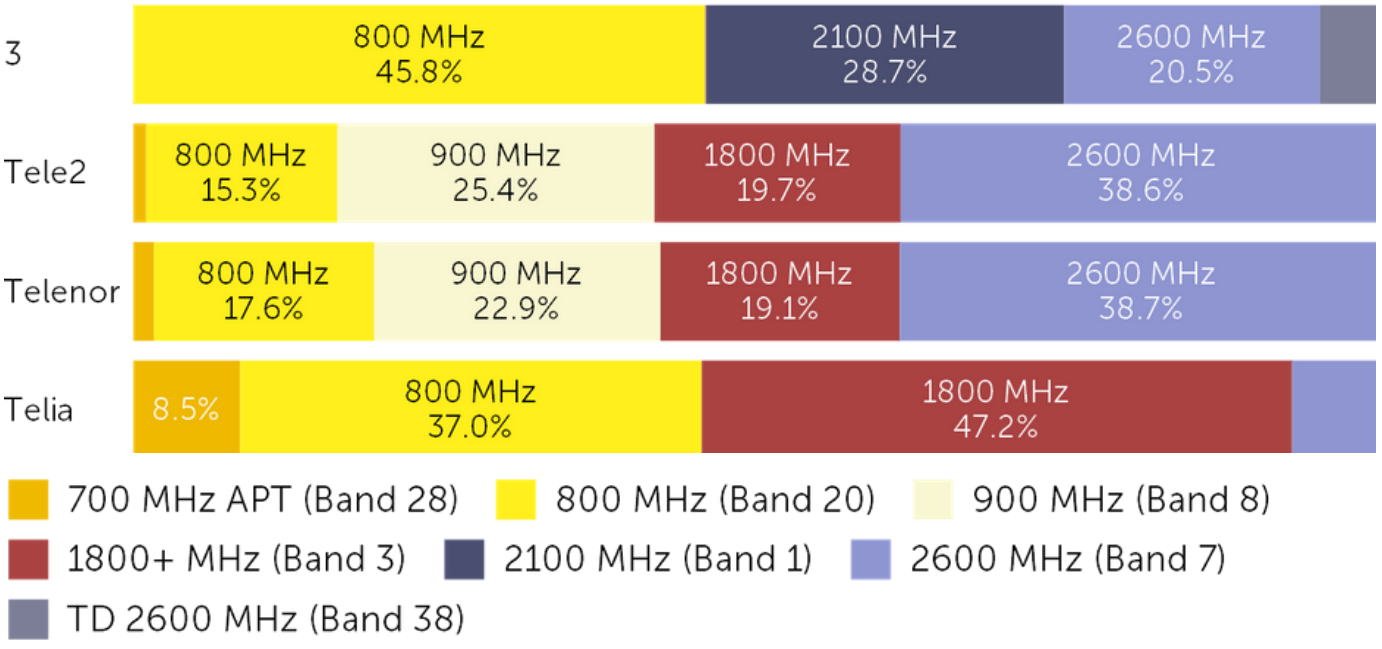
Mobile Data Volume by LTE Band Nationwide



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 organizations in the mobile industry to understand and improve the world's networks. Tutela is a member of the Comlinkdata family.

Tutela collects data and runs network tests via software embedded in a diverse range of consumer applications, which enable the measurement of real-world quality of experience for mobile users, 24/7. For this report, Tutela has collected over 1.8 million speed and latency tests, between July 1st and December 31st, 2020.

