Forward-Looking Statements

“Safe Harbor” Statement under the Private Securities Litigation Reform Act of 1995: This presentation contains forward-looking statements concerning our goals, beliefs, strategies, future operating results, underlying assumptions and expectations for the evolution of technology. Actual results and outcomes may differ materially from those indicated by these forward-looking statements as a result of various important factors, including those described in item 1A of our Form 10-K for the year ended December 31, 2017 under the caption “Risk Factors.” We undertake no obligation to update the information contained in this presentation to reflect subsequently occurring events or circumstances. Definitions are provided at the end of the presentation.
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Historical U.S. Wireless Network Overview
Mobile Data Usage Trends

*Historical U.S. Mobile Data Traffic Growth (petabytes per month)*

- **iPhone (1st generation) released**
- **Motorola DROID launched**
- **iPad (1st generation) released**
- **500 millionth iPhone sold**

92% Mobile Data Usage CAGR from 2006-2016

Notes: 2006-2016 U.S. mobile data traffic assumed to comprise 90% of North America (U.S. & Canada) traffic
Sources: Cisco VNI, 2006-2016; 2014-2015 figures provided by Cisco VNI Feb 2017; Forbes; AV&Co. Research & Analysis
Mobile Data Usage Trends

Growth in usage has been driven by technology and device evolution

U.S. share of device connectivity standards (% of devices) vs. Avg. Monthly Usage per Subscriber (MB)

Notes: 2006-2014 U.S mobile data traffic assumed to comprise 90% of North America (U.S & Canada) traffic
Sources: Cisco VNI, 2006-2017; Forbes; AV&Co. Research & Analysis

Technology & Device Evolution → Development of Advanced Applications
= More Data Consumption
**Network Spending and Capital Intensity**

*Historical U.S. Carrier Investment: Wireless Capex and Spectrum*  
($ in billions)

**2G → 3G**  
2000-2004: ~$17/year

**3G**  
2005-2009: ~$23/year

**4G**  
2010-2016: ~$30/year

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**Major Spectrum Auctions**

- **PCS**  
  - $17
- **AWS-1**  
  - $14
- **AWS-3**  
  - $43
- **700MHz**  
  - $19
- **600MHz**  
  - $20

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Sources: SNL Kagan, CTIA; AV&Co. Research & Analysis
Network Spending and Capital Intensity

Historical tower leasing costs per GB of U.S. Mobile Data Traffic have declined at a 40% CAGR

Estimated Annual U.S. Tower Revenue Per GB(1)(2)

Investments in tower equipment and technology such as carrier aggregation have enhanced mobile networks’ ability to support exponential growth in mobile data traffic

Notes: (1) 2006-2014 U.S. mobile data traffic assumed to comprise 90% of North America (U.S. & Canada) traffic. Annualized year-end monthly rates.
(2) Tower revenue includes U.S. property revenue generated by AMT, CCI and SBAC.
Sources: Cisco VNI, 2006-2014; Forbes; Wall Street research; AV&Co. Research & Analysis
Network Spending and Capital Intensity

Capital Intensity\(^{(1)}\) remains stable as wireless network operators have invested across their networks to support coverage and capacity needs.

Estimated U.S. Wireless Macro Cell Sites
(Big 4 Carriers)

<table>
<thead>
<tr>
<th>Year</th>
<th>Installed Macro Sites (thousands)</th>
<th>Capital Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>196</td>
<td>18%</td>
</tr>
<tr>
<td>2007</td>
<td>213</td>
<td>14%</td>
</tr>
<tr>
<td>2008</td>
<td>242</td>
<td>12%</td>
</tr>
<tr>
<td>2009</td>
<td>247</td>
<td>12%</td>
</tr>
<tr>
<td>2010</td>
<td>253</td>
<td>14%</td>
</tr>
<tr>
<td>2011</td>
<td>283</td>
<td>14%</td>
</tr>
<tr>
<td>2012</td>
<td>302</td>
<td>14%</td>
</tr>
<tr>
<td>2013</td>
<td>304</td>
<td>15%</td>
</tr>
<tr>
<td>2014</td>
<td>298</td>
<td>14%</td>
</tr>
<tr>
<td>2015</td>
<td>308</td>
<td>14%</td>
</tr>
<tr>
<td>2016</td>
<td>308</td>
<td>11%</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Reflects Wireless capex as a percentage of carrier revenue

