5G vision and D2D communications

Aleksandr Ometov
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Tampere, Finland
What is 5G?

– We had 2G, 3G and now have 4G.
  • What is 5G, any ideas? – No Googling!

"5G is something that they are selling to you"

The fifth generation of mobile technology (5G) is positioned to address the demands and business contexts of 2020 and beyond.
How did it happened?

- The standards for 5G have not yet been set.
What 5G is about

- Smart wearables
- Smart mobility
- Smart parking
- eHealth
- Traffic priority
- Smart Car
- Car-to-car communication
- Smart House
- Domotics
- Connected house
- Security & Surveillance
- Entertainment
- Apps beyond imagination
- Smart Grids

- Water quality
- Utility management
List of changes

- **Need for Speed**
  - X40 times faster
  - i.e. 100 Mbps per device
- **Higher frequencies**
  - GHz
- **More different devices**
  - +IoT, wearables, cars
- **Different technologies**
  - HetNets
- **More dense deployments and mobility**
- **New applications/services**
What do we have now as researchers?

- We have not a lot, really..
- White papers from Industry
  - Helping us with problem statements
- Tasks from business partners
  - Projects from Ericsson or Qualcomm would be most probably implemented in next releases of LTE
- Requests from users
  - ”We want full HD videos!”
- Forecasts
  - Cisco guys know what they are doing.
Use cases – Nokia
Use cases – detailed

• **Broadband Access in Dense Areas**
  – Service availability in densely-populated, where thousands of people per square kilometer live and/or work

• **Broadband Access Everywhere**
  – 50+ Mbps Everywhere (100 is a target)

• **Higher User Mobility**
  – Mobile services in vehicles, trains and even aircrafts

• **Massive Internet of Things (IoT)**
  – Smart wearables, WSNs

• **Extreme Real-Time Communications**
  – Tactile Internet (the real-time reaction that is expected to be within sub-millisecond)

• **Lifeline Communication**
  – Natural disaster – no more infrastructure

• **Ultra-reliable Communications**
  – Traffic control, controllable robots, public safety, health

• **Broadcast-like Services**
  – News, matches, events
5G Requirements – User

– User Experience
  • Consistent User Experience – to give what was offered
  • User Experienced Data Rate
  • Latency and Mobility

– Device Requirements
  • Operator Control Capabilities on Devices
  • Multi-Band-Multi-Mode Support in Devices
  • Resource and Signaling Efficiency
  • Device Power Efficiency
5G Requirements – System

– System Performance
  • Connection Density
  • Traffic Density
  • Spectrum Efficiency
  • Coverage
  • Resource and Signaling Efficiency

– Enhanced Services
  • Connectivity Transparency
  • Contextual information -- Location
  • Security
  • High Availability
  • Reliability
5G Requirements – Deployment
– Network Deployment, Operation and Management

• Cost Efficiency
• Energy Efficiency
• Ease of Innovation and Upgrade
• Ease of Deployment
• Flexibility and Scalability
• Ultra Low-cost Networks (Rural areas)
Technology

– Well, everything you got from the previous lectures.
Just a recall about latency

LTE - min 10ms

4ms

5G service sub-1ms

<0.5ms

Core Network

Internet

4ms 1-2ms 5-10ms if in the same country as the customer

Content

<0.5ms
D2D as one of the enablers

– Direct communication between devices controlled by the ”Big brother” network

– Direct connectivity:
  • in-band D2D in cellular networks (LTE Direct)
  • out-of-band D2D in cellular networks (WiFi, BLE?)
D2D Applications

- Infrastructure communication
- Direct communication
- Emergency communication

- Vehicular communication
- Cellular base station
- Smart parking
- Public safety service
- Smart home
- Wearables
- Public transport
- Content sharing
- Local advertising
- Direct user link
- Industrial automation
- High-density environment
- Proximal communication

- Coverage area
D2D application list

– M2M communications
– Relaying
– Content distribution
– Gamming
– Cellular offloading
– Direct connectivity
– Advertisements
– Social networks
– Wearables
D2D challenges
– Proposing adequate D2D-aware scenarios
  • How to sell it?
– Developing D2D-centric system architecture
  • The network core should be capable of D2D
– Designing efficient D2D operation mechanisms
  • We do not want our battery to drain instantly
– Performance evaluation of D2D solutions
  • Profs for industry are needed
– Leveraging available D2D benefits
  • For operators
  • For clients
Lessons learned

• 5G is not something scary
  – It’s just a new set of technologies
• Try to memorize the usecases
• What are the main targets of 5G?
• D2D would be a part of 5G
• What is the difference between D2D and your Bluetooth link to transfer a photo?
  – Also usecases here
Thank you

KEEP CALM AND BE A NETWORK ENGINEER