

# What to Expect from 5G



# Overview

- 5G is technically here, but will not be mainstream in 2019.
- 5G means putting into place a new infrastructure that can support the new technology.
- Tensions between the U.S. and China are mounting as a 5G race takes shape.

# Investment Implications

## Big Effects On:

- Phones
- Home internet
- Industrial robots
- Internet of Things
- Security cameras
- Drones
- Smart Cars

# What exactly is 5G?

5G is the next generation of wireless technology after 4G/LTE.


5G will revolutionize our wireless ecosystem.

# The Goal


Far higher **speeds** and far higher **capacity per sector**,  
at far **lower latency**.



How long does it take to download  
the movie *A Star is Born*?

4G   
100 Mbps  
(2009)

6 minutes

5G   
10 Gbps  
(2020)

3.6 seconds

# 1G, 2G, 3G, 4G...

- 1G: analog cellular.
- 2G: first generation of digital cellular technologies. Gave us texting.
- 3G: brought speeds from 200kbps to a few megabits per second. Gave us mobile internet access.
- 4G: Gave us mobile broadband and integration of voice and data.



# ...And Now 5G

5G brings three new aspects to the table:

- Greater speed (to move more data)
- Lower latency (to be more responsive)
- The ability to connect a lot more devices at once (for sensors and smart devices)

# How It Works

- 5G networks use a system of cell sites that divide their territory into sectors and send encoded data through radio waves. Each cell must be connected to a network backbone.
- 5G will be able to boost capacity by 4x over current systems by leveraging wider bandwidths and advanced antenna technologies.



# The Next Step in Connectivity

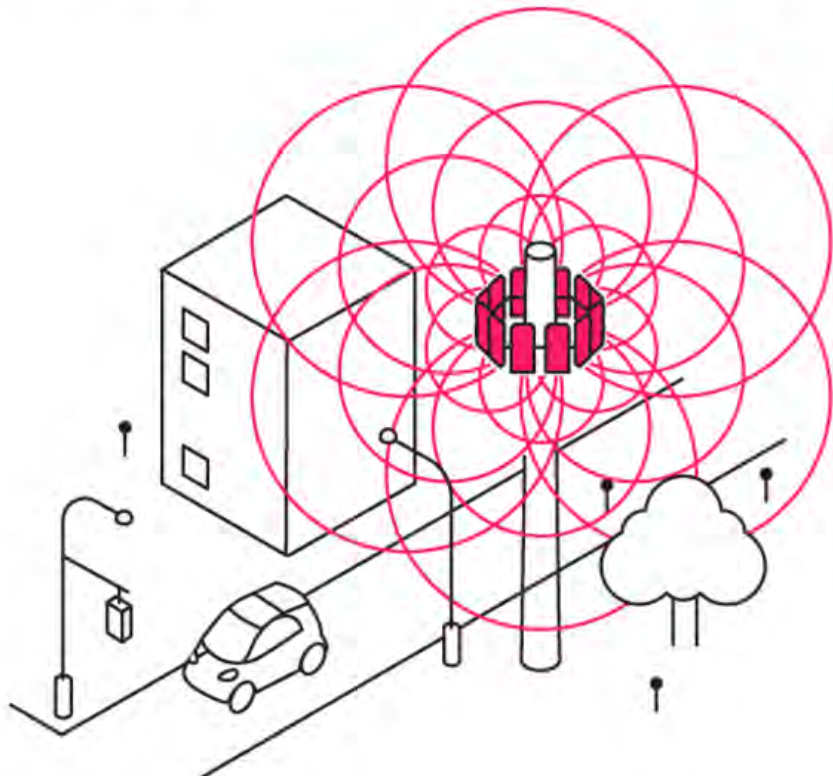
## 4G

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Signals broadcast in all directions

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All data sent to and from the network



