

US State of the Mobile Union 2H 2020

Carrier performance at national, state, and metro levels,
plus a look at how 5G is changing your connected experience



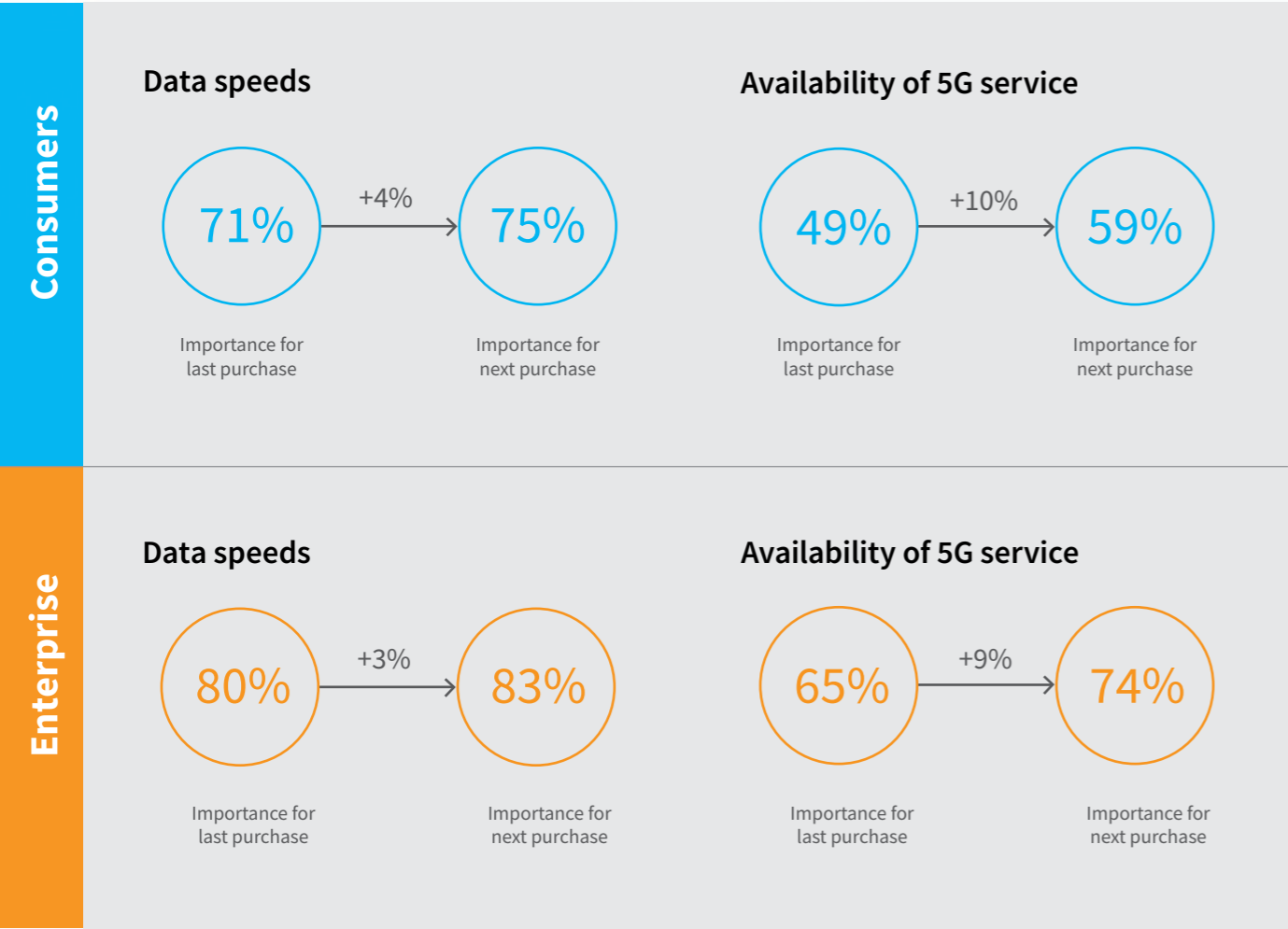


2020 marked a seismic shift to an already fluid and constantly evolving mobile landscape. With the COVID-19 pandemic leading to unprecedented levels of remote learning and working, the importance of fast and reliable mobile connectivity has never been greater. And as more and more people use their smartphones for streaming videos, mobile gaming, and much more, data usage has continued to explode, and end-user demands for flawless connectivity will only increase.

