



TUTELA 

The impact of mid-band 5G: lessons learned from early adopters

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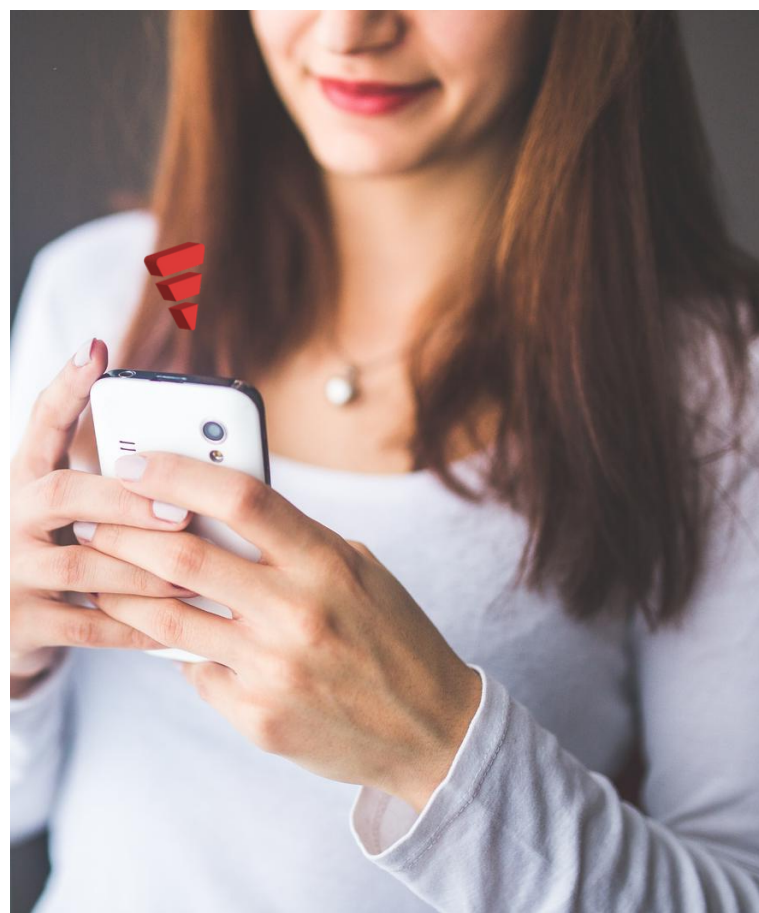
Introduction

While mmwave 5G has attracted a lot of attention for its potentially revolutionary improvements over previous network deployments in terms of both capacity and performance, mid-band, predominantly in the 3.5-3.6 GHz range, has quietly emerged as one of the more prominent deployment choices in the mid-band 5G space. As countries like the US and Canada move to auction off spectrum blocks in this frequency range, it serves as a useful point to examine the state of mid-band 5G

deployments in other countries around the world. In this report, Tutela has looked at a selection of countries where mid-band spectrum is a critical part of operators' current 5G deployment strategies to evaluate some of the lessons early deployments can demonstrate as 5G gains momentum around the world. This report does not include countries who pioneered early adoptions in the mmWave or low-band 5G space (like the US), due to the differences in network characteristics.

Key findings

- South Korea has a significant lead over other countries when it comes to 5G coverage, with users spending more than 90% of their time in a 5G covered area
- While geographic coverage with 5G is relatively sparse, it can still deliver coverage of areas where users spend significant amounts of time
- When comparing the experience of users with 5G devices, subscribers in Saudi Arabia see the biggest percentage improvement on a 5G network in terms of user experience, while the UK sees the biggest percentage improvement to download speed



5G rollout timing

Most notably, South Korea concluded its first 5G mid-band spectrum auction in June 2018(1), and the country was the first to roll out standards-based commercial 5G deployments in April 2019(2). All three national operators currently offer 5G

services, as well as MVNOs like Liiv M(3). Now, over two years from beginning deployment, South Korea serves as a useful benchmark for the likely timelines and impacts we can expect from 5G in the short-term.

