The state of 5G in the US - 2H 2021

RootMetrics®

Which carrier won a competitive 5G race in 2H 2021?

Why 5G matters

From streaming HD videos to gaming on the go to a host of industrial IoT applications, fast and reliable internet connectivity has become just as fundamental to everyday life as highways, bridges, or any other type of physical infrastructure.

Mobile users—and especially those on 5G—expect great performance anywhere and everywhere they go, and the good news is that 5G in the US keeps expanding and improving. More good news is that the 5G experience should only get better once **C-Band spectrum** is integrated.

Our **November 5G Scorecard** offered high-level look at the 5G experience across the first 60 cities we tested in the second half of 2021 (out of 125), showing the current leaders for 5G availability, speed, and reliability.

Now that we've finished our 2H 2021 testing across 125 of the most populated metropolitan markets in the US (as defined the US Census Bureau's Census Urbanized Areas or CUAs), we're pleased to announce that we've declared the 5G winners in those same three categories, as well as the carrier that offered the Best 5G experience in the most cities in 2H 2021.

The 5G race is highly dynamic and prone to rapid change, so it wouldn't be a surprise to see the leaderboard shift as we move further into 2022 and beyond. That said, it's important to keep in mind that such a fluid, competitive landscape should ultimately be good news for consumers: with increased competition often comes better performance, continued innovation, and more options for users.

Read on to see who won the 5G race in the second half of 2021, as well as key performance indicators and insights on each carrier's 5G availability, speed, and data reliability results.

The foundation of the ideal 5G experience: availability plus performance (not one or the other)

The 5G experience is shaped by two main pillars: availability and performance. Not only do you need to know how much 5G is available, you also need to understand the speed and data reliability performances you're likely to experience when you access that 5G.

It's critical that the two pillars of availability and performance be considered together—not in isolation—because the ideal 5G experience is marked by a combination of both widespread availability and strong speed and reliability performance.

To see how consistently the carriers delivered on that key combination of availability plus performance, check out the performance intervals and market tallies below. You can see exactly how many cities each carrier offered broad 5G availability, fast speeds, and outstanding data reliability, all of which in combination reflect the optimal end-user 5G experience.

The 5G race results are in. The winners in 2H 2021 are:

Best 5G experience
T-Mobile

5G Availability Winner: T-Mobile

5G Speed Winner: T-Mobile

5G Reliability Winner: Verizon

Best 5G - key takeaways

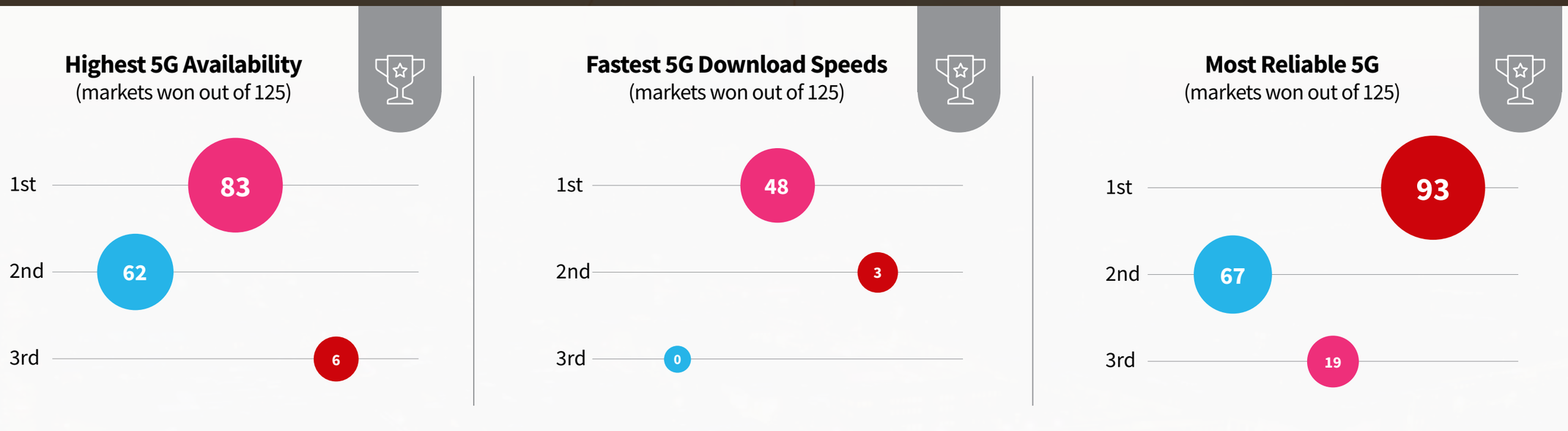
AT&T delivers great 5G reliability and improving availability: While AT&T was unable to defend its Best 5G crown from 1H 2021, the carrier posted strong second-place finishes for both 5G reliability and availability in 2H 2021. AT&T increased its tally of 5G availability wins by 18 markets since 1H 2021, while adding another 8 reliability victories to its ledger. To reclaim its Best 5G title going forward, AT&T must improve its speeds while continuing to post good 5G availability and reliability. The good news is that the AT&T's speeds should see a boost once it integrates the C-Band spectrum it picked up at auction for $23B in 2021.

