5G Technology Overview

National Domestic Communications Assistance Center
CALEA Standards Team

• Six Personnel attend various meetings with Industry and Partners (3GPP, ETSI, etc) to support law enforcement

• Working on the following areas of 5G
  • Virtualization
  • Architecture
    • Main components of core network
    • Interworking with other technologies
  • Core Network and Terminals
    • Equipment and Mobility
  • Lawful Intercept
    • Designs all aspects of LI for 3GPP
Objectives of CALEA Standards

• Participate in standards development before technology is a reality
  • Understand the impacts of the technology on law enforcement
  • Raise awareness on industry trends
  • Assure CALEA standards for LI are in place or close to completion when new services and technologies that are covered are deployed
• Continued participation on deployed technologies allows feedback and updates to support law enforcement
  • Monitor developments in existing technologies and get industry feedback
    • New services
    • Changes to interworking
    • Security and Integrity
  • NDCAC has a statutory responsibility to participate in the development of CALEA standards
    • Develop capabilities to address services covered by CALEA
    • Address limitations or operational issues that are experienced after technology deployment
Mobile Technology Background

• The telecommunications industry has continually improved network technologies to keep pace with commercial and consumer needs
  • Evolutions in cellular technology have been measured in “generations” of releases
  • Currently, network providers widely deploy the technologies known as 4th generation, or 4G

• Many industry trends are creating a need for new capabilities within cellular networks

• The next generation of wireless technology – 5G – is designed to address these needs
Timeline of Cellular Technology

1999
- Standardized in 1999
- Full rollout 2004
- ~5 years to implement widely

2008
- Standardized in 2008
- Large scale rollout in 2011-2012
- ~4 years to implement widely

2018
- Standardized in 2018
- Limited network rollout in 2019
- ? years to implement widely
Objectives for 3G and 4G

• 3G
  • Increasing the speed of communication
  • Increased network security
  • Provide various value added services
    • video calling
    • live streaming
    • mobile internet access
    • IPTV

• 4G
  • Seamless connectivity and global roaming across multiple networks
  • High quality of service for next generation multimedia support
    • real time audio
    • high speed data
    • HDTV video content
    • mobile TV
  • Interoperability with existing wireless standards
  • An all IP, packet-switched network
  • IP-based femtocells
Objectives for 5G

• Very low latency and high reliability
  • human-centric communication
  • machine-centric communication
• High user density - Cell size is being reduced (e.g., tens of meters)
• Ultra-accurate positioning applications
• High quality at high mobility (UHD)
• Enhanced multimedia services
• Internet of Things
• Convergence of applications (e.g., e-Gov, e-health) - New market segments
• Global operation and economies of scale
Throughput: 10 Gbps
Latency: 1 ms
Connections: 2.6M Connections per mile²
Mobility: 300 MPH
Network Architecture: Dynamic and Flexible

100x
30-50x
100x
1.5x

Virtualization

100 Mbps
30ms - 50ms
26k connections
200 mph
fixed
Fixed Broadband and Enhanced Mobile Broadband

- All major wireless carriers have announced plans for both fixed and mobile 5G broadband services
  - This will be the first aspect of 5G consumers experience

Launched fixed wireless broadband service in 2017
- Available in rural parts of 18 states including Alabama, Arkansas and California
- Initial offering is at 10/1 Mbps speeds at a cost of $60 a month, with a monthly cap of 215 gigabytes

Expects to offer nationwide mobile 5G service by the end of 2020
- Initial offerings in parts of 12 cities including Houston, Dallas, Atlanta, Charlotte and New Orleans
- Initially offered to limited customers, but will be open to subscribers in available markets starting in early 2019
  - Using a mobile hotspot only, with mobile phone availability to follow later in the year
  - AT&T pegs peak theoretical speeds for the service at around 1.2 Gbps
Fixed Broadband and Enhanced Mobile Broadband

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Launched fixed wireless broadband service in 2018
- Houston, Indianapolis, Los Angeles and Sacramento
- Speeds ranging from 300 Mbps to 1 Gbps

Mobile 5G service launched on April 3rd
- Initial offering in Chicago and Minneapolis with service expanding to more than 30 U.S. cities in 2019
- Initial offering with a snap-on module for the Moto Z3 with a 5G version of the Samsung’s Galaxy S10 to come later
Fixed Broadband and Enhanced Mobile Broadband

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  - This will be the first aspect of 5G consumers experience

Still in the planning phase for 5G rollout
- Long-term strategy tied to the potential Sprint merger

Fixed Service
- No specific launch date for fixed service has been announced
- In a statement to the FCC, T-Mobile said by 2024, it plans to be a fixed 5G option for more than half the ZIP codes in the U.S

Mobile Service
- T-Mobile won’t be launching 5G service in its first 30 cities until the second half of 2019
- T-Mobile is still aiming to deliver nationwide 5G by 2020
Throughput - Things to Consider

• Higher throughput available to consumers to allow more diverse and media rich content

• The combination of high throughput and low latency will allow devices to offload data to the cloud
  • Provide carriers with an opportunity to offer consumers with remote computing services
Latency - Things to Consider

- 5G will allow remote control and robotics over cellular networks

- Interactive games and VR rely of very low latency response for immersion

- New games and services that further entrench technology in culture
  - Application providers will find new and interesting ways to leverage additional capabilities for services

- Automakers’ will leverage 5G networks for autonomous driving and cars telemetry
  - Vehicle location
  - Video/mapping of the environment
  - Audio
Connections - Things to Consider

- IoT will represent a significant portion of traffic and services envisioned on 5G networks
  - Alarm systems
  - Video cameras
  - Activity/Sensor data
- Allows for more robust and creative capabilities in dense environments
- Smaller cells and higher cellular density to allow more connections
  - Location information available to providers for services may be more precise
Mobility - Things to Consider

- 5G will allow drones controlled through cellular
  - Both latency and Mobility/Reliability are essential to make cellular drones possible
  - Several companies have announced intention to use 5G for control of drones and have begun trials
Architecture - Things to Consider

- 5G networks will rely heavily on virtualizing network functions and services
  - What is a network?
  - Carrier may provide a virtual network to a customer, not an individual connection
  - May provide a point-to-point connection between locations
  - MVNO models may be different

- Intelligence and provisioning can be centralized for a multinational network

- Information that may have been maintained by a single provider may now be disbursed
High Level 5G LEA Considerations

• 5G is in the very early stages of deployment
  • Currently more hype than reality
  • LE will first encounter 5G bandwidth
    • Theoretical – how much will subscribers use?
    • Services and broader capabilities to come much later

• New network capabilities will change the way we think of mobile devices and networks
  • These will impact how mobile technology is used and how law enforcement will have to approach them

• New identifiers and more complicated networks will be a challenge for law enforcement
Summary

• 5G is the next generation mobile technology
  • Deployment is starting and it will take years to reach its full potential
  • Goals include
    • Increasing bandwidth
    • Reducing delays
    • Increasing reliability
    • Adaptable networks

• Much of the current discussion around 5G focuses on what will be possible when fully implemented
  • Technology and economic drivers will shape applications and services that are eventually deployed

• Law enforcement will have to adapt to 5G networks they encounter the technology
  • This will be similar to the learning curve when moving from 3G to 4G
  • Standards and CALEA will help shape capabilities available in cellular networks
Questions