TUTELA

Singapore

State of Mobile Networks

Analysts

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Annual Report

FEBRUARY 2020

www.tutela.com

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Introduction

With the first month of 2020 mired down by an abundance of 5G news hype coming out of the US and Europe, Tutela sets the limelight on the Singapore mobile industry. In just the first half of January, Optus Australia made an inter-country 5G test video call with Singtel(1), and StarHub signed an agreement along with M1 to submit a joint bid for 5G licenses(2). Singapore has become a hot commodity for tech business, and we can see this in the way the country topped the Cisco Global Digital Readiness Index of 2019 which judges nations based on such things as ease of business, technology adoption and technology infrastructure(3). The mobile operators of Singapore must also keep up with the latest communication technology and infrastructure. There are three major telcos in Singapore with 15+ years of experience in the game but they are staring down the barrel of new competition with the emergence of TPG Telecom, an Australian operator(4).

In this State of Mobile Networks report, Tutela has collected and analyzed over 11 million speed tests, 138 million latency tests, and 542 million total mobile records between July 1st and December 31st 2019 to build a complete picture of mobile network experience across the country.

(1) Telecompaper, Optus completes 5G video call with Ericsson, Oppo, demos dynamic spectrum sharing
https://www.telecompaper.com/news/optus-completes-5g-video-call-with-ericsson-oppo-demos-dynamic-spectrum-sharing--1322983
Retrieved 01 February 2020

(2) Telecompaper, StarHub, M1 to jointly bid for 5G spectrum licence in Singapore
https://www.telecompaper.com/news/starhub-m1-to-jointly-bid-for-5g-spectrum-licence-in-singapore--1323846
Retrieved 01 February 2020

(3) Telecoms.com, UK stumbles to 13th in Digital Readiness rankings as Singapore leads
https://telecoms.com/501841/uk-stumbles-to-13th-in-digital-readiness-rankings-as-singapore-leads/
Retrieved 01 February 2020

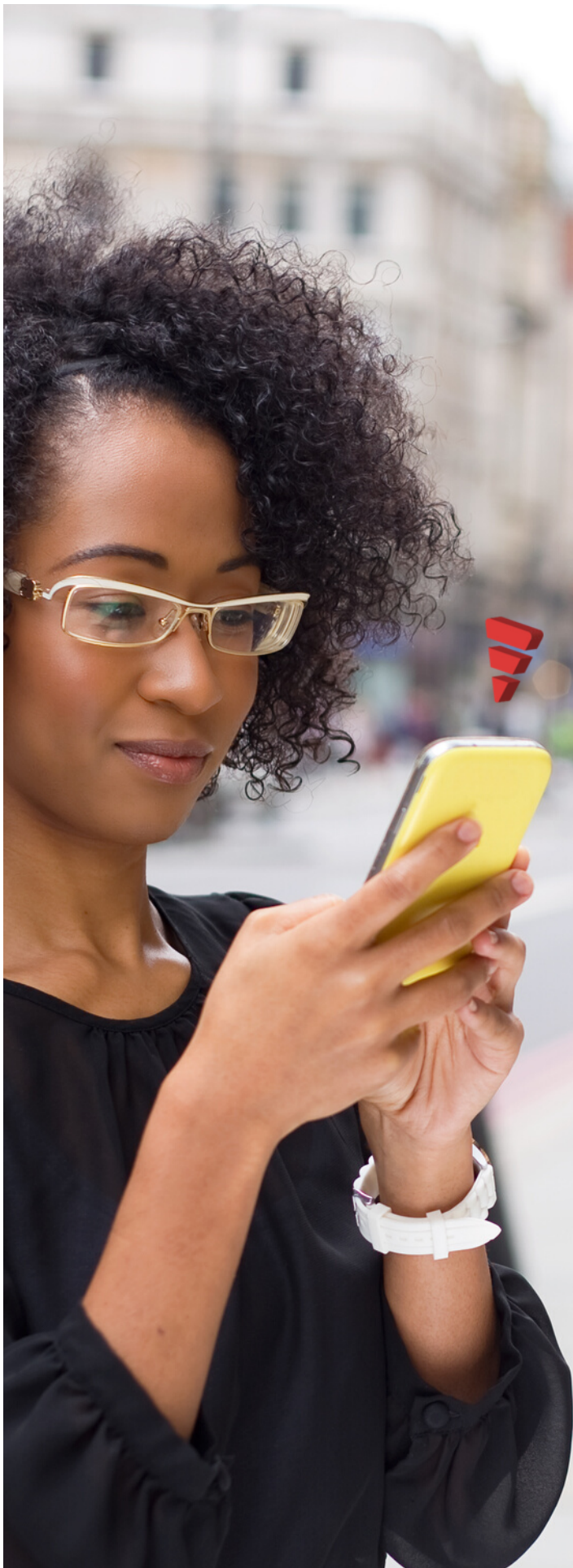
(4) Telecoms.com, The top five markets to watch in the Asia-Pacific MVNO sector
https://telecoms.com/opinion/the-top-five-markets-to-watch-in-the-asia-pacific-mvno-sector/
Retrieved 01 February 2020

