TUTELA

Canada

State of Mobile Networks

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Annual Report

APRIL 2020

www.tutela.com

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Introduction

While some wireless network operators around the world spent 2019 rolling out commercial 5G deployments, Canadian operators instead spent the year cementing their position at the forefront of 4G networks. Billions of dollars were spent acquiring new valuable low-band spectrum, unlimited plans emerged for the first time in the LTE era, and average download speeds increased across the board.

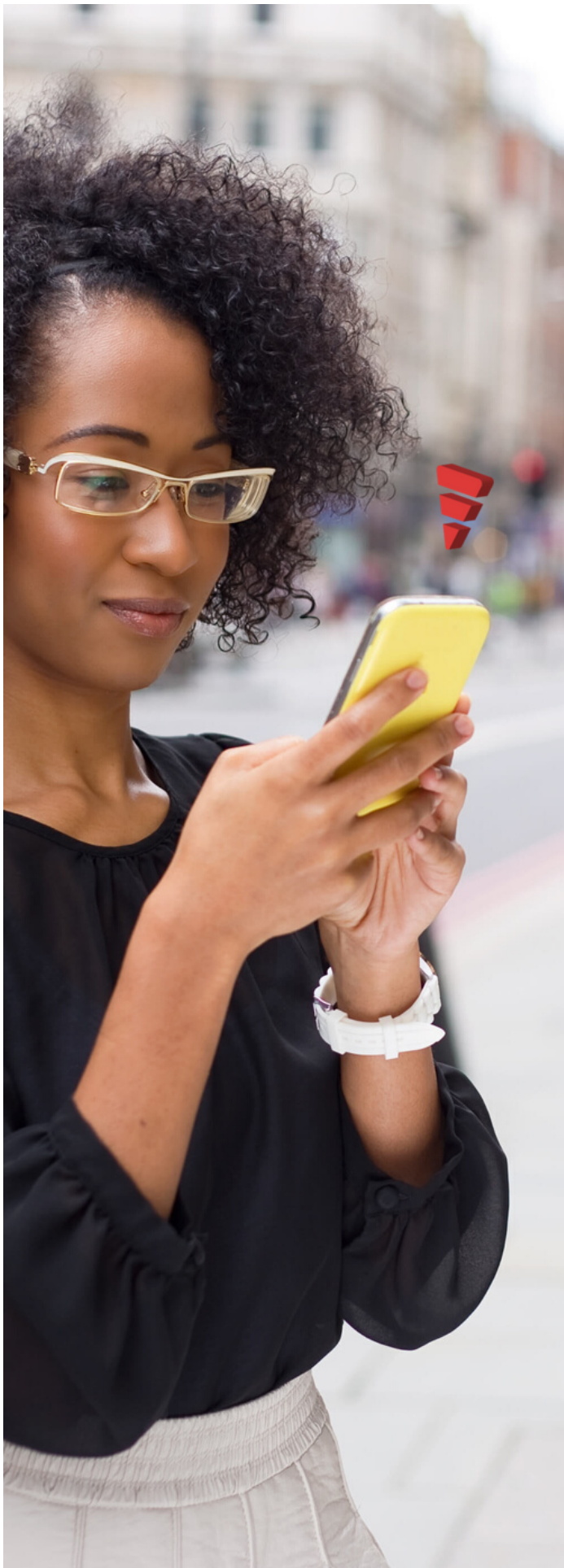
Looking forward, it's clear that the industry is primed for yet more disruption. The Canadian government made clear in recent announcements that it's after an aggressive decrease in consumer prices, and has raised the spectre of wholesale MVNO pricing or spectrum license conditions as potential remedies to do so. But while the affordability and value-for-money of Canadian wireless plans remains a hotly-debated topic, one thing is clear: it's one of the best times in memory to be a Canadian wireless subscriber. Networks are faster and cover more area than ever before, unlimited plans have drastically reduced the incidence of overage charges, and the growth of challenger and regional networks has given a majority of Canadians at least four network operators to choose from.

Of course, not all networks are created equal, and the mobile experience that subscribers can expect can vary significantly. To best evaluate the mobile experience and inform subscribers, Tutela has evaluated 3.9 billion records in Common Coverage Areas across Canada, including 44 million speed tests and 541 million latency tests, collected from over 900,000 smartphones between September 1, 2019 and February 29, 2020.

Key findings

- Bell and Telus, which share the radio portion of their infrastructure across most of Canada, provided very similar results nationwide. The two operators were tied for the best Excellent Consistent Quality, just 0.2% apart on Core Consistent Quality, and were within 0.5 Mbps of each other for median download speed. In cities, the results were a little more differentiated, and the traditional regional advantages — Bell in the East, Telus in the West — were more apparent.

- When looking just at top-tier users (users on premium devices, and only on the "core" brand of each operator), Rogers showed considerable improvement compared to its overall results, which were lowered by the impact of its pre-paid flanker brand, chatr. Telus still led for Excellent Consistent Quality, although the results were extremely close between all three operators, and median download speed. It drew with Rogers for Core Consistent Quality, while Rogers had the best median upload speed and latency among these top-tier consumers.



- Although Bell, Telus, and Rogers remain the only three networks to boast coast-to-coast coverage, the impact of regional carriers is apparent in urban areas. Both Freedom and Videotron are competitive with the "big three" in cities where their network is present. This is particularly apparent in the network experience – although not necessarily the raw speeds – offered by these providers, and this growth in facilities-based competition is likely to push all of Canada's operators to continue innovating.

- In the six cities tested, Telus shone in particular in Calgary with its highest Excellent Consistent Quality result recorded here – and interestingly, this was also where Rogers had its best showing with an Excellent Consistent Quality of 72.7%. Bell delivered its individual highest Excellent Consistent Quality in Montreal, where it drew with Telus for the top spot – and also excelled in Toronto where it was the sole winner.

Results overview

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Mobile experience results

Canada, April 2020

	TELUS	Bell	ROGERS
Excellent Consistent Quality	★ Draw	★ Draw	
Core Consistent Quality	★ Winner		
Download throughput	★ Winner		
Upload throughput		★ Winner	
Latency	★ Winner		

Results from over 3.9 billion records in Common Coverage Areas across Canada, collected between September 1, 2019 and February 29, 2020.

"Telus & Bell delivered the highest percentage of Excellent Consistent Quality in Tutela's tests"

TUTELA
Best Mobile Network Experience
APRIL 2020

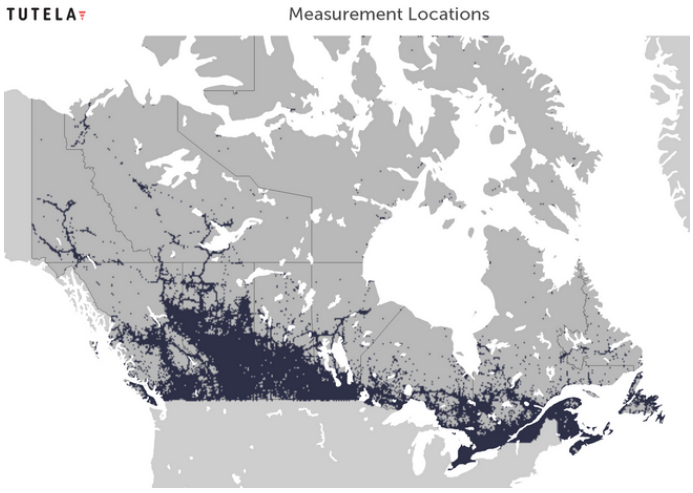
Based on the highest Excellent Consistent Quality in Common Coverage Areas.

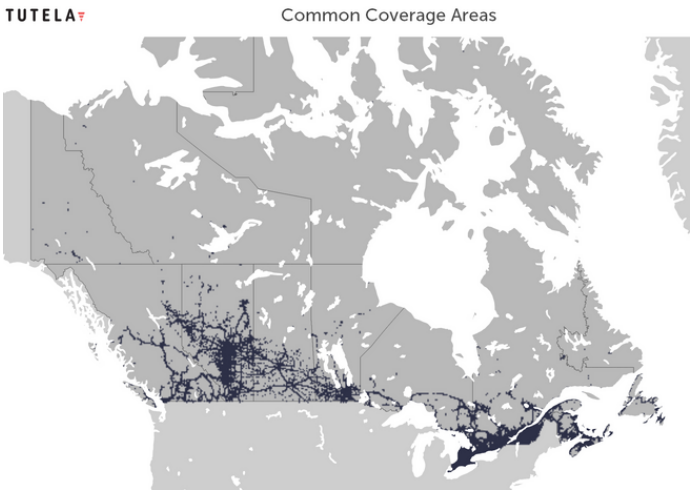
Understanding this report

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.