As our connected communities continue to grow in the face of rising connectivity demands, the good news is that 5G is expanding and improving across the US, and 2021 could mark a turning point as we move closer to achieving 5G ubiquity. And with Sprint and T-Mobile having completed their merger in 2020, a mobile landscape once previously dominated by four major carriers is now down to three, and the competition among this new “Big 3” should become more intense going forward.

Seamless connectivity is more critical than ever

We recently conducted an extensive study of high-intensity mobile users—both enterprise users and general consumers—to understand the factors people consider when switching networks or making purchasing decisions. Our study showed that seamless connectivity is becoming more and more important when users consider future purchasing decisions.



Our study also showed that high-intensity users—those who use at least eight mobile apps per day—are far more likely to switch operators than other users, and this rapidly growing segment is also likely to consider independent network performance information (like this report) when considering purchasing decisions. Whether you’re one of those high-intensity users considering a change or not, read on for detailed summaries and insights into all three carriers’ performances in the second half of 2020.



Connected insights for your connected lives

Our test results show you how the major carriers in the US performed across all the spaces in which you use your smartphone, from the country’s 125 most populated metro areas to each of the 50 states, and across the US as whole.

We’ve also taken a look at how 5G can change (and improve) your daily connected experience in cities across the US. Read on to see how the carriers performed in the second half of 2020.

We tested:



The entire US



The 50 states



The US’s 125 biggest metros



Testing highlights and stats at a glance



2,916,419
Tests performed



302,012
Miles driven



125
Metro areas tested



Over 3000
Total places visited

With the Sprint/T-Mobile merger completed in 2020, this is our first State of the Mobile Union Report in which results for Sprint are not included.

In response to the COVID-19 pandemic, RootMetrics testing included extensive safety measures and strict adherence to local and national COVID-19 guidelines and best practices. To accommodate all safety guidelines while still following RootMetrics scientific testing methodologies during the pandemic, we did not collect test samples indoors in the US in 2H 2020.

Performance across the United States

Providing strong service across the entirety of the US is a tall order. To earn our US RootScore Awards, a carrier needs to offer outstanding performance across all the different spaces where consumers use their smartphones, from cities and towns of all sizes, to roadways, rural areas, and all the places in between.

United States RootScores 2H 2020

Rank	Overall	Reliability	Accessibility	Speed	Data	Call	Text
1	96.0	96.5	95.2	95.9	97.1	94.5	96.8
2	94.5	95.3	90.9	94.9	96.3	92.1	
3	87.5	88.2	90.5	84.6	89.8	82.4	91.5
4							

Note:
- Our Accessibility RootScore Award was first introduced in 1H 2020.
- To reflect shifting end-user expectations and performance, we've fine-tuned the way we measure network speed. See page 12 for more details.

● AT&T ● T-Mobile ● Verizon

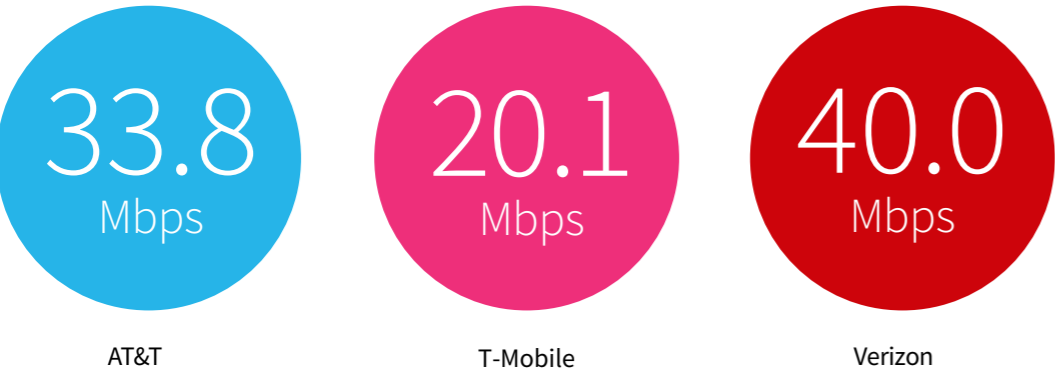
Key takeaways (alphabetized by operator)