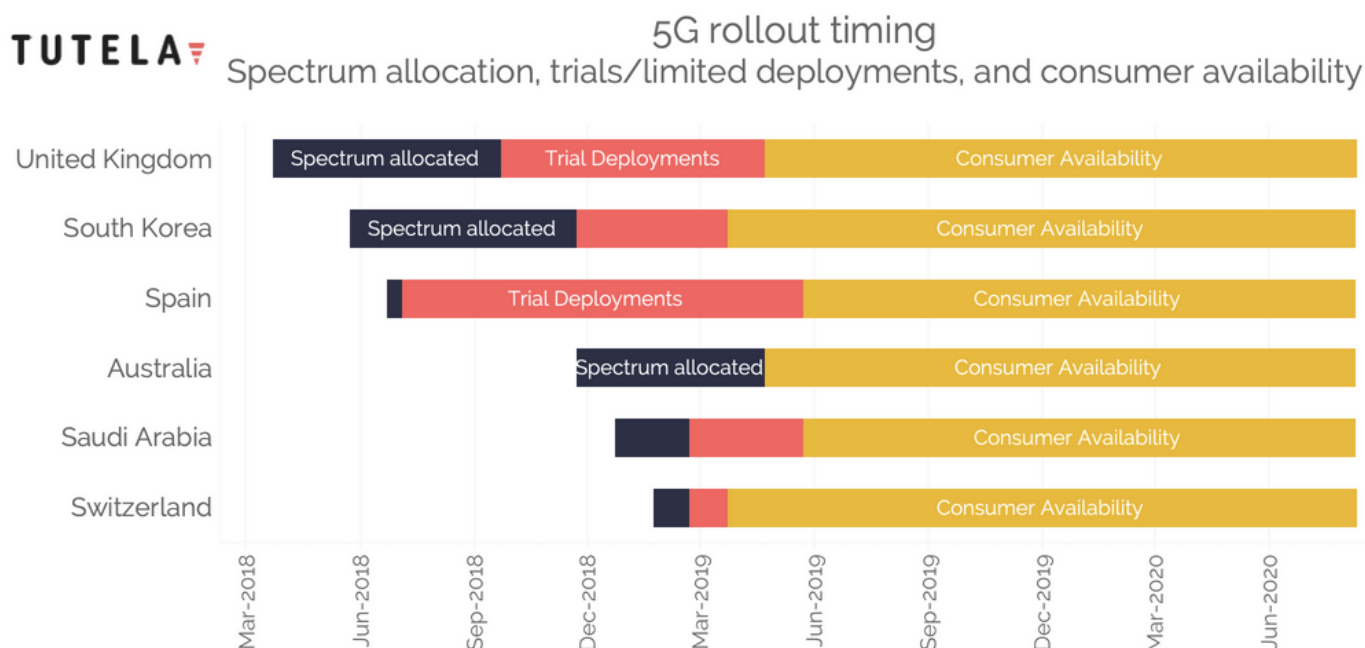


Chart shows time since the conclusion of the first relevant spectrum auction in "Spectrum allocated". "Trial deployments" encompasses limited access deployments and 5G tests based on publicly released information, beginning with the date that the first one was publicly announced. Consumer availability indicates when users on at least one network would be able to purchase a 5G device and connect to a 5G connection.

(1) ZDNet, South Korea completes 5G spectrum auction

<https://www.zdnet.com/article/south-korea-completes-5g-spectrum-auction/>

(2) The Straits Times, South Korea first in the world to roll out commercial 5G services

<https://www.straitstimes.com/tech/south-korea-first-in-the-world-to-roll-out-commercial-5g-services>

(3) Korea Times, Kookmin Bank launches budget phone Liiv M

https://www.koreatimes.co.kr/www/biz/2019/11/126_277816.html

Australia completed its 3.6 GHz auction a few months later than South Korea in December 2018, although the spectrum was not made fully available to operators until March 2020. Australia was just one month behind South Korea in the announcement of its first live 5G service, which came from Telstra in May 2019. Both Optus and Telstra have significant 5G deployments to date, while Vodafone is targeting 5G deployments in major areas(4) from mid-2020 onwards.

Saudi Arabia's 5G auctions were considerably later, completing in January 2019. However, by June, STC had launched its first 5G commercially-available services, with both Zain and Mobily following suit soon after. Switzerland's midband auction concluded in February 2019. It was the first country in Europe to have commercially

available 5G, with Swisscom and Sunrise both activating 5G networks for consumers in mid April 2019. Salt has previously announced its plans to launch its 5G network in H1 2020.

