Use Cases Driving 5G/Vision

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Who Needs 5G?
Why 5G?

100,000% increase in data traffic on AT&T national wireless network

5G is viewed as a new ecosystem from end-to-end, harnessing both evolutionary as well as revolutionary technologies to:

- Expand capabilities, performance, and availability of mobile broadband for always-connected people and devices
- Leverage enhancements to LTE-Advanced radio and core ecosystems
- Utilize all spectrum types—licensed, unlicensed, and shared access in existing and new radio bands
- Employ architecture concepts aligned with virtualization and flexibility (e.g., SDN, Cloud Computing, NFV)
- Address deployment and operating cost

Some evolutionary technologies in play:

- Device-to-Device (D2) Communications
- Higher order MIMO, Carrier Aggregation
- SDN, NFV
- Network efficiencies for IoT/M2M

Some revolutionary technologies now in research:

- Complete re-architecture of the core network
- Harnessing Millimeter Wave spectrum
- Massive MIMO
- Self-backhauling and self discoverable
Key Drivers for 5G

**Higher Data Rate and Capacity**
- Achieve Big Gains – even at the expense of backward compatibility in new bands
- Handle massive data volumes with much lower latencies than 4G
- Be capable of utilizing existing cellular spectrum and new spectrum efficiently – including MM wave

**Machine Centric Focus**
- Support connectivity to massively larger number of low-cost, low-power, devices
- Devices with widely varying degrees of data rates, latency, mobility, and reliability requirements
- Ultra-low latency will be a “big” new requirement for a certain class of applications

**Ultra-Robust and Resilient**
- Address specialized and mission critical applications (e.g., public safety services, health care)
- Support wireline PSTN replacements

**Efficient (Cost and Energy)**
- Support Dense Networks with massively larger numbers of “cells” – Pervasive use of Green Technologies
- Utilize concepts such as NFV/SDN and other open platforms to provide significant cost advantage over previous generations

**New Concepts**
- New ways to deal with mobility management in the wake of ultra dense networks and massively large numbers of not-very-mobile devices in the Internet of Things (Mobility-on-Demand)
- Addresses cross layer enhanced QoS capabilities and management
- Support multi-RAT networks efficiently and effectively
- Support indoor and outdoor location determination with high precision and cost effectiveness
5G Use Cases

- Internet of Things
- Extreme Video and Gaming Applications
- Explosive Data Density
- Public Safety
- PSTN Sunset
- Context Aware Services
5G Requirements Categories

Requirements

- SYSTEM MANAGEMENT & OPERATION
  - QoS Management, SON, etc.

- CAPACITY & BANDWIDTH
  - Additional spectrum
  - Ultra high/low channel bandwidth options with support for ultra low latency
  - Grow the network capacity by 1000x – 5000x in the next decade

- SCALABILITY
  - Increased battery life for 5G based sensors
  - Support for connectivity of very large number of devices

- COST
  - NFV / SDN /Cloud, etc

- ROBUSTNESS
  - device-to-device, multihop, mesh infrastructure-less operation, etc.
Harness New Spectrum

Sub 6GHz Spectrum

LTE (Rel 13)
- Licensed + Unlicensed Band
- FD-MIMO
- CA up to 320 MHz (16CC)
- Enhanced D2D

Backwards Compatible Solution
- Utilize the existing OFDMA numerology

Non Backwards Compatible Solutions
- New waveform
- Much shorter latency and wider channel bandwidth

Above 6GHz Spectrum

- Licensed Access + Unlicensed
- Large scale antenna processing
- New MCS Waveform (L1 CA)
- Self backhauling multi-hop
- > 100 MHz bandwidth
- Ultra low TTI (100 micro sec)
- Small cell based ultra dense network

4G

5G
5G End-to-End Ecosystem
The Path Forward

Performance
- Greater throughput
- Lower latency
- Ultra-high reliability
- Higher connectivity density - IoT
- Mobility on demand

Capabilities
- Control a highly heterogeneous environment
- Help ensure security, trust, identity, and privacy
- Consistent user experience

Expected Timing
- Technical studies & initial specifications through 2018
- Technical specifications with a rich set of 5G deployable features 2020
- Commercial deployment 2020 and
Thank You