Sources: CTIA, Company SEC Filings; AV&Co. Research & Analysis
Technology Cycles

Networks Have Evolved from 2G to 3G to 4G

based on % of devices

While new generations of network technologies have been introduced, the lifecycle of legacy technologies has continued to be 15-20 Years+

Sources: AV&Co. Research & Analysis
Technology Cycles

*Historical network buildouts have consisted of 2 broad phases: Coverage and Capacity*

**Coverage Builds**
(solving for maximizing percentage of population with access to the network)

**Capacity Builds**
(solving for meeting increased capacity needs in areas where the network is reaching high utilization)

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Carriers typically build a wide, thin layer of coverage first and then invest in capacity to meet demand as subscriber adoption occurs.
Technology Cycles

We are now in the 4G capacity stage and will be for at least the next several years

### Key Components of 4G Capacity Build-out

<table>
<thead>
<tr>
<th>Why?</th>
<th>New Spectrum Deployed</th>
<th>Carrier Aggregation</th>
<th>Spectrum Re-farming</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Add more aggregate capacity to a given cell site</td>
<td>Allow multiple bands of spectrum to be paired together, allowing for faster speeds (Mbps) to be delivered including unlicensed</td>
<td>Add more aggregate capacity to a given cell site by redeploying underutilized 2G/3G spectrum to 4G</td>
</tr>
<tr>
<td>How?</td>
<td>Add additional equipment (antennas, transceiver cards, remote radio heads) to existing base stations</td>
<td>Typically upgrade base station or add new equipment (if new spectrum deployed as part of aggregation)</td>
<td>Swap out 2G/3G equipment with 4G equipment</td>
</tr>
<tr>
<td>Impact on Towers?</td>
<td>Incremental equipment including antennas on the tower drive amendments</td>
<td>To the extent new equipment deployed, drive amendments</td>
<td>Swap out of equipment as well as possibly new equipment (e.g. newer antennas) could drive amendments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Network design migrates towards higher frequency bands, smaller sites with shorter propagation for capacity driving suburban densification and new colocations</td>
<td></td>
</tr>
</tbody>
</table>

Source: AV&Co. Research & Analysis
The Path Towards 5G
What is 5G?

5G is not a single technical innovation, but rather a set of advances with spectrum

**Network Architecture: 4G LTE vs. 5G**

<table>
<thead>
<tr>
<th>Core Network</th>
<th>Transport</th>
<th>Tower / Access Point</th>
<th>Antenna</th>
<th>Air Interface Technology</th>
<th>Spectrum</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most computing resources located in core</td>
<td>Legacy copper, wireless, or fiber backhaul</td>
<td>eNodeB macro cell base stations</td>
<td>MIMO sends / receives limited # of signals simultaneously</td>
<td>One size fits all waveform with OFDM</td>
<td>Carrier aggregation maximum of five component carriers (100 MHz bw)</td>
<td>Standard LTE chipsets and battery life</td>
</tr>
</tbody>
</table>

4G

5G

NFV and SDN technologies, NSA, SA slicing

Fiber Fronthaul

Macro-sites + Many small cells

Massive MIMO and adaptive beamforming

Rel 15 OFDMA with improved flexibility

Higher freq (mmWave) and wider bandwidths carrier aggregation

Multi-mode, low power 5G chipsets

**Greater Capacity**

**Faster Download Speeds**

**Lower Latency**

Source: AV&Co. Research & Analysis
5G Roadmap

The path towards true 5G is expected to be lengthy

5G is expected to consist of updates to the LTE standard together with new radio-access technology – 5G standardization will start with release 14/15 with full standard setting targeted in release 16 (2019)