AT&T earns a share of the US Text RootScore Award and posts strong results in general: AT&T shared the US Text RootScore Award for the eighth straight time, ranked second in every other category, and registered a strong aggregate median download speed of 33.8 Mbps, which was bested by only Verizon's 40.0 Mbps. While the carrier delivered strong speeds across all levels of testing—national, state, and metro—AT&T's ranking in the Network Speed RootScore category slipped from first place in 1H 2020 to second place in the second half of 2020.

T-Mobile ranks third in all six categories: In the first half of 2020, when Sprint was included in our results, T-Mobile ranked third for network speed and fourth in the other six categories. This time, meanwhile, T-Mobile finished third in all six categories. While T-Mobile typically performs much better in major cities than it does at state or national levels, that could change going forward if the carrier adds more towers outside of urban areas as it continues to aggressively integrate Sprint's highly beneficial mid-band spectrum into its 5G service. In effect, 2020 was a transitional period for T-Mobile as it continues to add Sprint resources into its network, and we look forward to watching T-Mobile's performance at national, state, and metro levels in 2021 and beyond.

Verizon shines on the national stage. Verizon continued its run of excellence in our national testing, winning or sharing all seven United States RootScore Awards while clocking the fastest aggregate median download speed of any network at a speedy 40.0 Mbps. Verizon increased its rank in the network speed category from second in 1H 2020 to first this time, and even more impressively, Verizon kept its record-setting performance streak alive, winning awards outright in the categories of overall performance, network reliability, data performance, and call performance for the fifteenth straight test period, spanning seven and a half years. In short, Verizon's results were remarkable across the board.

United States speeds (ordered alphabetically)



Note: The speeds above show each carrier's aggregate median download speed across the entirety of the US and include speeds recorded on all network technologies, including 4G LTE and 5G, where available.

Keep in mind that if a carrier's ranking(s) declines in a given test period, it doesn't necessarily mean that the operator's performance was worse compared to the previous test period. Rather, a strong performance from another operator(s) can correspond with lower rankings for others.

Mobile performance across the 50 states

Providing strong service across an entire state isn't an easy task. Excelling in metropolitan markets or big cities doesn't necessarily mean that strong service will translate to success in other areas of a state. Our State RootScore Report studies balance performance from dense urban areas, smaller towns, rural spaces, and highways to paint a complete picture of the consumer mobile experience at the state level.



State RootScore Award tally - by category

	Overall	Reliability	Accessibility	Speed	Data	Call	Text	Total
AT&T	17	18	7	30	25	20	44	161
T-Mobile	0	0	0	4	0	0	7	11
Verizon	45	43	46	37	39	47	43	300

Note:
- Due to conditions brought about by the COVID-19 pandemic early in 2020, we did not have State RootScore Awards in the 1H 2020 version of this report.
- Also note that prior to 2H 2020, our award tallies included those of Sprint. However, now that Sprint and T-Mobile have merged, apples-to-apples comparisons of awards across different test periods are inappropriate.

Key takeaways (alphabetized by operator)

AT&T delivers a strong showing in state-level testing: Similar to what we saw at the national level, AT&T registered a strong second-place showing at the state level, with a far greater tally of State RootScore Awards (161) than that of T-Mobile but nearly half as many of that of Verizon (300). AT&T stood out in the text category, with its 44 State Text RootScore Awards the most of any carrier, though Verizon was close behind with 43.

