# 5G in South Korea: widespread 5G access plus incredible speeds

South Korean 5G networks setting an example for the rest of the world



RootMetrics® By IHS Markit





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The importance of flawless connectivity has never been greater, and the pandemic has amplified that fact more than ever before. With data usage continuing to explode and remote learning and working becoming key components of an increasingly new normal, consumers rely on fast and reliable connectivity at all times and in all places.

As our connected communities continue to grow in the face of rising connectivity demands, the good news is that 5G is getting faster and more widespread all over the world, and nowhere is that more true than in South Korea.

As the first country to launch 5G on a broad scale, South Korea's 5G performance has been nothing short of outstanding since initial deployments. And as the networks have matured and expanded over time, 5G in the country has continued to become even faster and more widely available.

In the first half of 2021, we tested South Korean operators KT, LG U+, and SK Telecom in four major South Korean cities. While all three operators provided users with broad 5G availability and excellent speeds in every city, we also saw strong improvements in Seoul compared to our testing in the second half of 2020.

Simply put, 5G in South Korea is excellent. While we've seen 5G continue to improve in other countries since early deployments, the fact remains that South Korea continues to hold a commanding lead in the worldwide 5G race.

Read on to see how the operators performed during testing across four major cities in South Korea in early 2021. We looked at performance from multiple angles, including indoor and outdoor results in each city, as well as a deep-dive look at how each operator's 5G network contributed to overall performance across all network technologies.



# Benchmarking what matters most

To provide a holistic view of each operator's real-world performance, we've included visuals showing 5G availability and other performance results along with key insights for the end-user experience in each of the four cities we tested. Taken together, this complementary information provides a full picture of the current end-user 5G experience in South Korea.



#### **5G median download speeds**

The 5G median download speeds in this report represent speeds recorded entirely on 5G. While end users won't access 5G all the time, we've included speeds recorded only on 5G to show what to expect when a user connects only to 5G. It's worth noting that the International Mobile Telecommunications Union (IMT-2020) has set expectations for "true" 5G median download speeds as those consistently reaching or exceeding 100 Mbps, and all operators in South Korea surpassed that mark in every city.

To assure our testing matches with the well-established methodology followed by the South Korean government's testing, all speed results within this report reflect Sustained Median Download Speeds. This approach allows for more direct comparisons between our testing and results reported by the Ministry of Science and ICT.





#### **5G availability**

Our 5G availability results provide an understanding of how often we connected to 5G across our suite of data tests (download, upload, and web and app testing). During data activities, consumers may switch between 5G, 4G LTE, and "mixed mode" (the user experience of switching between 5G and 4G LTE during the same data activity). However, to provide the most accurate view of a true 5G experience and to allow for the most direct comparisons between operators, the 5G availability metrics in this report reflect results recorded entirely on 5G and do not factor in mixed mode results.



#### **Overall median download speeds**

Unless specifically noted as a "5G median download speed," the median download speeds in this report reflect the overall speeds we recorded across all network technologies, including 5G, mixed mode, and 4G LTE. Since users may switch between different network technologies while using their smartphones, median download speeds across all network technologies represent the most typical user experience.







#### Latency

Latency refers to response time (or delay) between a user request and an action being taken by a simple function, application, or machine. The latency metrics in this report are from our secure web and app latency testing, which characterizes use cases that require continuous data usage such gaming, streaming videos, and AR/VR applications over secure connections. The lower the latency, the better the end-user experience. As a frame of reference, major cloud gaming platform Microsoft Xbox Game Pass recommends latency below 60ms for optimal mobile cloud gaming.

**ENDC** (E-UTRAN New Radio - Dual Connectivity) is a **non-standalone** 5G architecture that allows smartphones to access both 5G and 4G LTE networks at the same time. ENDC combines the bandwidth of both 5G and 4G LTE, allowing operators to boost 5G availability, improve reliability, and

Using our "lower-layer" data, which allows for deeper-dive analysis and insights, we looked at how 5G contributed to overall ENDC median download speeds for each operator across both indoor and outdoor testing. For more on ENDC, please see the appendix for more information.

# South Korea testing overview

To show what to expect from South Korean operators across the four cities we tested in the 1H 2021, we measured 5G performance indoors and outdoors in each city where and when people most often use their smartphones: tourist areas, business districts, and other areas at times of peak mobile usage. All tests were performed while walking and driving and were designed to represent the end-user's real-world 5G experience.



