



TUTELA 

Global Mobile Experience

Annual Report



SEPTEMBER 2019

www.tutela.com

Introduction

It's hard to ignore stories of the "race to 5G" between nations competing for 5G supremacy; it's a narrative we see in the media, and in the marketing from governments, regulators and operators. Across the world, networks are hyping the potential of 5G to deliver almost unimaginably fast mobile speeds and better network experiences for consumers.

The received wisdom is that the frontrunners(1) include South Korea, the US, Japan and China, while other research also highlights Qatar, Switzerland, Finland, Spain, UAE and Australia(2) as potential leaders in this space. However, while 5G is no doubt the future, it's important not to overlook the mobile experience of consumers today. According to the GSMA, in 2018, 4G overtook 2G as the most prevalent mobile

technology globally, accounting for 43% of total connections. Even looking ahead to 2025, current GSMA predictions suggest that 59% of connections will be over a 4G connection, compared to just 15% utilizing 5G(3). In the rush to 5G leadership, it's important to remember that 4G (and to a smaller extent 3G) still represents the main "workhorse" for carrying mobile traffic.

With that in mind, Tutela's first annual Global Mobile Experience Report(4) takes stock of the Consistent Quality experienced by users of mobile networks around the world today – that is, how current networks, relying heavily on 4G, perform against today's common mobile use cases, using Tutela's Excellent and Core benchmarks for network Quality of Experience.

(1) SDxCentral, The Top Countries Most Likely to Launch 5G First <https://www.sdxcentral.com/5g/definitions/5g-network-countries/> Retrieved 27 August 2019

EY, China is poised to win the 5G race [https://www.ey.com/Publication/vwLUAssets/ey-china-is-poised-to-win-the-5g-race-en/\\$FILE/ey-china-is-poised-to-win-the-5g-race-en.pdf](https://www.ey.com/Publication/vwLUAssets/ey-china-is-poised-to-win-the-5g-race-en/$FILE/ey-china-is-poised-to-win-the-5g-race-en.pdf), <https://www.ctia.org/news/race-to-5g-report>. Retrieved 28 August 2019

CNN, Who's winning the 5G race? <https://edition.cnn.com/2019/04/02/tech/5g-us-china-ctia-readiness-report/index.html>. Retrieved 2 September 2019 -- among many others

(2) Arthur D Little Global, South Korea most advanced in 5G Leadership, Arthur D. Little analysis finds <https://www.adlittle.com/en/insights/press/press-release/south-korea-most-advanced-5g-leadership-arthur-d-little-analysis-finds>. Retrieved 26 August 2019

(3) GSMA, The Mobile Economy 2019 <https://www.gsmaintelligence.com/research/2019/02/the-mobile-economy-2019/731/>, Retrieved 20 August 2019

(4) It is important to note that some countries are not included in this report in cases where their data protection requirements are not compatible with Tutela's own commitments to, and provisions for, user privacy and data protection. In addition, countries where there was a low level of crowdsourced data have been excluded to ensure a fair comparison.



Key findings

- In the country rankings, Japan came top of the leaderboard with the highest level of Excellent Consistent Quality, while Norway (which came second for Excellent Consistent Quality by just 0.1%) came top for Core Consistent Quality.
- By operator, LG U+ in South Korea was the world's best mobile network, as measured by Excellent Consistent Quality. Telenor in Norway delivered the highest Core Consistent Quality, and came in second for Excellent Consistent Quality by just 1.2%.
- While Europe dominates the ranking table for both Excellent and Core Consistent Quality, Oceania achieved the highest overall Excellent and Core Consistent Quality across the continent.
- More than a third of countries tested delivered a Core Consistent Quality above 90%, indicating that many of the world's networks are already suitable for standard-definition video streaming and core mobile use cases. However, just two countries delivered an Excellent Consistent Quality percentage over 90%. This indicates that while basic connectivity is becoming more widespread, there is a clear need for the extra capacity offered by 5G to enable the next generation of mobile use cases

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. This report used over 170 million speed tests from 60 million unique iOS and Android devices. Data was collected from 1st May 2019 to 1st August 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.

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%

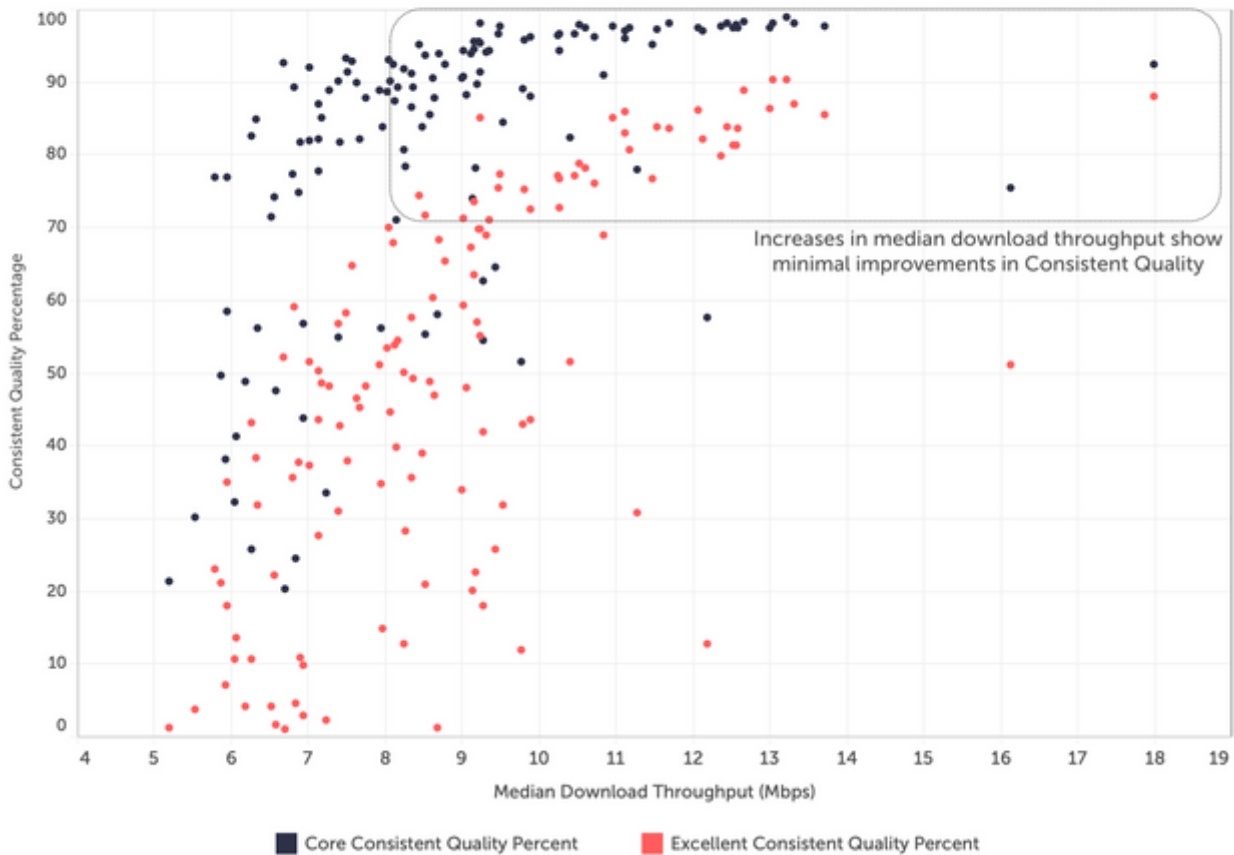
So how does this relate back to speeds? Above a certain threshold, speed becomes almost irrelevant in delivering a better network quality against Tutela's Consistent Quality thresholds. Countries with a median download throughput of 6.7 Mbps (like Bosnia and Herzegovina) could deliver a Core Consistent Quality over 90%, in the same league as South Korea with a median download throughput of 17.99 Mbps. The same is true for Excellent Consistent Quality – Estonia, for example, had a median