T-Mobile better in metros than at the state level: Historically, T-Mobile's state-level award tally has been much lower than those of either AT&T or Verizon, and that was again the case in 2H 2020. That said, T-Mobile delivered generally strong results in our metro area testing, and as its 5G continues to expand and mature, we could see T-Mobile's performance improve outside of major cities going forward, especially with T-Mobile continuing to integrate the highly coveted mid-band spectrum it acquired from Sprint during their merger.

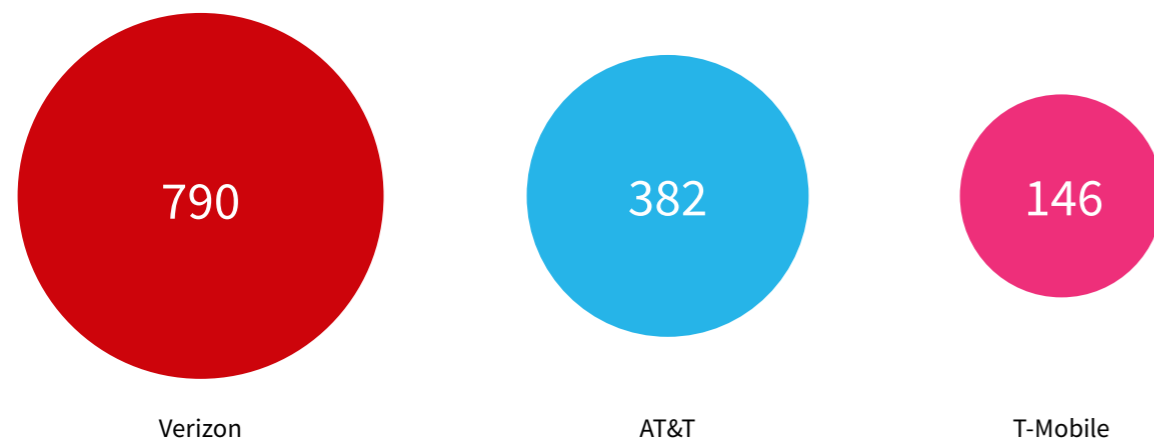
Verizon offers the best combination of fast speeds and great reliability: The foundation of the end-user mobile experience rests on two key factors: speed and reliability, and Verizon shined in both areas. Verizon won or shared an exceptional 300 State RootScore Awards out of 350 possible award opportunities in 2H 2020, including an impressive 45 State Overall RootScore Awards, 43 State Reliability RootScore Awards, and 37 State Speed RootScore Awards. In fact, Verizon took home at least 37 awards in all seven categories. For perspective, AT&T was the only other carrier that won at least 37 awards in any single category, and AT&T did so in one category (text).

Metro area performance

Major metropolitan markets are much more than just city centers. They also include the suburbs, business districts, tourist areas, and the roadways that connect them. With the 5G era having started in the US, end users expect fast and reliable mobile performance across all of these spaces, whether they live and work in a metropolitan market or are visiting on vacation.

This section of our report provides a carrier-by-carrier overview of performance across the 125 most populated metro areas in the US, as well as a high-level look at how each carrier's 5G network has performed as deployments continue.

Metro Area RootScore Award tally



Metro performance in a nutshell:

AT&T delivered another strong showing in metro area testing, clocking fast speeds, good reliability, solid 5G results, and the second-highest tally of RootScore Awards.

T-Mobile delivered fast speeds and strong reliability in many markets, and its text results were particularly strong. T-Mobile also offered 5G in more markets than any other carrier.

Verizon remained the top performer at the metro level, with fast speeds, outstanding reliability, expanding 5G, and by far the highest tally of RootScore Awards.



