5G First Look: Atlanta, Chicago, and Dallas

RootMetrics® By IHS Markit

Promise, Potential, and Real-World Performance

5G First Look: Atlanta, Chicago, and Dallas:

Promise, Potential, and Real-World Performance

The 5G race has officially started. On April 3 2019, mobile network operators in the US and South Korea scrambled to lay claim to launching the first publicly available 5G networks. While there remains debate about which operator "won" the 5G release race, there are much more than bragging rights at stake as 5G deployments continue.

While the most advanced capabilities of 5G won't be ready at initial launch, 5G networks will be the backbone of our connected communities and promise to open up new use cases for enterprise, industries, and consumers.

5G will help improve existing services and provide the capability to make new use cases possible

Always-on seamless connectivity

Substantial increases in bandwidth

Uninterrupted video

Zero-lag video calls

Driverless cars

Zero-latency gaming

Immersive entertainment and virtual reality with zero delay

IoT growth and development of smart cities, smart homes, and smart industries

Excitement for 5G is high, but because we are in the initial stages of commercial deployments, it's unclear how 5G networks will perform under real-world conditions. In this special report, RootMetrics by IHS Markit is offering a first look at 5G deployments in Atlanta, Chicago, and Dallas, complete with scientific testing that provides an objective benchmark of real-world 5G performance for each carrier's network. Our testing shows what is currently possible with initial deployments and how closely the reality of 5G matches earlier 5G promises.

While there is justifiable excitement surrounding 5G, initial test results suggest that several early growing pains must be worked out. This shouldn't a surprise, nor should it dampen enthusiasm for the possibilities that 5G will eventually bring. New technologies and infrastructure almost always need time to mature in order to reach their full capability. In our many years of testing mobile network performance, we've found that it can take several years for a new technology to realize its full potential. As 5G continues to grow, RootMetrics performance benchmarking results can help carriers and infrastructure providers identify and solve network issues to optimize the end-user 5G experience.

This first look report series will expand throughout the year as additional 5G networks launch across the globe. Updates with additional data and insights are currently planned after benchmark testing is complete in the following areas:

- The United Kingdom
- Switzerland
- Additional US markets

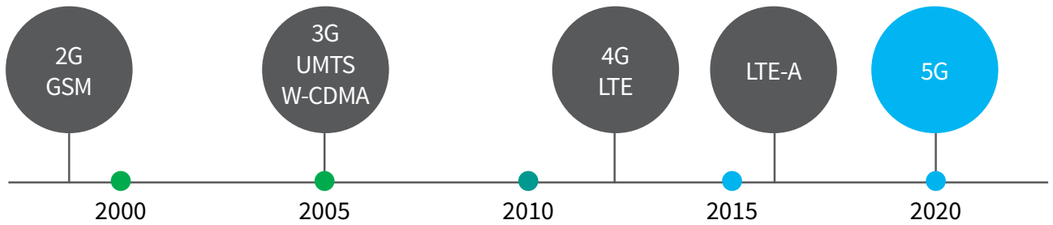
For more on what 5G is and how IHS Markit defines it, see our whitepaper:
The promise and potential of 5G (Evolution or revolution?)

Off to a quick start

Although commercial 5G deployments have begun, the full range of planned 5G capabilities will be implemented in a phased approach over the next several years. Advanced capabilities will likely match closely with the plan of upcoming 3GPP Releases.