download throughput of 9.24 Mbps, and an Excellent Consistent Quality percentage of 85.08%. South Korea, meanwhile, whose median download speed was almost double that of Estonia's, had an Excellent Consistent Quality just 2.97 percentage points more. In short: provisioning networks in such a way as to excel in terms of median download throughput delivers diminishing returns in user experience of network quality, as can be seen in the below chart.



Download Throughput Increases over ~8 Mbps Deliver Minimal Consistent Quality Improvement

Comparison of Median Download Throughput and Consistent Quality

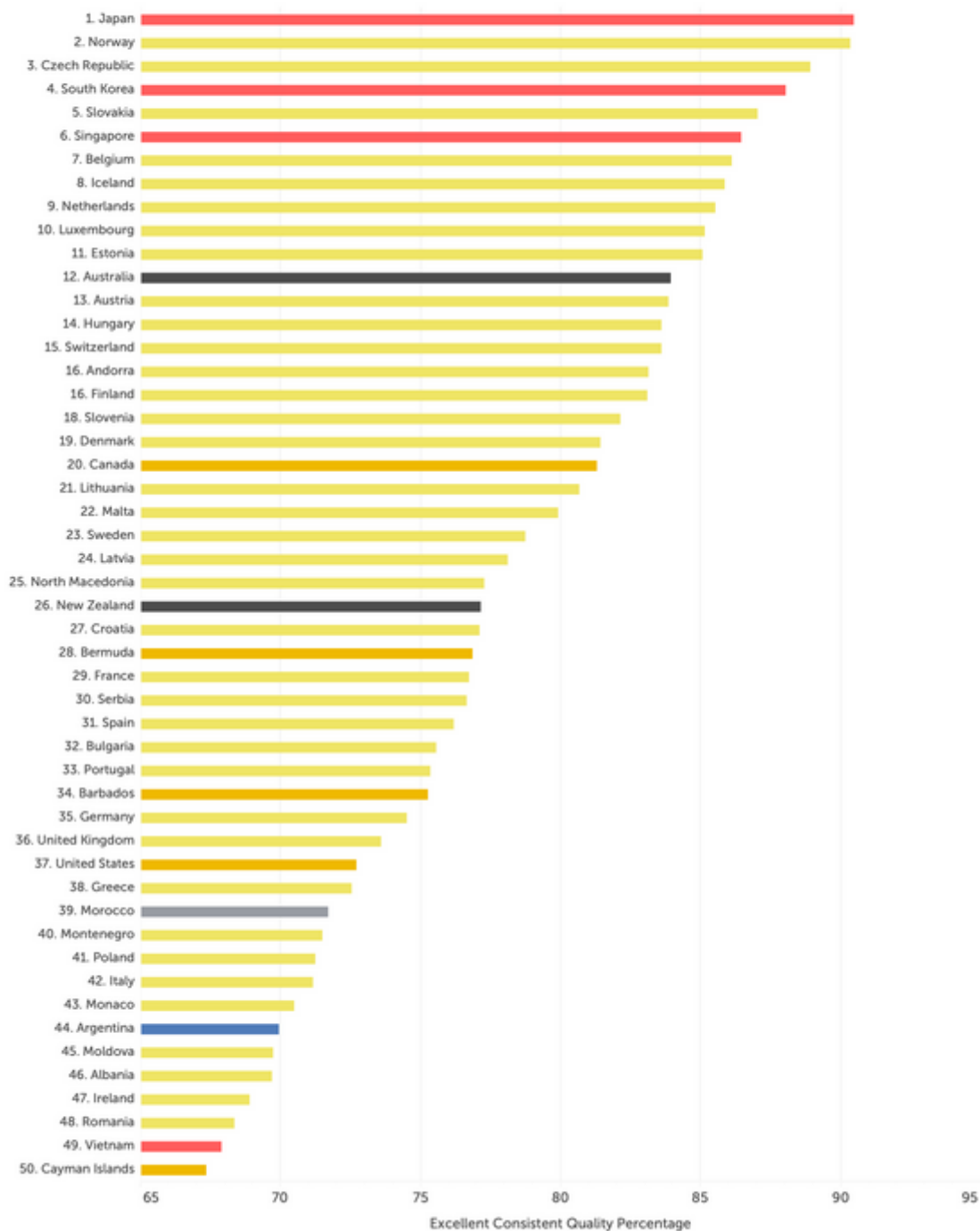


Excellent Consistent Quality - Global ranking

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Excellent Consistent Quality Percentage (3G and 4G) - Top 50 Countries

The % of tests where a mobile connection was good enough for the most demanding popular apps (including HD video group calls and 1080p video streaming)



 Africa

 Asia

 Europe

 North America

 Oceania

 South America

The competition for first place for Excellent Consistent Quality was significant, with Japan just beating Norway for the top spot by just 0.1%. This means Japanese subscribers, when they had a connection, had the highest proportion of tests meeting the network requirements for HD video streaming, group HD video calling and other demanding mobile use cases.