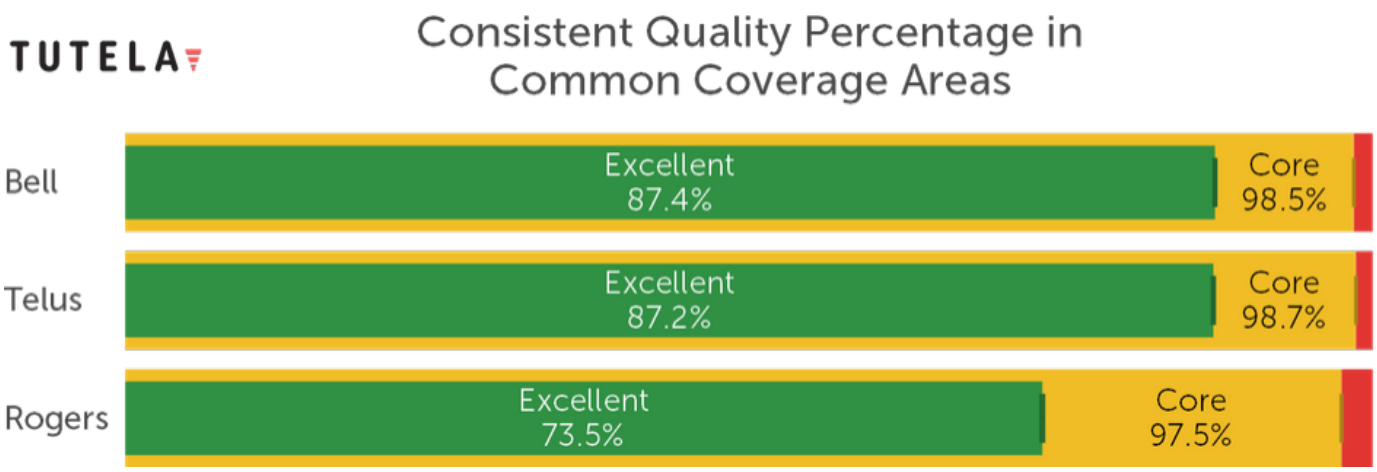
The methodology is covered in detail at the end of this report and on our website, but simply put, there are two sets of thresholds, Excellent and Core. A connection that hits the Excellent threshold is sufficient for use-cases like 1080p video streaming or multiplayer gaming, while a Core connection 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.

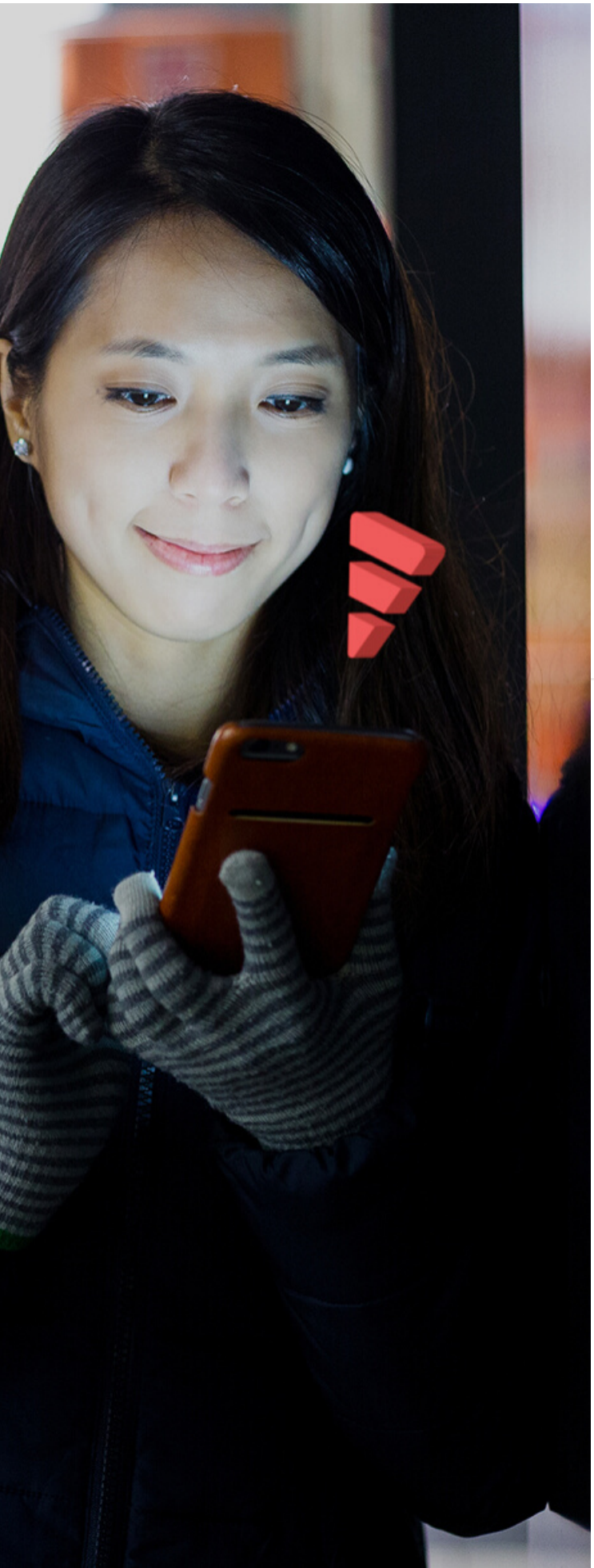




Consistent Quality



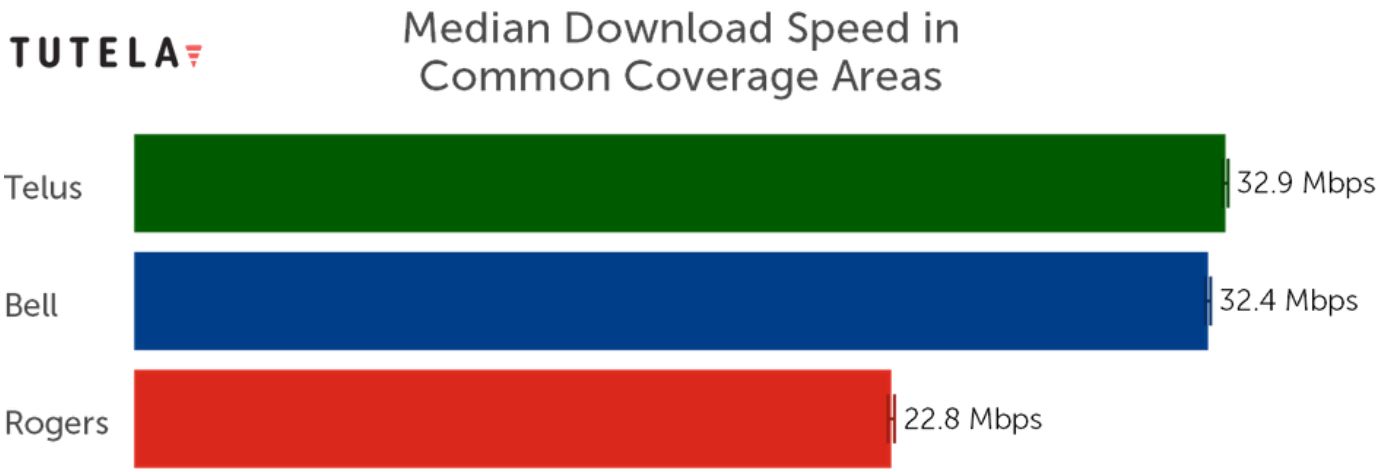
Looking at tests on all mobile connections in Canada, including those on 3G, and with results from Fido, chatr, Virgin, Lucky, Koodo and Public wrapped into their parent brand, Bell and Telus drew for Excellent Consistent Quality in Common Coverage Areas. To contextualise the results, this means that just under nine in 10 times when a Bell or Telus customer had a signal, the connection likely was able to support a range of demanding use-cases including 1080p video streaming, realtime mobile gaming and HD group video calling. Rogers came last, although its Excellent Consistent Quality of 73.5% is still a highly competitive result compared to other operators globally. It is also worth noting that Rogers has the largest base of prepaid subscribers compared to its competitors based on its FY2019 publicly reported numbers – and these are mainly tied to its Chatr sub-brand, where users can only access 3G connections. These are typically throttled customers, with speeds limited below the 5 Mbps threshold used in Excellent Consistent Quality. This is likely a major reason for Rogers' weaker performance when compared to Bell and Telus on both Excellent Consistent Quality and download throughput. Rogers's higher market share of prepaid users (on chatr) is a major contributor to its lower download speed and Excellent Consistent Quality compared to Bell and Telus. However, it is also worth noting that chatr's median download speeds and Excellent Consistent Quality do fall below those of Lucky and Public Mobile (Bell and Telus' prepaid brand), while its median latency is higher. This is likely an impact of pushing users solely onto 3G rather than limiting to 3G-only speeds on a 4G connection. 3G networks are less spectrally efficient, with more impact from heavy data loads. Such networks also tend to have higher latency on average than 4G ones, and lower maximum speeds.



When it comes to Core Consistent Quality, the rankings were much closer. Here, Telus narrowly edged ahead, although the difference was again extremely small. The Core Consistent Quality results for Rogers are also much closer to the other two - with almost all users on the network (including flanker brands Fido and Chatr) experiencing a network capable of meeting the requirements for most day-to-day use-cases including SD video streaming, social media sharing and VOIP calls 97.5% of the time when a user was in range.