AT&T provides fast speeds, great text results, and the second-highest award total

Fast speeds in general: AT&T’s speeds were fast in most markets, even though the number of cities in which the carrier clocked median download speeds of at least 50 Mbps declined from 42 in 1H 2020 to 14 this time. In fact, AT&T’s 14 cities with speeds above 50 Mbps was still far more than that of T-Mobile (0) and wasn’t all that far behind Verizon’s 20 such markets. Looking at our speed intervals together, AT&T delivered median download speeds of at least 30 Mbps in 67 cities (and 20 Mbps or better in 103 cities), a total far higher than that of T-Mobile (17) but well behind that of Verizon (111).

The single fastest speed of any carrier: For the second straight test period, AT&T delivered the single fastest median download speed of any carrier across all 125 cities we tested, registering an impressive 77.5 Mbps in Kansas City, MO, a speed which was aided by the carrier’s impressive 5G results in the city.

Stellar text results and a strong award tally in general: AT&T’s text performance was second to none, with the carrier winning or sharing the Text RootScore Award in every city we tested. AT&T’s results were strong across the board, with its tally of 382 Metro Area RootScore Awards well over twice as many as that of T-Mobile (but nearly half as many as that of Verizon).

Encouraging 5G results and an expanded 5G footprint: We recorded 5G results for AT&T in 106 cities in 2H 2020, up from 78 in 1H 2020, and the carrier’s 5G availability reached at least 50% in 33 of those cities (compared to 57 for T-Mobile and 10 for Verizon). AT&T also registered strong 5G speeds in several cities, with 5G median download speeds of 60 Mbps or better in 18 markets and its fastest 5G median download speed coming at in a speedy 94.8 Mbps in Kansas City, MO.

AT&T’s median download speed intervals (all network technologies)						
Median download speed intervals	0-10 Mbps	10-20 Mbps	20-30 Mbps	30-40 Mbps	40-50 Mbps	50+ Mbps
1H 2020	0	8	22	28	25	42
2H 2020	0	22	36	31	22	14

- Number of markets out of 125 in which AT&T delivered median download speeds at various intervals.
- Median download speeds on the table above represent speeds recorded on all network technologies, including 5G, where available.



AT&T’s fastest and slowest median download speeds

(and how long it takes to download a 600MB video)



Speeds above show the markets in which AT&T recorded its fastest and slowest median download speeds (Mbps), and the times indicate how long it typically takes to download a 600MB video at each speed (times in minutes).

AT&T Metro Area RootScore Award tally

AT&T	Outright	Ties	1H 2020 total
Overall RootScore Award	9	23	32
Reliability RootScore Award	4	48	52
Accessibility RootScore Award	15	11	26
Speed RootScore Award	13	32	45
Data RootScore Award	14	20	34
Call RootScore Award	3	65	68
Text RootScore Award	6	119	125
Total awards	64	318	382

T-Mobile delivers fast speeds in many markets, strong text results, and widespread 5G availability

Fast speeds in several metros: T-Mobile usually delivers impressive speeds in several major cities, and that was again the case in 2H 2020. While the carrier didn’t register median download speeds faster than 30 Mbps in nearly as many markets as either AT&T or Verizon, T-Mobile clocked speeds of at least 20 Mbps in 63 cities, and speeds above 20 Mbps will provide users with generally fast file downloads and quick streaming. It’s worth noting that in many ways, 2020 could be seen as a transitional period for T-Mobile, with work continuing on its merger with Sprint that could allow for stronger results going forward.

Strong text results: T-Mobile once again performed particularly well in the Text RootScore Award category, taking home 93 Text RootScore Awards, which accounted for the majority of its award total of 146.

T-Mobile introduces “Layer Cake” 5G strategy: T-Mobile launched its “Layer Cake” 5G strategy in 2020, marking the first time any of the major carriers utilized a combination of low-band, mid-band, and millimeter wave (mmWave) spectrum for 5G deployments. Tapping into all three types of spectrum provides T-Mobile with the ability to offer both fast speeds plus broad geographical coverage to its users, rather than one or the other. See our article about T-Mobile’s initial [layer cake 5G deployment in New York City](#) to learn more.