European countries in particular dominate the top 50 table, accounting for approximately 75% of entries. In the top 10 spots, second-place Norway was joined by the Czech Republic, Slovakia, Belgium,

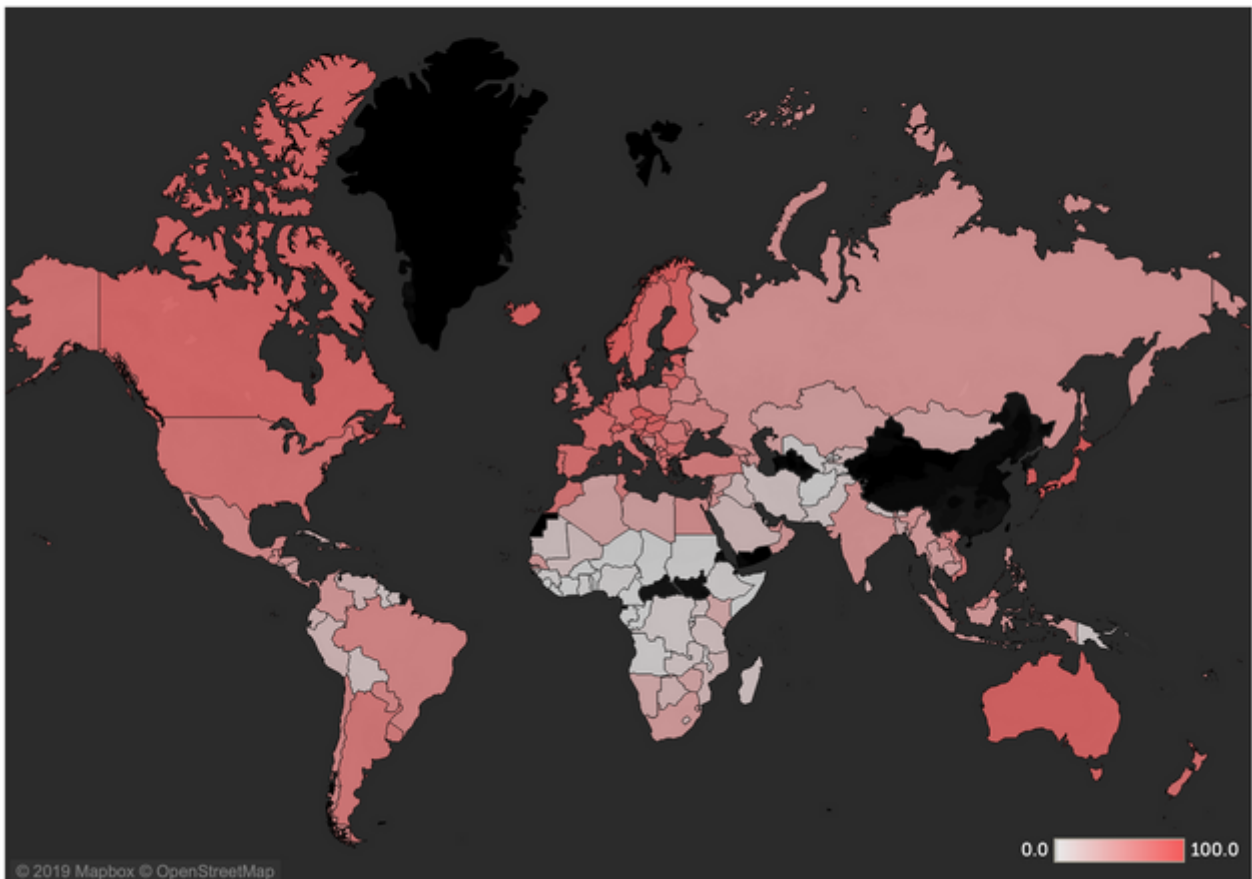
Iceland, the Netherlands and Luxembourg. These appeared alongside some of the technological heavyweights in Asia – Japan took first place, South Korea came in fourth, and Singapore in sixth.

Outside of Eurasia, the Oceanic continent was lead by Australia in 12th place, with New Zealand also appearing in the top 50 rankings at 26th. Canada's networks provided the highest Excellent Consistent Quality in North America (20th overall), while Morocco led in Africa (39th) and Argentina in South America (44th).

Excellent Consistent Quality Percentage (3G and 4G)

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The % of tests where a mobile connection was good enough for the most demanding popular apps (including HD video group calls and 1080p video streaming)