T-Mobile takes home Best 5G honors: In a shift from 1H 2021 when T-Mobile led the way for 5G availability but finished third for both speed and reliability, T-Mobile not only surpassed both AT&T and Verizon in the 5G speed race, the carrier also maintained its lead for 5G availability. With T-Mobile showing much faster 5G speeds since 1H 2021, along with excellent availability and good reliability, the carrier's unmatched combination of availability plus performance allowed T-Mobile to provide its users with the Best 5G experience in the second half of 2021.

Verizon wins the prize for 5G reliability (again), with improving availability and speeds: With its second consecutive win in the 5G reliability race, Verizon is currently the standard bearer when it comes to offering the Most Reliable 5G experience of any carrier. Verizon also showed improved speeds and broader availability in many cities across the country. If Verizon can continue to improve in both categories, it could make a run at the Best 5G crown. Considering that Verizon's investment of $45B at the C-Band auction was more than those of AT&T and T-Mobile combined, the carrier appears poised to show further improvement ahead.

For more on how we determine the 5G leaders, see **page 14**.

The 5G winners by category (availability, speed, and reliability)



Values above represent the number of markets out of 125 in which each carrier delivered the Highest 5G availability, the Fastest 5G download speeds, and the Most Reliable 5G experience. All numbers can include ties.

5G winners by category - key takeaways

T-Mobile continues to set the standard for 5G availability: T-Mobile has built a well-deserved reputation for offering widespread 5G availability, and the carrier didn't disappoint in 2H 2021. Delivering the highest 5G availability in 83 markets, a tally much higher than those of either AT&T (62) or Verizon (6), T-Mobile remained the 5G availability leader in 2H 2021.

T-Mobile also delivers the Fastest 5G experience in 2H 2021: T-Mobile picked up serious speed in 2H 2021, surpassing incumbent AT&T in the 5G speed race in 2H 2021. T-Mobile increased its usage of mid-band **spectrum** by roughly 50% since 1H 2021, and as a result, T-Mobile's 5G median download speeds improved in every market tested since 1H 2021. With the fastest 5G experience in 48 markets—compared to 0 for AT&T and 3 for Verizon—T-Mobile led the competition by a comfortable margin.

Verizon provides the Most Reliable 5G experience for the second straight time: The second half of 2021 marks Verizon's second straight win in the 5G reliability race. With the best 5G data reliability in 93 markets, a tally far higher than those of either AT&T (67) or T-Mobile (19), Verizon's 5G reliability results remained second to none.