Impressive 5G availability, with faster 5G speeds expected to follow thanks to Sprint merger: Not only did T-Mobile have the largest 5G footprint of any carrier, offering 5G in every market we tested, the carrier’s 5G availability was generally broad in most cities, with 5G availability of at least 50% in 57 cities, a number far higher than those of either AT&T (33) or Verizon (10). While most of T-Mobile’s 5G median download speeds were similar to its speeds on 4G LTE, the carrier did deliver 5G speeds of at least 60 Mbps in five markets, topping out at a tidy 88.0 Mbps in Fayetteville, NC. As the carrier continues to integrate Sprint’s coveted [mid-band spectrum](#) into its 5G solution, T-Mobile’s speeds should get faster over time.

T-Mobile’s median download speed intervals (all network technologies)						
Median download speed intervals	0-10 Mbps	10-20 Mbps	20-30 Mbps	30-40 Mbps	40-50 Mbps	50+ Mbps
1H 2020	3	55	43	17	7	0
2H 2020	4	58	46	14	3	0

- Number of markets out of 125 in which T-Mobile delivered median download speeds at various intervals.
- Median download speeds on the table above represent speeds recorded on all network technologies, including 5G, where available.

T-Mobile’s fastest and slowest median download speeds (and how long it takes to download a 600MB video)



Speeds above show the markets in which T-Mobile recorded its fastest and slowest median download speeds (Mbps), and the times indicate how long it typically takes to download a 600MB video at each speed (times in minutes).

T-Mobile Metro Area RootScore Award tally

T-Mobile	Outright	Ties	1H 2020 total
Overall RootScore Award	0	0	0
Reliability RootScore Award	0	11	11
Accessibility RootScore Award	0	7	7
Speed RootScore Award	0	11	11
Data RootScore Award	0	7	7
Call RootScore Award	0	17	17
Text RootScore Award	0	93	93
Total awards	0	146	146

Verizon shows fast speeds, great reliability, expanded 5G, and the highest award total.

Consistently fast and reliable: Verizon impressed at both the high and low ends of our speed intervals: Verizon had the highest tally of markets with speeds of at least 30, 40, or 50 Mbps, and Verizon didn’t record any median download speeds below 20 Mbps. For context, AT&T clocked speeds below 20 Mbps in 22 cities while T-Mobile did so in 62. While fast speeds are key, it’s important to remember that great reliability is also critical for users, and Verizon’s reliability was excellent. Verizon earned 120 Reliability RootScore Awards, over twice as many as that of AT&T (52) and more than 10 times that of T-Mobile (11).

By far the highest award total: Verizon earned an exceptional 790 RootScore Awards out of 875 total award chances at the metro level. In fact, Verizon brought home over twice as many awards as AT&T (382) and nearly five times more than T-Mobile (146).

DSS allows Verizon to expand its 5G offering: In 1H 2020, we recorded results on Verizon’s millimeter wave (mmWave) 5G network in 27 cities. Verizon’s mmWave 5G offers super-fast speeds but limited availability, with its highest 5G availability in 1H 2020 coming in at 0.7%. In October of 2020, however, Verizon utilized **Dynamic Spectrum Sharing (DSS)** technology to launch its **nationwide 5G** service. DSS allowed Verizon to use its existing LTE spectrum for 5G, and we recorded 5G results for the carrier in 49 markets in 2H 2020. Verizon’s 5G availability also saw a huge boost, surpassing 30% in 34 cities and exceeding 50% in 10 of those metros.

Verizon delivers strong 5G speeds, especially with mmWave: While DSS allowed Verizon to increase its 5G footprint and availability, its mmWave 5G speeds will likely differ from those on its low-band 5G. Verizon’s fastest 5G median download speed with mmWave clocked in at a sterling 223.1 Mbps in Houston (with 0.3% 5G availability), while its fastest low-band 5G median download speed was recorded in Washington, D.C., at 68.9 Mbps (with 42.8% 5G availability).