Key findings

- StarHub delivered the best Excellent Consistent Quality for Singapore with an impressive 90.7%, although all three of the big operators delivered an Excellent Consistent Quality in excess of 87%, meaning that the vast majority of the time, all three networks were good enough for uses cases such as 1080p video streaming, realtime mobile gaming or group HD video calls.

- Singtel also had an impressive showing in the results; it performed best in both Core Consistent Quality and median download speed. A high result for Core Consistent Quality shows a network that reliably delivers the quality required for day-to-day uses such as social media, SD video streaming and more.

- TPG's market-entry strategy of offering free SIM trials has no doubt succeeded in winning over subscribers to try the service, however it is unclear if this will be successful in the long term. TPG users were 15 times more likely than those on other networks to be using a second SIM from another operator in their phone, and Tutela's initial data suggests that performance on the TPG network does not currently rival the more established operators.



Results overview

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Mobile experience results

Singapore, February 2020

	StarHub	Singtel	m1
Excellent Consistent Quality	★ Winner		
Core Consistent Quality		★ Winner	
Download throughput		★ Winner	
Upload throughput	★ Winner		
Latency	★ Draw		★ Draw

Results from over 11 million speed tests, 138 million latency tests, and 542 million total mobile records between July 1st and December 31st 2019 in Singapore.

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

TUTELA
Best Mobile Network Experience
FEBRUARY 2020

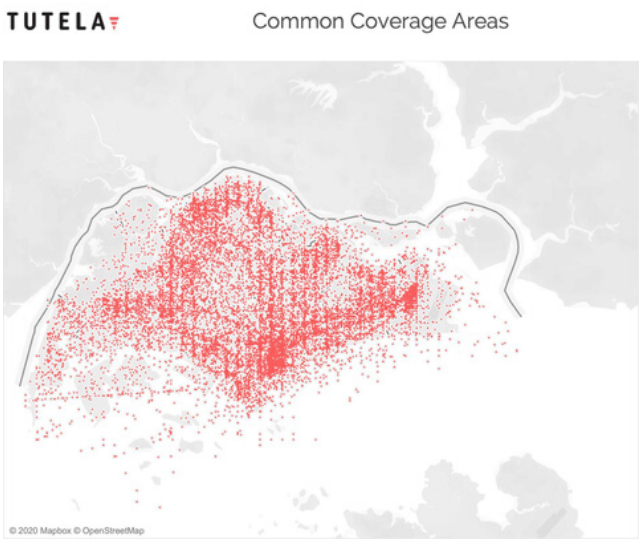
Based on the highest Excellent Consistent Quality in Common Coverage Areas.

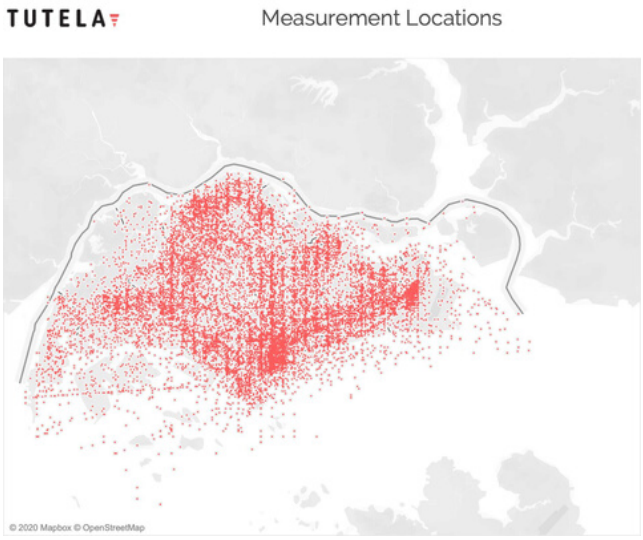
Understanding this report

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.