Download throughput

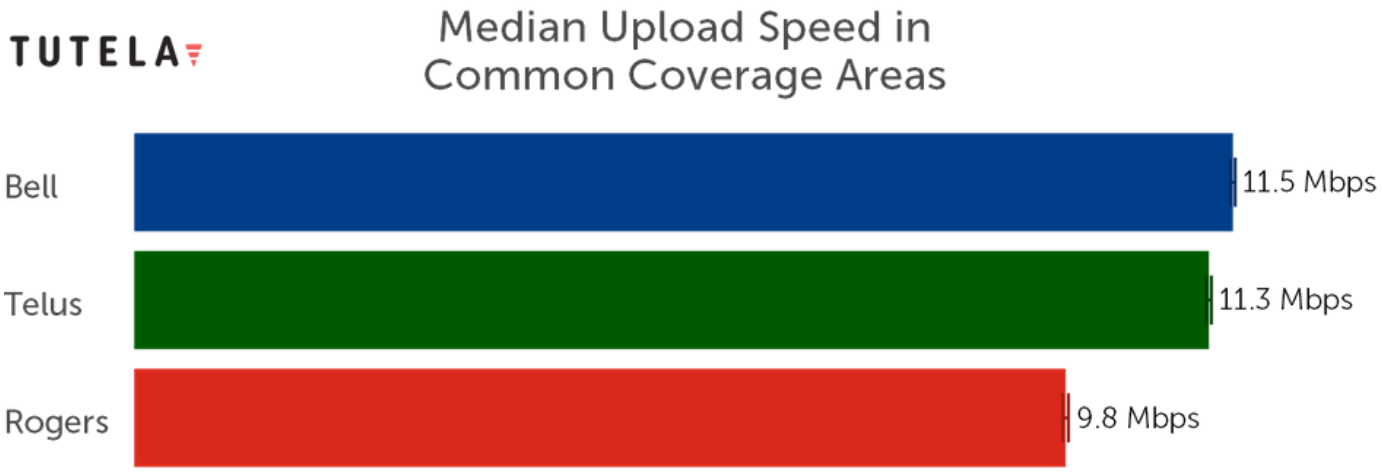
In a comparison of the fastest median download speeds across 3G and 4G networks in Common Coverage Areas across Canada, Telus narrowly inched into first place, with Bell just 0.5 Mbps behind. All three operators offer world-class speeds that exceed those of even the fastest network south of the border in the USA. Again, a big reason for Rogers' weaker download speeds can be attributed to its 3G throttled Chatr customers, who experience speeds significantly below those on more premium plans.



*Total Network Analysis: includes both 3G and 4G users

Upload throughput

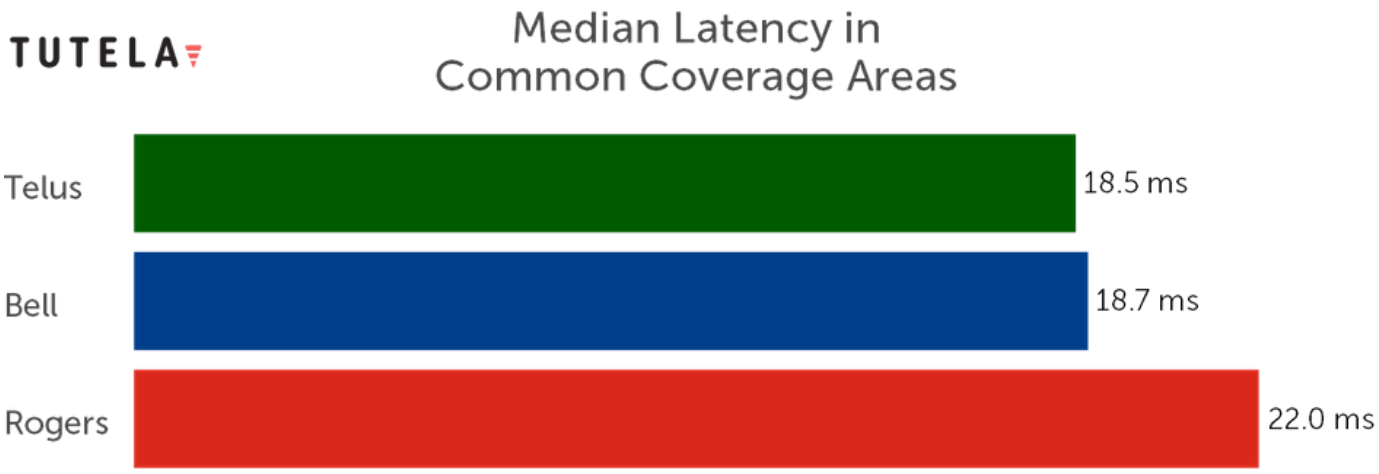
Bell narrowly took the lead for median upload speed, with a difference of just 0.2 Mbps. Meanwhile, the rankings were considerably closer than on other metrics, with third-place Rogers just 1.7 Mbps behind the leader. An often-overlooked metric in network operations, upload speeds are important for uses ranging from sharing images over social media to live streaming video and making VoIP calls.



*Total Network Analysis: includes both 3G and 4G users

Latency

Telus was Canada's most responsive network in Tutela's testing, with a one-way latency of 18.5 ms. As in other metics, Bell was very close behind, and just 0.2 ms separated the two. Meanwhile, Rogers' 22.0ms latency is still extremely fast, well below the 50 ms threshold that Tutela uses for Excellent Consistent Quality. All networks in Canada likely perform well for latency-heavy applications such as real-time gaming or voice and video calls over a data connection.

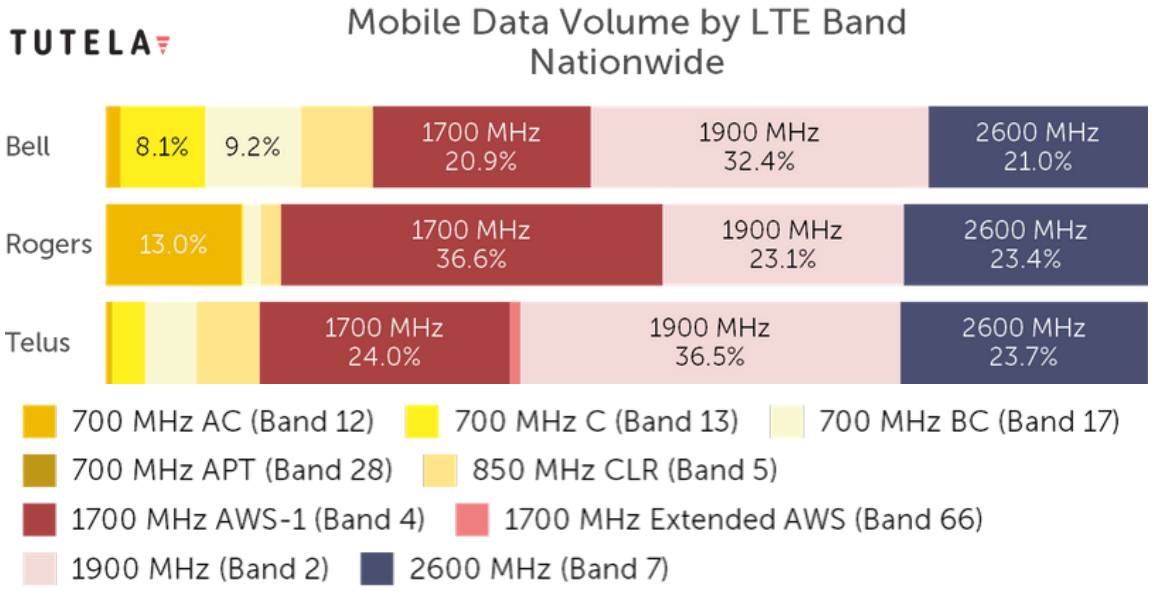


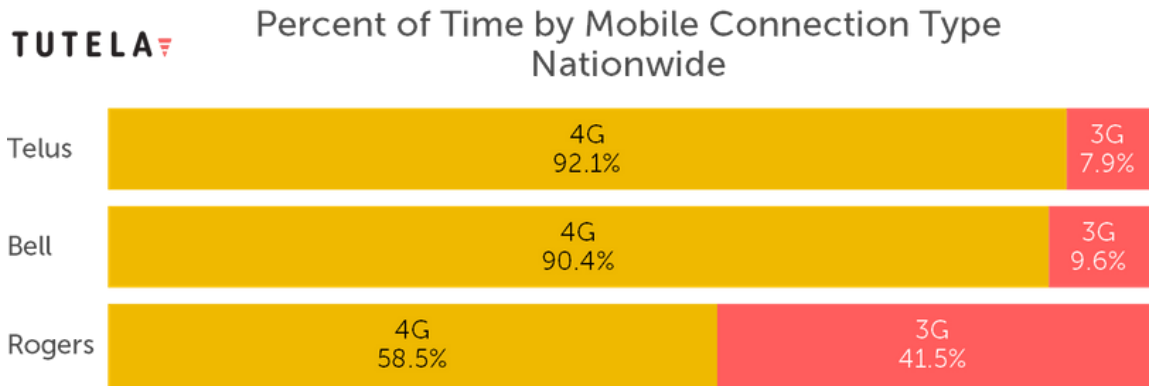
Technology usage

Many aspects of the three operators' spectrum distribution are fairly consistent, although it is interesting to note the difference in data usage on low band spectrum (demonstrated in yellow) between Bell and Telus subscribers, given the level of network sharing between the two. This lends some weight to Bell's decision not to participate in the 600 MHz auctions in 2019, where the stated reason was that Bell already had enough "supply of other low-band spectrum" to deliver 4G and 5G services(1). The overlap of Bell and Telus's network can also be seen in the similar levels of 4G utilization seen on Telus and Bell, which varies by a minimal 1.7%.

(1) BCE, Bell update on federal auction of 600 MHz spectrum
https://www.bce.ca/news-and-media/releases/show/bell-update-on-federal-auction-of-600-mhz-spectrum-1
Retrieved 01 April 2020

Roger's 4G/3G distribution is unusual - and it is important to note that this is not because its 4G network does not cover the areas where some users are using a 3G connection. Indeed, Rogers' marketing material suggests that the LTE network covers approximately 97% of Canadians. Instead, Tutela's data suggests that this is the impact of Chatr users which are limited to the 3G network. In other parts of the world, Tutela tends to see operators allow users on these types of discount plans onto the 4G network but with speed caps in place to simulate 3G conditions. In the case of Chatr, Tutela observes network speeds up to a maximum of 3 Mbps, which, as noted above, goes some way to explaining Rogers' lower results for both download throughput and Excellent Consistent Quality, where the download throughput threshold required for a "pass" is 5 Mbps.

