



5G: Can it Do the Splits?

Dave Wolter

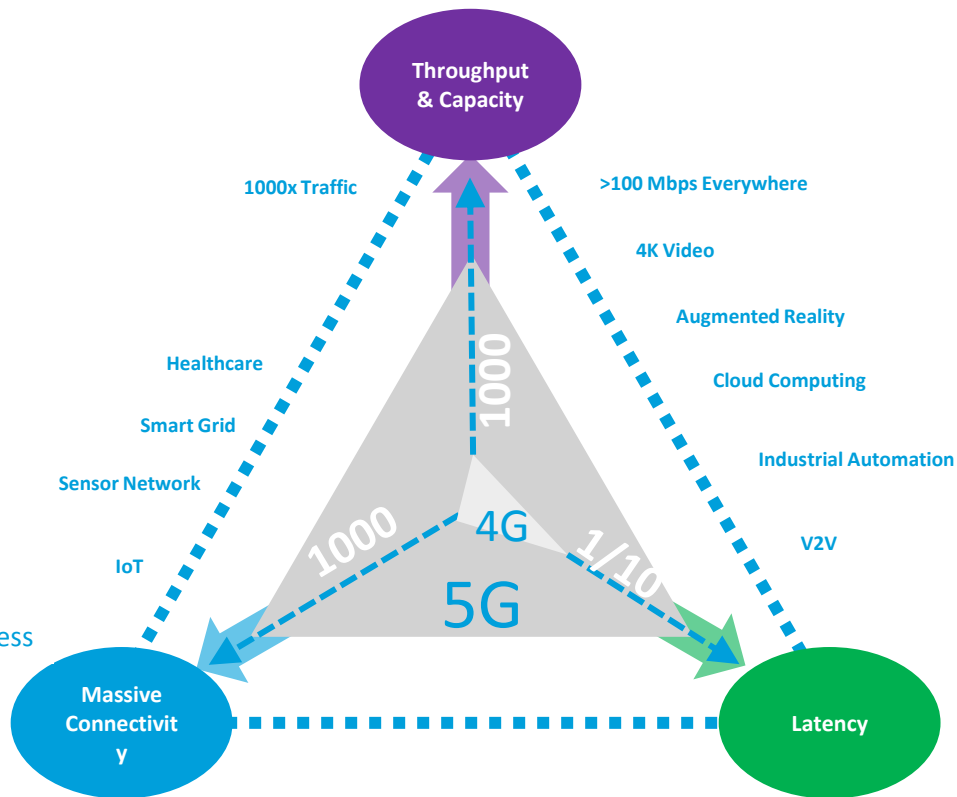
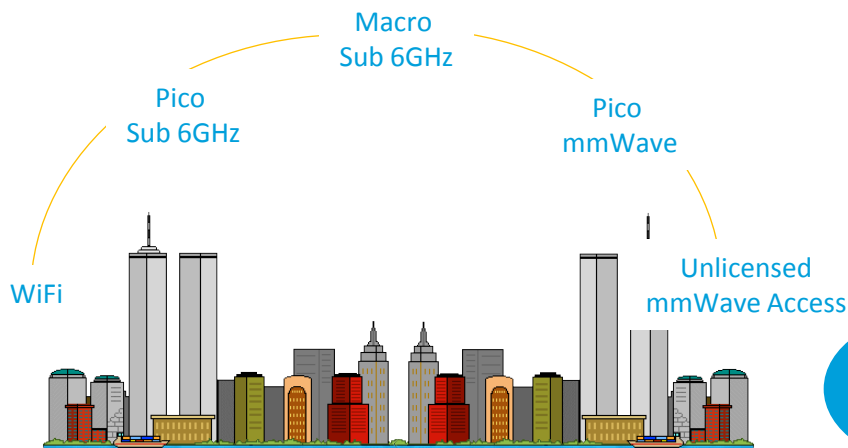
Assistant Vice President

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Agenda

- Standardization
- Requirements and Expectations
- AT&T Testbed and Trial



5G in 3GPP

What do we know now?

Estimated Standards Timeline

- 3GPP Phase 1: 2018
- 3GPP Phase 2: end of 2019
- Expected widespread industry deployments: Phase 2 and beyond