While the UK was slightly behind Switzerland with its May 2019 5G launch on EE's network, all four operators have active 5G deployments, though these range greatly in scale. The UK was also among the first countries to conclude its mid-band auctions, in April 2018(5). Spain completed its mid-band 5G auctions in late July 2018, with Telefonica, Orange and Vodafone all being awarded spectrum in this range. To date, Vodafone has the most significant 5G network, covering 21 cities(6), while other operator's deployments are considerably smaller.

(4) Vodafone, Demonstrating the power of 5G

<https://www.vodafone.com.au/red-wire/5g-demonstration>

(5) The Guardian, UK mobile operators pay close to £1.4bn for 5G spectrum

<https://www.theguardian.com/business/2018/apr/05/uk-mobile-operators-pay-close-to-14bn-for-5g-spectrum>

(6) RCR Wireless, Vodafone Spain's 5G coverage already reaches 21 cities: Report

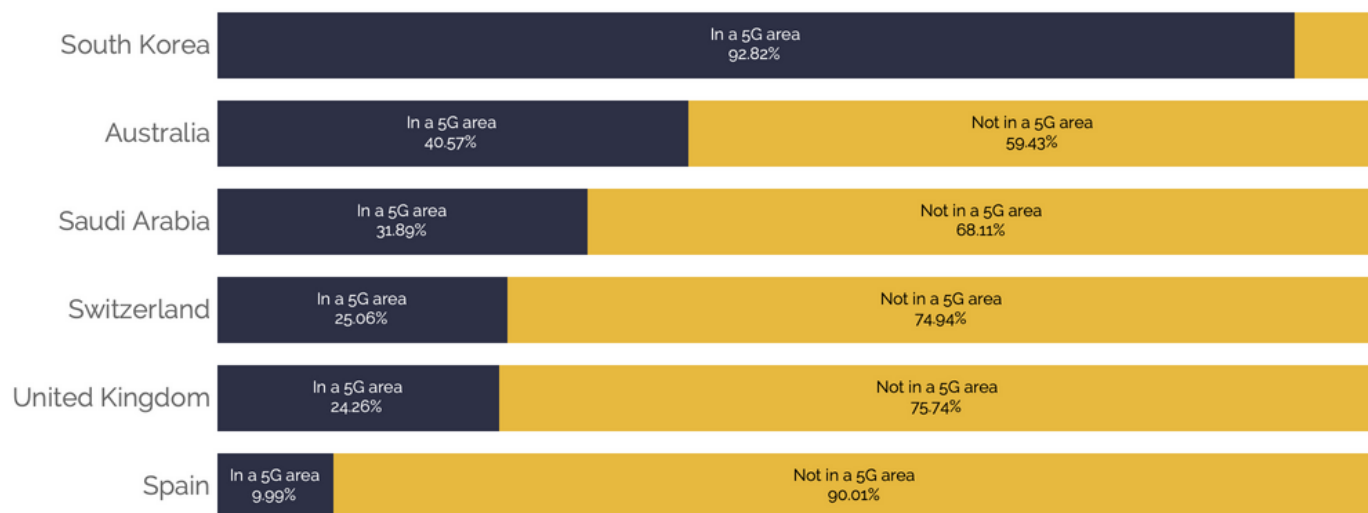
<https://www.rcrwireless.com/20200513/5g/vodafone-spain-5g-coverage-already-reaches-21-cities-report>

5G coverage

One of the most often-quoted stats about South Korea's 5G is that the networks have achieved 90% population coverage with 5G, with 6.8 million subscribers(7) having access to the latest generation of connectivity as of May. In Tutela data, we also see mobile subscribers spending just short of 93% of their time in an area where at least one provider has 5G coverage. This is more than twice that of the next-closest country in the test, Australia.

This discrepancy highlights one of the most important differentiating factors between South Korea's 5G approach and that of other countries: South Korea has been far more aggressive in the so-called "Race to 5G", with operators slated to invest \$22 billion on 5G networks by 2022(8). This is a significant factor in explaining the significant gulf in time users spend in 5G covered areas between South Korea and other countries in this study.