Verizon’s median download speed intervals (all network technologies)						
Median download speed intervals	0-10 Mbps	10-20 Mbps	20-30 Mbps	30-40 Mbps	40-50 Mbps	50+ Mbps
1H 2020	0	2	15	57	39	12
2H 2020	0	0	14	44	47	20

- Number of markets out of 16 in which Verizon delivered median download speeds at various intervals.
- Median download speeds on the table above represent speeds recorded on all network technologies, including 5G, where available.



Verizon’s fastest and slowest median download speeds and how long it takes to download a 600MB video



Speeds above show the markets in which Verizon recorded its fastest and slowest median download speeds (Mbps), and the times indicate how long it typically takes to download a 600MB video at each speed (times in minutes).

Verizon Metro Area RootScore Award tally

Verizon	Outright	Ties	1H 2020 total
Overall RootScore Award	93	23	116
Reliability RootScore Award	66	54	120
Accessibility RootScore Award	96	12	108
Speed RootScore Award	76	35	111
Data RootScore Award	89	21	110
Call RootScore Award	50	72	122
Text RootScore Award	0	103	103
Total awards	470	320	790

Spectrum: the key to understanding 5G

Because of the complexity of spectrum, 5G launches can often lead to confusion. The key to understanding 5G is understanding spectrum—the different types, the advantages of each, and how those spectrum types can work together to deliver an optimal 5G experience. For a deeper look at spectrum, watch our [new spectrum video](#) and read our comprehensive report on [understanding spectrum and 5G](#).

When it comes to spectrum, there is no best, only different.

Low-band <1 GHz Travels far and penetrates deep indoors. Can reach rural communities. Works with 5G and 4G LTE. Biggest disadvantage: slowest speeds of all spectrum types.	Mid-Band 1-6 GHz Known as the “sweet spot” for 5G connectivity. Offers fast speeds plus broad geographical coverage. Works with 5G and 4G LTE. Biggest disadvantage: difficult for carriers to acquire.	High-Band (mmWave) Incredibly fast speeds and hotspots of 5G connectivity. Faster than other bands. Works with 5G only. Biggest disadvantage: travels a very short distance.
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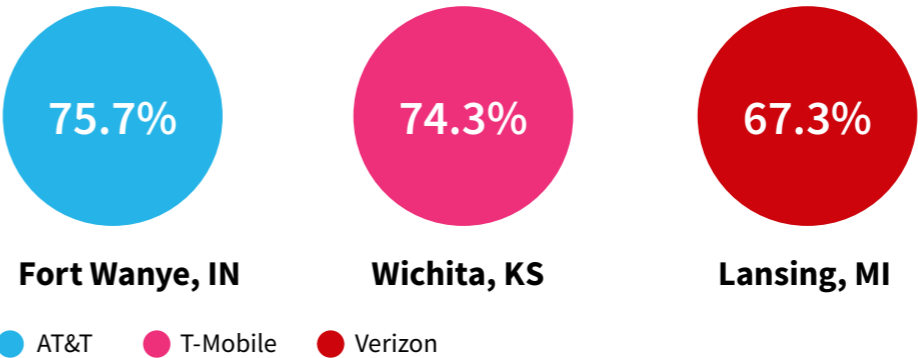
5G spectrum assets in use by carrier:

- AT&T** uses low-band spectrum extensively for its nationwide 5G network, while utilizing its **mmWave spectrum holdings in parts of 35 cities**, including urban centers, event venues, campuses, and other densely populated areas. AT&T has also used DSS to expand the availability of its 5G.
- T-Mobile** has deployed low-band, mid-band, and mmWave 5G as part of its **“Layer Cake” 5G strategy**. The ability of T-Mobile to acquire Sprint’s mid-band spectrum, which offers fast speeds plus broad geographic coverage, was a key reason why the two companies merged and should prove hugely important for T-Mobile going forward.
- Verizon** began its 5G rollout with mmWave spectrum, which provides remarkable speeds but limited 5G availability. Then in October of 2020, the carrier used DSS technology to launch its low-band nationwide 5G service, which expanded Verizon’s 5G offering across the country. To bolster its spectrum holdings, the carrier **recently spent \$1.9 billion** on mid-band spectrum at the CBRS auction. To learn more about CBRS spectrum, check out our new **CBRS eBook**.