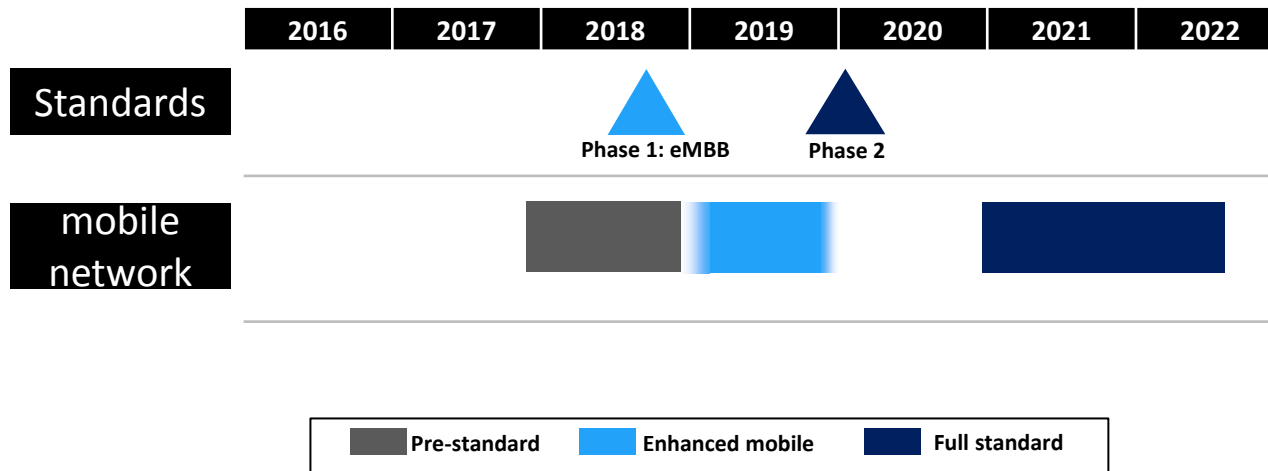
Use Case Opportunities

- Enhanced mobile broadband
 - Throughput of 5 Gbps +
- Massive IoT
 - Connection Density
 - Long battery life
- High reliability / low latency
 - Industrial control
 - Remote manipulation

Highly Flexible RAT Design
(Here is where it does the splits)



5G Estimated Timeline



4

Forward Compatibility Is Critical



Path to 5G

(Don't Forget LTE-Adv.)

Pre-Deployment

LTE-Advanced Evolution (R13&14)

- FD-MIMO
- Improved densification management
- Dual connectivity
- Improved latency
- Higher order modulation
- Virtualization

Narrowband LTE

- Designed for low-power devices, with 10-year battery life
- Standards this summer; deployment late 2017 / early 2018

5G Industry Expectations

So much more than speed

- Multi-gigabit speeds and high capacity
- Connectionless Massive IoT
- Ultra-Low Latency and high reliability
- Sub 6 GHz for wide area coverage with improved spectral efficiency
- Flexible, lean carrier design
- Multi-RAT network using sub 6 GHz, mmWave and unlicensed bands in concert
- Massive MIMO
- Densification with self-backhaul
- SDN/NFV based architecture

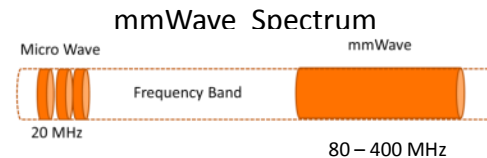
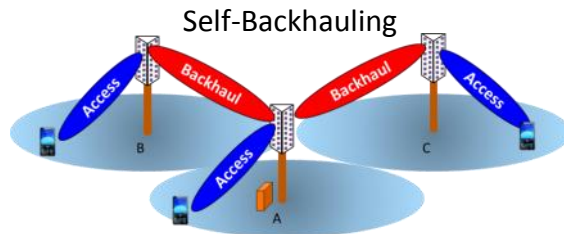
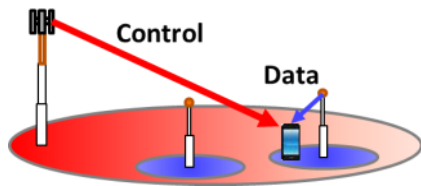


New Frequency Regimes

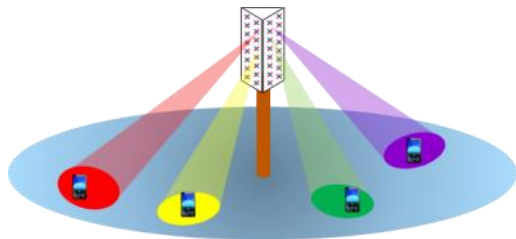
- Sub 6 GHz
 - Wider bandwidth
 - CA at layer 1
 - IoT optimization
- mmWave
 - New propagation characteristics
 - Extremely wide channels
 - New channel models
 - New interference analysis, coordination, and mitigation
 - Channel sounding needed in multiple parts of the world



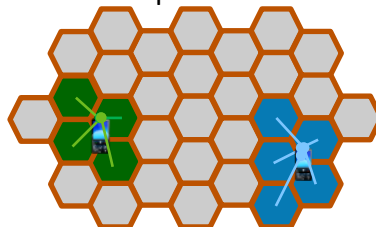
Key Technology Building Blocks of 5G



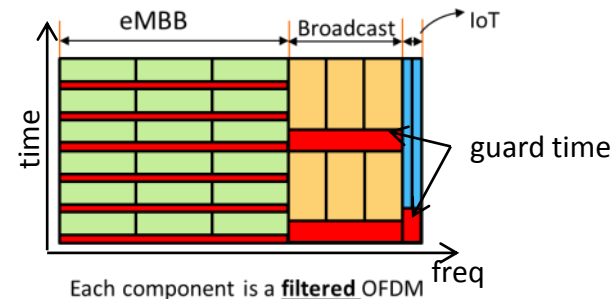
Massive MIMO



UE Specific Cell



Flexible Lean Carrier



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Many components of 5G such as dual connectivity, massive MIMO, spectrum sharing are already being developed for LTE-advanced