TUTELA Time users spend in an area where at least one provider offers 5G vs other mobile connections



(7) MSIT, Wireless service communication line status

<https://www.msit.go.kr/SYNAP/skin/doc.html?fn=f46759aa020a7b37e89b05bd73a38420&rs=/SYNAP/sn3hcv/result/202007/>

<https://www.msit.go.kr/SYNAP/skin/doc.html?fn=f46759aa020a7b37e89b05bd73a38420&rs=/SYNAP/sn3hcv/result/202007/>

(8) RCR Wireless, South Korean operators to invest \$22 billion in 5G networks by 2022

<https://www.rcrwireless.com/20200716/5g/south-korean-operators-invest-22-billion-5g-networks-2022>

While users spend notable amounts of time in 5G covered areas in all six countries tested, the geographic coverage of 5G tells a different story. Even South Korea, with its wide-reaching 5G deployments, only offers approximately 14% geographic coverage in the observed footprint of all providers. Again, Australia is in second place at 1.95%,

with all other countries around 1%. Spain, where only one operator has a significant 5G deployment so far, has just 0.12% area coverage. This highlights a key learning about 5G: when it comes to mid-band deployment, these are unlikely to offer significant improvements in rural areas for quite some time to come.

TUTELA Observed geographic coverage by connection type

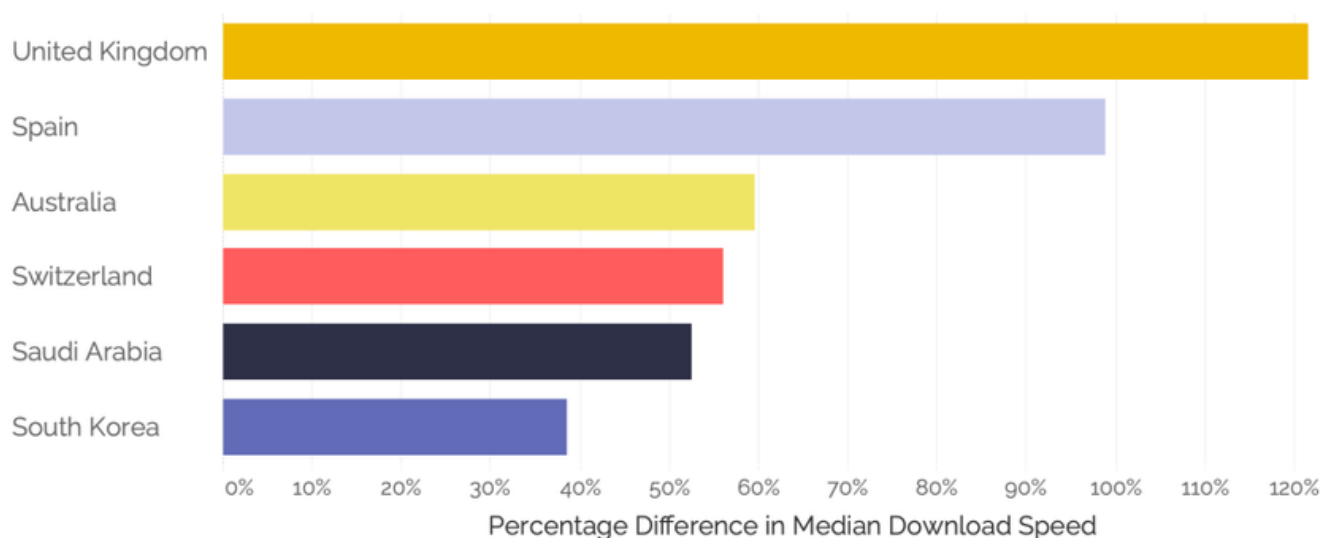


5G performance

One of the oft-cited benefits of 5G is its superior performance over 4G. There is no question that the additional capacity offered by new spectrum bands will be instrumental in allowing operators to provide a better user experience as data usage grows. However, current non-standalone 5G (5G NSA) deployments do not continuously offer the gigabit speeds we see in headlines in real-world situations. This is not to say that speeds aren't dramatically increased. In the six countries tested, 5G device users on a 5G network saw download speeds between 38-122% faster than they did on a 4G connection. In Tutela's data, the UK saw the greatest percentage improvement in median