#### Where we tested Busan, Gwangju, Incheon, Seoul



Dates of testing 6 May 2021 - 17 May 2021



**Operators tested** KT, LG U+,



Total test samples collected 48,526



and SK Telecom



Indoor locations visited



Device used Samsung Galaxy S21+ 5G





# 5G in Seoul: trong improvements since 2020

During our previous testing in Seoul in 2H 2020, the 5G availability we saw was outstanding, with each operator recording 5G availability of at least 71.3%, with LG U+ leading the way at a nearly ubiquitous 90.9%. In 1H 2021, each network delivered even broader 5G availability. Not only that, two out of three operators also clocked faster 5G speeds in 2021.

#### 5G availability on the rise and providing users with nearly universal access to 5G

Mobile users in Seoul are benefiting from widespread—and improved—5G availability across the board. In 2H 2020, 5G availability in Seoul topped out at LG U+'s 90.9%, with SK Telecom recording the lowest 5G availability in the city at 71.3%. This time, on the other hand, 5G availability was at least 93.2% for all operators. In short, 5G is nearing ubiquity in Seoul.



#### Consumers in Seoul have much more widespread access to 5G than networks in other major cities

In Seoul, LG U+ users have nearly universal access to 5G (95.2%), allowing subscribers to take advantage of the operator's incredibly fast 5G speeds almost anytime they user their smartphones. In comparison, 5G availability didn't reach 75% in any of the other three major cities we tested around the world.



\*Note: results in Zurich are from 2H 2020, while all others are from testing in 1H 2021.

# 5G availability and latency by operator

#### **5G availability**

**5G availability was generally broad in all four cities and approached 100% in Seoul:** LG U+ led the way with 5G availability of at least 80.2% in every city, with remarkable 5G availability of 94.9% in Incheon and 95.2% in Seoul. In short, LG U+ customers should find widespread access to 5G in any of the cities we visited.

KT and SK Telecom also posted broad 5G availability in general. 5G availability for SK Telecom and KT dipped in Gwangju, but users are still likely to find 5G service the vast majority of the time.

#### Latency

Low latency in South Korea means lag-free gaming: The lower the latency, the better, and when latency is below roughly 50-60ms, consumers should be able to enjoy responsive gaming and video streaming with little to zero delays. LG U+ was the only operator with latency below 30ms in every city, while KT stood out for recording the lowest latency of any operator at 17.0ms in Incheon. LG U+ was excellent in Seoul, where it recorded its lowest latency of 22.0ms. SK Telecom, meanwhile, was consistent across the board, with latencies ranging from 40.0ms in Gwangju to 42.0ms in Seoul.



5G availability (%) Scale: 0-100%

Latency (ms)

Scale: 0-50ms



50.0 40.0 30.0 20.0 10.0 0 0 Busan Gwangiu





# Overall median download speeds and bandwidth used by operator

5G bandwidth used (4 cities) (MHz)



Gwangju

**KT clocks its fastest speed in Gwangju:** KT's fastest speed came in Gwangju, where its overall median download speed of 575.1 Mbps was just a bit behind that of the city's speed leader SK Telecom (586.4 Mbps). At 575.1 Mbps, KT users can download their favorite film (at a file size of 600MB) from Netflix in only 9 seconds. KT also performed comparatively well in Busan, where its speed was faster than that of LG U+ but slower than SK Telecom. Even KT's "slowest" speed of 441.9 Mbps, recorded in Incheon, was impressive and fast enough for users to access content incredibly quickly.

LG U+ clocks its fastest speeds in Incheon and Seoul: LG U+ provided strong speeds in general but was especially impressive in both Incheon and Seoul, where LG U+ delivered the fastest speeds of any operator, exceeding 640 Mbps in each city. In fact, LG U+'s median download speed of 664.2 Mbps in Incheon was not only the fastest in the city, it was also the fastest of any operator across all four cities. At that speed, a user could download a 600MB video in just 8 seconds. With speeds above 436 Mbps in all four cities—and above 640 Mbps in two of those cities—LG U+ customers should find fast speeds and quick file downloads in all of the cities we visited.

SK Telecom shines in Busan and Gwangju: SK Telecom delivered the fastest overall median download speeds of any operator in both Busan and Gwangju, posting median speeds of 632.4 Mbps in Busan and 586.4 Mbps in Gwangju. SK Telecom's success wasn't limited to those two cities, though, as the operator was consistently fast in every city. SK Telecom clocked median download speeds above 622.0 Mbps in three out of four cities, and even its "slowest" median download speed of 586.4 Mbps was the fastest in Gwangiu. In fact, SK Telecom was the only operator that didn't clock any speeds below 500 Mbps.