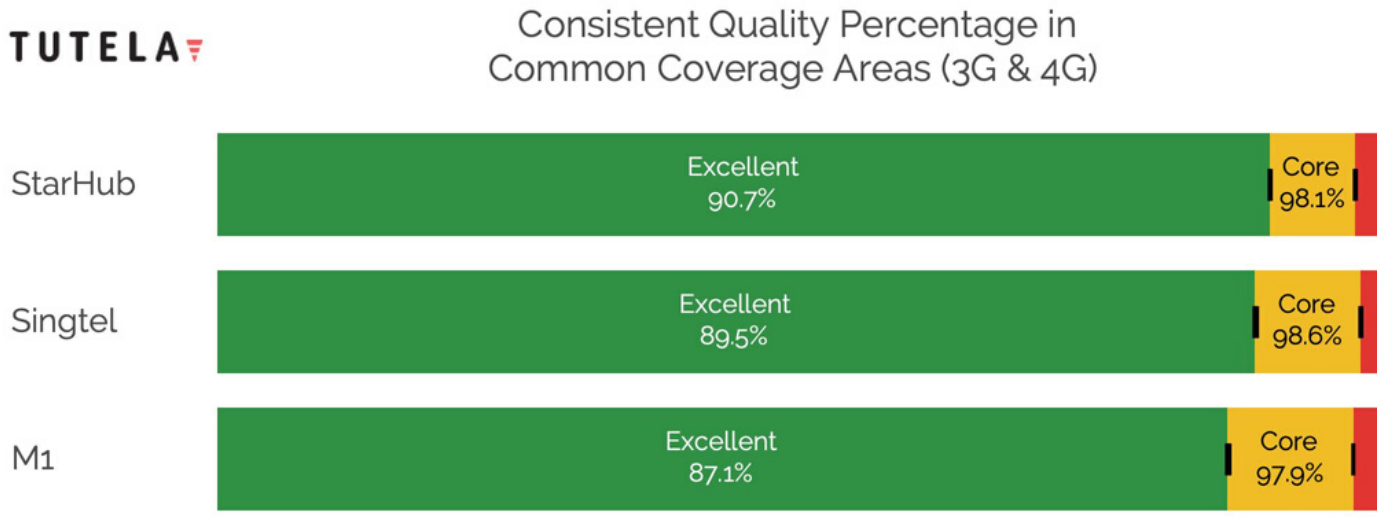
Common Coverage Areas are parts of the country where the majority of operators offer service. In this report, we present results nationally and from Common Coverage Areas, which helps present both a full national picture, as well as highlighting network conditions wherever operators are directly in competition.





Consistent Quality

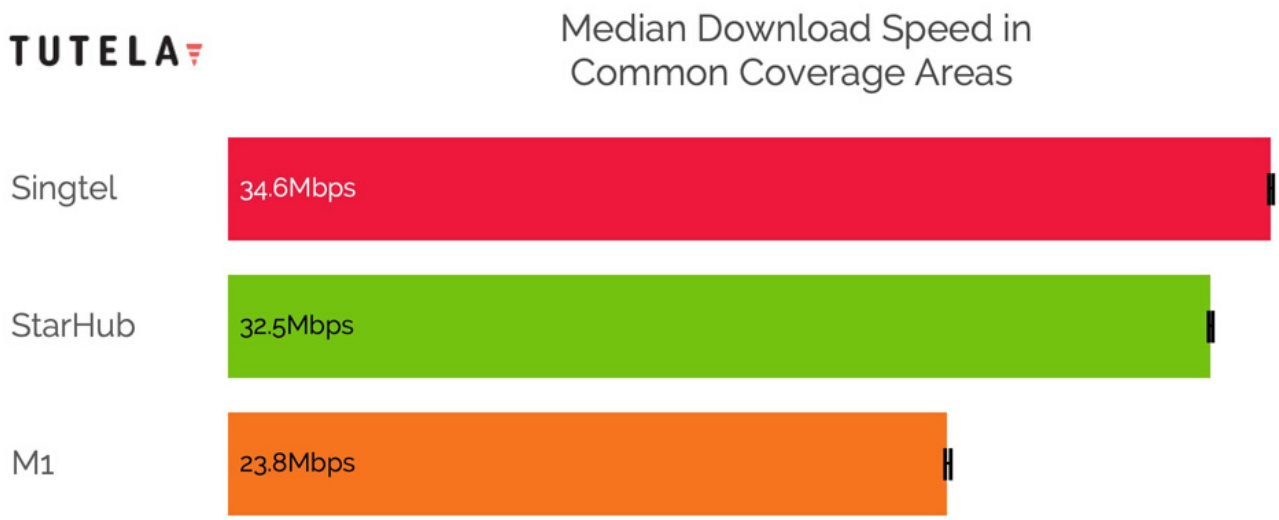
In Tutela's latest Global Mobile Experience report(5), StarHub ranked 16th globally among national operators for Excellent Consistent Quality, and in the Common Coverage areas of Singapore, StarHub continues to have the best performance for Excellent Consistent Quality with 90.7%, but narrowly misses out on the title for best Core Consistent Quality with 98.1%. With only 1.2% difference in Excellent performance, Singtel has an Excellent Consistent Quality percentage of 89.5% but has the best Core Consistent Quality percentage of 98.6%. Despite having the lowest Excellent Consistent Quality percentage of 87.1%, there is only a difference of 3.6% in performance between first place StarHub and 0.7% difference in performance between Singtel for Core, making for stiff competition on this small island city-state.