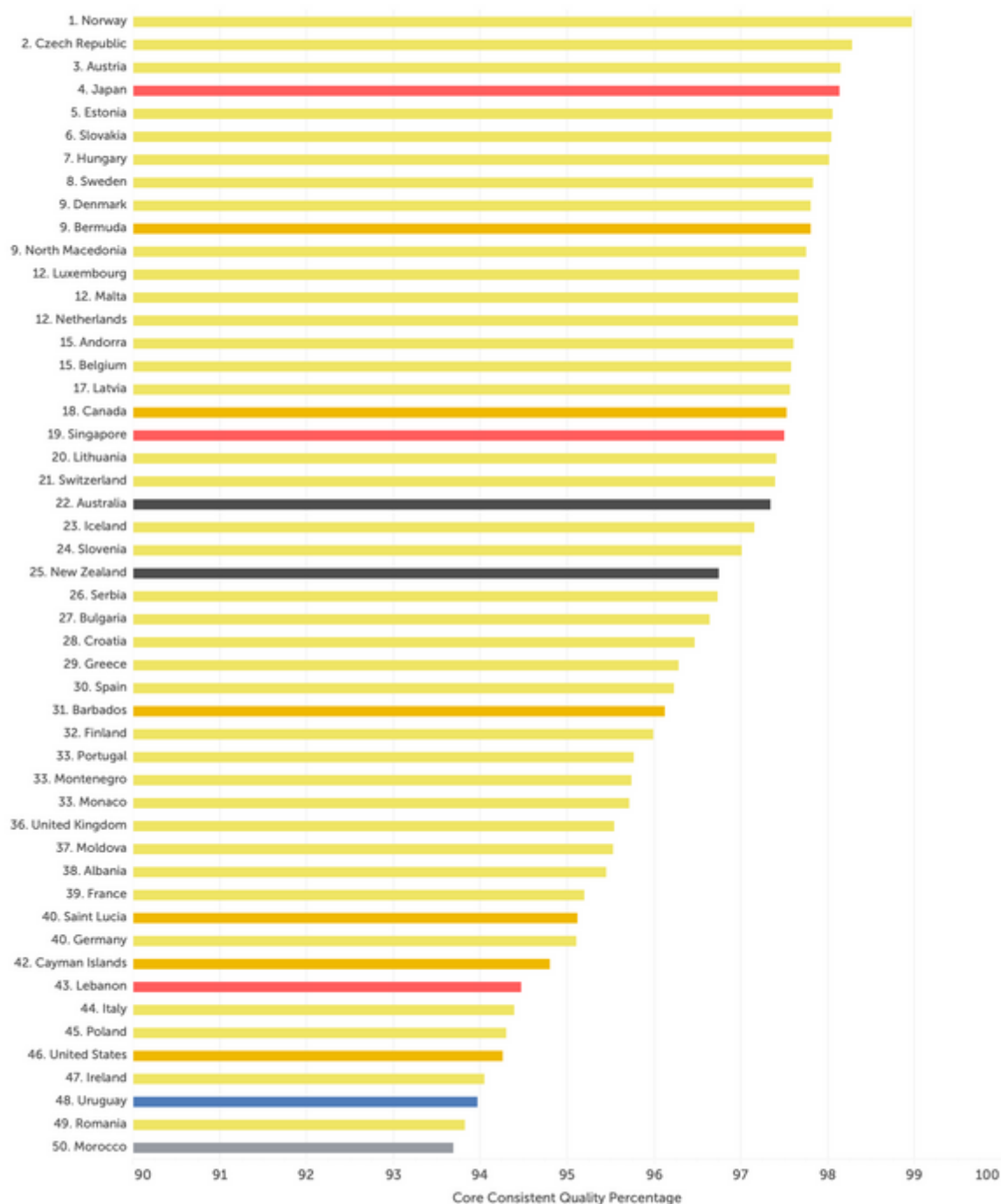


Core Consistent Quality - Global ranking

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Core Consistent Quality Percentage (3G and 4G) - Top 50 Countries

The % of tests where a mobile connection was good enough for daily usage apps (including 420p video streaming, VOIP calls and photo-sharing apps like Snapchat and Instagram)



Africa

Asia

Europe

North America

Oceania

South America

Unlike Excellent Consistent Quality, where there was a significant decline in the percentage of tests that met Tutela's thresholds for this metric with each step down the ranking table, Core Consistent Quality was a much closer picture. 70 of the total countries tested had a Core Consistent Quality of 90% or higher. In practical terms this means that, when a user in those countries had a connection, the network was suitable for use cases such as standard video streaming, browsing the web, VOIP calls and uploading photos to social media at least 90% of the time.


Once again, European countries performed strongly overall. Norway took the top spot in the international comparison. Meanwhile, Japan continued to offer the strongest performance in Asia, although it ranked fourth overall for Core Consistent Quality. Australia again came top for Oceania at 22nd, while Uruguay had the highest Core Consistent Quality in South America (ranked 48th), and Morocco came top in Africa (50th).

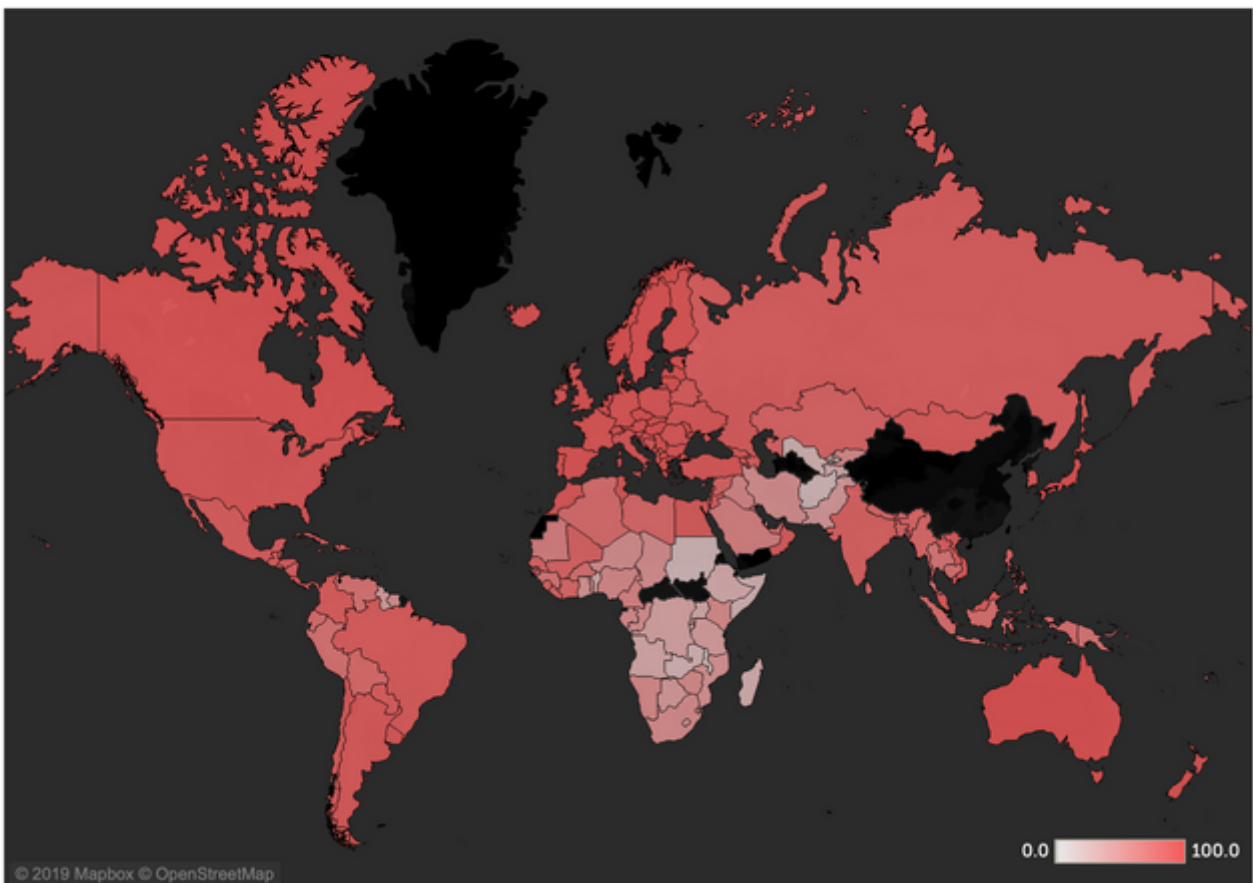
"70 of the total countries tested had a Core Consistent Quality of 90% or higher"



Notably absent in the top 50 ranking for Core Consistent Quality is South Korea, which came in 56th. Given the country's excellent performance in the Excellent Consistent Quality ranking this is indicative of just how competitive the Core ranking becomes. In South Korea's specific case, small differences in performance between the leading operators, particularly around packet loss, were the leading cause for

losing those few percent for Core Consistent Quality. That said, South Korea achieved a Core Consistent Quality of 92.6% – indicating that the overwhelming majority of successful connections were suitable for the day-to-day use cases that Core Consistent Quality represents. This can also be seen in the world map above – where many countries are nearly indistinguishable in colour.