Sources: AV&Co. Research & Analysis

March 2017: 3GPP launches Non-Standalone 5G NR Option 3 to leverage existing LTE infrastructure. Approved in December, 2017

Release 14
Q2 2017
- LTE enhancements and early 5G technology targeted to reduce latency
- C-V2X
- 3D MIMO
- Supports transmissions in unlicensed spectrum

Release 15
Late 2018
- First set of 5G standards as well as maturing of LTE-Advanced Pro specs
- New Radio (NR) with Non-Standalone 4G control channel
- Focus on eMBB, latency reduction and reliability improvement
- Broader frequency range
- V2V and V2I communication
- Massive machine-type communication

Release 16
Late 2019
- Defined as “5G Phase 2” i.e. 5G advances with increased focus on specific use cases in Internet of Things (IoT)
- Standalone 5G operation options
- Ultra-lean design ‘always on’
- Multi-site connectivity for enhanced data rate

Sources: AV&Co. Research & Analysis
5G Rollout – Country Comparison

The US & China have an early 5G lead, with South Korea & Japan close behind

### International Progression Overview

<table>
<thead>
<tr>
<th>Country</th>
<th>Commercial Rollout</th>
<th>Trials Complete</th>
<th>Trials Begun</th>
<th>Partnerships Announced</th>
<th>Spectrum Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>South Korea</td>
<td></td>
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<td></td>
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<tr>
<td>Japan</td>
<td></td>
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<td></td>
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<tr>
<td>UK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Germany</td>
<td></td>
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</tr>
</tbody>
</table>

### Highlights

- **mmWave trials:**
  - AT&T (5 markets), VZ (11 markets)
  - 600MHz: T-Mo announced 600MHz 5G deployment plans

- **Sub-6 GHz:**
  - ZTE employs over 3k FTEs on 5G R&D
  - China Telecom trials 5G in six cities in 2018

- **mmWave (28GHz) – KT launch 5G back-end for Olympics; Limited device use-cases pre-NR (autonomous bus, tablet)**

- **Samsung and KDDI trial 5G on high-speed trains**

- **NTT DoComo trials FW in parts of Tokyo**

- **3.4 / 28 GHz in June ’18**

- **3.4GHz in 2018**

- **9/17 Deutsche Telekom claim first EU 5G ntwk @ 3.7GHz**

### Notable Carriers

- **All carriers have announced 2H18/1H19 launch plans**
- **Commercial network targets June 2018 launch**
- **Commercial launch in select markets 2019**
- **Nokia partners with DoCoMo for 5G by 2020**
- **Further auctions in 2020, EE targets 2022 launch**
- **Commercial launch planned for 2020**

Sources: AV&Co. Research & Analysis, Financial Times, PR Newswire, Japan Times, Company Press Releases
The Current and Future 4G Environment

*4G will remain critical, even post-5G introduction*

U.S. market share of connectivity standards (2000-2025E) based on % devices

- **2G**
  - ~24 years lifecycle (1996-2020)
- **3G**
  - ~20 years lifecycle (2002-2022)
- **4G**
  - Est. ~18-20 years lifecycle (2010-2028/30)
- **5G**
  - Likely early 5G launches in 2018/2019 covering both fixed wireless but also mobile (e.g. T-Mobile at 600MHz)

The commercial launch of 5G mobile networks is expected in the 2020 timeframe (with some earlier 5G standard launches possible) – In the meantime, significant 4G investments are expected to continue, with over 50% estimated 4G market share through 2025

Sources: AV&Co. Research & Analysis
The 4G Environment in the Meantime

*U.S. Mobile Data Traffic is projected to continue to grow rapidly*

**U.S. Total Mobile-Connected Devices**
(Millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-IoT</th>
<th>IoT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>481</td>
<td>372</td>
<td>853</td>
</tr>
<tr>
<td>2017</td>
<td>372</td>
<td>109</td>
<td>481</td>
</tr>
<tr>
<td>2018</td>
<td>427</td>
<td>481</td>
<td>808</td>
</tr>
<tr>
<td>2019</td>
<td>587</td>
<td>427</td>
<td>1,014</td>
</tr>
<tr>
<td>2020</td>
<td>587</td>
<td>427</td>
<td>1,014</td>
</tr>
<tr>
<td>2021</td>
<td>587</td>
<td>427</td>
<td>1,014</td>
</tr>
</tbody>
</table>