(5) Tutela, Global Mobile Experience
https://www.tutela.com/blog/global-mobile-experience-2019
Retrieved 01 February 2020

Download throughput

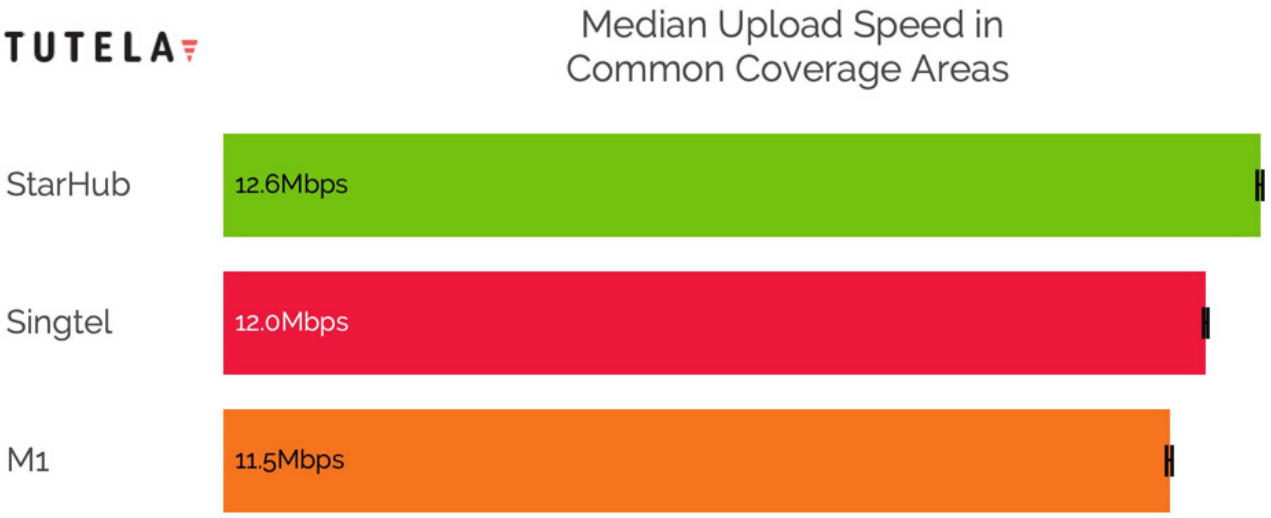
Looking at download speeds in Common Coverage Areas of Singapore, we can see M1 drop slightly away from the competition with a difference of 10.8 Mbps between first place Singtel - with the fastest median download speed of 34.6 Mbps. StarHub misses out on top spot by 2.1 Mbps with a median download speed in Common Coverage Areas of Singapore of 32.5 Mbps, and M1 posts the slowest median download speed of 23.8 Mbps.