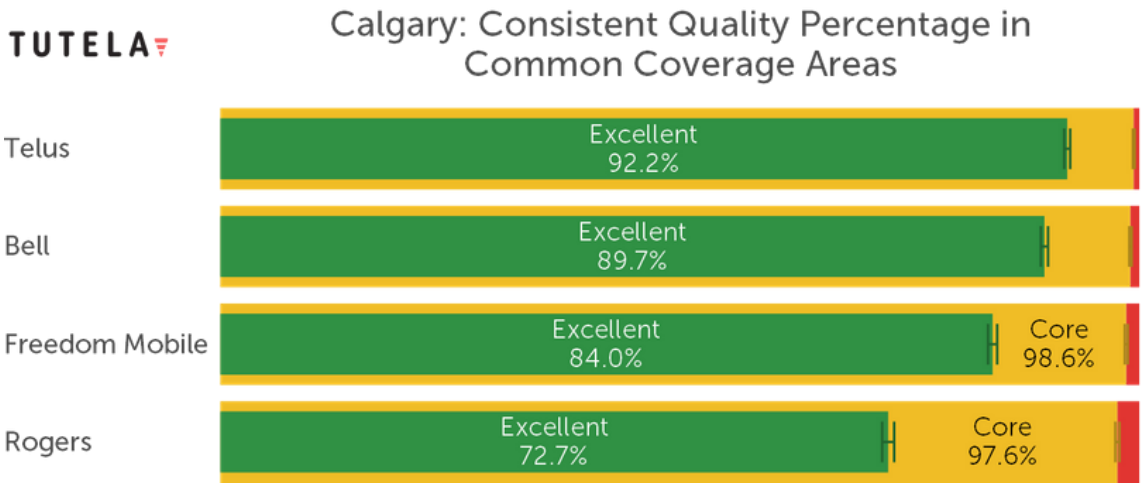


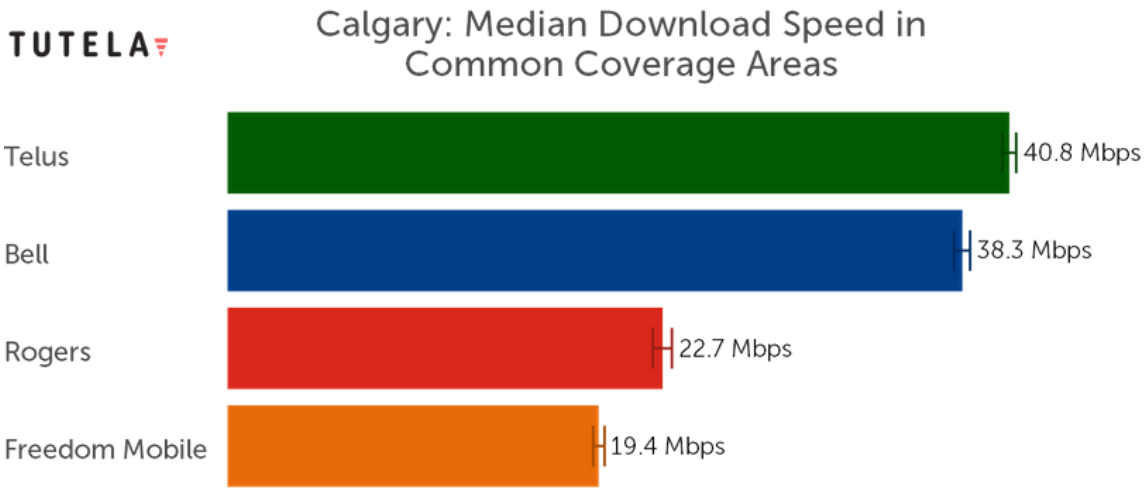


(2) Rogers, Rogers wireless network coverage
https://www.rogers.com/business/products-and-solutions/wireless/network-coverage
Retrieved 01 April 2020

Calgary

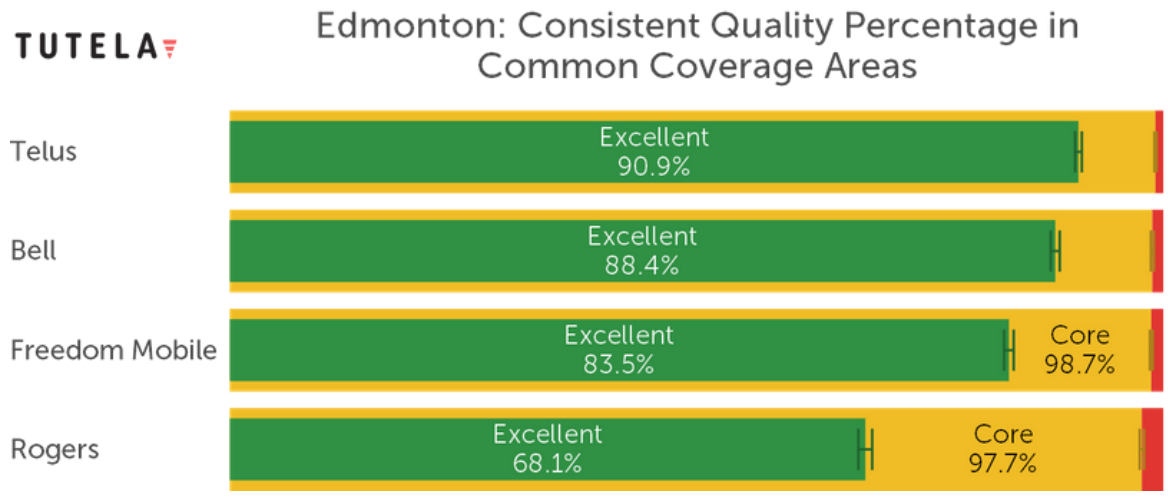
In the Albertan city of Calgary, Telus had the highest Excellent Consistent Quality percentage with 92.2%. With a difference of only 2.5%, Bell was hot on the heels of Telus with an Excellent Consistent Quality percentage of 89.7%. Freedom Mobile posted an Excellent Consistent Quality percentage of 84.0% for Calgary. Rogers fell away from the competition significantly with an Excellent percentage of 72.7%, 19.5% less in performance than first-place Telus. For download speeds, Telus had the fastest speed in Calgary with 40.8 Mbps. Bell was again close behind with 38.3 Mbps. Despite being in close competition with Consistent Quality, Freedom Mobile fell to last place in the download speed test with only 19.4 Mbps. Rogers took out third spot with a median download speed of 22.7 Mbps, nearly half the performance of Telus.

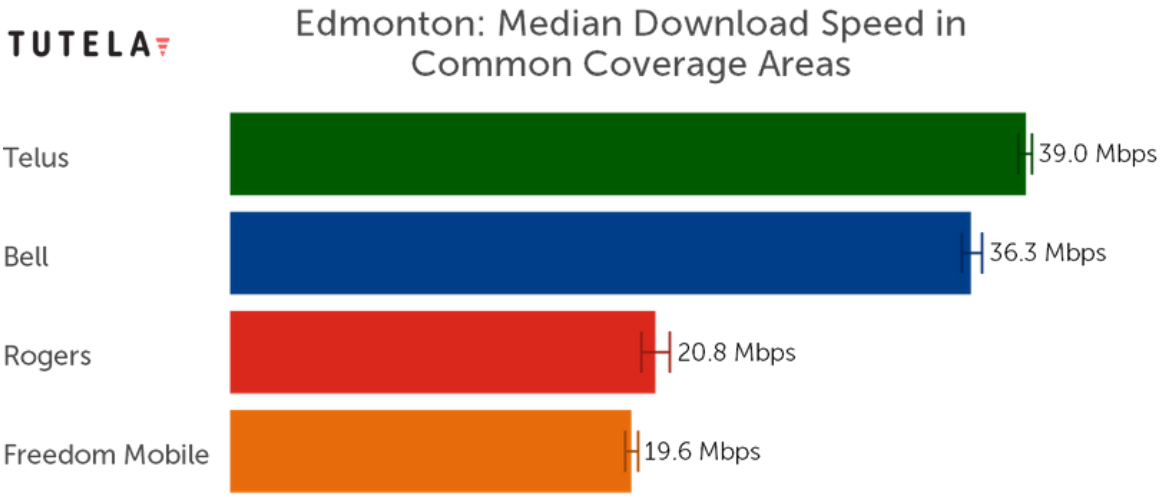




Edmonton

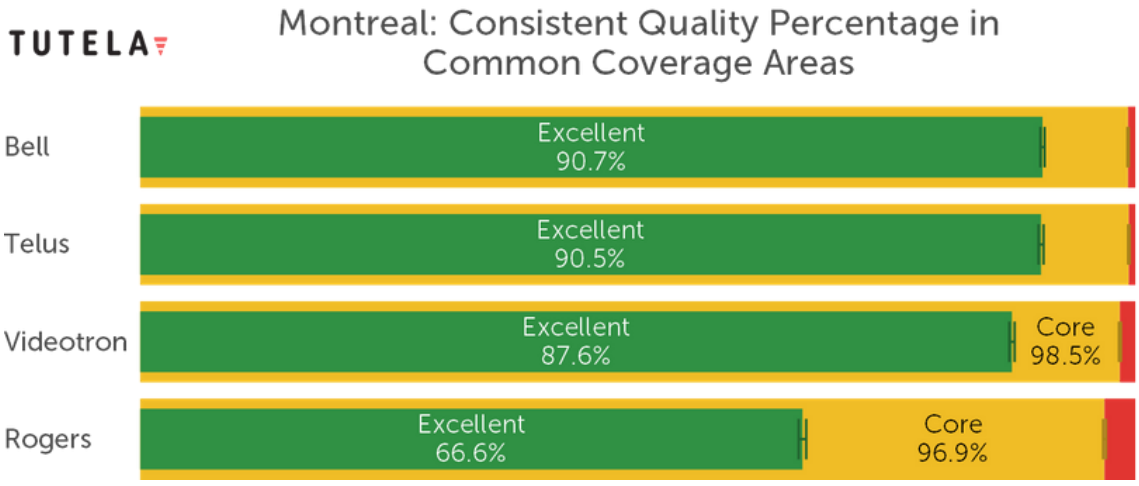
Telus took the top spot in Edmonton, Alberta's capital, but with close competition. Telus had the highest Excellent Consistent Quality percentage in the city with 90.9%, however Bell is again only 2.5% behind in performance with an Excellent Consistent Quality of 88.4%. Freedom Mobile had the third highest percentage in Edmonton with 83.5%, and Rogers was in last place with the lowest Excellent Consistent Quality at 68.1%, a difference in performance compared to Telus of 22.8%. Despite having strong Excellent and Core Consistent Quality percentages, we observed a drop in performance for the operators in the download speed metric compared to Calgary. Freedom Mobile had the slowest median download speed in Edmonton with 19.6 Mbps which is almost on par with Rogers result of 20.8 Mbps, but does not compare to Telus and Bells' fast median speeds of 39.0 Mbps and 36.3 Mbps, respectively.