## 5G

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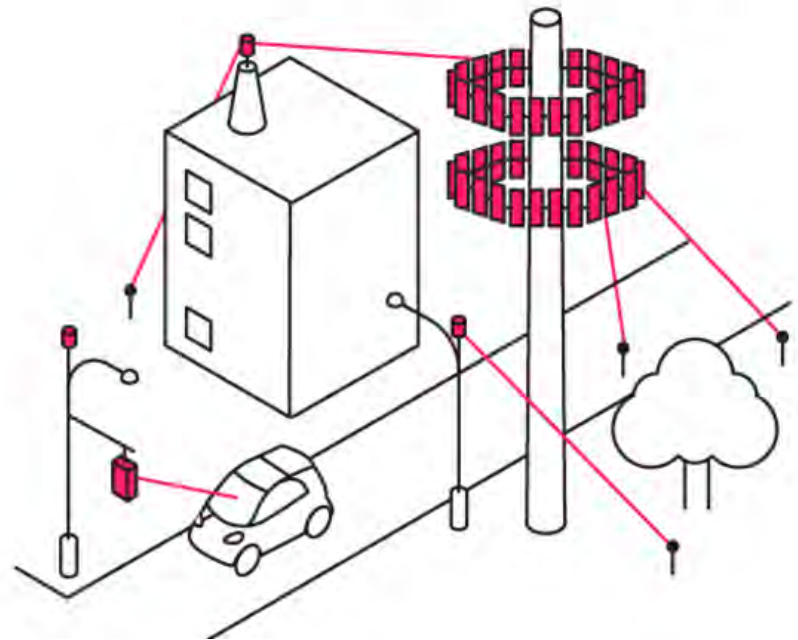
Focused signals

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Small base stations extend reach and handle some exchanges directly

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Device-to-device communication



# Millimeter Wave

To get super-high, multi-gigabit speeds, carriers will have to use newer, much higher frequencies, known as **millimeter wave**.

- Millimeter wave signals drop off faster with distance than lower-frequency signals do.
- The massive amount of data they transfer will require more connections to landline internet.
- Cellular providers will have to use smaller, lower-power base stations rather than fewer, high-power macro-cells to offer multi-gigabit speed.

# "5G is Here...Sort Of"

## Initial Progress:

- Verizon has a 5G home service in small parts of Houston, Indianapolis, Los Angeles, and Sacramento.
- AT&T is running user trials with mobile hotspots in 12 cities, but it looks like it will be a few months before regular folks can use 5G.
- Production volume for 5G smartphones will likely only be 5 million units this year.



# An Investment for the Next Decade

5G will produce new technologies and investment opportunities as it becomes established in the mainstream.

Example :4G

- Appeared in 2010
- But major 4G applications didn't appear until later:
  - Snapchat (2012)
  - Uber (2013)
  - Video calls over LTE networks widespread in 2013

Therefore, expect 5G applications to crop up around 2022.

# The Smartphone Market

- The smartphone market has stagnated in recent years, with both Apple and Samsung reducing sales forecasts.
- Increasing price tags on smartphones and longer upgrade cycles are the primary reason for slumping sales.
- 5G could mean higher prices for early 5G phones, potentially tempering hopes for a quick revival in an industry that is dealing with a reduction in sales.

# The New Space Race?

“Officials in the United States and China see 5G networks as a competitive edge. The faster networks could help spread the use of other cutting-edge technologies.”

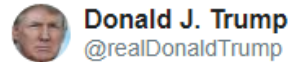
— *The New York Times*

Countries Ranked by 5G Readiness:

1. China
2. South Korea
3. U.S.
4. Japan



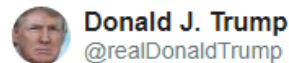
# The 5G (or 6G?) Race with China



I want 5G, and even 6G, technology in the United States as soon as possible. It is far more powerful, faster, and smarter than the current standard. American companies must step up their efforts, or get left behind. There is no reason that we should be lagging behind on.....

February 21st 2019

11,293 Retweets 53,473 Likes



....something that is so obviously the future. I want the United States to win through competition, not by blocking out currently more advanced technologies. We must always be the leader in everything we do, especially when it comes to the very exciting world of technology!