LG U+ uses its 5G bandwidth more efficiently than the other operators: While LG U+ had less 5G bandwidth (80 MHz) than either KT or SK Telecom (100 MHz each), our results showed that LG U+ made the most efficient use of its 5G bandwidth. LG U+ had 20% less bandwidth than the other operators but registered the fastest speeds in Incheon and Seoul.







\*Overall median download speeds factor in speeds recorded across all network technologies (5G, mixed mode, and non-5G)

Incheon Seoul

KT





## 5G results by city A look at operator performance in: Busan, Gwangju, Incheon, and Seoul



SK Telecom clocks the fastest overall median download speed in Busan, while KT offers the most 5G, and LG U+ registers the lowest latency.

KT delivers the most widespread 5G availability and the second-fastest speed in Busan: KT registered easily the highest 5G availability in Busan at 91.8%. The operator's overall median download speed of 460.7 Mbps, meanwhile, was a bit faster than that of LG U+ (436.3 Mbps) but not as fast as that of SK Telecom (632.4 Mbps). KT's overall latency of 42.0ms was the highest in the city but still low enough for users to enjoy smooth gaming and video streaming.

LG U+ records the lowest latency in the city: LG U+ stood out in Busan for recording the lowest latency of any operator at 29.0ms. We recorded 5G during 80.2% of our tests in Busan and LG U+ delivered an overall median download speed of 436.3 Mbps. Those are fantastic numbers, and LG U+ was even better in the other cities we tested.

**SK Telecom clocks the fastest speed in Busan:** While SK Telecom's 5G availability of 76.1% in Busan was the lowest of any operator, its overall median download speed of 632.4 was easily the fastest in the city. The operator's latency of 40.5ms, meanwhile, was low enough for responsive gaming.

**Overall median download speeds (User experience across all network types)** 











## Contribution of 5G (NR) to overall median download speeds

Our testing measures speed results from multiple angles. 5G networks today use a technology called EN-DC (E-UTRA NR – Dual Connectivity). The key benefit of EN-DC is that it allows mobile network operators to send data to your 5G device over both 4G (LTE) and 5G (NR) radio air interface from the network. The addition of 5G (NR) to existing 4G (LTE) spectrum increases the overall data speed available to end users. The charts on this page show the 5G (NR) data throughput side of EN-DC only to help understand the improvements in performance 5G (NR) technology is bringing to end consumers Korea in addition to underlying 4G (LTE) deployed Radio Access Network. To learn more about ENDC, see page 4 above or visit our **blog**.

KT slightly faster than LG U+: KT's 5G speeds impressed and surpassed 500 Mbps both indoors and outdoors. That said, KT's 5G speeds were still slower than those of the city's speed leader SK Telecom.

LG U+ registers slightly slower 5G speeds in Busan: Although the speeds recorded on LG U+ trailed those of KT and SK Telecom, its 5G performance was easily fast enough to provide users with a guick mobile experience.

SK Telecom was fast, efficient, and excellent indoors: SK Telecom posted outstanding 5G speed results in Busan. The operator made the most efficient use of its 5G spectrum in the city, and its 5G speeds were easily the fastest both indoors and outdoors. SK Telecom's 5G was particularly fast during indoor testing, with its indoor 5G median download speed of 704.4 Mbps nearly 200 Mbps faster than the next-best indoor speed.

### Contribution of 5G to overall median download speeds

Scale: 0-1,000 Mbps



#### 5G contribution to indoor and outdoor speeds



# Gwangju

LG U+ posts the highest 5G availability and lowest latency in the city, while all three operators deliver consistently fast speeds.

KT registers strong results in general: Speeds in Gwangju were fast—and similar—across the board, and KT's overall median download speed of 575.1 Mbps was very impressive indeed. At that speed, KT subscribers could download their favorite movie from Netflix in about 9 seconds. KT's 5G availability of 75.4% and latency of 35.5ms were also guite strong and the second-best in the city. In short, KT customers should enjoy a great mobile experience in Gwangju.

LG U+ registers the highest 5G availability, the lowest latency, and fast speeds: LG U+ recorded the highest 5G availability in the city at nearly 90% and by far the lowest latency of any operator at 22.0ms. At 554.1 Mbps, LG U+ delivered a median download speed that wasn't too far behind those of the other operators and was fast enough for users to access content and entertainment quickly.