TUTELA  **Core Consistent Quality Percentage (3G and 4G)**
The % of tests where a mobile connection was good enough for daily usage apps (including 420p video streaming, VOIP calls and photo-sharing apps like Snapchat and Instagram)

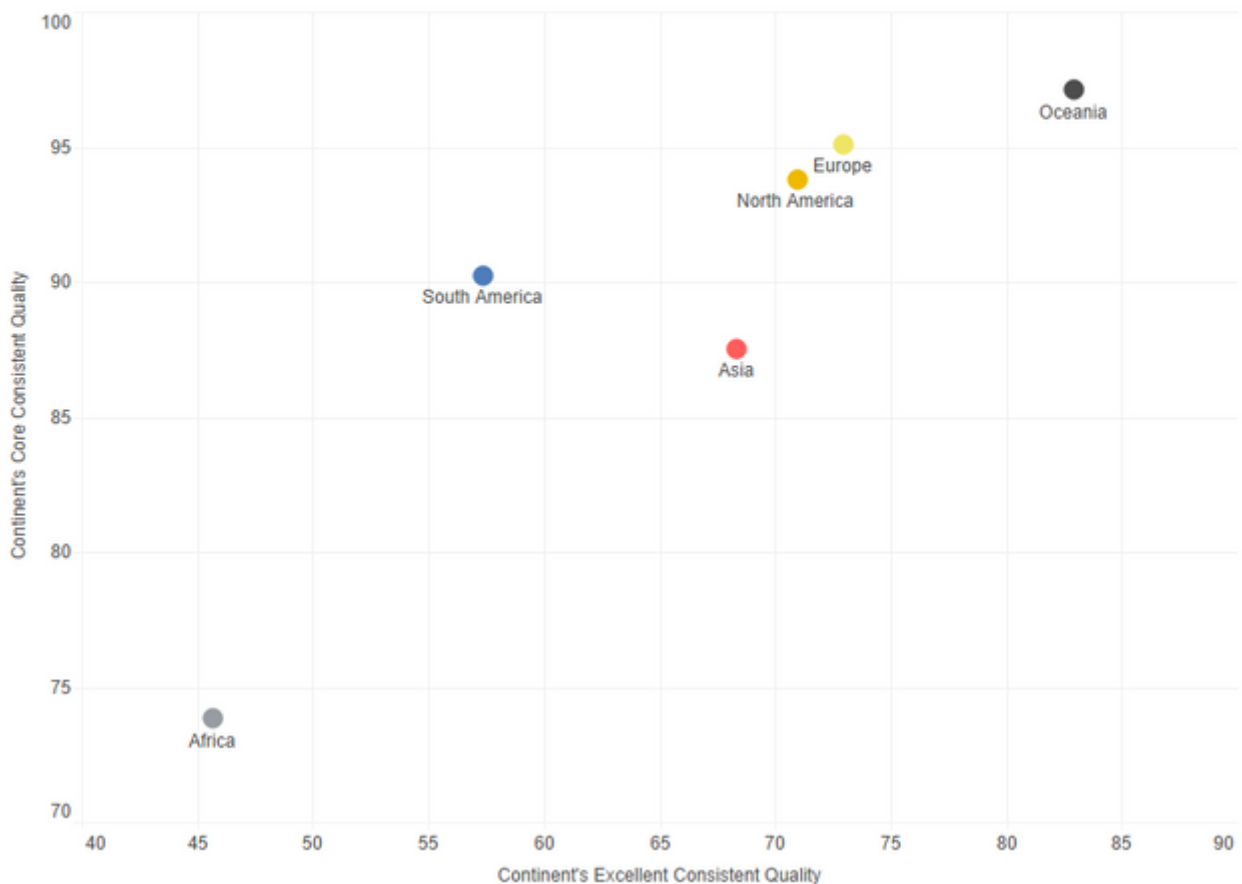


One thing that bears considering when looking at both the Excellent and Core Consistent Quality top 50 charts is the not-inconsiderable variance between countries within a continent. While it's notable that European countries appear most frequently in both graphs, on a continental level it is actually Oceania that overall has the highest Excellent and Core Consistent Quality. Similarly, looking at the overall picture at a continental level, North America and Europe are more comparable than they may appear on a country by country basis.

"Oceania has the highest Excellent and Core Consistent Quality overall"



