

# WIRELESS NETWORKS: 5G & WHAT HAPPENS NEXT

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Cell phones and smartphones have penetrated society in countless ways. As the phrase goes, if you need something, there's an app for that. Per the Pew Research Center, in 2018, 95% of adult Americans own a cell phone and 77% own a smartphone—an increase from 35% in 2011. Smartphones are integrated into every aspect of our lives: from using GPS to ordering an Uber or paying a bill, the smartphone is the Swiss Army Knife of the information age.

With such integration into everyday life, it is very easy to take these new technologies for granted. Every year Apple and Samsung produce shiny new smartphones that grab the headlines, but these devices wouldn't be nearly as useful or powerful if not for the behind the scenes innovation that powers the wireless network. As the introduction of 5G networks looms over the horizon, so do new technological possibilities, challenges, and opportunities.

## NEW TECHNOLOGY

5G wireless networks represent the next generation of mobile communication and is the continued evolution of 50 years of wireless innovation. Each new generation has brought with it increased speeds and data bandwidth, along with myriad technological advances. As this decade draws to a close, the 2020s look to usher in a new age of connectivity and capability.

	1G	2G	3G	4G	5G
Deployment	1970-1980	1990-2000	2000-2010	2010-present	2020-
Speed	2 Kbps	64 Kbps	2 Mbps	1 Gbps	1-10 Gbps
Services	Analog voice transmission	Digital transmissions of voice, text	Basic data services: SMS, MMS, video, Internet	Apps, HD video, streaming	Low latency, 4k video, self-driving cars, augmented reality

## Key Points

01. The next generation of wireless will be here soon
02. 5G networks can lead to exciting new technologies and connectivity
03. The 5G rollout will require a national overhaul in wireless infrastructure, creating opportunities for investment

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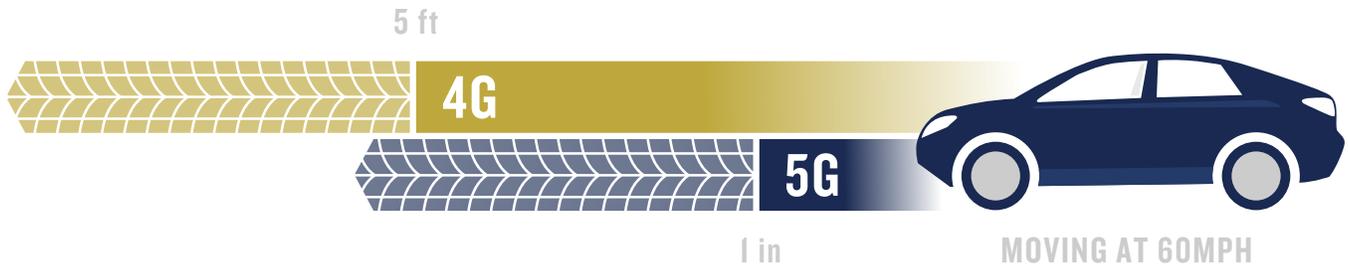
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## THE POSSIBILITIES

The 5G rollout won't just make smart phones faster; it will enhance the entire experience. Similar to how 4G enabled a buffer-free mobile video experience and changed consumer TV behavior, the key attribute of 5G could be low latency. Latency measures how quickly your device can send a signal to a tower and receive back a response. While your cellphone may seem quick today, take the example of an

autonomous car. A vehicle traveling at 60mph detects a potential obstruction on the road but needs to send the data to a centralized server to confirm. Over today's 4G network, that vehicle would travel 5 feet before it received confirmation, while a vehicle operating on a 5G network would get a signal back in the time it takes to travel only 1 inch.



Low latency should unlock opportunities for us to interact not just with a digital world, but with an increasingly connected physical world. Driverless cars, smart cities, virtual reality,

and more are feasible today, but under the 5G umbrella have the potential to become commonplace.

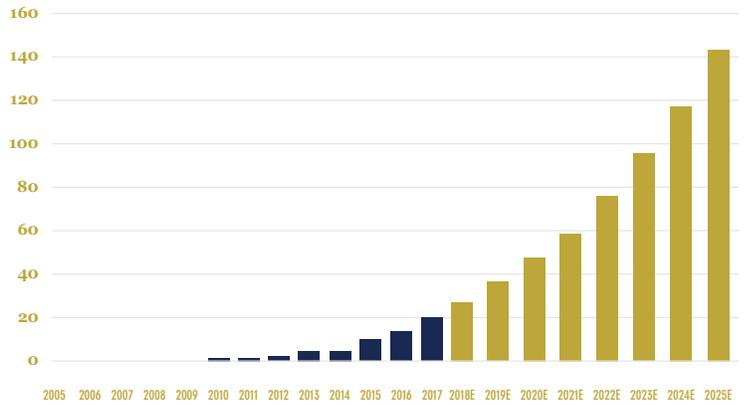
	Applications	Key Requirements	4G	5G
Today's Applications	HD Video Streaming	Download: 5 Mbps	✓	✓
	4K Video Streaming	Download: 20 Mbps	✗	✓
	Online Console Gaming	Latency: <50 ms Reliability > 99.9%	✗	✓
	Connected Vehicles	Download: 20 Mbps	✗	✓
Future Applications	Cloud Gaming	Latency: <50 ms	✗	✓
	Remote Surgery	Latency: <50 ms Reliability > 99.999%	✗	✓
	Self-Driving Cars	Latency: <50 ms	✗	✓
	Virtual and Augmented Reality	Latency: <10 ms	✗	✓
	Industry Control/ Automation	Latency: <1 ms	✗	✓

## THE CHALLENGES & OPPORTUNITIES

Historically, new applications unleash a massive expansion in data consumption and we believe 5G will be no different. For example, each self-driving car on the road is expected to generate about as much data as 3,000 people. In order to have one million self-driving cars on the road, it would represent the equivalent of 3 billion additional smartphones, a volume that would easily overwhelm today’s telecom infrastructure. Add in the data required for virtual reality, augmented reality, and other uses, and suddenly these new applications don’t seem so immediate.