**U.S. Traffic per Mobile Connection**
(MB per mo.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-IoT</th>
<th>IoT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>290</td>
<td>801</td>
<td>1,091</td>
</tr>
<tr>
<td>2017</td>
<td>587</td>
<td>801</td>
<td>1,388</td>
</tr>
<tr>
<td>2018</td>
<td>1,014</td>
<td>801</td>
<td>1,815</td>
</tr>
<tr>
<td>2019</td>
<td>1,342</td>
<td>801</td>
<td>2,143</td>
</tr>
<tr>
<td>2020</td>
<td>1,342</td>
<td>801</td>
<td>2,143</td>
</tr>
<tr>
<td>2021</td>
<td>1,342</td>
<td>801</td>
<td>2,143</td>
</tr>
</tbody>
</table>

**U.S. Total Mobile Data Traffic**
(Petabytes)

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-IoT</th>
<th>IoT</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>36</td>
<td>36</td>
<td>72</td>
</tr>
<tr>
<td>2017</td>
<td>36</td>
<td>36</td>
<td>72</td>
</tr>
<tr>
<td>2018</td>
<td>36</td>
<td>36</td>
<td>72</td>
</tr>
<tr>
<td>2019</td>
<td>36</td>
<td>36</td>
<td>72</td>
</tr>
<tr>
<td>2020</td>
<td>36</td>
<td>36</td>
<td>72</td>
</tr>
<tr>
<td>2021</td>
<td>36</td>
<td>36</td>
<td>72</td>
</tr>
</tbody>
</table>

**Notes:** Internet of Things (IoT) based on M2M module connections, traffic and data usage; IoT includes everything other than M2M modules (e.g., smartphones, laptops, etc.); Sources: Cisco VNI 2016, AV&Co. Research & Analysis

Exponential Growth in Devices and per Device Usage = Significant Growth in Overall Traffic
The 4G Environment in the Meantime

*Investments in 4G are expected to continue as carriers seek to preserve network quality*

### Coverage Bands
- **850 MHz**: 4G
- **700 MHz**: 4G
- **600 MHz**: 4G

### Capacity Bands
- **mmWave**: 5G (Predominantly fixed wireless)
- **3.7-4.2GHz**: Likely 5G
- **2.5GHz**: More 2.5GHz band assets deployed to LTE but also likely 5G
- **WCS**: WCS LTE deployment completed
- **PCS**: PCS 3G re-farming to LTE
- **AWS**: Continued densification

### 2018-2020 Investments
- **5G**: Majority available 2019/2020; some carriers (e.g. T-Mobile) may deploy early 5G variants directly on 600MHz if possible
- **2G re-farming to LTE**: Likely 5G

Source: AV&Co. Research & Analysis
The 4G Environment in the Meantime

Ongoing 4G activity includes new wrinkles on equipment configurations

<table>
<thead>
<tr>
<th>Typical 3G Deployment</th>
<th>4G Deployment</th>
</tr>
</thead>
</table>
| 3G Base Station includes the Baseband Unit, Transceivers, Power Amplifiers, and other auxiliary equipment | **Multi-Band MIMO Antennas**
2x2 MIMO now common on LTE, growing to 4x2 and 4x4 (provide higher spectral efficiency) |
| SISO Antennas – only antennas deployed on the tower | **LTE Remote Radio Heads** (includes transceiver cards, power amplifiers and filters) |
| Coax cable | **Fiber running down the tower (rather than coax)** |
| 850/1900MHz BTS | **Consolidated base stations broken out into Remote Radio Heads and Baseband units** |