February 21st 2019

2,656 Retweets 11,751 Likes

# The 5G Race with China

- A standalone 5G network in China will mark government efforts to put the country at the forefront of the next generation of mobile networks.
- Through state-led initiatives, China wants to have capabilities for every single advanced technology being developed.
- The economic advantage of being first in 5G is huge, potentially bringing in hundreds of billions of dollars.
- 5G will also give the front-running country a national security edge.



# The 5G Race with China

- U.S. and allies' efforts to exclude Chinese networking equipment suppliers from Western and allied 5G networks will continue.
- The push for a China-free 5G alternative is likely to delay 5G deployment in some countries.
- A bifurcated 5G ecosystem will increase the risk that the global technology ecosystem will give way to two separate, politically-divided spheres of influence.

# The 5G Race with China

## The Global Market

- Developing countries that are more sensitive to cost will go after China's 5G offerings.
- Infrastructure and project financing available through the Belt and Road Initiative will be hard to pass up, particularly if China gains an edge in related technology applications.
- Chinese smartphone companies are heavily targeting India, the last remaining market for rapid smartphone sales growth.

# Cracking Down on Chinese Tech

- U.S. Investigations into ZTE.
- The arrest of Meng Wanzhou – CFO of Huawei.
- Several countries have raised security concerns about Huawei's products.
- Poland arrests Huawei employee on suspicion of spying on January 12, 2019.

Who has shown concern?

Australia

U.S.

Canada

U.K.

EU

Germany

New Zealand

# Investing in 5G\*

## Hardware Technology

- **Qualcomm:** Provides modem and processor chipsets for a massive chunk of the 5G market.
  - Working on its Snapdragon X50 Modem for 5G, with companies like Nokia/HMD, Sony, Xiaomi, Oppo, Vivo, HTV, LG, Asus, XTE, Sharp, and Fujitsu all on board.
  - Recently announced its QTM052 mmWave antennas for phones.
- **Intel:** Announced its first 5G modem for phones, cars, drones, and other connected devices.
  - Partnership with Microsoft, Dell, HP, and Lenovo to build 5G laptops.
- **Samsung:** Announced new Exynos 5100 modem, compatible with legacy networks (2-4G), all in a single chip.

# Investing in 5G\*

## Equipment Market

Forecast: The global market for mobile radio access network equipment is set for healthy annual growth over the five-year period to 2022.\*\*

- **Ericsson:** Telecom network infrastructure provider, based in Sweden.
  - Ericsson has won more than 80 5G trials against Huawei's 64 wins.
  - Will supply T-Mobile, AT&T, Verizon, and Sprint.
  - If the EU limits China in Europe's 5G market, Ericsson will benefit.
- **Nokia:** Operates through 2 businesses, Nokia Networks and Nokia Technology. Based in Finland.
  - Announced its first 5G modem for phones, cars, drones, and other connected devices.
  - Deals made with T-Mobile, AT&T, Verizon, and Sprint.
  - Deals with top 3 Chinese telcos.

\*These are not investment recommendations.

\*\*According to the research company Dell'Oro Group  
Goldman Sachs (2 December 2018), *Financial Times* (9 October 2018),  
Bloomberg (18 February 2019), *Fiercewireless.com* (10 September 2018)

# Investing in 5G\*

## Equipment Market

- **CommScope:** Provides fiber optic and copper connectivity solutions, as well as wireless infrastructure.
  - Will benefit from 5G preparation. Ex.: Small cells setup in urban environments.
  - Partnered with Nokia and Ericsson.
- **Corning Inc.:** Manufacturer of specialty glass and advanced optical fiber products.
  - 5G small-cell antennas connects to fiber optic wiring.
  - Signed a deal with Verizon to supply \$1 bn in optical fiber wiring for telecom networks.
- **Keysight:** Supplier of electronic test and measurement equipment. Used by chipset, device, and network equipment manufacturers.
  - 5G orders have grown over the past few quarters, signaling the benefits Keysight will feel from the transition to 5G.
  - Partnered with Qualcomm and Samsung.

# Investment Ideas

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