For more on how we determine the 5G leaders, see **page 14**.

The results

The consistency of 5G availability and performance

5G availability

Quick takeaway: T-Mobile offers the most widespread 5G availability of any carrier.

Key takeaways (ordered alphabetically by carrier):

AT&T trails T-Mobile but posts broader 5G availability than Verizon: AT&T delivered the highest 5G availability in 62 markets, up from 44 in 1H 2021, allowing the carrier to narrow the gap with T-Mobile (83). AT&T had 5G availability above 85% in the second-most cities of any carrier at 34. The carrier also registered availability above 70% in nearly half the markets we tested at 62, a total trailing that of T-Mobile (114) but higher than that of Verizon (18). While AT&T recorded availability below 25% in 25 more markets than it did 1H 2021, AT&T's 5G availability results were strong in general.

T-Mobile maintains its 5G availability lead: T-Mobile delivered the highest 5G availability in 83 out of 125 markets, easily the highest tally of any carrier. T-Mobile offered broad 5G availability across the board, with availability above 55% in every market in 2H 2021 (up from 119 last time). The carrier also registered 5G availability above 85% in 68 cities, twice as many as that of AT&T and over 22 times more than that of Verizon.

Verizon's 5G availability improves in the most cities of any carrier: Verizon's 5G availability improved in 64 markets since 1H 2021, the most of any carrier. Verizon increased its number of markets with availability above 40% by 9 since 1H 2021, while also recording 5G availability over 55% in 7 more cities this time. Overall, Verizon registered good 5G availability, and the carrier continued to build on the rapid 5G expansion we've seen over the past year.

5G availability – 2H 2021 market tally
(Numbers in parentheses reflect changes since 1H 2021)

Carrier	0.0%	0-10%	10-25%	25-40%	40-55%	55-70%	70-85%	85%+	Number of cities with 5G
AT&T	13 (-2)	5 (+2)	27 (+25)	5 (+3)	4 (-1)	9 (-6)	28 (-16)	34 (-5)	112 (+2)
T-Mobile	0 (0)	0 (0)	0 (0)	0 (-3)	0 (-3)	11 (+2)	46 (+8)	68 (-4)	125 (0)
Verizon	3 (-2)	13 (+6)	6 (-1)	13 (-12)	31 (+2)	41 (+13)	15 (-3)	3 (-3)	122 (+2)

Values represent the number of 5G markets out of 125 tested that fell into each interval in 2H 2021.
Values in parentheses reflect the difference in market tallies since 1H 2021.

5G median download speeds

Quick takeaway: T-Mobile delivers the strongest 5G median download speed results.

Key takeaways (ordered alphabetically by carrier):

AT&T offers solid speeds despite minor declines: AT&T users should see good speeds that are generally similar to those from 1H 2021. The carrier delivered 5G median download speeds above 50 Mbps in 28 cities in 2H 2021, down from 37 last time, while registering 5G median download speeds below 50 Mbps in 11 more markets than it did in 1H 2021. Despite its relatively minor declines, AT&T's 5G remained fast enough for users to handle most mobile activities with ease.

T-Mobile shows massive speed improvements and wins the 5G speed race: T-Mobile users should see much, much faster speeds since 1H 2021. T-Mobile's 5G median download speeds not only increased in every market we tested since 1H 2021, but they also improved significantly (increases of at least 50 Mbps) in most of those cities. T-Mobile clocked 5G median download speeds above 100 Mbps in a whopping 67 markets, up from 1 last time, while surpassing 200 Mbps in 26 of those cities and *even exceeding 300 Mbps* in three. T-Mobile also delivered 5G median download speeds below 50 Mbps in 84 fewer markets than it did in 1H 2021.