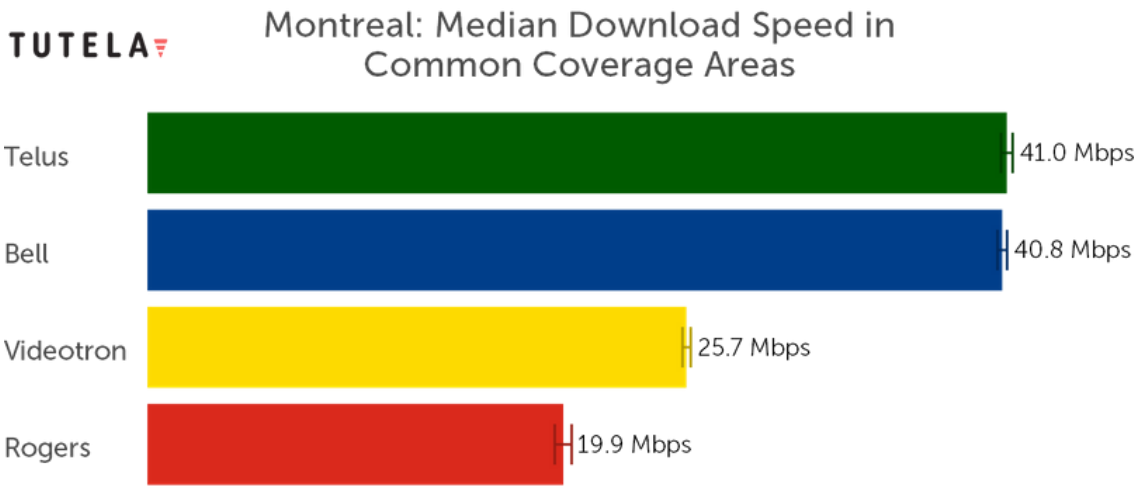




Montreal

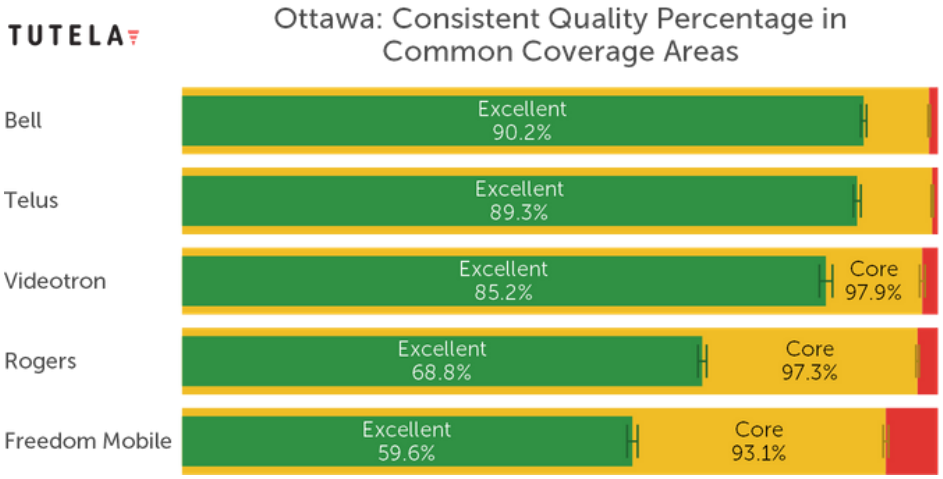
In Common Coverage Areas of Montreal, Bell and Telus tied in both the Excellent and Core Consistent Quality metrics, as well as for median download speed. With the inclusion of Videotron to both Montreal and Ottawa, it is an excellent chance to see how this operator fared against its competition with its more regionalized presence. For Excellent Consistent Quality, Videotron had the third highest percentage with 87.6%, only 3% difference in performance between Bell and Telus. Videotron also had a Core Consistent Quality of 98.5%. Rogers did not fare as well for Excellent Consistent Quality at only 66.6%, however the operator did perform better for Core Consistent Quality with a percentage of 96.9%. As noted above, Bell and Telus tied for download speed to have a very healthy lead over both Videotron and Rogers. Videotron had a median download speed of 25.7 Mbps and Rogers with the slowest median download speed in Montreal with 19.9 Mbps.

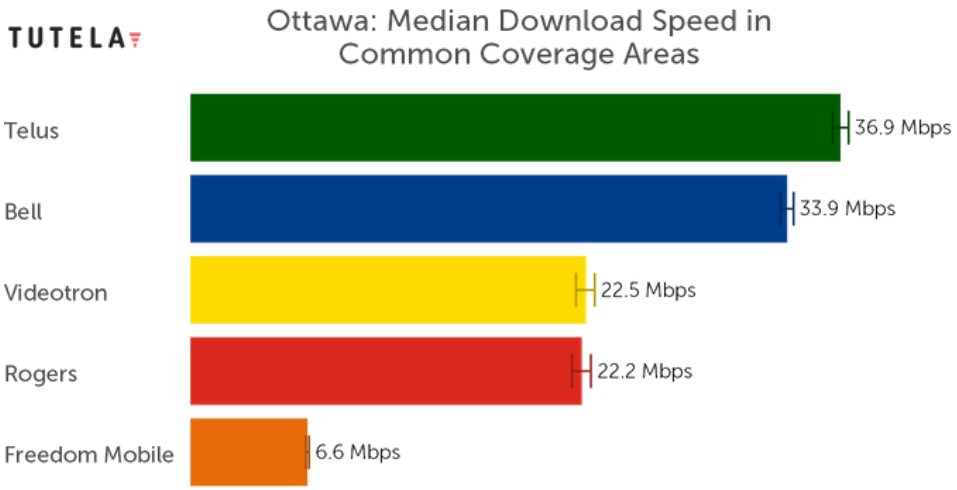




Ottawa

In the capital of Canada, Bell and Telus tied for Excellent Consistent Quality, however Telus managed to obtain the highest Core Consistent Quality in Common Coverage Areas across Ottawa. Videotron took the third-place spot with an Excellent Consistent Quality percentage of 85.2%, only 5% behind Bell and Telus. For Rogers and Freedom Mobile, we see the two operators slip away from the competition with Excellent Quality under 70%. However, for Core Consistent Quality Rogers is only 0.6% under Videotron and Freedom Mobile provides a Core Consistent Quality of 93.1%. Telus had a lead of 3 Mbps over Bell to have the fastest median download speed in Ottawa with 36.9 Mbps. Videotron and Rogers tie for third place, with the 95% confidence interval for their results overlapping to form a statistical tie. Freedom Mobile posted the worst median download speed with a result of only 6.6 Mbps in Ottawa. However, it was not all bad news for the operator; with a Core result that exceeded the 90% threshold, users are at least able to do simple tasks on their devices with ease more than 90% of the time.