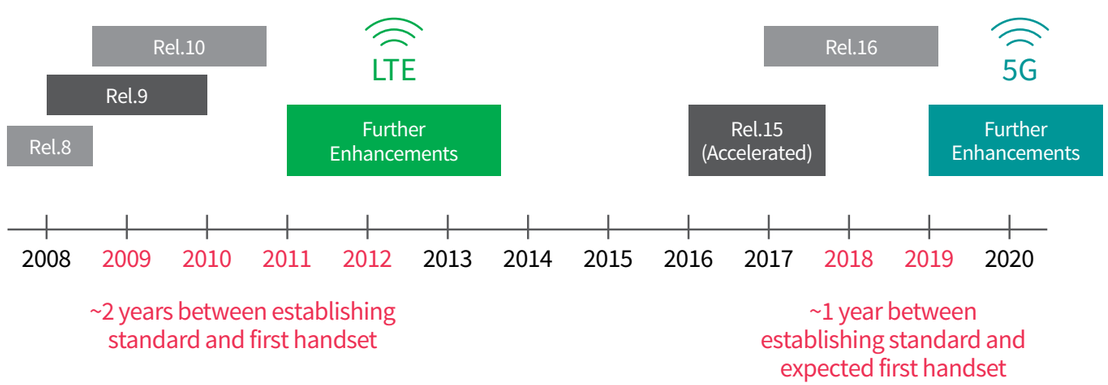
That said, the impact of 5G deployments is expected to be felt more quickly than what was seen during initial rollouts of LTE networks. For instance, the lag time between announcement of 3GPP standards and the availability of new handsets has decreased by approximately half when comparing LTE and 5G.

The path to 5G



Mass market cellular

The full range of planned 5G capabilities will not be available during initial 5G launches and will be implemented in a phased approach over the next few years.



A note on sample size: Because we chose to measure the 5G performance of AT&T, Sprint, T-Mobile, and Verizon at the earliest stages of each carrier's 5G deployment in Atlanta, Chicago, and Dallas, the 5G sample sizes in some cities are relatively low for various carriers. To that end, in the carrier sections below, we've noted areas in which low sample size could have affected the results.

Keep in mind, however, that even though our samples are relatively low in some cities, our results do reflect the real-world consumer 5G experience at the time of our testing. As the low sample size indicates, the early 5G story in Atlanta, Chicago, and Dallas isn't only about the eye-catching speeds that 5G promises; an equally important story centers on how likely (or not) consumers are to connect to 5G in a given city during the nascent stages of 5G rollouts. Indeed, 5G can be extremely limited upon initial launch, and without a strong 5G presence, those eye-catching speeds you may be looking for could take a bit longer than expected to become a reality.

Benchmarking what matters most

To provide a holistic view of each network's 5G performance, we've included a quick-view scorecard of results along with key insights across multiple performance categories. We've also included real-world examples showing how long it would take to download a 600MB video at each carrier's median download speed—on 5G where available and on LTE when 5G isn't available. Further, we've provided a use case discussing the speed and latency requirements for a user to enjoy a "great" gaming experience, and we've defined "Excellent" reliability as a carrier's ability to get connected and then stay connected long enough to complete our tests at rates of 97% or better during our web/app tests. Taken together, this complementary information provides a full picture of the current end-user experience.

5G-enabled mobile handsets:

76.2 million in 2020

616 million in 2025

Speeds on 5G

This first category is about the promise and potential of 5G speed. End-users won't always access a 5G network as they move through a city, so we've removed all non-5G mode test results to show what to expect when 5G is available. Maximum download speeds show what topline performance might be, while median download speeds provide a closer look at "everyday" 5G performance.

Speeds on non-5G mode

Since an end-user won't be on 5G all the time, we've looked at speed results that occur on technologies other than 5G—typically LTE—to offer a comparison between purely 5G speeds and those occurring on LTE.

Speeds on mixed mode

Since mobile users will connect to 5G for only a portion of the time, it's important to know what speeds users are likely to experience when the networks make handovers between 5G and LTE. Mixed mode results represent the user experience of connecting to 5G with their smartphone and then switching to LTE during the same data activity, or vice-versa.

Speed consistency

At the end of the day, consistency of speed performance has the most impact on the end-user experience. Our speed consistency tables bring together test results across all network technologies to show how often different speed thresholds were reached or surpassed.

Latency

A critical benefit of 5G is lower latency. Latency refers to the response time between a user request and an action being taken by a simple function, application, or machine. Full latency results are available with a subscription to our 5G First Look service.

5G availability

5G speeds are impressive but are only helpful if an end-user can actually access a 5G network. Understanding how often we connected to 5G during download testing helps put those speeds in broader context.

A note on 5G availability rates: During the nascent stages of 5G rollouts, connecting to 5G at relatively low availability rates isn't necessarily a surprise. Mobile network operators often choose to launch 5G only in certain areas of a city and/or may target very specific audience segments, such as enterprise customers. That said, we do expect 5G service to become more prevalent as the networks make upgrades and as 5G networks mature over time.