5G availability overview

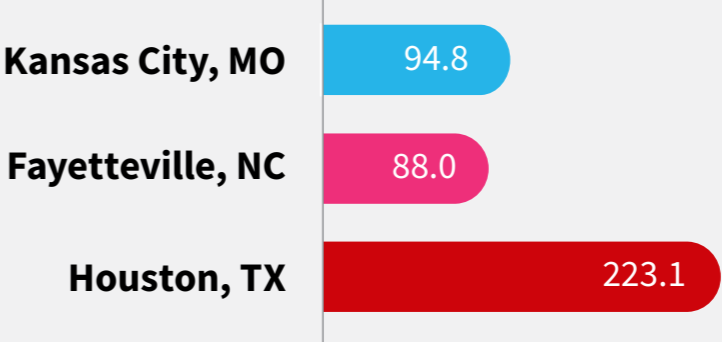
Keep in mind that there are important availability differences based on spectrum types, and carriers face a sometimes-difficult trade-off between broad geographical coverage and fast speeds. A balance of spectrum types is often considered ideal as 5G continues to expand.

Each carrier’s highest 5G availability (%)

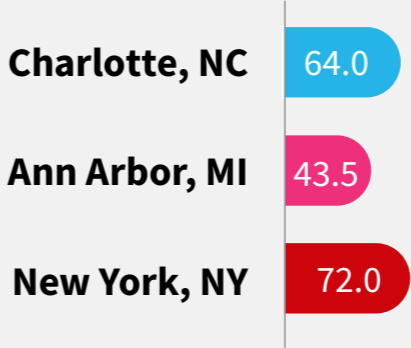


Note: 5G availability is based on the percentage of 5G recorded across all data tests (download, upload, and web and app tests).

Each carrier’s fastest 5G median download speed (Mbps)



Each carrier’s fastest 4G LTE median download speed (Mbps)



How we test

We believe that real-world results come from real-world testing. All RootMetrics testing is conducted from the consumer's point of view. For national, state, and metro testing in 2H 2020, we used Samsung Galaxy S20+ 5G smartphones purchased off the shelf from carrier stores to test both 4G LTE and 5G performance, and tests were conducted during the day and night while walking and driving. We utilize random sampling techniques to ensure our results offer a robust characterization of performance in the places consumers most often use their smartphones, and all testing is focused on the activities for which consumers typically use their mobiles, including data, call, and text usage.

To ensure our results are current and reflect shifting consumer behaviors and emerging technologies, we've made two notable changes to our methodology in 2020. We introduced our new Network Accessibility RootScore Award, which offers a holistic look at accessibility performance across data, call, and text testing and includes latency results during data testing, as well as speed results during call and text testing. We also fine-tuned our Network Speed RootScore category in 2020; we've updated various speed thresholds to capture the most accurate possible picture of when users experience diminishing returns based on changing end-user expectations and performance. As a result, Network Speed RootScores from 2020 cannot be compared to those from 2019 or earlier. To learn more about our testing, visit the [methodology page](#) of our website.

A note about our 5G results in the US

With all three carriers having launched 5G in the US, we used 5G-enabled smartphones to test carrier performance on both 5G and other network technologies, such as 4G LTE or sub-4G LTE technologies. Because 5G users will likely switch from 5G to 4G LTE (or vice versa) during a typical mobile activity, the metrics in this report, unless explicitly stated as 5G or 4G LTE, reflect performance across all network technologies, including 5G if available.

Also note that 5G users can sometimes switch between 5G and 4G LTE during the same data activity, which is known as "mixed mode" technologies. Performance on mixed mode typically isn't as strong as that on 5G-only. Therefore, to provide the most accurate view of a true 5G experience and to assure the most direct comparisons between 5G and 4G LTE, we did not include mixed mode results in our 5G availability or 5G speed reporting.



For more information, visit