Verizon picks up speed in nearly every city tested: Verizon users should see faster 5G speeds in most cities since 1H 2021, as the carrier increased its 5G median download speeds in 105 of its 122 cities with 5G and was one of two carriers that delivered a speed over 100 Mbps. In a win-win scenario for users, Verizon improved at both the high and low ends of our intervals: Verizon registered 5G median download speeds above 50 Mbps in 50 more cities than it did last time, while delivering speeds below 50 Mbps in 48 fewer markets.

5G median download speeds – 2H 2021 market tally
(Numbers in parentheses reflect changes since 1H 2021)

Carrier	0-25 Mbps	25-50 Mbps	50-100 Mbps	100-150 Mbps	150-200 Mbps	200-250 Mbps	250+ Mbps	Number of cities with 5G
AT&T	6 (+2)	78 (+9)	28 (-9)	0 (0)	0 (0)	0 (0)	0 (0)	112 (+2)
T-Mobile	0 (-41)	15 (-43)	43 (+18)	23 (+23)	18 (+17)	16 (+16)	10 (+10)	125 (0)
Verizon	0 (-19)	44 (-29)	75 (+48)	2 (+1)	0 (0)	0 (0)	1 (+1)	122 (+2)

Values represent the number of 5G markets out of 125 tested that fell into each interval in 2H 2021.
Values in parentheses reflect the difference in market tallies since 1H 2021.

4G LTE still matters: a look at 4G LTE median download speeds in the US

When 5G first launched, speeds were often similar to—or even slower—than those on 4G LTE, but that dynamic is rapidly changing. We're now seeing 5G speeds 2-3 times faster on average than those on LTE, with speeds much, much faster in many cases. However, until 5G availability becomes universal and **standalone 5G** architecture becomes the norm, 4G LTE will continue to play a key role in the end-user 5G experience.

While all three carriers delivered strong 4G LTE median download speeds (above 25 Mbps) in at least 35 markets, Verizon was the clear standout, with speeds faster than 25 Mbps in nearly every city we tested (108). Verizon also had the fewest markets with speeds below 25 Mbps. That's good news for Verizon customers, as its 5G availability is improving and users will see fast speeds when 5G isn't available.

On the flip side, while T-Mobile had the most markets with LTE speeds below 25 Mbps at 90, the carrier's widespread 5G availability—above 70% in nearly every market tested—means that T-Mobile users shouldn't find themselves connected to LTE very often.

4G LTE median download speeds - 2H 2021

Carrier	0-25 Mbps	25-50 Mbps	50-100 Mbps
AT&T	75	38	12
T-Mobile	90	34	1
Verizon	17	97	11

Values represent the number of markets out of 125 tested that fell into each interval in 2H 2021.

C-Band is here and could change the game going forward

The C-Band auction in 2021 generated massive hype (and dollars), and the good news is that AT&T and Verizon have already begun rolling out C-Band in the US (T-Mobile is set to launch C-Band in 2023).

With C-Band **spectrum** (and mid-band in general) providing an ideal blend of both coverage and performance, the 5G experience in the US is poised to become much, much faster going forward. That's especially true for Verizon users, as the carrier's investment of $45B at auction was more than those of AT&T ($23B) and T-Mobile ($9B) combined.

While T-Mobile has an early lead when it comes to mid-band spectrum (and is delivering amazing speeds as a result), the continued integration of C-Band should lead to more than just faster speeds and **new branding strategies**; it also holds the potential to drive significant progress on the path toward a fully connected future. Keep checking back for more on C-Band and how it performs.

5th percentile (worst-case) 5G download speeds

Quick takeaway: Verizon leads the way with the top **5th percentile** "worst-case" speeds.

Key takeaways (ordered alphabetically by carrier):

AT&T delivers consistently strong 5th percentile speeds: AT&T's 5th percentile or "worst-case" 5G download speed results were nearly identical to those from 1H 2021. AT&T delivered speeds above 10 Mbps in 36 markets for the second straight time, while recording speeds below 5 Mbps in the same number of cities as last time. While both tallies weren't quite as impressive as those of Verizon, they topped those of T-Mobile and indicate that in worst-case speed scenarios, users shouldn't notice much difference compared to the first half of 2021.