Testing overview

To show what to expect from the US carriers as the 5G era begins, we measured 5G performance indoors and outdoors where people most often use their smartphones: tourist areas, business districts, and other high-population areas in Atlanta, Chicago, and Dallas. And to ensure our results offer a holistic picture of network performance, we also tested while driving in urban and suburban areas in each city. All tests were performed during peak-usage hours and are designed to represent the end-user's real-world 5G data experience.

Carriers tested
AT&T, Sprint, T-Mobile, Verizon

Atlanta

Dates of testing
July 24 – July 26

Devices used
LG V50 ThinQ 5G (Sprint); Samsung Galaxy S10 5G (T-Mobile); Samsung Galaxy S10 (AT&T and Verizon)

Total test samples collected
6,897

Indoor locations visited
11

Miles driven
162

Chicago

Dates of testing
August 7 – August 10

Devices used
Samsung Galaxy S10 (AT&T and T-Mobile); LG V50 ThinQ 5G (Sprint and Verizon)

Total test samples collected
6,402

Indoor locations visited
11

Miles driven
153

Dallas

Dates of testing
July 30 – August 1

Devices used
Samsung Galaxy S10 5G (AT&T and T-Mobile); Samsung Galaxy S10 (Verizon); LG V50 ThinQ 5G (Sprint)