Upload throughput

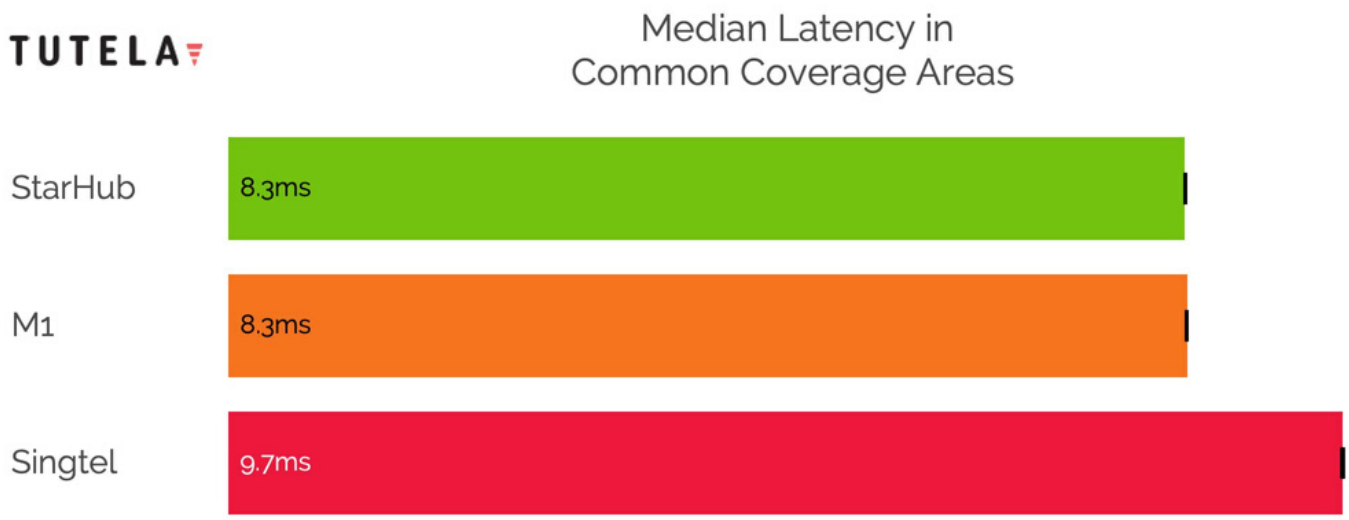
Across all three operators, upload speeds are well over half of those of download, and we see a slight change in the rankings. StarHub scratches back its first place position with a median upload speed of 12.6 Mbps. There is a relatively small gap between operators with Singtel in second place with 12.0 Mbps and M1 in third with 11.5 Mbps.

"StarHub scratches back its first place position with a median upload speed of 12.6 Mbps."



Latency

In Common Coverage Areas of Singapore, we see the first equal tie with both StarHub and M1 having the fastest one-way latency of 8.3 ms. With a difference of only 1.4 ms, Singtel barely has the slowest latency with 9.7 ms. For M1 users, It's positive news that despite the operator having the slowest download and upload speeds in the country, the lag when video calling or gaming will be low and less noticeable due to low latency. All three operators offer one-way latencies far below the 50ms threshold Tutela uses in its Excellent Consistent Quality thresholds, highlighting how impressively responsive Singaporean networks are.