SK Telecom clocks the fastest speed in Gwangju, with good results across the board: While SK Telecom's 5G availability of 66.2% was the lowest recorded, its overall median download speed of 586.4 Mbps was the fastest in Gwangju. SK Telecom's latency of 40.0ms should support most gaming needs but was nearly twice as slow as that of latency leader LG U+.

**Overall median download speeds (User experience across all network types)** Scale: 0-1,000 Mbps





\*Latency factors in web and app latency results recorded across all network technologies (5G, mixed mode, and non-5G).







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KT slightly trails in 5G speed: 5G speeds in Gwangju were similar across all three carriers, with KT very slightly behind the speeds offered by LG U+ and SK Telecom.

LG U+ clocks fast speeds in general, with the fastest 5G speed outdoors: LG U+ posted the highest 5G median download speed during outdoor testing, edging ahead of SK Telecom. LG U+ also delivered an excellent 5G speed during indoor testing at 609.1 Mbps.

SK Telecom achieves the fastest 5G speeds in Gwangju: Generally speaking, speeds are usually faster outdoors than indoors, but SK Telecom was certainly an exception: its 5G speed indoors was not only faster than its outdoor speed, it was easily the fastest in the city. SK Telecom also clocked the fastest 5G speed overall at 600.6 Mbps.

## Contribution of 5G to overall median download speeds

Scale: 0-1,000 Mbps



#### 5G contribution to indoor and outdoor speeds



# Incheon

LG U+ shows outstanding results in Incheon, with the highest 5G availability and the fastest overall median download speed.

KT delivers by far the lowest latency in the city: Good news for KT gamers: the operator's latency of 17.0ms was the lowest in the city and over twice as low as that of SK Telecom (40.5ms). That said, KT's 5G availability of 84.3% was over 10% lower than that of LG U+. By nearly any standard, KT's overall median download speed of 441.9 Mbps was guite fast, but it was still over 200 Mbps slower than that of LG U+ and also slower than that of SK Telecom.

LG U+ impresses in Incheon: With the highest 5G availability in Incheon at an almost universal 94.9% and the fastest overall median download speed at 664.2 Mbps, LG U+ customers should find both near universal access to 5G along with incredibly fast speeds. LG U+ also offered low latency of 27.5ms. While that number wasn't as low as KT's, LG U+ users should still be able to stream videos or play video games with little to zero delays.

SK Telecom posts strong speeds but the highest latency in the city: SK Telecom's 5G availability of 91.7% was outstanding but not quite as high as that of LG U+. Likewise, SK Telecom clocked an excellent overall median download speed of 623.3 Mbps. While slightly slower than that of LG U+, SK Telecom's speed would allow its users to download a 600MB film from Netflix in just 9 seconds. On the other hand, the operator's latency was the highest in the city.

**Overall median download speeds (User experience across all network types)** Scale: 0-1,000 Mbps











## Contribution of 5G (NR) to overall median download speeds

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KT's 5G approaches 600 Mbps during indoor testing: KT's speeds slightly trailed those of the competition but were strong in general, including an impressive 593.4 Mbps recorded during our indoor testing.

LG U+ delivers the fastest 5G speeds in the city: LG U+ pulled ahead of SK Telecom and recorded the top 5G performance in Incheon. With LG U+ registering 5G availability of nearly 100% in Incheon. its subscribers should find widespread access to 5G and outstanding speeds.

SK Telecom clocks the fastest 5G indoor speed: SK Telecom delivered excellent 5G performance across all areas but especially stood out for its 781.6 Mbps indoor speed.

## Contribution of 5G to overall median download speeds

Scale: 0-1,000 Mbps



#### 5G contribution to indoor and outdoor speeds



LG U+ leads the way in Seoul, with 5G availability approaching 100%, the fastest overall median download speed, and the lowest latency in the city.

KT registers impressive 5G availability: KT registered nearly ubiquitous 5G availability of 95.0% in Seoul. KT's overall median download speed of 461.2 Mbps is fast enough for its subscribers to download content quickly, but it was roughly 180 Mbps slower than that of LG U+ and about 160 Mbps behind that of SK Telecom. KT's latency of 34.5ms, meanwhile, was lower than that of SK Telecom (42.0ms) but not quite as low as that of Seoul's latency leader LG U+ (25.5ms).

LG U+ shines in Seoul: LG U+ posted outstanding results in Seoul, registering the highest 5G availability of any operator at 95.2%, the fastest overall median download speed at 640.7 Mbps, and the lowest latency at 25.5ms. In short, LG U+ users should find nearly universal access to 5G, along with outstanding speeds and latency low enough for nearly instantaneous video streaming and incredibly fast file downloads.