T-Mobile's 5th percentile speeds get much faster: T-Mobile's 5th percentile 5G download speeds showed excellent improvement since 1H 2021. The carrier delivered 5th percentile speeds above 10 Mbps in 20 more cities than it did in 1H 2021, while recording speeds below 5 Mbps in 61 fewer cities. While T-Mobile's 5th percentile speeds trailed those of AT&T and Verizon, the carrier's huge improvements suggest that when T-Mobile's speeds do fall into a "worst-case" scenario, users shouldn't see their speeds decline nearly as much as they might have in 1H 2021.

Verizon delivers improved and impressive 5th percentile speeds: Verizon's 5th percentile 5G speeds improved any way you look at the numbers. Verizon recorded speeds above 10 Mbps in 22 more cities than it did 1H 2021, while clocking speeds below 5 Mbps in a whopping 31 fewer markets than last time. Verizon provided users with the highest speed floor of any carrier, which is particularly important for applications that have minimum speed requirements, such as streaming movies or gaming, among others.

5th percentile (worst-case) 5G download speeds – 2H 2021 market tally
(Numbers in parentheses reflect changes since 1H 2021)

Carrier	0-5 Mbps	5-10 Mbps	10-30 Mbps	30+ Mbps	Number of cities with 5G
AT&T	22 (0)	54 (+2)	36 (0)	0 (0)	112 (+2)
T-Mobile	44 (-61)	60 (+41)	21 (+20)	0 (0)	125 (0)
Verizon	13 (-31)	64 (+11)	44 (+21)	1 (+1)	122 (+2)

Values represent the number of 5G markets out of 125 tested that fell into each interval in 2H 2021.
Values in parentheses reflect the difference in market tallies since 1H 2021.

95th percentile (best-case) 5G download speeds

Quick takeaway: T-Mobile registers the top 95th percentile speeds.

Key takeaways (ordered alphabetically by carrier):

AT&T shows steady 95th percentile speeds: AT&T delivered 95th percentile 5G download speeds above 100 Mbps in 102 cities in 2H 2021, a slight decline from 106 last time, while recording speeds below 100 Mbps in 6 more cities. With AT&T's 95th percentile speed results remaining similar to those from 1H 2021, the end-user "best-case" speed scenario should be roughly the same as it was in the first half of 2021.

T-Mobile stands out with stellar 95th percentile speeds: T-Mobile posted 95th percentile speeds above 250 Mbps in far more markets than any other carrier, doing so in 117 of 125 cities, a huge jump from 54 in 1H 2021. In short, with nearly all of T-Mobile's 95th percentile speeds above 250 Mbps, users should see a huge jump in speeds in best-case speed scenarios.

Verizon steps up its 95th percentile speeds: Verizon showed excellent improvement, delivering 95th percentile speeds faster than 150 Mbps in 50 more markets than it did in 1H 2021, with speeds below 100 Mbps in 16 fewer cities. Verizon also delivered 95th percentile speeds above 250 Mbps in eight more cities since 1H 2021. In short, Verizon's improvements should equate to a much faster best-case scenario for users.

95th percentile (best-case) 5G download speeds – 2H 2021 market tally
(Numbers in parentheses reflect changes since 1H 2021)

Carrier	25-50 Mbps	50-100 Mbps	100-150 Mbps	150-200 Mbps	200-250 Mbps	250+ Mbps	Number of cities with 5G
AT&T	0 (0)	10 (+6)	50 (-7)	50 (+7)	2 (-4)	0 (0)	112 (+2)
T-Mobile	0 (0)	0 (-7)	1 (-11)	1 (-23)	6 (-22)	117 (+63)	125 (0)
Verizon	1 (+1)	3 (-17)	32 (-32)	47 (+25)	24 (+17)	15 (+8)	122 (+2)

Values represent the number of 5G markets out of 125 tested that fell into each interval in 2H 2021.
Values in parentheses reflect the difference in market tallies since 1H 2021.