Core and Excellent Consistent Quality Percentage – Continents

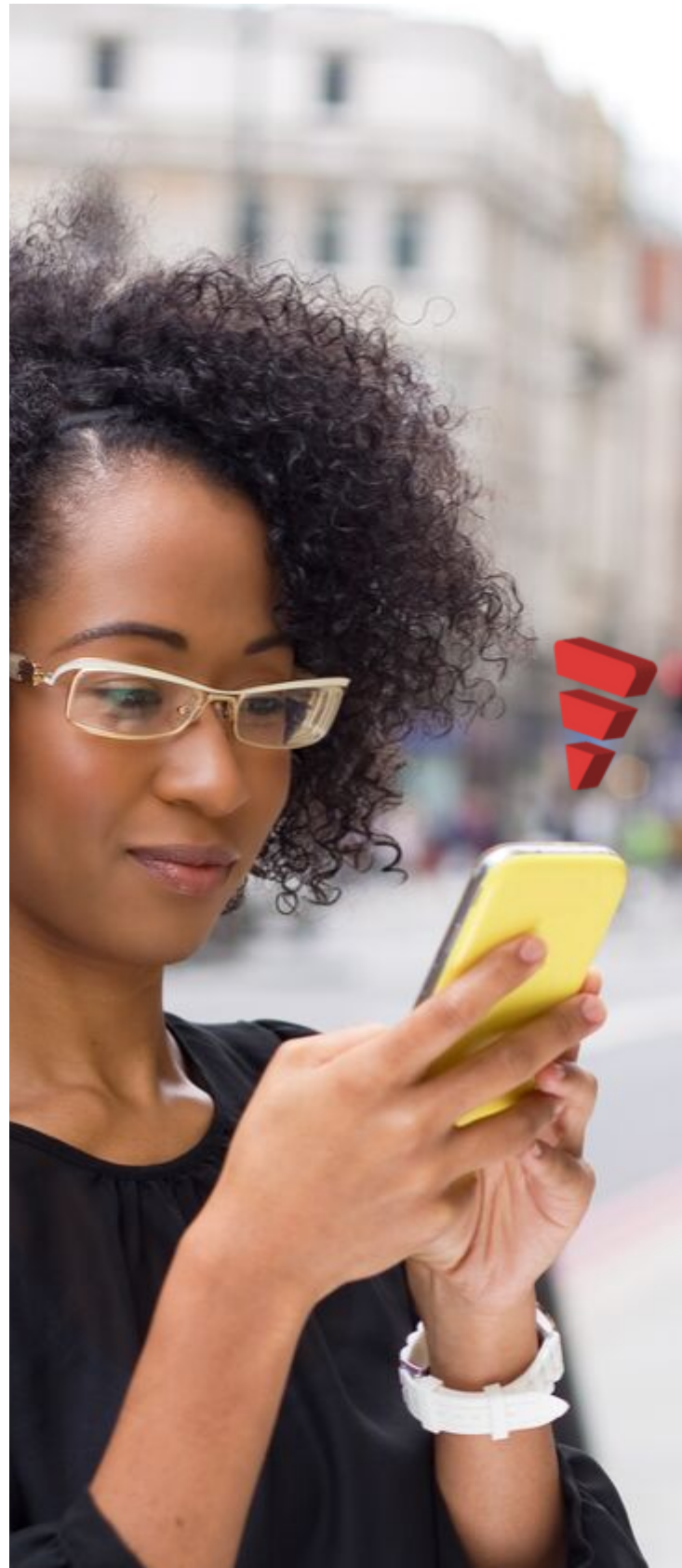


Moving from Core to Excellent Consistent Quality – What Does it Take?

One of the most striking findings in this analysis is the rate of change in Excellent Consistent Quality compared to Core Consistent Quality. In particular, there is a consistent increase in the difference between the two when plotted against the country rank for Excellent Consistent Quality.

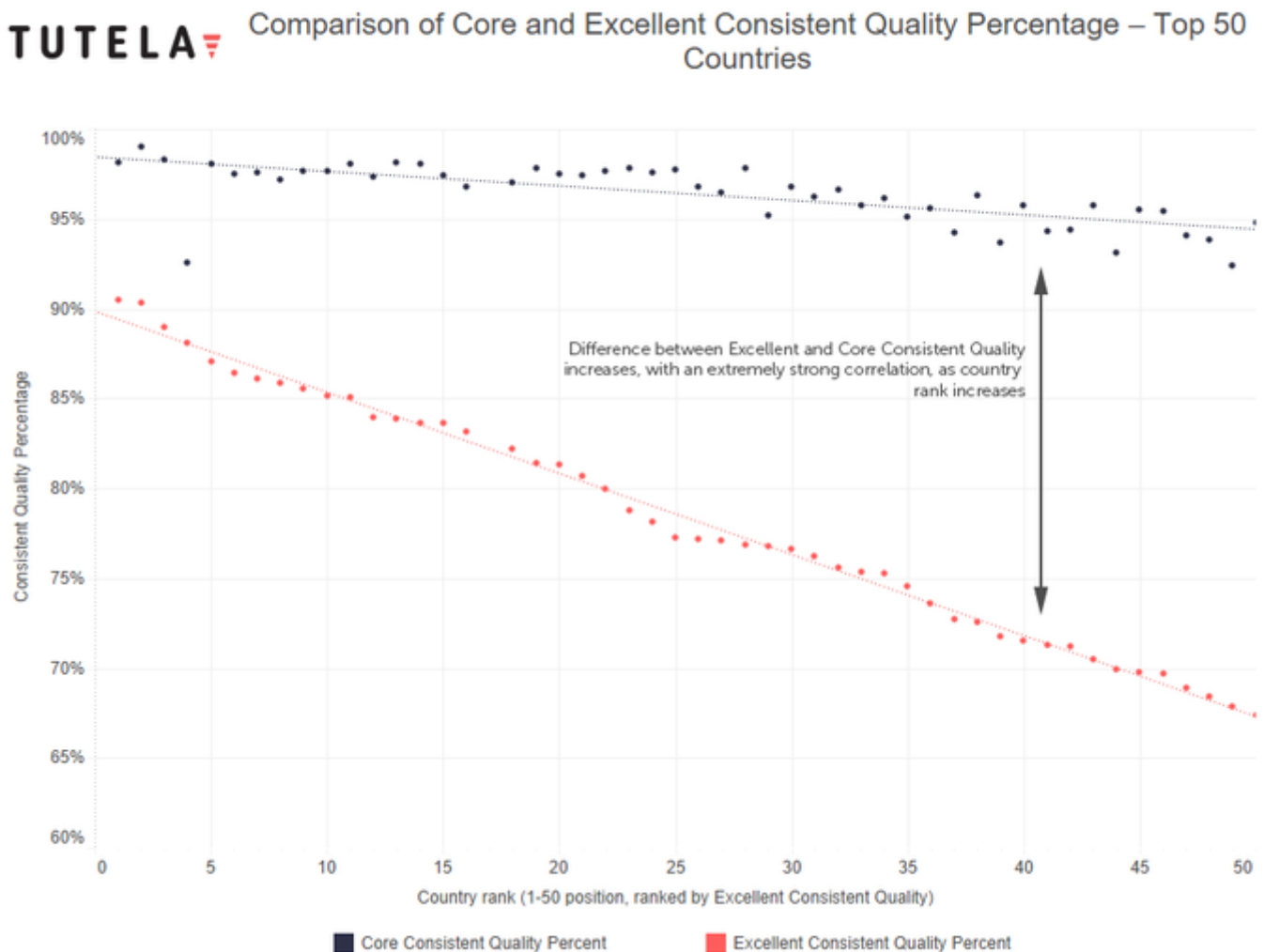
This suggests a number of things – firstly, that in many countries, mobile internet that is good enough for standard definition video streaming, VOIP calls and sharing photos over social media is near-ubiquitous in locations where there is signal.

For many operators the challenge is closing off the final few percentage points to provide an ultra-consistent Quality of Experience for these day-to-day use cases that many users expect as standard.



Providing a world-class Excellent Consistent Quality result often relies on a network having a high proportion of connections over 4G, but also requires operators to address issues such as network congestion that tend to affect users on a day-to-day basis. It is also important to note that in cases where users are experiencing network throttling these connections can also fail to