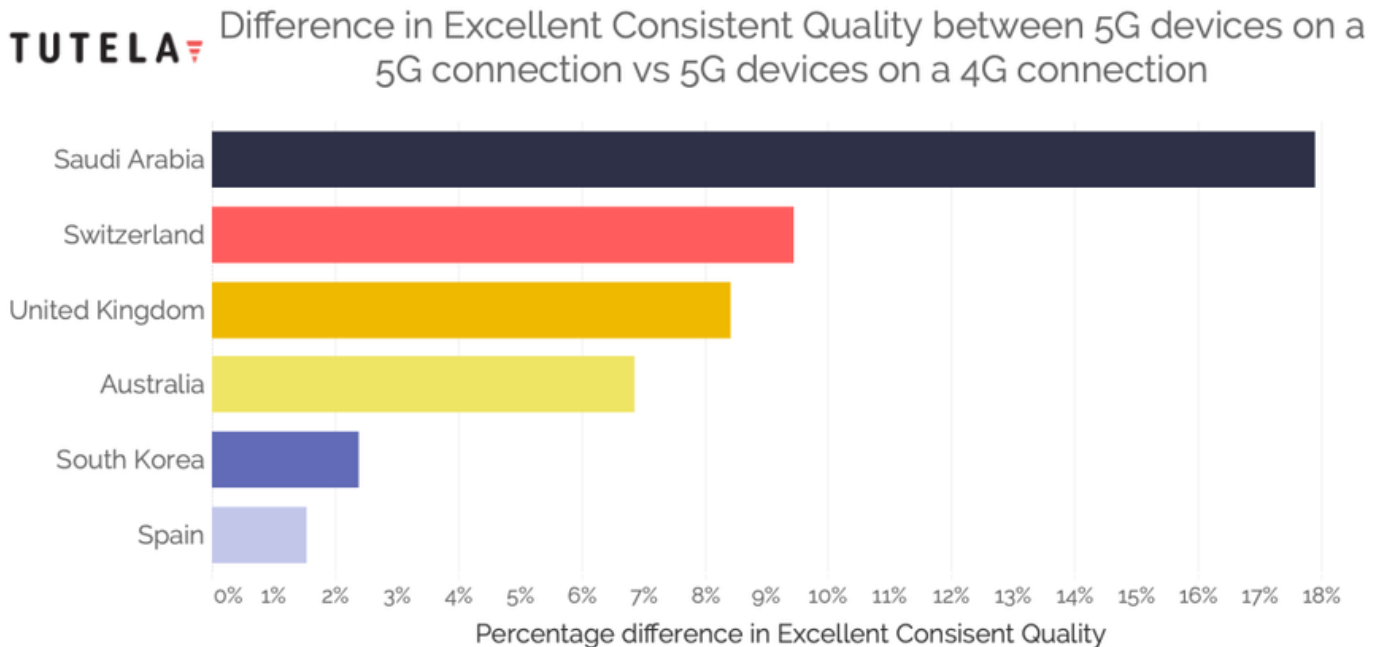
download speed from users on a 5G connection vs a 4G one, followed by Spain. Australia, Switzerland and Saudi Arabia all hovered between 50-60% improvement. However strikingly, South Korea saw the least percentage improvement from 5G. This is likely due to South Korea's already superior 4G download speeds and may present a challenge to adoption further down the line. If operators cannot demonstrate that 5G offers a notably superior experience (either because the 5G itself is underperforming or the existing 4G infrastructure is so good) it will likely be a hard sell to convince customers to pay more for the plans.

TUTELA Difference in median download speed between 5G devices on a 5G connection vs 5G devices on a 4G connection



In terms of the improvement 5G offered to user experience as measured using Excellent Consistent Quality, the results were more modest. As currently implemented, 5G NSA only supports download, and upload continues to be handled over the 4G connection. Similarly, 5G NSA does not deliver the latency improvements we can expect further down the line with standalone 5G. As a result, improvements to

Excellent Consistent Quality ranged from just short of 18% in Saudi Arabia, down to just 1.5% in Spain. Here, South Korea was second to last in terms of percentage Excellent Consistent Quality improvement at just 2.4%, highlighting that while 5G undoubtedly offers faster speeds, its improvement to day-to-day user experience is slightly more modest.



About Tutela

Tutela Technologies, Ltd., is an independent crowdsourced data company. It gathers information on mobile infrastructure and tests wireless experience, helping organizations in the mobile industry to understand and improve the world's networks. Data and insights provided by Tutela are trusted by the engineering teams at mobile network operators and network equipment manufacturers around the world and used to compare operators as well as inform decisions in network and infrastructure planning and optimization. The organization is headquartered in Victoria, British Columbia.

Tutela does not collect any sensitive personal data and is compliant with international privacy regulations including CCPA and GDPR.

For further information about the methodology, data and tools used to create this report, please contact analysis@tutela.com or visit www.tutela.com.

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