What are 5th and 95th percentile 5G download speeds?

While median download speeds represent the most typical user speed experience, 5th percentile or "worst-case" 5G speeds represent the floor of your 5G experience and are particularly useful if you know the speed thresholds your apps require. Why?

In short, because users will exceed 5th percentile speeds almost all the time (learn more at our **article**). On the other hand, 95th percentile or "best-case" 5G speed results represent the ceiling of your 5G experience and provide an indication into the potential of a network's 5G.

Consumers shouldn't experience best- or worst-case speeds often, but they do provide an important barometer for the progress of 5G. It's worth keeping in mind that as 5G speeds improve in general (like we saw with T-Mobile and Verizon), the carriers' 5th percentile speeds should also get faster.

5G data reliability

Quick takeaway: Verizon delivers the Most Reliable 5G experience in 2H 2021, though reliability was strong in general.

Key takeaways (ordered alphabetically by carrier):

AT&T registers strong 5G data reliability in most markets: AT&T posted results similar to those from the first half of 2021. While AT&T had the most markets with 5G data reliability success rates above 99.5% for getting connected at 104—1 more than Verizon but 17 more than T-Mobile— the carrier's results weren't as good as those of Verizon when it comes to staying connected. However, AT&T's 5G reliability results were good in general and a step above those of T-Mobile.

T-Mobile improves its 5G reliability since 1H 2021: From a market count perspective, T-Mobile trailed both AT&T and Verizon when looking at 5G data reliability success rates of 99.5% or better for getting connected or staying connected. However, the carrier showed strong improvements since 1H 2021. T-Mobile, which had the top 5G reliability in 19 markets (compared to 67 for AT&T and 93 for reliability leader Verizon), increased its tally of cities with 5G reliability success rates above 99.5% for getting connected by 9 since 1H 2021, while adding 20 more markets above that mark for staying connected.

Verizon wins another 5G reliability title: Verizon's reliability results were exceptional, especially in terms of staying connected to the network. In fact, Verizon's tally of 112 markets with 5G data reliability success rates of 99.5% or higher for staying connected was 40 more than that of the next-best carrier (AT&T). Verizon's outstanding combination of both getting and staying connected to 5G allowed the carrier to defend its 5G reliability title in 2H 2021.

5G data reliability - getting and staying connected (market tallies)
(Numbers in parentheses reflect changes since 1H 2021)

Carrier	Getting connected 99.5% +	Staying connected 99.5% +	Number of cities with 5G
AT&T	104 (+2)	72 (-5)	112 (+2)
T-Mobile	87 (+9)	70 (+20)	125 (0)
Verizon	103 (-7)	112 (+8)	122 (+2)

Values represent the number of 5G markets out of 125 that exceeded data reliability success rates of 99.5% for getting connected and staying connected.
Values in parentheses reflect the difference in market tallies since 1H 2021.

5G data reliability

We measure 5G data reliability during our secure web and app testing (a good proxy for overall data reliability). We look at each carrier's ability to get connected to the network and then stay connected long enough to complete our tests. Our secure web and app reliability testing characterizes data reliability for use cases that require continuous data usage over secure connections.

While the data reliability expectations in IMT-2020 are near-perfect at 99.9999%, to account for the growing state of 5G in the US, our benchmark for excellent 5G data reliability is success rates of 99.5% or higher for getting and staying connected.