SK Telecom delivers speeds above 600 Mbps: While SK Telecom's 5G availability of 93.2% was the "lowest" in Seoul, it was still very impressive. SK Telecom's overall median download speed, meanwhile, was much faster than KT's but not guite as fast as that of LG U+. In short, SK Telecom users will connect to 5G most of the time and experience fast speeds in general. And while the operator's latency of 42.0ms was the highest in the city, it should still support most gaming needs with ease.

#### **Overall median download speeds (User experience across all network types)** Scale: 0-1,000 Mbps





#### Latency (ms) Scale: 0-50



\*Latency factors in web and app latency results recorded across all network technologies (5G, mixed mode, and non-5G).

#### 5G Availability (%)



# ENDC & 5G insights

## Contribution of 5G (NR) to overall median download speeds

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KT fast but slightly trails speeds from LG U+ and SK Telecom: KT nearly hit 550 Mbps while on 5G but the other operators were still slightly faster. That said, subscribers should find speeds that deliver a quick overall experience.

LG U+ delivers the fastest 5G speeds in Seoul: LG U+'s 5G median download speeds were easily the fastest in Seoul, including when comparing indoor and outdoor performance. That's particularly impressive considering LG U+ has less 5G bandwidth (80 MHz) than either KT or SK Telecom (100 MHz each).

SK Telecom offers consistent 5G performance across all testing in Seoul: SK Telecom registered 5G median download speeds near or above 600 Mbps overall and during both indoor and outdoor testing.

### Contribution of 5G to overall median download speeds

Scale: 0-1,000 Mbps



#### 5G contribution to indoor and outdoor speeds



# Conclusion and looking ahead

The first half of 2021 marks the fourth time we've tested 5G in South Korea, and performance was once again brilliant and could serve as a blueprint for 5G deployments in other cities across the world.

Not only are South Korean operators providing users with broad access to 5G, fast speeds, and low latency, they also continue to lead the worldwide 5G race. Moreover, we've seen 5G performance in South Korea improve every time we've visited the country.

While we're seeing 5G improve and expand quickly in other countries, South Korean 5G remains far ahead of the global competition. That said, with recent spectrum auctions wrapping up in both the **US** and **UK**, we could soon see better 5G results going forward. That additional spectrum—much of it speedy **mid-band spectrum**—could level the playing field over time, but for now, South Korea remains the leader.

Stay tuned to RootMetrics for more insights on the real-world 5G experience in cities across the world, and if you enjoyed this report, sign up for our **newsletter** to make sure you don't miss anything.



# How we test & appendix

We believe that real-world results come from real-world testing. All RootMetrics testing is conducted from the consumer's point of view. We used a Samsung Galaxy S21+ 5G to test the networks of KT, LG U+, and SK Telecom in each of the four South Korean cities we tested in the first half of 2021. The smartphones we used during testing were purchased off the shelf from operator stores to test both 5G and 4G LTE performance, and tests were conducted during the day and night while walking and driving.

To ensure results reflect the typical consumer experience, testing utilized a regional AWS server located within South Korea. To minimize the impact of significant outlier results (i.e., a single excessively fast or slow test result) and provide insight into the most likely experience, RootMetrics always reports on median rather than average speeds.

We utilized random sampling techniques to ensure our results offer a robust, objective, and accurate characterization of performance in the places consumers most often use their smartphones in South Korea, and all testing is designed to reflect the real-world end-user experience. To learn more about our testing, visit the **methodology** page of our website.

#### Appendix

#### A note about ENDC speeds

The ENDC speed results in this report reflect physical-layer (PDSHC) results, while all other speeds are applicationlevel results. While physical-layer results are often more instructive for deeper-level analysis, application-level speeds are more representative of the real-world consumer speed experience.

That said, application-level speed results can often be up to 35% different than physical-layer speeds, so the ENDC speeds in this report likely won't match with other speed metrics in this report. Also note that unless specially stated as an "ENDC" speed, all other speed results in this report reflect application-level speeds. To learn more about ENDC, visit out 5G FAQ blog.

#### **City-specific testing facts and figures**

City	Testing dates	Total tests	Kilometers driven	Indoor locations tested
Busan	5/10-5/13	9,485	597	22
Gwangju	5/14-5/17	9,893	580	22
Incheon	5/10-5/13	9,773	404	22 00 000
Seoul	5/6-5/9	19,375	748	42





## For more information, visit