Total test samples collected
7,398

Indoor locations visited
18

Miles driven
207

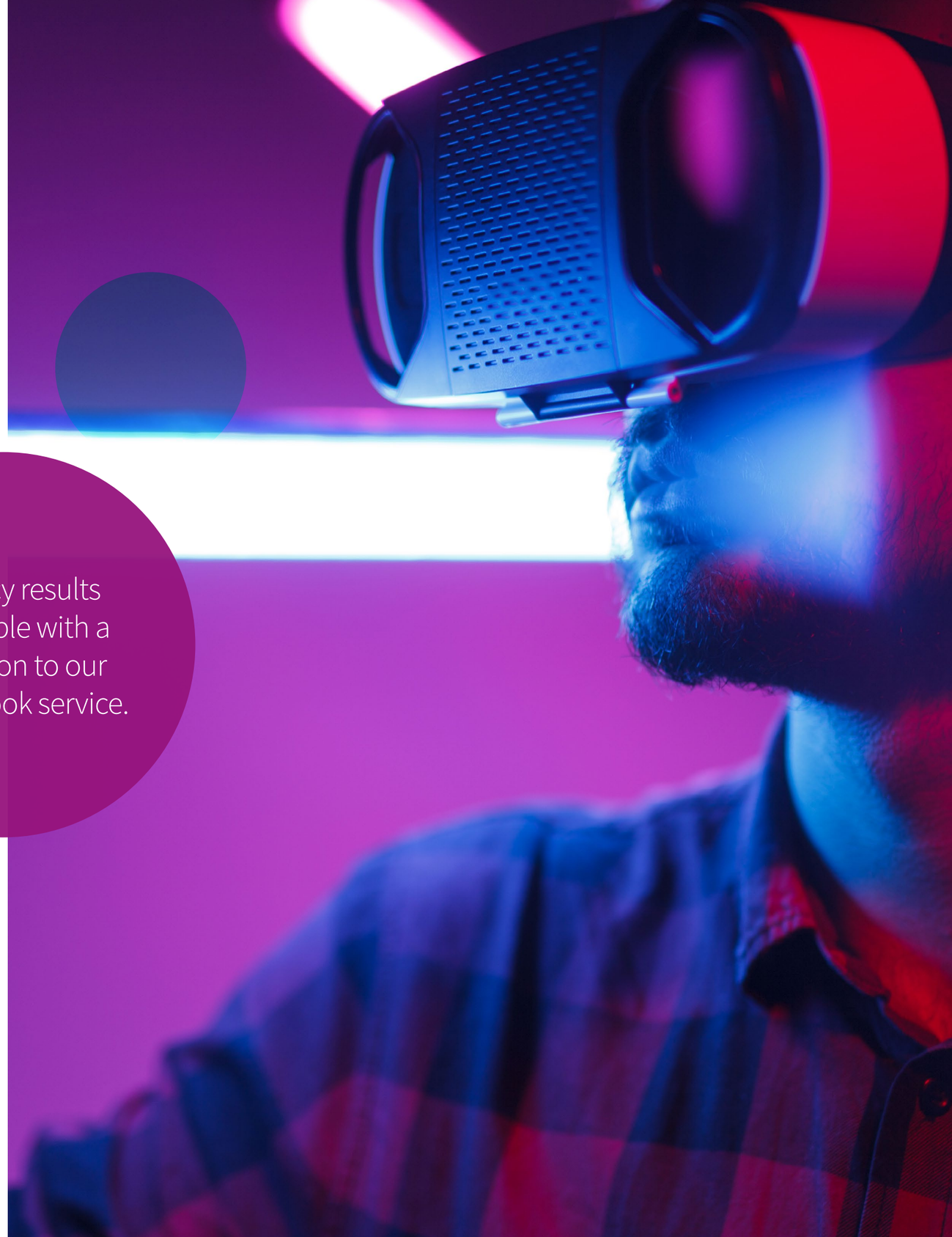
Latency - at a glance

As noted above, lower latency is a critical benefit of 5G. The lower latency of 5G is expected to substantially reduce lag and help improve consumer streaming applications like online gaming, virtual reality (VR) applications, and interactive live sports experiences, among others.

Real-world example: gaming

Based on the latency found during testing, we've evaluated which carriers are currently providing the latency and speed required for a "great" gaming experience. A "great" gaming experience would entail zero buffering, nearly instantaneous data transfers, and zero interruptions to the user. In order for an end user to have a "great" gaming experience, median web/app latency times must range from 20-70 milliseconds (ms) and median download speeds faster than 120 Mbps are required.

We're already seeing improved latency on 5G, and we expect latency to get even better moving forward as 5G networks continue to upgrade and mature. Furthermore, as content providers continue to move content closer to the edge—and therefore closer to end users—latency should improve even further.



Full latency results are available with a subscription to our 5G First Look service.

Spectrum allocation across Atlanta, Chicago, and Dallas

During our testing of initial US 5G rollouts in Atlanta, Chicago, and Dallas, we observed differences in spectrum by the carriers that could potentially affect 5G coverage and performance. Our tests showed the following:

- **AT&T:** Millimeter wave (mmWave) spectrum in Dallas
- **Sprint:** Sub-6 GHz spectrum in all three cities, specifically 2.5 GHz
- **T-Mobile:** mmWave spectrum Atlanta and Dallas
- **Verizon:** mmWave spectrum in Chicago

When it comes to spectrum and the 5G experience, 6 GHz is a tipping point, with potentially very different 5G results at higher frequencies compared to lower frequencies. For instance, a user's 5G experience with mmWave spectrum (which is above 6 GHz) could be markedly different than those on sub-6 GHz spectrum because propagation can vary significantly between low and high frequencies. Lower frequency spectrum including sub-6 GHz can travel farther and penetrate solid objects like buildings better than a higher frequency spectrum such as mmWave.

In addition to propagation differences, coverage can also be affected by spectrum. While mmWave's coverage and range are limited to spaces of approximately one city block, sub-6 GHz spectrum can provide coverage over long distances. In short, mmWave spectrum doesn't offer the broad coverage that sub-6Hz spectrum supports, and in our first look 5G testing in the US, Sprint was the only carrier using sub-6 GHz spectrum.

While both sub-6 GHz and mmWave spectrum should, in theory, provide much faster speeds compared to LTE, mmWave technology offers the potential to deliver lightning-fast speeds theoretically as high as 5 Gbps or better, compared to just 100 to 200 Mbps for existing 4G LTE services.

Given the coverage and performance implications for different types of spectrum, the carriers must manage a delicate tradeoff based on what they hope to provide to users and the spectrum they have available. In short, the tradeoff becomes a matter of offering potentially slower speeds but broader coverage with sub-6 GHz spectrum or offering faster speeds but less reliable coverage with mmWave spectrum.