**Example:** Multiple antennas used for the same sector rather than 1

**LTE Baseband unit**
Could be deployed at the bottom of the tower or also remotely at a datacenter (Cloud RAN architecture)

The Trend Has Been *More* Equipment Being Placed on Towers

Source: AV&Co. Research & Analysis
Ongoing Evolution of Wireless Networks

Heterogeneous Networks (Hetnets) and unlicensed LAA will continue to play an important role in urban deployments as well as shared spectrum for neutral host indoors

Network deployments are expected to consist of multiple layers—traditional macro cell towers provide a blanket of coverage, while underneath this umbrella, a combination of other technologies are deployed to increase network capacity, particularly in dense urban areas

- Macro sites expected to continue providing wide area coverage for high mobility users and be the core of wireless networks
- Multiple solutions including DAS, Rooftops, Wi-Fi and Small Cell networks expected to complement the coverage provided by towers in urban locations

Source: AV&Co. Research & Analysis
Ongoing Evolution of Wireless Networks

Macro sites remain critical given vast majority of the U.S. landmass is either rural or suburban

While Hetnets are used in dense urban and urban areas, > 80% of the U.S. population lives in suburban or rural areas (<7,500 people per square mile) where macro towers are optimal for wireless network deployments

- 54% live in suburban (600-7,500 people per square mile)
- 28% live in rural (<600 people per square mile)

Sources: U.S. Census; AV&Co. Research & Analysis
Expected 5G Timelines and Implications for AMT
### Detailed Expected 5G Timeline

*While the full 5G standard will only be officially defined in 2020, a non-standalone variant is now targeted for 2019*

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>3GPP Release 14</td>
</tr>
<tr>
<td>2018</td>
<td>3GPP Release 15</td>
</tr>
<tr>
<td>2019</td>
<td>WRC (possible global allocation of 600 MHz for mobile)</td>
</tr>
<tr>
<td>2020</td>
<td>Full 5G Device Availability (4G + 5G radios + core) (Oct. 2020)</td>
</tr>
<tr>
<td>2026</td>
<td>Large Scale Global Deployment of 5G</td>
</tr>
</tbody>
</table>

#### Key 5G Events

- **Non-standalone 5G NR added** (5G radios using the LTE core)
- **600 MHz**
  - Former Licensees cease operations (July 2017)
  - 600 MHz auction (Complete)
  - Repacking period for newly auctioned spectrum and device portfolio upgrades for new 5G bands (39 months)
- **mmWave**
  - FCC Order for use of mmWave bands @ 28, 39 and 70
  - Deployment of mmWave band 2018-2019 for FWA, Hot Spots

#### 600 MHz

- Carriers likely to deploy spectrum (New licensees must build out 40% of pops within 6 yrs)

#### Sources:
- FCC, ComputerWorld, AV&Co. Research & Analysis
5G Capabilities, Characteristics and Potential Impacts

When it becomes reality, mmWave-based 5G promises to yield revolutionary network benefits – in select locations

<table>
<thead>
<tr>
<th>Technology Characteristic</th>
<th>5G vs. 4G</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Download Speeds</td>
<td>10-100x</td>
<td>Drastic performance improvement for high bandwidth applications (e.g. high resolution video)</td>
</tr>
<tr>
<td>Average Roundtrip Latency</td>
<td>5-10x lower</td>
<td>Supports highly latency sensitive applications</td>
</tr>
<tr>
<td>Spectral Efficiency b/s/Hz</td>
<td>&gt;3x</td>
<td>Provides carriers more “bang for buck” per unit of spectrum holdings</td>
</tr>
<tr>
<td>Max Simultaneous Connections per Cell</td>
<td>300x</td>
<td>Supports many more densely packed IoT connections than today</td>
</tr>
</tbody>
</table>

The only way to achieve these benefits is by having access to substantial spectrum depth

AND

The new bands where this depth exists is in extremely high-band, mmWave frequencies

mmWave 5G Would Add Value in:

- Urban Locations
- High Population Density Areas
- Areas w/ Acute Network Capacity Needs
- Areas not currently served by towers (e.g. rooftop sites)

Sources: Nokia 5G Deployment White Paper; Samsung: 5G Vision; AV&Co. Research & Analysis
Scenarios for 5G Mobile and Wireless Communications: The Vision of the METIS Project (IEEE Communications Magazine, May 2014)
5G Capabilities, Characteristics and Potential Impacts

5G also has the potential to open the door for carriers to gain access to new revenue streams

**U.S. Network and Access Services Revenue: 2015**

- **Mobile:** $236 Billion
  - Broadband: $137B
  - Voice: $99B

- **Residential:** $177 Billion
  - Broadband: $51B
  - Video: $101B
  - Voice: $25B

5G May Help Allow Wireless Carriers to Compete in New Segments like Fixed Wireless to Drive Increased Profitability

*4+ Competitors*

The capacity capabilities of mmWave spectrum may enable carriers to pursue a fixed wireless competitive offering, driving new revenue growth potential

*2-3 Competitors*

Source: AV&Co. Research & Analysis
5G Capabilities, Characteristics and Potential Impacts

The Internet of Things (IOT) is another aspect of the 4G and 5G ecosystem which is expected to experience rapid growth

**Multitude of IoT use cases**

- **HIGH MB USAGE**
  - Backup Routers
  - Video Surveillance
  - Infotainment
  - Streaming Video
  - Mobile ICU
  - Vehicle Diagnostics

- **LOW MOBILITY**
  - Security System
  - Smart Grid
  - Kiosks
  - Vending Machine
  - Mobile POS
  - Asset Management

**Huge IoT Volumes**

(U.S. numbers shown)

- **2015**
  - Total IoT traffic: 317 PB/month
  - Total IoT devices: 513M

- **2020E**
  - Total IoT traffic: 22X growth (85% CAGR)
  - Total IoT devices: 6.8X growth

Sources: Cisco VNI 2016; AV&Co. Research & Analysis
Spectrum Considerations: mmWave

*Initial 5G deployments are expected to heavily utilize mmWave spectrum to address the most pressing capacity constraints in dense urban areas*

**Overview of mmWave Spectrum (over 24 GHz)**
*(Illustrative, Not to Scale)*

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**LMDS**
*(27.5GHz-31GHz)*

- 850 MHz (out of 1.3 GHz) proposed for mobile use
- LMDS licensed by BTA for fixed wireless through A1 block (27.5-28.35); A2 (29.1-29.25); B (31.0-31.3) – A1 is currently proposed by FCC for mobile use
- Active licenses cover ~75% of U.S. population
- Current license holders would get their rights extended to mobile while non active licenses would be auctioned

**37 GHz**
*(37.0GHz-38.6GHz)*

- 1.6 GHz proposed for mobile use
- Not currently licensed
- FCC proposes a hybrid licensing scheme, with county-based geographic licensing for outdoor use, and operating rights by rule to property owners

**39 GHz**
*(38.6GHz-40GHz)*

- 1.4 GHz proposed for mobile use
- Licensed by EA with 14 paired blocks of 50x50 MHz
- Active licenses cover ~49% of U.S. population
- Current license holders would get their rights extended to mobile while non active licenses would be auctioned
- 39.5-40.0MHz may be used for military FSS/MSS operations

**64 GHz**
*(64GHz-71GHz)*

- 7.0 GHz proposed for mobile use
- Not currently licensed
- FCC proposes to authorize operations for unlicensed uses such as Wi-Fi-like “WiGig” operations
- Could be used with unlicensed 57-64GHz band to create combined 17 GHz band

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(*) FCC has considered other bands in its Oct. 2014 Notice of Inquiry (NOI) for 24 GHz+ use for mmWave, but latest Notice of Proposed Rulemaking (NPRM) in 2015 does not propose those bands for mobile use. All bands may have satellite interference issues, but FCC has rejected satellite requests to not use those bands for mobile use and in return has proposed to develop a "flexible rules" framework that would permit mobile and satellite to cohabit in bands.

