

5G: expanding mobile networks beyond smartphones into the IoT



Introduction

5G: the next leap forward in connectivity

The path to full 5G adoption is complicated and still evolving. The deployment cycle and potential timeline for 5G maturity is a story in the making, with both new opportunities and challenges ahead for mobile network operators, infrastructure providers, device manufacturers and end users.

1G to 5G: continuous extension of capabilities beyond voice

Connectivity has come a long way since the first generation of the 1980s, but we still have far to go before our path to 5G is defined and the industry has a collective understanding of how to overcome future obstacles.



Analog phone

1G 1980s



Digital phone with text messaging





Digital calls, messaging + data, 3.5G with mobile broadband

All IP-based mobile





4G 2010s



What lies ahead for connectivity

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The 5G story is evolving rapidly.

However, a tremendous amount of evolution is required in the coming years with regard to 5G becoming reality.



5G standards specifications aren't expected until 2020. 2018 will see some preliminary specifications.



5G realization requires a heavy focus on technical innovation to clear hurdles and break into largely uncharted territories such as mmWave.



Desired capabilities are ambitious, such as ultra-reliable low latency (URLLC) communications.

The 5G story is evolving rapidly.



The amount of infrastructure necessary to densify the network is unclear.



Different operators, content providers, and infrastructure in different regions are moving at different speeds with regard to testing and deployment.



The 5G story has many unanswered questions.

Across the ecosystem, from mobile network operators and infrastructure providers to semiconductor manufacturers and devices makers, many details prove unsettled.



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5G will likely start by addressing enhanced wireless broadband use cases.



The enhanced mobile broadband usage scenario will come with new application areas and requirements—in addition to existing mobile broadband applications for improved performance and an increasingly seamless user experience.



Hotspot case is an area with high user density. Very high traffic capacity is needed, the requirement for mobility is low, and the user data rate is higher than that of wide area coverage.



Wide area coverage case needs seamless coverage. Medium-to-high mobility is desired, with a much-improved user data rate compared with existing data rates.

In the end, industry—not humans—will be the primary driver of 5G adoption through compelling business use cases.

Ultra-reliable and low latency communications (URLLC)

Wireless control of industrial manufacturing or production processes, remote medical surgery, distribution automation in a smart grid, and transportation safety.

Massive machine type communications (MTC)

A very large number of connected devices typically transmitting a relatively low volume of non-delay-sensitive data.



Enhanced mobile broadband

- Capacity for peak data rates in large crowds
- Network intelligence to allocate resources

The road to 5G - a story in the making

In the end, industry—not humans will be the primary driver of 5G adoption through compelling business use cases.

5G promises a wide range of potential use cases, each of which will require advanced technical capabilities.



What lies ahead for connectivity

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Considerations and challenges

The 5G story continues to build. Expectations are sky-high, with a wide range of features and capabilities being promised.

It is important to remember that 5G is still in very early days, and 4G/LTE has a tremendous amount of technical innovation still to come.





Considerations and challenges

The 5G story continues to build. Standards development and deployment is expected to reach into 2022 and beyond.



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Considerations and challenges The 5G story continues to build.

When considering the current state of development and deployment for 5G, it is important to consider the following topics:

- Standard
- Spectrum
- Network infrastructure
- Semiconductors



Considerations and challenges **Spectrum considerations**

5G will most likely need three main frequency ranges:

sub-1 GHz	1-6 GHz	20-30 GHz

Challenges remain

- These spectrum ranges are not empty; significant reallocation and accommodation will need to take place.
- Repurposing spectrum means existing users must move to higher frequencies and/or optimize other resources currently used.
- Spectrum auctions are planned throughout 2017, but the same spectrum ranges aren't available everywhere. Regional and country differences will make achieving a global standard difficult.



Considerations and challenges Network infrastructure considerations

The good news:

 All RAN vendors are developing 5G air interfaces and new RAT ahead of spectrum release.

Challenges remain:

- 4G will compete with 5G, particularly after two significant waves of upgrades: LTE-A and LTE-A Pro.
- Early 5G systems will be pre-5G and operating in sub-6GHz spectrum.
 mmWaves are far from being ready for primetime.
- 5G CAPEX spend is expected to be lower than 4G, continuing the trend seen in the transition from 3G to 4G.
- Backhaul must be ultra-high capacity, ultra-low latency, SDN-controlled; trend to X-haul transport.



Considerations and challenges **Chipset considerations**

Announced 5G modems:

- Qualcomm Snapdragon X50 (Multimode 5G NR), expected in smartphones by 2019
- Intel "5G" Modem w/ mmWave RFIC, sampling late 2017 (not true 5G NR)

Anticipated modem/chipsets from:

– Samsung

– Huawei (HiSilicon)

Other component suppliers/vendors (not expected to announce before 2019):

– MediaTek

– Leadcore

– Spreadtrum

Potential challenge

RF front end/radio path design to support both sub-6 and mmWave 5G NR



Key takeaways

- The proposed 5G standard is very ambitious, with technical capabilities designed to support an extensive range of use cases from low power and minimal bandwidth, to extremely low latency and high throughput.
- 2 Given the need for technical innovation, the standard is expected to be completed in phases, impacting operator strategies and timelines for some of the use cases.
- 3 Additional challenges are expected in trying to create a global standard while dealing with the diverse range of spectrum assets. It will be difficult to achieve economies of scale.
- Despite many challenges, the hype around 5G is already building, similar to what was seen for 3G and 4G.
 - It is crucial to be able to identify relevant issues for 5G planning.
- Mobile network operators are still experimenting with LTE applications and business models, with NB-IoT and Gigabit LTE in the more immediate future.



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