One notable observation from our testing in both the US and in South Korea was that Sprint's 2.5 GHz spectrum has remarkably similar propagation characteristics to the 3.5 GHz spectrum utilized by all three South Korean operators (KT, LG U+, and SK Telecom). This similarity in spectrum potentially portends good things for Sprint's 5G network because speeds in South Korea were incredibly fast in general and much faster than what we found in the US.

Prioritizing download speeds: Our testing in Atlanta, Chicago, and Dallas indicates that initial 5G deployments are primarily focused on improving download speeds, rather than upload speeds or data reliability. It's worth noting that we observed a similar prioritization of download speeds during testing in South Korea as well.

Carrier performance highlights:

AT&T delivers strong 5G results in Dallas on limited 5G footprint

AT&T 5G availability

Percentage of download tests	Atlanta	Chicago	Dallas
5G	NA	NA	2.6%
Non-5G mode	100.0%	100.0%	96.5%
Mixed mode	NA	NA	1.0%

AT&T speeds (Mbps)

Download speeds	Atlanta	Chicago	Dallas
5G maximum download speed	NA	NA	669.2
5G median download speed	NA	NA	256.1
Non-5G mode median download speed	20.7	41.2	19.4
Mixed mode median download speed	NA	NA	16.6

Overview

We were able to connect to AT&T's 5G network in Dallas, where we recorded only 2.6% of our tests on 5G. While the carrier's 5G speeds in Dallas were quite strong, questions remain about how often users will actually connect to AT&T's 5G network in Dallas during the early stages of deployment.

A note on 5G availability rates: During the nascent stages of 5G rollouts, connecting to 5G at relatively low availability rates isn't necessarily a surprise. Mobile network operators often choose to launch 5G only in certain areas of a city and/or may target very specific audience segments, such as enterprise customers. That said, we do expect 5G service to become more prevalent as the networks make upgrades and as 5G networks mature over time.

Speed specifics

Despite the carrier's low 5G availability rate in Dallas, AT&T's 5G median download speed of 256.1 Mbps in Dallas was over 13 times faster than its non-5G mode median download speed of 19.4 Mbps in the same city. At 256.1 Mbps, it would take a little under 20 seconds to download a 600MB video on AT&T's 5G network, which marks a game-changing improvement from the roughly 4 minutes it would take to download the same video at the carrier's non-5G mode speed.

With maximum speeds offering a glimpse of the future of a network's 5G experience, AT&T customers will likely be pleased with the carrier's 5G maximum download speed of 669.2 Mbps in Dallas, which was the second-fastest fastest 5G maximum download speed we found in any of the three cities tested, trailing only Verizon's 1.1 Gbps in Chicago. AT&T's maximum download speeds on non-5G mode in Atlanta (180.8 Mbps) and Chicago (368.1 Mbps) were also strong and hint at a fast and reliable 5G experience in both cities going forward.

Download speed consistency

City	0-10 Mbps	10-20 Mbps	20-50 Mbps	50-100 Mbps	100+ Mbps
Atlanta	32.2%	16.4%	25.9%	18.9%	6.6%
Chicago	18.4%	9.7%	30.3%	22.5%	19.1%
Dallas	26.3%	23.7%	32.7%	12.2%	5.1%

Conclusion

While we were able connect to AT&T's 5G network in Dallas during only a small portion of our tests (2.6%), the 5G results we did find were encouraging, with the carrier delivering fast 5G speeds and excellent reliability. However, until AT&T's 5G footprint expands over time, end users will likely spend the majority of their time on the carrier's non-5G mode (LTE) network in Dallas.