Sources: Av&C Research & Analysis, FCC Spectrum Frontiers NPRM
Spectrum Considerations

The recently auctioned 600 MHz spectrum is likely to be impactful for towers as it is deployed as well as for the global harmonization of Sub-6Ghz 5G at 3-4Ghz

600 MHz Spectrum Estimated Timeline

- **March 2017**
  - Auction Closed
  - T-Mobile, Dish, Comcast, and AT&T purchased spectrum worth $19.8B

- **April 2017**
  - Initial licensing

- **July 2017**
  - (3 months after auction ended)
  - Licensees relinquishing spectrum must cease operations

- **~Early-2020**
  - Repacking must be completed (39 months after the official repacking process starts, ~end of auction)

- **~Early-mid 2020**
  - Final licensees likely issues after 39-month repacking period

- **~2020-2021**
  - Carriers likely to deploy spectrum
  - (some such as T-Mobile may deploy earlier - 2018/2019 – in certain markets where repacking is accelerated)

- **2026**
  - 6 years after initial licensing
  - New licensees must build out to 40% of pops in service area (must build out to 75% within 12 years)
  - = in mostly rural areas

- **6 years after initial licensing**
  - Holding period ends: reserve spectrum can be sold to non-reserve-eligible entities

Source: AV&Co. Research & Analysis
Spectrum Considerations

While mmWave spectrum is ideal for capacity purposes, 600MHz is much better suited to provide broad coverage outside of dense urban areas.

<table>
<thead>
<tr>
<th>Frequency Ranges:</th>
<th>600MHz</th>
<th>mmWave</th>
</tr>
</thead>
<tbody>
<tr>
<td>~600-700MHz</td>
<td>~100MHz</td>
<td>~11GHz</td>
</tr>
</tbody>
</table>

Total MHz Bandwidth Available:

- ~100MHz
- (~11X total 600MHz capacity)

Propagation Characteristics:

- Very good
- Challenging

Ideal for:

- Broader Suburban & Rural Wireless and IoT Development
- Dense Urban Hot Spot, Fixed Wireless Deployment

Currently proposed bands:

- ~LMDS (27.5GHz-31GHz)
- 37 GHz (37.0GHz-38.6GHz)
- 39 GHz (38.6GHz-40GHz)
- 64 GHz (64GHz-71GHz)

Source: AV&Co. Research & Analysis
Spectrum Considerations

Overlapping timing and poor mmWave coverage characteristics should drive parallel 5G coverage deployment at 600MHz with capacity deployment at mmWave bands.

### Today
- **mmWave**
- **3.7-4.2GHz**
- **2.5GHz**
- **WCS**
- **PCS**
- **AWS**

### 2018-2020 4G Investments
- **Capacity & small-cell centric 5G deployment at mmWave (beginning with fixed wireless)**

### Likely 5G Deployments
- **5G**

Source: AV&Co. Research & Analysis

Note: The 5G standard currently does not support the 600MHz band, although it may in the future; T-Mobile’s offering will be a 5G-like service or a pre-5G standard service.
AMT Positioning – Macro Towers

Deployment of 600 MHz (as well as 2.5GHz and other) spectrum for 5G could result in incremental demand for AMT’s suburban and rural Macro towers.

AMT’s U.S. Portfolio is Well-Positioned\(^{(1)}\)

- 40k+ Towers
- 95%+ Suburban/Rural
- Capacity for Incremental Equipment

“The timing of the incentive auction makes the 600 MHz band a prime candidate for deployment of a wide-area 5G coverage layer. In much the same way that 700 MHz paved the way for America's world-leading deployment of 4G, so could 600 MHz accelerate U.S. deployment of 5G.”

– Tom Wheeler, FCC Chairman, Aug ’15

“We’re committed to drive a 5G rollout by 2020 across the nation…there’s been a lot of discussion [of] millimeter wave and the kind of surgical, tactical deployments of 5G, and we’ll be there too. But we’ll deploy in the 600 MHz for 5G as we move into the next decade.”