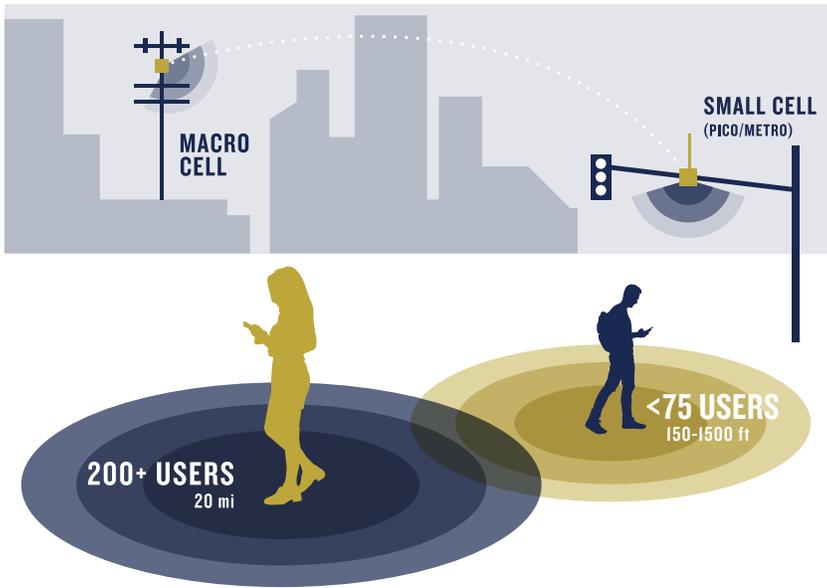
To keep up with demand and unleash the full potential of 5G, the industry will need to make large investments in infrastructure. The most familiar form of this infrastructure are the cell phone towers we see dotting the skyline along highways and around neighborhoods. While these towers will continue to be the backbone of the wireless network, they will not be adequate to support the new 5G applications that require additional wireless

Annual US Mobile Traffic in Exabytes



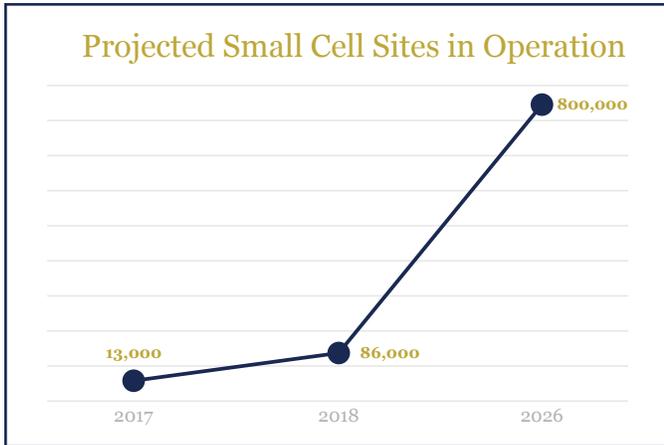
Note: Annual US Mobile Traffic in EB  
 Source: CTIA Annual Wireless Industry Survey 2017 and Cisco VNI Mobile Forecast 2017  
 Years 2022 through 2025 estimated using Cisco VNI growth trends

spectrum with a shorter wavelength. This spectrum will enable low latency and extreme speed, but at a cost: limited range. To solve the range issue, the industry has turned towards “small cells,” essentially tiny cell phone towers that are often attached to or disguised as street lights, traffic poles, or bus stops. Where the range for traditional towers is measured in miles, small cell range is measured in feet.



Large mobile carriers like Verizon and AT&T have already begun rolling out small cells across the country, primarily to solve network congestion in urban areas. We expect these deployments to accelerate as 5G becomes mainstream. Mobile network carriers are expected to double their capex spending by 2026 and small cell sites are projected to increase 10-fold to over 800,000 locations. For comparison, there are approximately 200,000 large “macro” towers in the US today.

Image Credit: Silicon Image



Source: Altman Vilandrie, CTIA

## CONCLUSION

Ten years ago, 4G networks allowed cell phones to become the digital hub of our lives. Today, over 80 million photos are shared daily on Instagram; Uber and Lyft each complete over 1 million trips per day; and Netflix users stream more than 140 million hours of video. A 5G network puts us at the precipice of another step change in technology with the potential to unlock brand new applications, many of which are still nestled deep in entrepreneurial minds. Today at Signature, we see opportunities for clients to invest in the towers, spectrum, data centers and fiber that will provide the infrastructure and platform to power future innovations over the next decade.

*You should carefully consider your risk tolerance, time horizon, and financial objectives before making investment decisions. Certain investments include the risk of loss of most or all of the investment and you should not invest in such investments unless you can afford a complete loss.*