Sprint the only carrier with meaningful 5G presence in all three cities but results were mixed

Sprint 5G availability

Percentage of download tests	Atlanta	Chicago	Dallas
5G	51.4%	32.2%	24.9%
Non-5G mode	42.0%	62.9%	68.7%
Mixed mode	6.6%	4.9%	6.4%

Sprint's speeds (Mbps)

Download speeds	Atlanta	Chicago	Dallas
5G maximum download speed	213.1	205.3	200.4
5G median download speed	53.9	123.5	1.2
Non-5G mode median download speed	37.7	26.1	17.0
Mixed mode median download speed	30.2	23.8	1.5

Overview

Sprint was the only carrier with a significant portion of its download tests on 5G in all three cities, and the carrier's speeds were much faster on 5G compared to non-5G mode in both Atlanta and Chicago. Sprint's most impressive results were found in Chicago, where the carrier registered a 5G availability rate of 32.2%. Sprint's 5G in Chicago is widespread, with fast speeds, low latency, and strong reliability. In Dallas, meanwhile, Sprint's 5G availability rate was its lowest at 24.9%. Sprint's 5G network was earlier to market than those of the other carriers, and the carrier has created a competitive advantage in the early rollouts of 5G by becoming the first carrier to build a relatively expansive 5G footprint in multiple cities.

A note on 5G availability rates: During the nascent stages of 5G rollouts, connecting to 5G at relatively low availability rates isn't necessarily a surprise. Mobile network operators often choose to launch 5G only in certain areas of a city and/or may target very specific audience segments, such as enterprise customers. That said, we do expect 5G service to become more prevalent as the networks make upgrades and as 5G networks mature over time.

Speed specifics

Sprint's fastest 5G median download speed was recorded in Chicago at an impressive 123.5 Mbps. At that speed, an end user could download a 600MB video in just under 40 seconds in Chicago, a vast improvement from the 3 minutes it would take to download the same video at the carrier's non-5G mode median download speed of 26.1 Mbps.

Sprint's results in Dallas were a bit of a mixed bag. Sprint's maximum download speed of 200.4 Mbps in Dallas was quite fast, but that speed was found on non-5G mode. Sprint's 5G maximum download speed in Dallas was 196.7 Mbps. What's more, Sprint's 5G median download speed of 1.2 Mbps was the slowest speed we found in any of the three cities. For perspective, Sprint's non-5G mode median download speed of 17.1 Mbps in Dallas was over 10 times faster than its 5G speed. Our tests showed that Sprint's 5G network in the downtown area of Dallas experienced network problems while using 5G for download tasks and/or transitioning between 5G and LTE, which likely impacted the carrier's results.

That said, Sprint delivered impressive maximum download speeds on 5G all three cities, with its top speed of 213.1 Mbps recorded in Atlanta. Given the carrier's strong maximum download speeds in each city, Sprint's 5G network could be poised for good things to come.

Download speed consistency

City	0-10 Mbps	10-20 Mbps	20-50 Mbps	50-100 Mbps	100+ Mbps
Atlanta	14.9%	8.5%	32.3%	25.5%	18.8%
Chicago	19.0%	10.5%	29.5%	17.1%	24.0%
Dallas	46.3%	19.7%	19.7%	11.0%	3.2%

Conclusion

Sprint delivered strong 5G speeds in Atlanta, and its 5G experience in Chicago was very good. While Sprint's 5G median download speed in Dallas was an outlier compared to those in other cities, we expect Sprint to show improvement in all three markets over time as the carrier's 5G network matures.

T-Mobile delivers impressive maximum download speeds in Atlanta

T-Mobile 5G availability

Percentage of download tests	Atlanta	Chicago	Dallas
5G	3.1%	NA	1.3%
Non-5G mode	88.9%	100.0%	96.5%
Mixed mode	8.0%	NA	2.2%

T-Mobile speeds (Mbps)

Download speed	Atlanta	Chicago	Dallas
5G maximum download speed	257.7	NA	18.5
5G median download speed	20.9	NA	13.6
Non-5G mode median download speed	48.9	18.3	19.1
Mixed mode median download speed	12.7	NA	5.9

Overview

T-Mobile was on 5G during our testing at very low rates in Atlanta (3.1%) and Dallas (1.3%), but the carrier delivered impressive maximum download speeds in Atlanta on both 5G and non-5G mode.

A note on 5G availability rates: During the nascent stages of 5G rollouts, connecting to 5G at relatively low availability rates isn't necessarily a surprise. Mobile network operators often choose to launch 5G only in certain areas of a city and/or may target very specific audience segments, such as enterprise customers. That said, we do expect 5G service to become more prevalent as the networks make upgrades and as 5G networks mature over time.