Carrier performance highlights

Each carrier's top 5G results in 2H 2021

A snapshot of carrier highlights across all 125 markets in 2H 2021

AT&T

Highest 5G availability

96.8%

Indio, CA

78.3 Mbps

Fastest 5G
median download speed

Pittsburgh, PA

Highest 5G data reliability
Getting connected

76 cities

100%

Highest 5G data reliability
Staying connected

31 cities

T-Mobile

Highest 5G availability

98.0%

El Paso, TX

367.7 Mbps

Fastest 5G
median download speed

Fayetteville, NC

Highest 5G data reliability
Getting connected

100%

8 cities

Highest 5G data reliability
Staying connected

99.9%

15 cities

Verizon

Highest 5G availability

91.7%

Rockford, IL

293.0 Mbps

Fastest 5G
median download speed

Shreveport, LA

Highest 5G data reliability
Getting connected

72 cities

100%

Highest 5G data reliability
Staying connected

55 cities

Conclusion and looking ahead

The 5G race in the US can change very quickly indeed. After finishing third in the 5G speed race in 1H 2021, T-Mobile showed huge 5G speed gains to surpass AT&T and take the lead for speed in 2H 2021. T-Mobile also maintained its hold on the 5G availability crown, allowing the carrier to earn honors for providing the Best 5G experience in the most cities of any carrier.

When it comes to reliability, Verizon defended its title for delivering the Most Reliable 5G experience in the US. While Verizon did see increased competition from AT&T in the reliability race, Verizon's reliability results were superb, with the top 5G data reliability in 93 out of 125 cities.

While the 5G landscape is highly dynamic, all the carriers are showing excellent progress, and the competition continues to increase. That's great news for 5G users, as more competition tends to lead to better performance, more innovation, and a better overall experience.

We've begun our 1H 2022 testing and are looking forward to seeing how the 5G race shakes out in 2022 and beyond. Keep checking back with RootMetrics for more on 5G and mobile performance in general.

Appendix

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. In 2H 2021, we used Samsung Galaxy S21 Ultra 5G smartphones to measure 4G LTE and 5G performance for all three carriers.

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 smartphones, including data, call, and text usage.

To learn more about RootMetrics testing, visit the **methodology** page of our website.

Report metrics:

The consistency of 5G availability and performance

5G availability

Our 5G availability results provide an understanding of how often we connected to both 5G-only and 5G “mixed mode” (the increasingly common user experience of switching between 5G and 4G LTE during the same data task), across our suite of data tests, including download, upload, and web and app testing.

5G speeds: median, 5th percentile (worst-case), and 95th percentile (best-case) 5G download speeds

5G median download speeds offer a look at the most typical speed performance when connected to 5G for any amount of time, while “worst-case” or **5th percentile** 5G speeds represent the floor of your 5G experience and are especially useful for applications that have minimum speed requirements. Our “best-case” or 95th percentile 5G speed results, in contrast, represent the ceiling of your 5G experience and provide an indication into the potential of a network’s 5G.

It’s worth noting that the International Mobile Telecommunications Union (PDF: **IMT-2020**) has set expectations for “true” 5G median download speeds as those consistently reaching or exceeding 100 Mbps. Our speed intervals show how the US carriers are progressing toward (or surpassing) that expectation.

5G data reliability

We measure 5G data reliability during our secure web and app testing (which acts as a good proxy for overall data reliability). We look at each carrier’s ability to get connected to the network and then stay connected long enough to complete our tests. Our secure web and app reliability testing characterizes data reliability for use cases that require continuous data usage over secure connections.

While the data reliability expectations in IMT-2020 (**PDF**) are near-perfect at 99.9999%, to account for the growing state of 5G in the US, our benchmark for excellent 5G data reliability is success rates of 99.5% or higher for getting and staying connected.

Determining the 5G winners by category

To determine the 5G winners by category (availability, speed, and reliability), we looked at the total number of cities that each carrier registered the:

Highest
5G availability

Fastest 5G download speeds in the same city across three key metrics: **5th percentile**, median, and 95th percentile speeds

Highest 5G data reliability success rates for both connected and staying connected in the same city

The carrier with the highest market tally in each category is the winner. It's that simple.

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