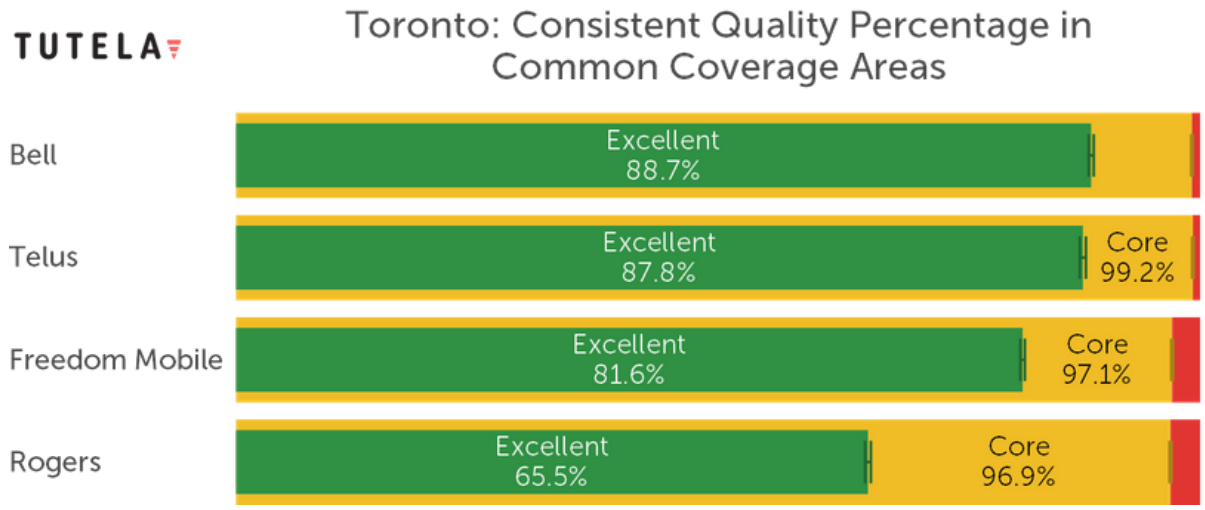


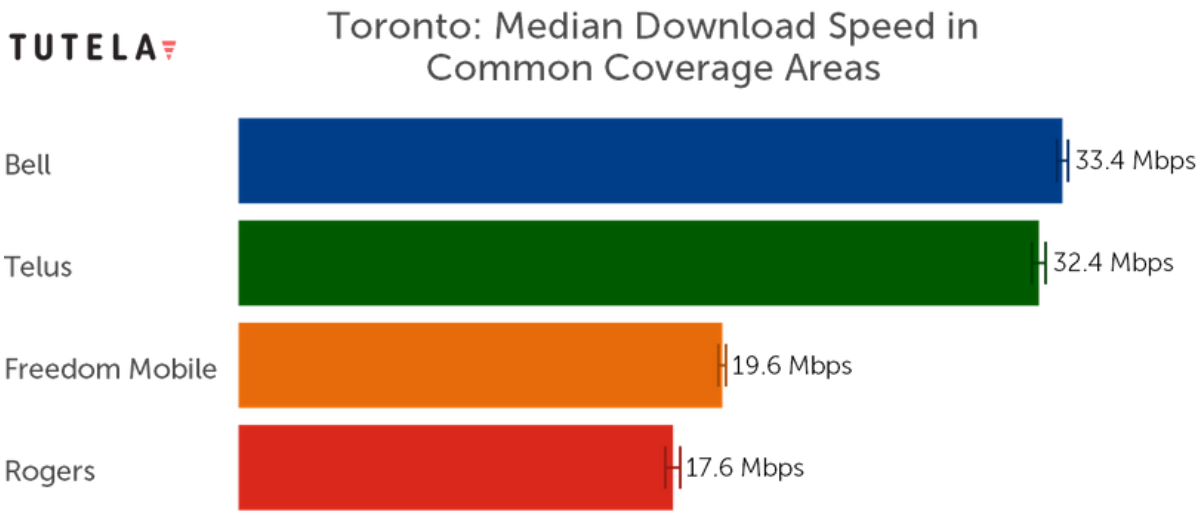


Toronto

In Toronto, Bell drew with Telus for both Excellent and Core Consistent Quality. Freedom Mobile just stayed in the race with an Excellent Consistent Quality percentage of 81.6%, but fell away from the pack with regards to download speeds with 19.6 Mbps, 13.8 Mbps difference in performance between the operator and Bell. Rogers had the lowest Excellent Consistent Quality percentage in Toronto with 65.5%.

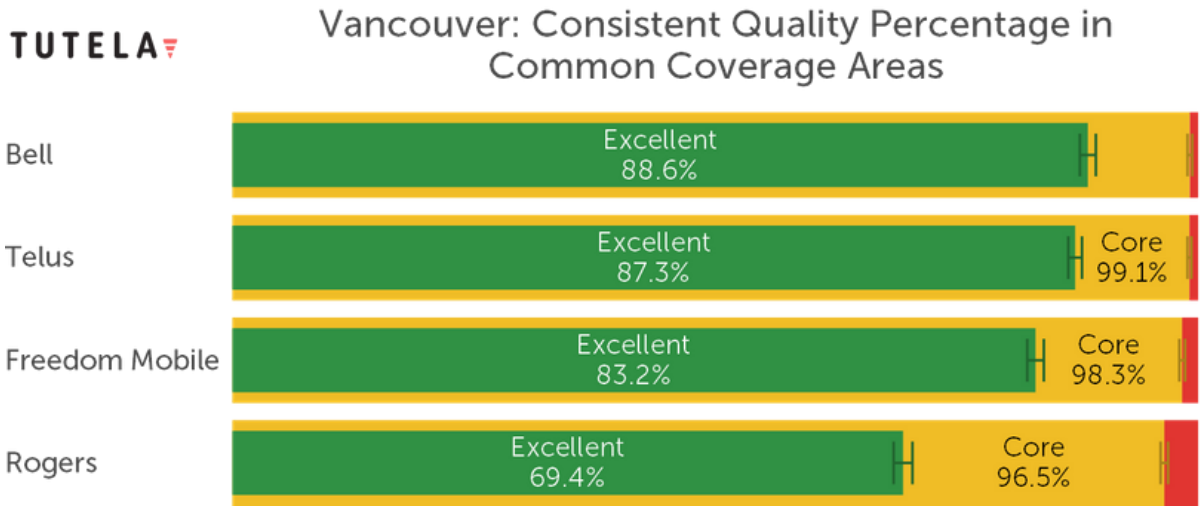
Bell had the fastest median download speed in Toronto for a result of 33.4 Mbps. As always, Telus is close behind with only a performance difference of 1 Mbps. Again we see Freedom Mobile do less well in the download speed than compared to the Consistent Quality metric, with a median download speed of 19.6 Mbps. For Rogers, the operator had the slowest median download speed of 17.6 Mbps.

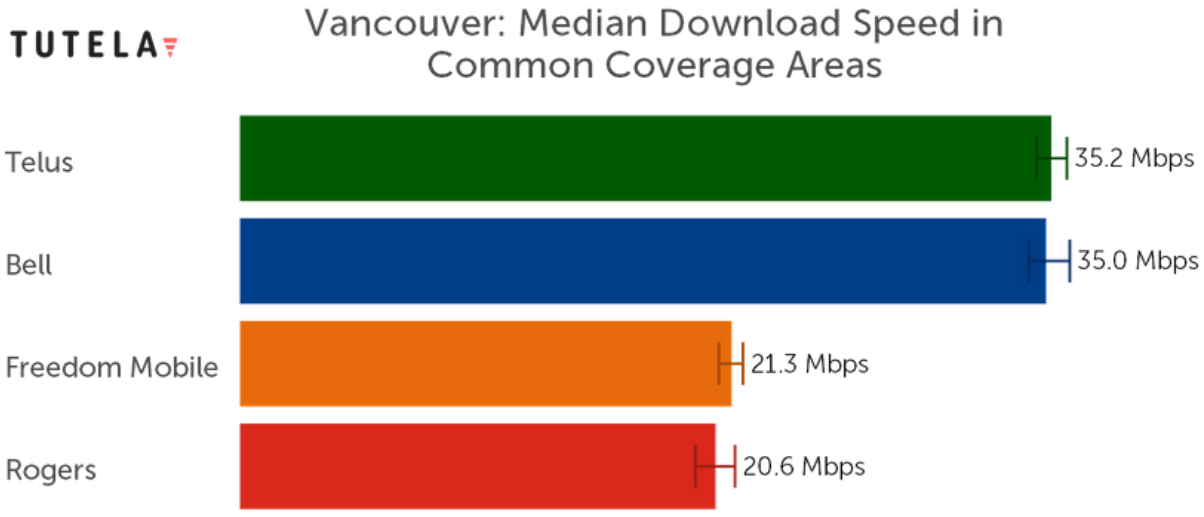




Vancouver

In Vancouver, Bell and Telus tied with the highest Excellent and Core Consistent Quality. Freedom Mobile placed next with an Excellent Consistent Quality percentage of 83.2%, and Rogers had the lowest Excellent Consistent Quality at 69.4%. Telus and Bell also tie for first place with the fastest median download speeds in Common Coverage Areas of Vancouver. Freedom Mobile and Rogers also tied for the third-place finish for download throughput, again due to overlapping confidence intervals making it a statistical tie.