Speed specifics

T-Mobile's fastest maximum download speed in Atlanta was found on non-5G mode at 388.5 Mbps, though the carrier's 5G maximum download speed of 257.7 Mbps was also quite strong and points toward a strong future for T-Mobile's 5G performance.

On the other hand, T-Mobile's 5G maximum download speed of 18.5 Mbps in Dallas leaves room for improvement and could be a result of connecting to T-Mobile's 5G network only 1.3% of the time during testing. That said, the carrier's non-5G mode maximum download speed in Dallas clocked in at a solid 220.8 Mbps.

T-Mobile's 5G median download speeds in both cities were both relatively slow, with its fastest 5G median download speed recorded at 20.9 Mbps in Atlanta. While the limited exposure to T-Mobile's 5G network likely played a role in its generally slow 5G speeds, the carrier's non-5G mode median download speeds in Atlanta and Dallas were strong and faster than its 5G median download speeds in each city.

The question for T-Mobile is: how often will its users experience 5G during the early stages of its rollout? While only a small percentage of our results in Atlanta and Dallas were recorded on T-Mobile's 5G, the good news is that the carrier has built a strong reputation for delivering fast speeds and strong reliability on its LTE network across the US.

Download speed consistency

City	0-10 Mbps	10-20 Mbps	20-50 Mbps	50-100 Mbps	100+ Mbps
Atlanta	11.8%	12.2%	31.4%	19.2%	25.4%
Chicago	30.8%	22.6%	29.7%	13.9%	3.0%
Dallas	35.5%	19.2%	28.8%	10.2%	6.4%

Conclusion

We found some promising 5G results in Atlanta for T-Mobile in terms of its strong maximum download speeds. While T-Mobile's 5G availability rates were generally low, we expect T-Mobile's 5G experience to improve going forward. And even when 5G isn't available, T-Mobile subscribers should still experience fast speeds and strong reliability on the carrier's LTE network.

Verizon's 5G maximum download speed in Chicago points to a promising future

Verizon 5G availability

Percentage of download tests	Atlanta	Chicago	Dallas
5G	NA	7.1%	NA
Non-5G mode	100.0%	91.4%	100%
Mixed mode	NA	1.5%	NA

Verizon speeds (Mbps)

Download speeds	Atlanta	Chicago	Dallas
5G maximum download speed	NA	1,066.3	NA
5G median download speed	NA	146.1	NA
Non-5G mode median download speed	95.3	34.5	57.0
Mixed mode median download speed	NA	97.9	NA

Overview

We recorded results on Verizon's 5G network in Chicago, and despite spending limited time on 5G (7.1%), the carrier's 5G speeds were outstanding and indicate a strong foundation for the carrier to build upon moving forward.

A note on 5G availability rates: During the nascent stages of 5G rollouts, connecting to 5G at relatively low availability rates isn't necessarily a surprise. Mobile network operators often choose to launch 5G only in certain areas of a city and/or may target very specific audience segments, such as enterprise customers. That said, we do expect 5G service to become more prevalent as the networks make upgrades and as 5G networks mature over time.

Speed specifics

Verizon was the only carrier in any city to deliver a 5G maximum download speed in excess of 1 Gbps (1.1 Gbps), and the carrier's 5G median download speed of 146.1 Mbps was over four times faster than its non-5G mode median download speed of 34.5 Mbps.

At 146.1 Mbps, Verizon users could download a 600MB video in about 34 seconds in Chicago, a time significantly faster than the 2.3 minutes it would take to download the same video at the carrier's non-5G mode speed.

Connecting to Verizon's 5G in its infancy could prove challenging, but its results on 5G were quite good in the early stages of deployment. It's also worth noting that Verizon's non-5G mode median download speeds in all three cities were very fast, particularly its remarkable non-5G mode median download speed of 95.3 Mbps in Atlanta. Verizon's non-5G mode maximum download speeds in Atlanta and Dallas were also quite good. In short, even when 5G isn't available, users can still expect a fast and reliable mobile experience on Verizon's network.