– Neville Ray, T-Mobile CTO, Nov ’17

\(^{(1)}\) As of December 31, 2017.

Sources: AV&Co. Research & Analysis, T-Mobile and FCC press releases
## AMT Positioning – Complementary Franchise Real Estate Solutions

<table>
<thead>
<tr>
<th>Smart Fusion Pole</th>
<th>Citybeacon Alliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>› Formed an alliance with Philips Lighting to deploy Smart Fusion Pole</td>
<td>› Formed an alliance with Citybeacon to provide a wireless and digital smart hub platform</td>
</tr>
<tr>
<td>› Combines energy-efficient LED lighting and controls with shared wireless infrastructure to meet the connectivity challenges faced by wireless carriers and municipalities in urban areas</td>
<td>› Co-developing first multifunction smart hub that incorporates wireless infrastructure for multiple wireless carriers</td>
</tr>
<tr>
<td>› Offers carriers scalable real estate solution for urban deployments, where network challenges created by increasing mobile data usage are most acute</td>
<td>› Enables a variety of other city and commercial applications, such as, IoT, sensors for environmental monitoring, community announcements, targeted digital advertisements and emergency services</td>
</tr>
</tbody>
</table>
AMT Positioning – In Summary

We expect continued strong demand for our macro towers as a result of 4G and 5G mobile network deployments, with additional optionality from other complementary urban real estate solutions.

**Driver**

**Continued Strong Demand for AMT Real Estate**

<table>
<thead>
<tr>
<th>Continued 4G Investments</th>
<th>4x4 MIMO, New band deployments (e.g. WCS, AWS-3) along with spectrum re-farming from 2G/3G (e.g. PCS) to 4G drive continued activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial 5G Deployments</td>
<td>Deployment of urban millimeter-wave focused solutions and simultaneous deployments of complementary wide-area 5G coverage and Massive MIMO, New 5G spectrum</td>
</tr>
<tr>
<td>Massive Expected IoT Demand</td>
<td>Next demand wave driving continuing need for more capacity and site densification including across suburban and rural macro towers and potential next-generation use cases like edge computing, Automotive AR/VR, etc.</td>
</tr>
</tbody>
</table>

Source: AV&Co. Research & Analysis
Definitions
Key Definitions

- **3GPP** – 3rd Generation Partnership Project; a collaboration between groups of telecommunications associations. The initial scope of 3GPP was to make a globally applicable third-generation (3G) mobile phone system specification, that has since been extended to LTE (4G), and eventually to 5G.

- **WRC** – World Radiocommunication Conference; organized by ITU to review, and, as necessary, revise the Radio Regulations, the international treaty governing the use of the radio-frequency spectrum and the geostationary-satellite and non-geostationary-satellite orbits. It is held every three to four years.

- **ITU** – International Telecommunication Union; a specialized agency of the United Nations that is responsible for addressing issues that concern information and communication technologies.

- **Carrier Aggregation** – Allow thicker bands of spectrum to be used (by combining disparate, possibly non-contiguous bands such as 700MHz and AWS) allowing for faster speeds (Mbps) to be delivered.

- **Latency** – delays in signal propagation.

- **Millimeter Wave Spectrum (mmWave)** – refers to spectrum typically above 5GHz within the context of 5G, such as the 28GHz band.

- **MIMO** – Multiple Input, Multiple Output; expands the capacity of a cell site by using multiple antennas to transmit and receive the signal. For example, 4x2 MIMO refers to using 4 antennas on the tower and 2 antennas on the mobile device.

- **Beam Forming** – a technique to improve cell site capacity through directional signal transmission or reception.

- **LTE-U** – LTE in Unlicensed Spectrum, targeting using the unlicensed 5GHz band for LTE. While the control channel uses licensed LTE spectrum, all data flows over the unlicensed 5GHz band (shared with Wi-Fi).

- **Licensed Assisted Access** – the 3GPP effort to standardize LTE operation in the Wi-Fi bands.