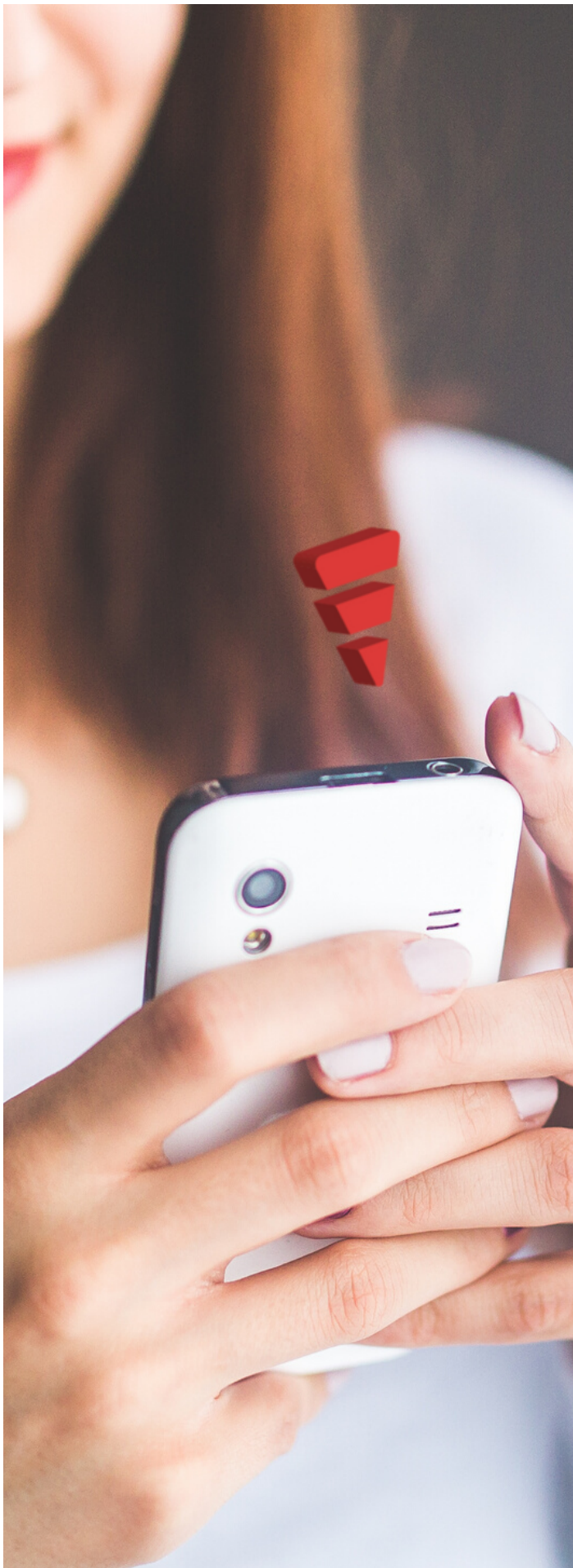




An alternative lens: Top-tier user experience on Canada's Big Three networks

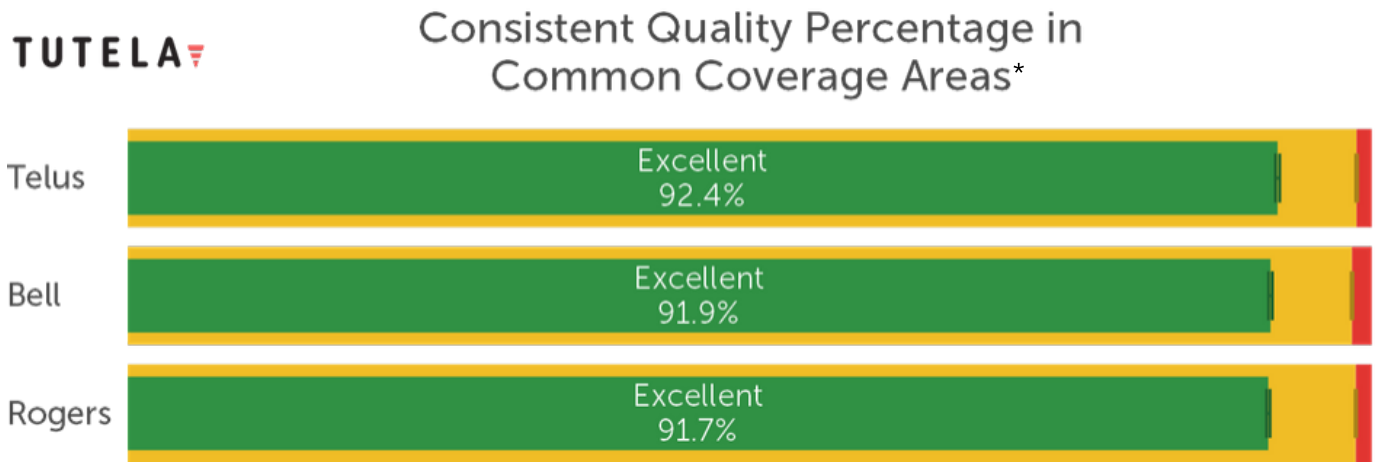
In order to show the full gamut of user experiences on a network, Tutela's methodology includes throttled users and flanker brands within each operator. This means that throttled users who may benefit from cheaper plans in exchange for a more limited network experience can lead to lower results overall – particularly for operators with a significant proportion of its user base on such plans. To account for this, Tutela has modelled a "best case" scenario for user mobile experience, looking only at the core brands (plans sold directly under the Rogers, Bell and Telus names) and on premium devices(3) which not only have the latest modems compatible with all the LTE-Advanced features, but are also more likely to be on the higher-tier plans and thus represent the best mobile experience available.

(3) Premium devices used were those with Snapdragon 845, 855 or 865 family chipsets – including devices like the Samsung Galaxy S10 and LG G8 ThinQ.

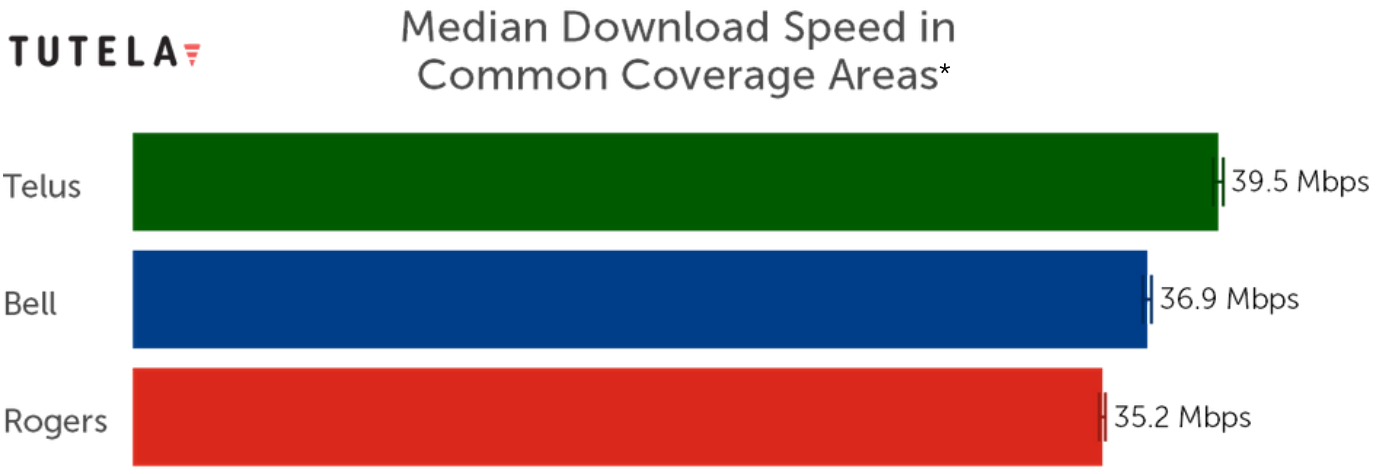


Looking at this top-tier demographic, Canada's networks approach near-parity for user experience, although Telus is the leader for Excellent Consistent Quality with a statistically-significant lead over joint second-place Rogers and Bell. A large driver of the change here is the removal of Rogers's chatr prepaid brand. For Core Consistent Quality, Telus and Rogers drew at 98.8%, meaning that premium users on both networks could almost always make VoIP calls, browse social media or stream SD video when connected to the network. Bell was only a hair behind at 98.4%.

For premium users only on the core brand, Telus remained the fastest network across Common Coverage Areas in Canada, with Bell in second and Rogers in third, although again the rankings were much closer with just 4.1 Mbps separating first and last place.



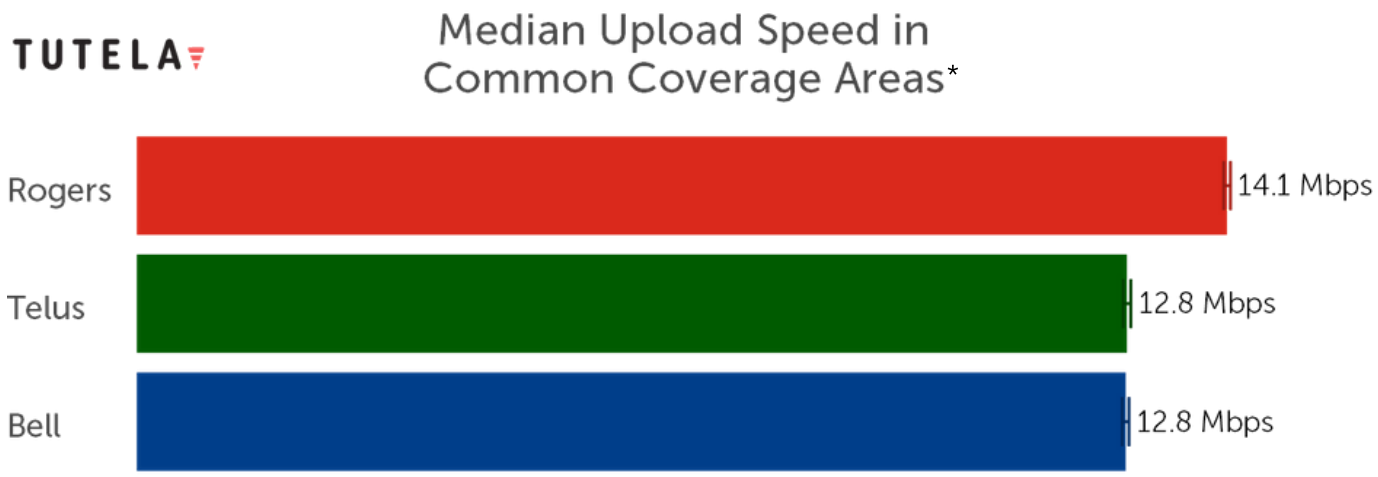
*Premium devices & core brands only.



