5G vision and D2D communications

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What is 5G?

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
- Connected house
- Entertainment: Apps beyond imagination
- Domotics
- Smart Car
- Car-to-car communication
- Security & Surveillance
- 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?

• 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 new services!”

• Forecasts
  – Cisco guys know what they are doing.
5G use cases – Nokia

- Security
- Connectivity
- Industrial internet
- Smart city
- Health
- Automotive
- Public safety
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

Tactile Internet is where latency is crucial!
Watch this video:
https://www.youtube.com/watch?v=OoeCBL_thNg
D2D as one of the enablers

– Direct communication between devices controlled by the infrastructure 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

Vehicular communication

Smart parking

Public safety service

Smart home

Wearables

Industrial automation

High-density environment

Direct user link

Local advertising

Proximal communication

Content sharing

Public transport

Local advertising

Proximal communication
D2D applications list

- M2M communications
- Relaying
- Content distribution
- Gaming
- 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

– 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
• D2D would be a part of 5G
• Try to memorize the use cases
• What are the main targets of 5G?
• What is the difference between D2D and your Bluetooth link to transfer a photo?
• Also use cases for D2D