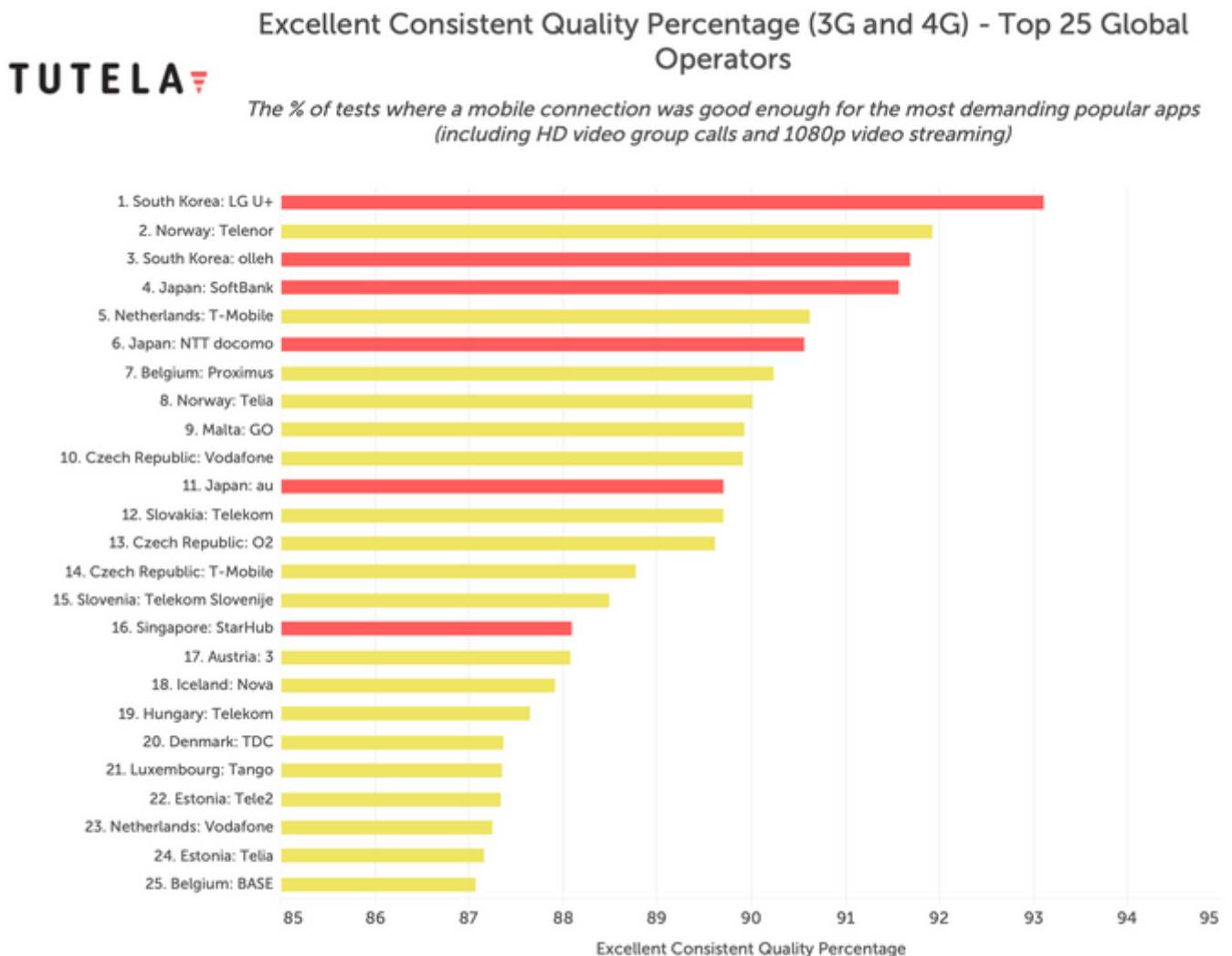
deliver the level of experience required for the Excellent Consistent Quality threshold. This may well be a reflection of a consumer choosing a cheaper tariff where speed controls are explicitly known and agreed to, but also highlights how, in some cases, such plans do have a noticeable impact on user experience when looking at more intensive use cases.



Global Consistent Quality for operators

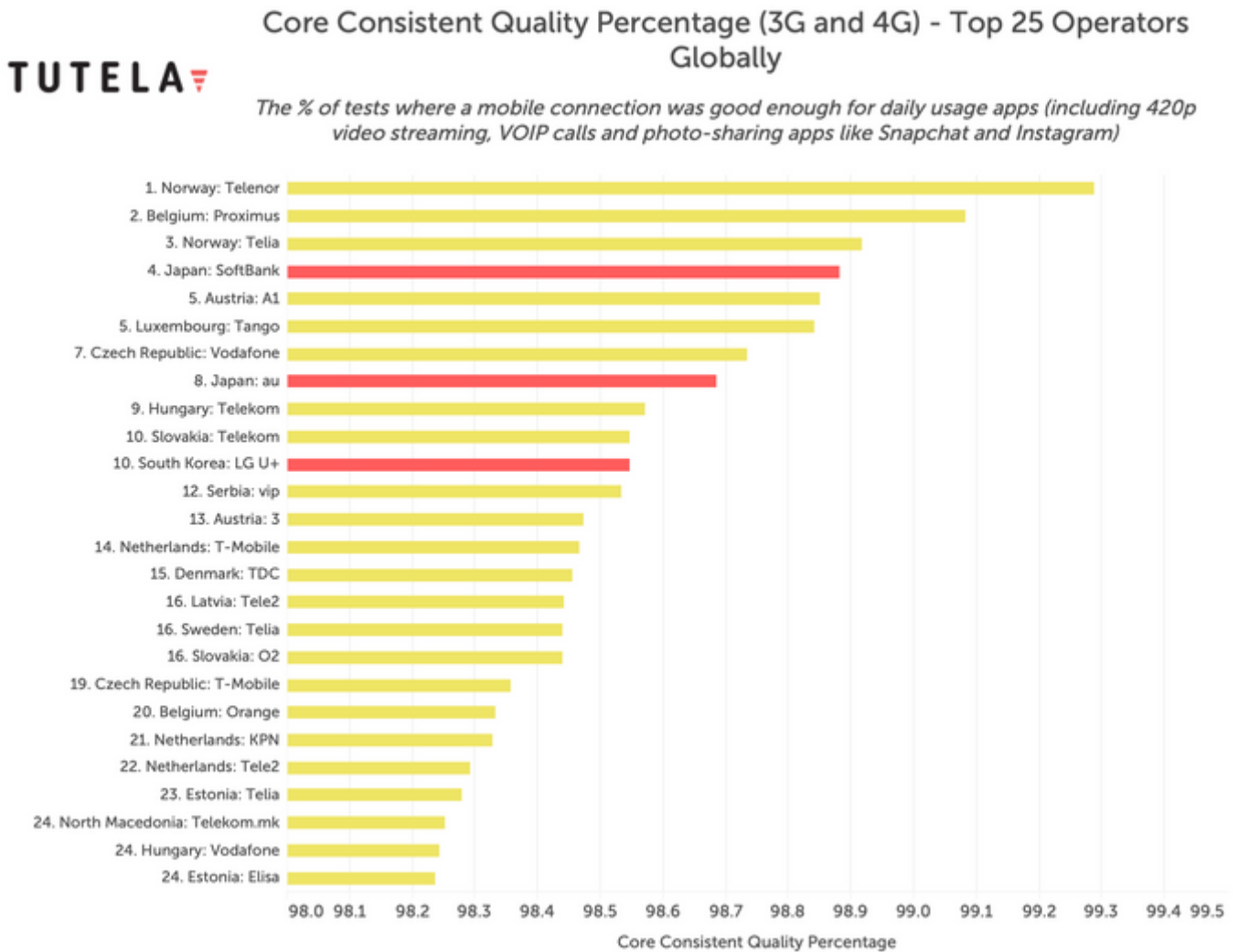
European and Asian network operators exclusively make up the list of the top 25 networks globally for both Excellent and Core Consistent Quality. South Korea's LG U+ came top overall for Excellent Consistent Quality, followed by Telenor in

Norway and olleh in South Korea. Norway's operators proved particularly competitive, with Telia coming in eighth overall for Excellent Consistent Quality and third for Core Consistent Quality.