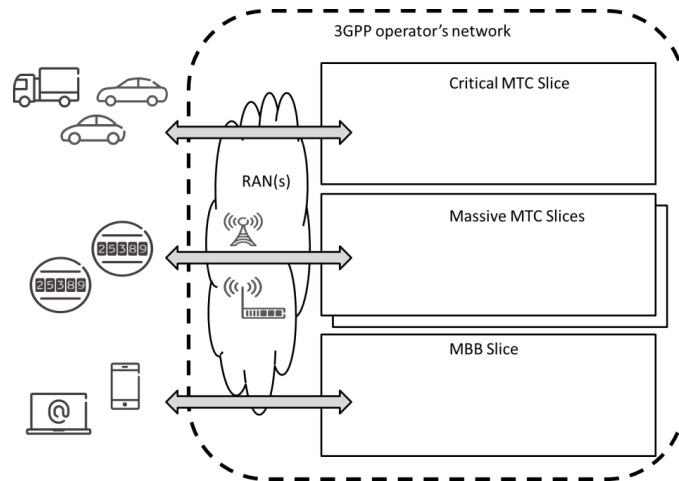
New 5G Core Network

• Core Needs

- Low end-to-end latency
- Diverse and highly varied requirements
- Flexibility in network design and operations (it needs to do the splits too)

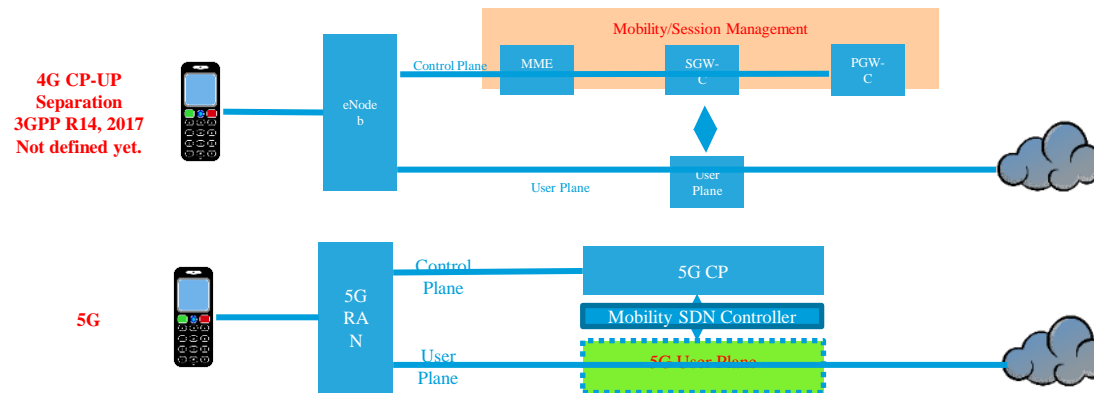
• Key Enablers

- Virtualization – NFV
- SDN – software centric control
- Open source (OpenDaylight, OpenStack, OPNFV, ON.lab, Linux Foundation, etc.)
- Big Data
- “Network Slicing”



Core Network Requirements

- New RAN-CN Interface
- SDN based policy framework for operator policies
- NFV implementation
- Mobility on demand
- Mobile Edge Computing (MEC)
- Access agnostic
- Control plane separated from the user plane



AT&T's 5G Trials

- Extension of current Lab testing – Austin, TX
- Channel sounding, testbed, trial
 - Detailed channel sounding including small scale parameters
 - Propagation/performance with foliage and weather
- Indoor and Outdoor Testbed
 - Freqs: 4 GHz, 15 GHz, 28 GHz
 - Antenna technologies
 - Coverage and throughput
 - Fixed and mobile
 - Latency
 - Virtual cell
 - Multi-RAT
- Friendly User Trial – EOY 2016
 - Fixed broadband
 - 28 GHz
 - Gbps+ connectivity to fixed locations



Next Steps

- Trials and Testing
- Standardization
- Key Architecture Components:
 - NFV / SDN
 - Big Data / Analytics
- Architecture Considerations:
 - X-RAN
 - Transport
- Core Network Development



“New experiences like virtual reality, self-driving cars, robotics, smart cities and more are about to test networks like never before,”

“Our approach is simple – deliver a unified experience built with 5G, software-defined networking (SDN), Big Data, security and open source software.”

John Donovan
Chief Strategy Officer and Group President
AT&T Technology and Operations



MOBILIZING
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