Tutela measures mobile experience based on the real-world performance of actual network subscribers for a given brand, 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 websites, 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 through to the latest 5G 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. To more objectively evaluate when connections 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 also considers times when a Consistent Quality style test was attempted, but subsequently failed for distinguishable connectivity issues on the download or server response component, towards the total percentage of "failed" tests against both sets of thresholds. 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, 2020. 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	Time to first byte
Minimum acceptable value	5 Mbps	1.5 Mbps	50 ms	30 ms	1%	3.2 s

Core Quality

KPI	Download throughput	Upload throughput	Latency	Jitter	Packet loss	Time to first byte
Minimum acceptable value	1.5 Mbps	500 Kbps	100 ms	50 ms	5%	10.67 s

Discover Tutela Explorer

Tutela Explorer is a powerful cloud-based solution for real-time analysis of crowdsourced data. Using the platform, mobile operators can:

- Create coverage and quality maps
- Benchmark network quality and coverage across all operators
- Drill down to any KPI at city, street or even building level
- Analyse spectrum utilisation, performance and more

Visit www.tutela.com/explorer to learn more

Learn more

Appendix

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Total Results Overview in Common Coverage Areas

		Download Throughput	Upload Throughput	Latency	Excellent CQ	Core CQ
Denmark	3	28.1 Mbps ± 0.19 Mbps	13.9 Mbps ± 0.03 Mbps	18.0 ms ± 0.036 ms	91.37% ± 0.20%	97.57% ± 0.07%
	Telenor	20.1 Mbps ± 0.18 Mbps	12.9 Mbps ± 0.04 Mbps	16.4 ms ± 0.025 ms	85.37% ± 0.21%	97.23% ± 0.06%
	Telia	18.0 Mbps ± 0.18 Mbps	12.4 Mbps ± 0.09 Mbps	16.5 ms ± 0.022 ms	89.35% ± 0.19%	97.62% ± 0.06%
	TDC	34.3 Mbps ± 0.13 Mbps	14.2 Mbps ± 0.02 Mbps	18.4 ms ± 0.017 ms	95.47% ± 0.10%	98.23% ± 0.05%
Finland	DNA	32.6 Mbps ± 0.34 Mbps	13.4 Mbps ± 0.06 Mbps	13.5 ms ± 0.032 ms	86.53% ± 0.35%	91.29% ± 0.27%
	Elisa	30.4 Mbps ± 0.31 Mbps	12.7 Mbps ± 0.06 Mbps	13.3 ms ± 0.024 ms	84.09% ± 0.29%	90.64% ± 0.21%
	Telia	29.2 Mbps ± 0.36 Mbps	12.9 Mbps ± 0.06 Mbps	13.6 ms ± 0.036 ms	88.23% ± 0.33%	95.80% ± 0.14%
Norway	ice	23.9 Mbps ± 0.56 Mbps	13.0 Mbps ± 0.11 Mbps	15.5 ms ± 0.089 ms	88.02% ± 0.51%	94.85% ± 0.22%
	Telenor	35.6 Mbps ± 0.31 Mbps	13.5 Mbps ± 0.08 Mbps	16.7 ms ± 0.058 ms	93.44% ± 0.30%	96.89% ± 0.12%
	Telia	30.0 Mbps ± 0.42 Mbps	14.7 Mbps ± 0.13 Mbps	15.5 ms ± 0.069 ms	90.88% ± 0.35%	95.57% ± 0.14%
Sweden	3	27.7 Mbps ± 0.31 Mbps	12.6 Mbps ± 0.11 Mbps	13.3 ms ± 0.051 ms	92.26% ± 0.30%	96.89% ± 0.11%
	Tele2	22.9 Mbps ± 0.49 Mbps	11.1 Mbps ± 0.21 Mbps	14.3 ms ± 0.138 ms	88.06% ± 0.70%	96.71% ± 0.33%
	Telenor	22.6 Mbps ± 0.32 Mbps	13.0 Mbps ± 0.17 Mbps	14.2 ms ± 0.060 ms	85.78% ± 0.45%	96.70% ± 0.14%
	Telia	35.4 Mbps ± 0.54 Mbps	13.9 Mbps ± 0.11 Mbps	13.7 ms ± 0.107 ms	89.65% ± 0.44%	96.22% ± 0.17%

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 CCPA and 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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