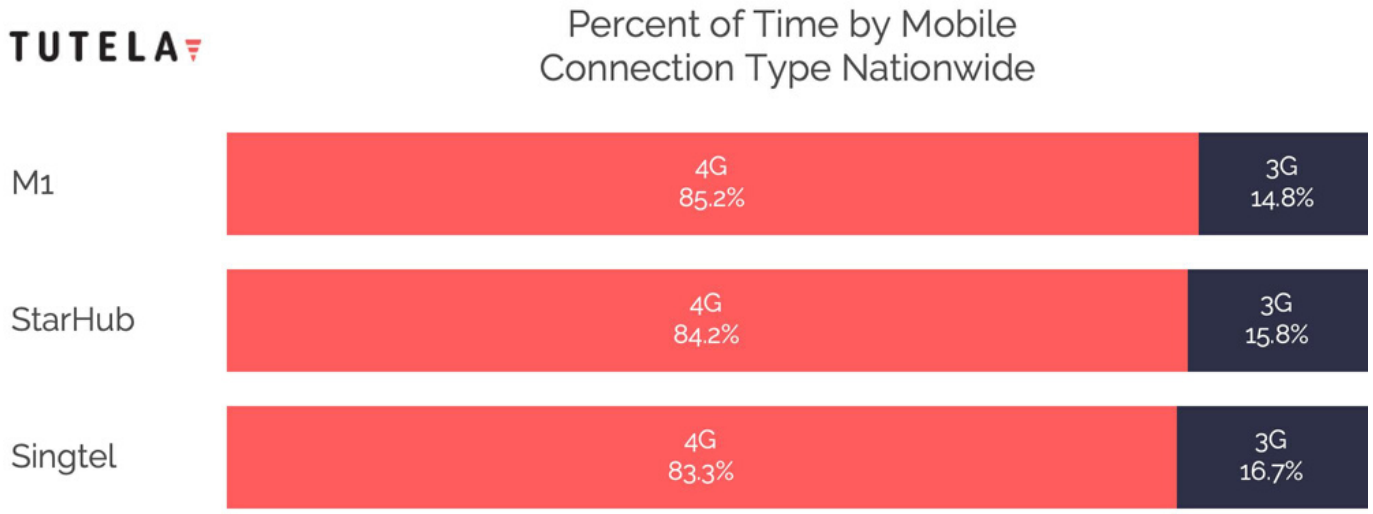
Technology usage

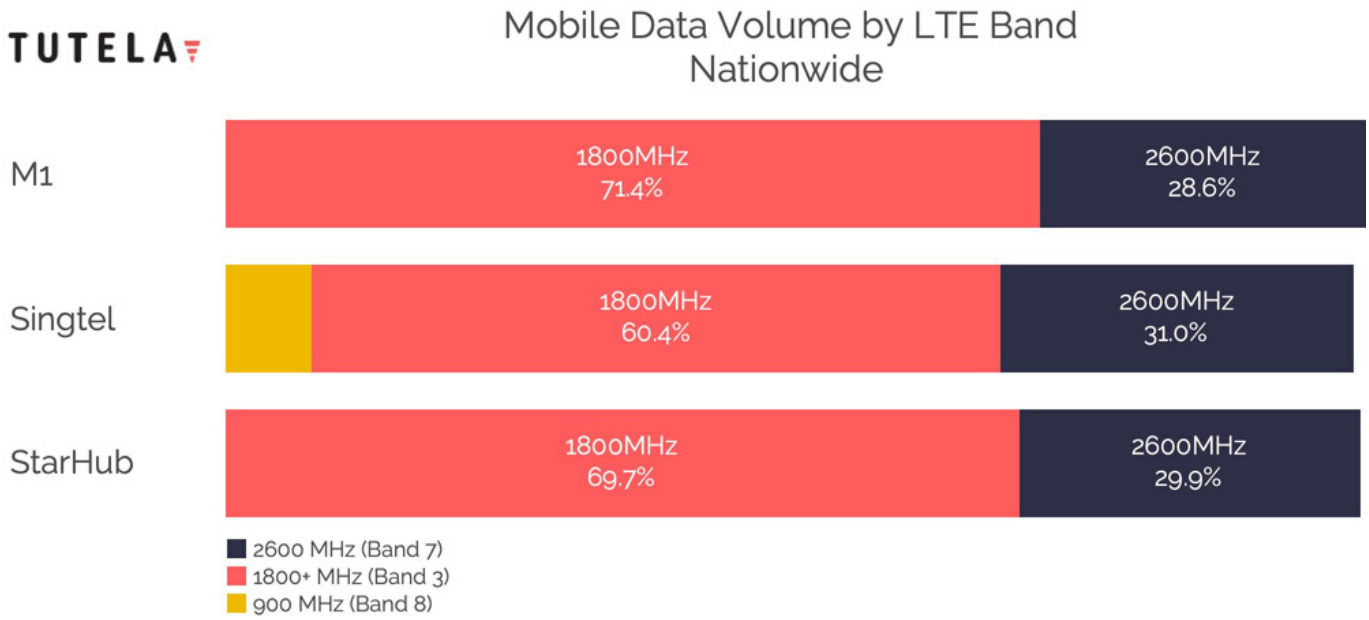
All three operators in Singapore had nearly identical levels of time on 4G – with M1 users spending very slightly more time on LTE networks overall. However, the difference is minimal and likely does not contribute significantly to the overall difference between operators.

The similarities continue on the spectrum level - by and large, all three operators have approximately 30% of their traffic going over the higher band 2600 Mhz spectrum, with mid-band 1800 Mhz supporting this.

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

Singtel's 900MHz spectrum used for LTE (branded as Singtel LTE900 in the company's marketing efforts) supports under 10% of overall data traffic, but is likely a useful differentiator in providing a consistent user experience; low band spectrum offers more reliable indoor coverage and is potentially contributing to Singtel's superior download throughput and Core Consistent Quality. StarHub and M1 both have 900MHz spectrum, but this appears to still be used for 3G.