Download speed consistency

City	0-10 Mbps	10-20 Mbps	20-50 Mbps	50-100 Mbps	100+ Mbps
Atlanta	2.8%	4.2%	18.8%	28.2%	46.0%
Chicago	14.0%	12.5%	38.1%	24.9%	10.6%
Dallas	4.5%	4.8%	34.2%	34.5%	22.0%

Conclusion

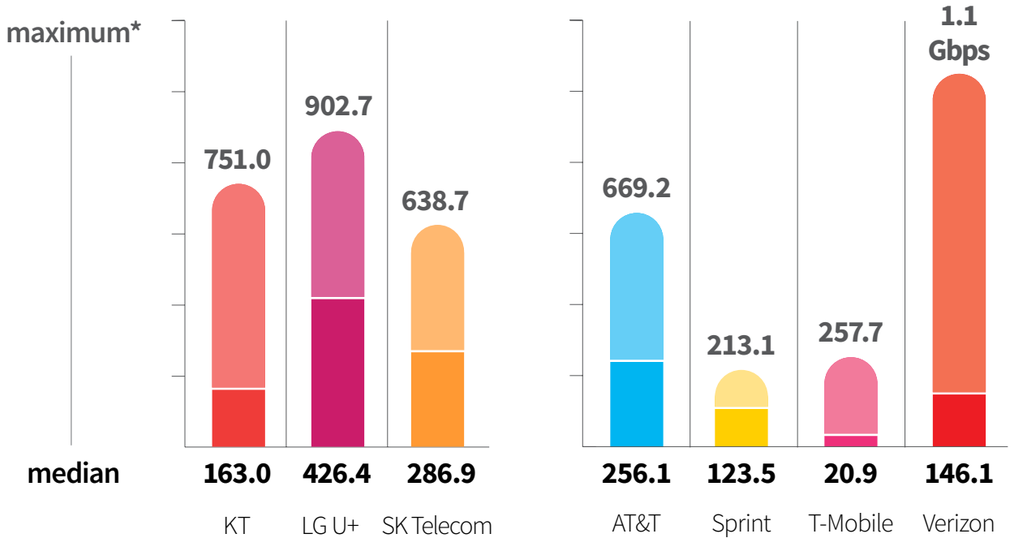
While we connected to Verizon's 5G less often than we did with Sprint, Verizon had the most mmWave 5G among all carriers and could be well-positioned to expand its mmWave 5G going forward. It's also important to note that Verizon delivered some of the fastest 5G speeds we found across all three cities. With excellent reliability and fast speeds, Verizon appears ready to provide an excellent 5G experience going forward.

5G in perspective: 5G in the US and South Korea

With the first widespread launch of 5G happening in South Korea, it might not be surprising to learn that the 5G speeds we found in South Korea were generally much faster than those in the US. Likewise, 5G availability rates in South Korea were also much higher than what we found in the US.

US 5G deployments are in their infancy compared to those in South Korea. In South Korea, the 5G availability rates for each operator ranged from 42.2% to 45.6%. In the US, Sprint was the only carrier with a 5G availability rate above 24.9% in any of the three cities we tested, and Sprint's 5G rates were at least that high in all three markets, topping out at 51.4% in Atlanta. AT&T, T-Mobile, and Verizon, however, each had 5G availability rates below 7.2%

To give perspective to the 5G speeds we found in the US, the graphic below shows the 5G median download speeds delivered by networks in South Korea (KT, LG U+, and SK Telecom) alongside the fastest 5G median download speed we found for each carrier across our testing of Atlanta, Chicago, and Dallas. We've also included each operator's 5G maximum download speed to give you a glimpse of what the future might hold for each network.



South Korea
5G median and maximum download speed (Mbps)

United States
Fastest 5G median and maximum download speed (Mbps)

* Top number represents 5G maximum download speeds.

**AT&T's results in the graphic above are from Dallas, Sprint's and Verizon's are from Chicago, and T-Mobile's are from testing in Atlanta.

5G is happening now, and RootMetrics is currently testing 5G deployments in the United Kingdom, Switzerland, and in additional US cities. Our series of 5G First Look reports will show you how 5G is changing the mobile landscape across the globe.

To learn more about South Korean 5G performance, read or download our **First Look South Korea 5G report**.

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