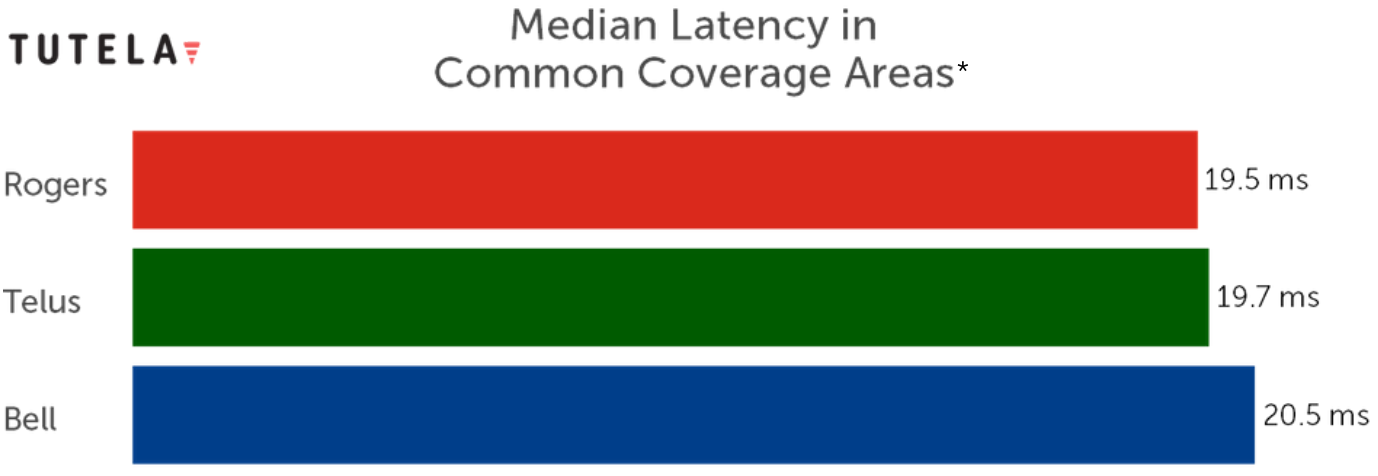
*Premium devices & core brands only.

For median upload speed, Rogers beat joint second-place Bell and Telus with a median of 14.2 Mbps – with the operators all finishing within 1.4 Mbps of each other.

Without the significant impact of a large number of 3G users on its network, Rogers also has the best median latency among users on premium devices in the core brands. However, Telus was a close second with just 0.3 ms separating the two. All three operators demonstrated median latencies far better than the 50ms threshold Tutela uses as part of its Excellent Consistent Quality thresholds.



*Premium devices & core brands only.



*Premium devices & core brands only.

Cities

Cities also tend to have significant variation in plan structure and large numbers of users on flanker brands due to their inherently broad demographics. To demonstrate the best possible experience available in cities, we looked again at how network experience compared for users on premium devices and on the core brands (that is excluding all flankers from Bell, Telus and Rogers, and removing Fizz users from Videotron's results). Freedom Mobile does not offer plans under alternate names, however limiting to just premium devices allows the fairest comparison of best-case performance here.

Through this lens, what is striking is how similar an experience top-tier users received, particularly on the Big Three brands – leading to two or even three-way ties for the highest Excellent Consistent Quality between the three in every one of the six cities tested. For users who can afford to upgrade to this tier of offerings, it is clear that their experience notably outstrips the average experience of users on the network as a whole.

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An Alternative Lens: Excellent Consistent Quality in Cities

Users on core brands with premium devices

	Calgary	Edmonton	Montreal	Ottawa	Toronto	Vancouver
Bell	95.48 ± 0.54	93.36 ± 0.69	94.88 ± 0.42	93.4 ± 0.79	95.98 ± 0.37	92.13 ± 1.54
Freedom	89.53 ± 0.8	88.49 ± 0.85		67.93 ± 1.34	87.2 ± 0.41	88.66 ± 1.55
Rogers	94.38 ± 0.63	95.51 ± 0.62	93.13 ± 0.41	93.09 ± 0.66	94.59 ± 0.31	93.51 ± 1.11
Telus	95.81 ± 0.53	95.19 ± 0.6	95.88 ± 0.51	94.47 ± 1.05	95.94 ± 0.52	95.24 ± 1.09
Videotron			92.93 ± 0.58	90.42 ± 1.48		

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 collected over 3.9 billion records in Common Coverage Areas across Canada, between September 1, 2019 and February 29, 2020.

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, and of users on the flanker sub-brands of operators. 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%

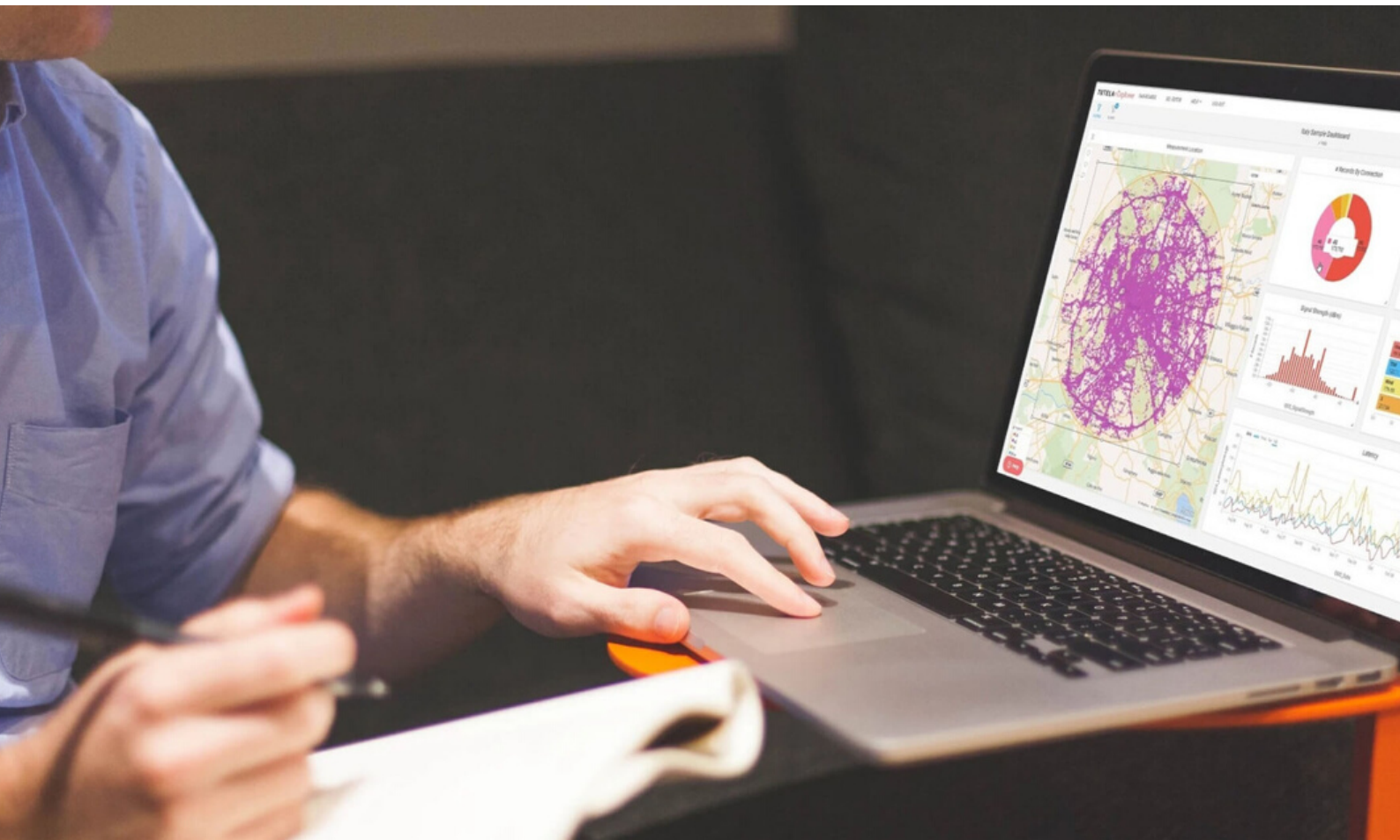
Discover Tutela Explorer

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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Results Overview Nationwide

	Download Throughput	Upload Throughput	Latency	Excellent CQ	Core CQ
Bell	31.6 Mbps ± 0.07 Mbps	11.3 Mbps ± 0.02 Mbps	19.0 ms ± 0.005 ms	86.70% ± 0.08%	98.33% ± 0.03%
Rogers	22.6 Mbps ± 0.10 Mbps	9.7 Mbps ± 0.03 Mbps	22.1 ms ± 0.005 ms	73.47% ± 0.11%	97.49% ± 0.04%
Telus	32.3 Mbps ± 0.08 Mbps	11.1 Mbps ± 0.03 Mbps	18.7 ms ± 0.004 ms	86.74% ± 0.09%	98.58% ± 0.03%

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Results Overview Common Coverage Areas

	Download Throughput	Upload Throughput	Latency	Excellent CQ	Core CQ
Bell	32.4 Mbps ± 0.08 Mbps	11.5 Mbps ± 0.02 Mbps	18.7 ms ± 0.005 ms	87.36% ± 0.08%	98.50% ± 0.03%
Rogers	22.8 Mbps ± 0.10 Mbps	9.8 Mbps ± 0.03 Mbps	22.0 ms ± 0.005 ms	73.52% ± 0.11%	97.51% ± 0.04%
Telus	32.9 Mbps ± 0.08 Mbps	11.3 Mbps ± 0.03 Mbps	18.5 ms ± 0.004 ms	87.23% ± 0.09%	98.67% ± 0.03%

An alternative lens

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Results Overview Common Coverage Areas

	Download Throughput	Upload Throughput	Latency	Excellent CQ	Core CQ
Bell	36.9 Mbps ± 0.16 Mbps	12.8 Mbps ± 0.04 Mbps	20.5 ms ± 0.009 ms	91.87% ± 0.15%	98.43% ± 0.07%
Rogers	35.2 Mbps ± 0.11 Mbps	14.1 Mbps ± 0.05 Mbps	19.5 ms ± 0.005 ms	91.69% ± 0.14%	98.73% ± 0.06%
Telus	39.5 Mbps ± 0.19 Mbps	12.8 Mbps ± 0.05 Mbps	19.7 ms ± 0.009 ms	92.44% ± 0.17%	98.79% ± 0.07%

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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