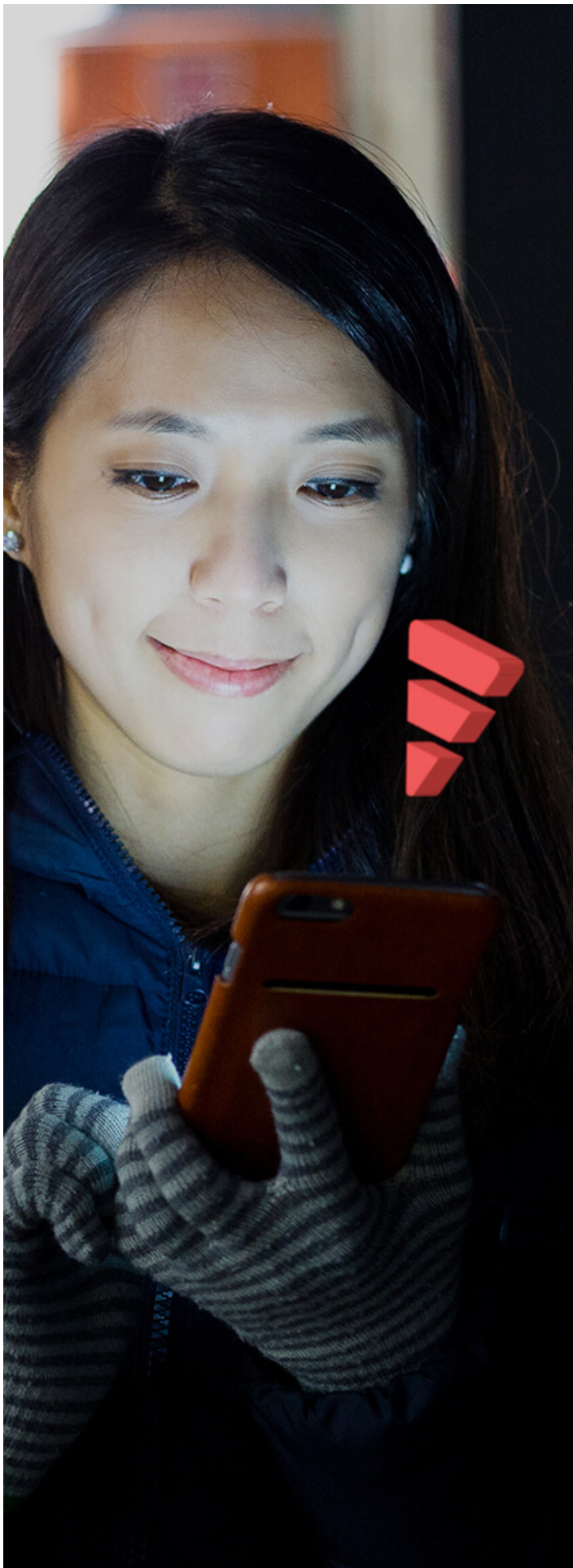




TPG

Singapore's 4th MNO, TPG, falls short of Tutela's rubric for inclusion as a national operator (among other considerations, Tutela requires a minimum of a 5% market share by subscribers to ensure a valid comparison, and for an operator to be commercially available to consumers). However, the network covers the entire city-state and has been noted for its disruption on the Singaporean telecoms market with a notable go-to-market strategy of free SIM trials. Moreover, its subscriber base now includes some 300,000 customers making it an interesting presence, if not a competitor, in the industry.

With the exception of median latency, TPG places distinctly behind the three established carriers by some margin. Its median download throughput was 15.5 Mbps –- significantly below the 23.8 Mbps offered by M1, the next fastest carrier. This seems to be, in part, caused by the load placed on the network. Despite the relatively low number of subscribers for the bandwidth available, we can see a notable decline in download throughput in Tutela's data during on-peak hours (8am-9pm) compared to at night, when the network has to handle less traffic.



However, it's interesting to note that even the peak speeds on TPG's network (the 90th percentile) are significantly below that of the other Singaporean providers. TPG's 90th percentile is 39.1 Mbps, while Singtel is the fastest at 64.1 Mbps.

Another interesting facet of TPG's current rollout is whether its landgrab strategy of offering free SIMs is succeeding in tempting customers away from the existing providers. Based on Tutela's data, TPG users were 15 times more likely than those on other providers to have a second data SIM from a different Singaporean provider. Of TPG users with a second SIM, 43% of them were using the other provider's SIM as their primary SIM for data. This suggests that while interest in TPG's offering has been high, many of its current user base have yet to be convinced to move away from their existing providers. As TPG's offering matures, time will tell if it is enough to fully win over customers from other brands.

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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 (%)
TPG	15.5	0.21	5.8	0.06	8.4	0.00	81.1	±0.46	96.1	±0.23

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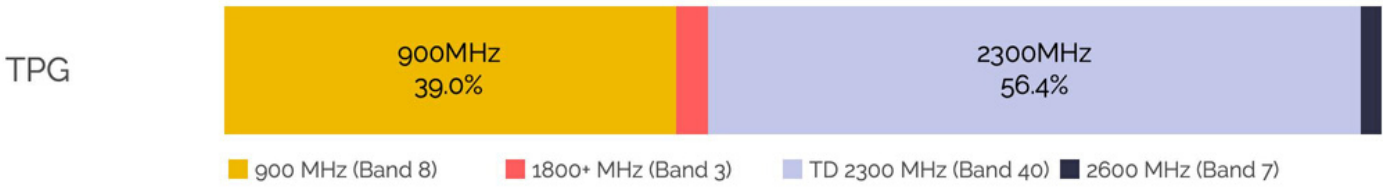
TPG Mobile Data Volume by LTE Band



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, Tutela has conducted over 11 million speed tests, 138 million latency tests, and 542 million total mobile records 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.