Telenor Norway, which placed second for Excellent Consistent Quality topped the leaderboard for Core Consistent Quality highlighting the sheer consistency of Norwegian networks with both of its

leading operators offering such high Quality of Experience. Another standout performer was SoftBank in Japan, which placed fourth for both Excellent and Core Consistent Quality.



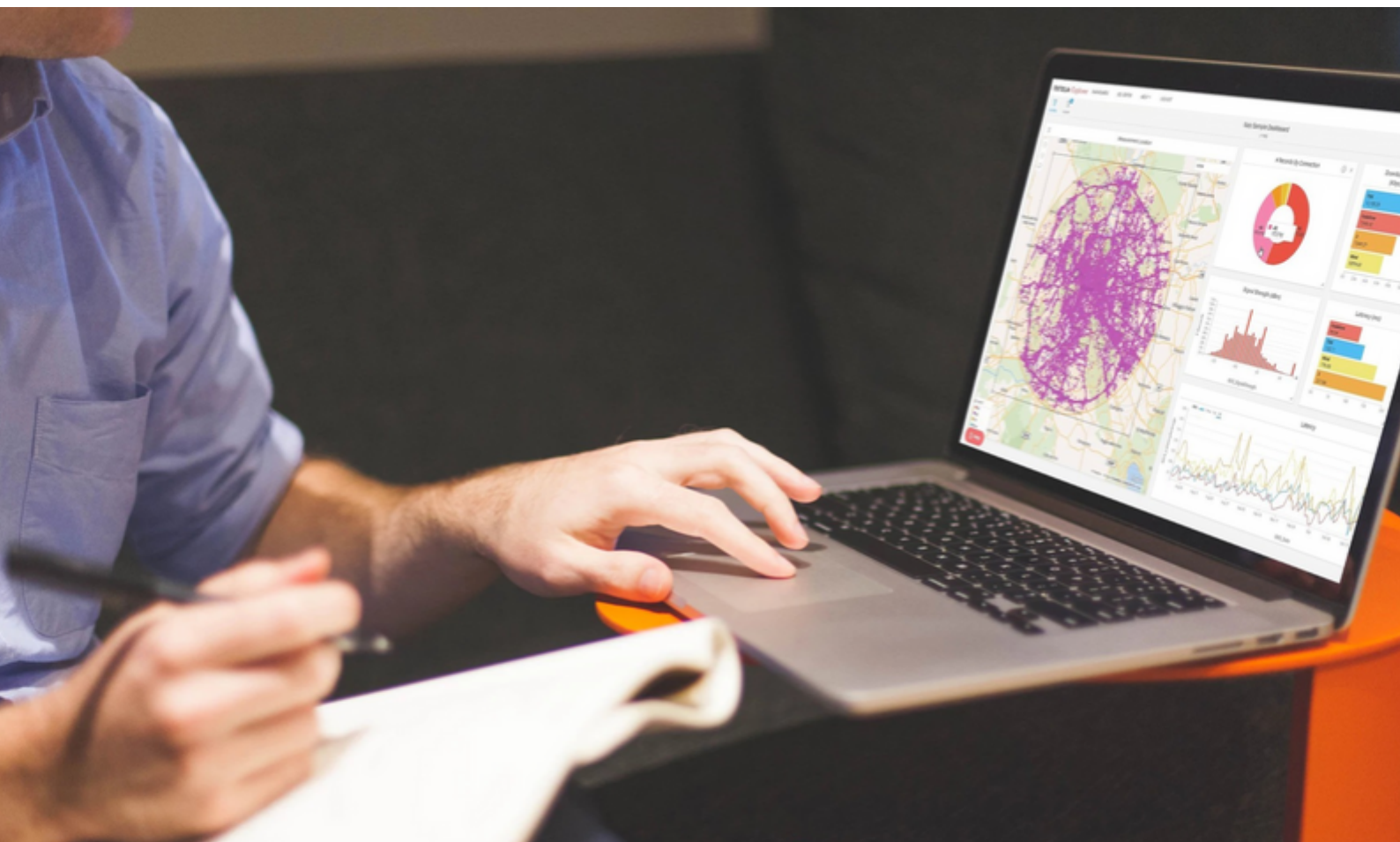
Discover Tutela Explorer

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

Country-level Percentages and Error Margins

"Excellent" rank	"Core" rank	Country	Excellent Consistent Quality	Excellent Error Margin	Core Consistent Quality	Core Error Margin
1	4	Japan	90.459	0.000	98.135	0.000
2	1	Norway	90.339	0.001	98.970	0.001
3	2	Czech Republic	88.931	0.001	98.279	0.001
4	56	South Korea	88.051	0.000	92.530	0.000
5	6	Slovakia	87.043	0.002	98.036	0.002
6	19	Singapore	86.436	0.001	97.495	0.000
7	15	Belgium	86.121	0.001	97.575	0.000
8	23	Iceland	85.852	0.006	97.150	0.006
9	12	Netherlands	85.535	0.000	97.659	0.000
10	12	Luxembourg	85.152	0.005	97.667	0.005

To download the full table [click here](#).

Appendix

Excellent and Core Top 25 Global Operator Percentages and Error Margins

"Excellent" rank	Country	Service Provider	Excellent Consistent Quality	Excellent Error Margin
1	South Korea	LG U+	93.103	0.000
2	Norway	Telenor	91.916	0.001
3	South Korea	olleh	91.681	0.000
4	Japan	SoftBank	91.569	0.000
5	Netherlands	T-Mobile	90.629	0.001

"Core" rank	Country	Service Provider	Core Consistent Quality	Core Error Margin
1	Norway	Telenor	99.288	0.001
2	Belgium	Proximus	99.083	0.001
3	Norway	Telia	98.918	0.002
4	Japan	SoftBank	98.881	0.000
5	Austria	A1	98.850	0.001

To download the full table [click here](#).

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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