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%

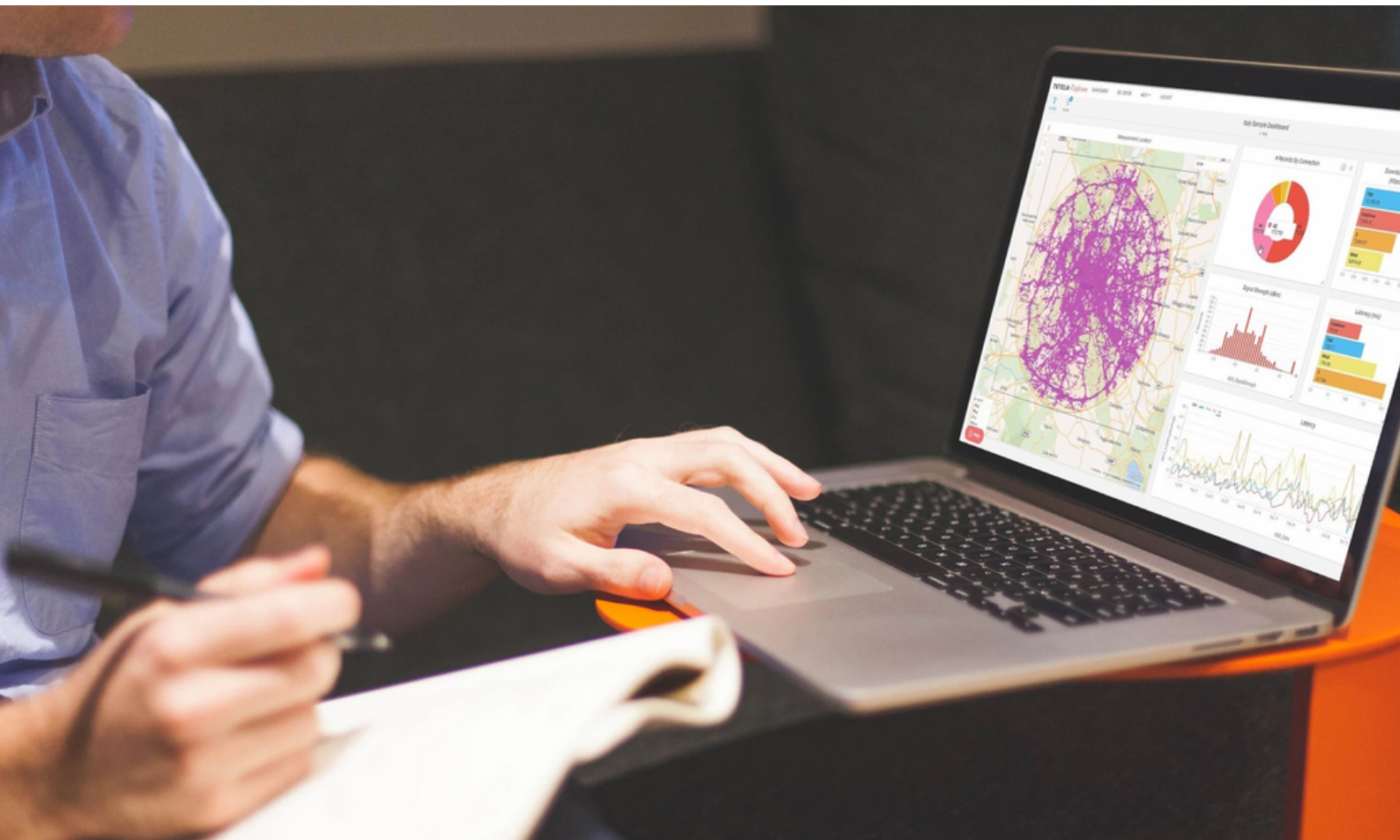
Discover Tutela Explorer

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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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 (%)
M1	23.8	0.09	11.5	0.03	8.3	0.00	87.1	±0.12	97.9	±0.05
Singtel	34.6	0.07	12.0	0.02	9.7	0.00	89.5	±0.08	98.6	±0.03
StarHub	32.5	0.09	12.6	0.04	8.3	0.00	90.7	±0.10	98.1	±0.05

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Nationwide 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 (%)
M1	23.8	0.09	11.5	0.03	8.3	0.00	87.09	±0.12	97.9	±0.05
Singtel	34.6	0.07	12.0	0.02	9.7	0.00	89.51	±0.08	98.6	±0.03
StarHub	32.5	0.09	12.6	0.04	8.3	0.00	90.74	±0.10	98.1	±0.05

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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