5G: 2020 and Beyond
Luigi Licciardi

Milan, December 15, 2015
IEEE World Forum on IoT
The road to 5G
5G will cover new use cases and requirements

- **BroadBand access everywhere**
  - Seamless experience of connectivity anytime, anywhere, across different access technologies.
  - Video services, possibly empowered by 3D and Augmented Reality.

- **High user mobility**
  - High user mobility on trains, while still enjoying HD movies or work in the office.
  - Speed up to 500Km/h.
  - +50Mbps everywhere.
  - Up to 1 Gbps.

**BB access in dense areas**
Use cases and requirements

Massive IoT

- Ultra low power, integrated sensors, e.g. wearable devices or blood pressure, ...
- Real-time sensing, data delivery, big data intelligence and real-time actuation to enable Tactile Internet
- Connection density: 200,000 /km²
- Latency < 1 ms
- Resilience & High Availability

Emergency & Safety

- Public Protection & Disaster Relief e.g. especially for community authorities and citizens

Extreme realtime communications
Use cases and requirements

Ultra-reliable communications

- Vehicles realize critical situations fast, react accordingly and alert other cars…

Information distribution

- Information distribution in areas such as arenas, event locations.

Broadcast like services

One-to-Many transmission capability

< 1ms latency
What is 5G?

An extremely flexible and highly programmable e2e system, application, customer, time and location aware

Serving at best high diversity types of communications (Human & Machine) with different performance attributes

Natively leveraging NFV technologies:
- Support on demand composition of network functions and capabilities
- Enforce required capability/capacity “where and when needed”

Profitably accommodating low- and high-ARPU traffic and sustainability thanks to cost saving and new business opportunities

Being future-proof and ready to serve even not yet identified use case and radio technologies
What’s different from 4G?
Beyond the usual x10, x 100, x 1000 improvements...

- Not only improved performance (or «doing better» what we can do today...)
- **Multi RAT**
  - LTE-Advanced for macro coverage
  - New RAT enabling new business
  - Higher data rate & lower latency
- **New design principles** for cost-effective deployment

- **Resource elasticity**: dynamic allocation of functions, processing and memory resources based on application requirements and load consumption over time/space
- **Greater cost efficiency to support IoT business**: simplified network to be tailored for different types of users
Spectrum framework evolution

- From sub-GHZ to mm-wave
- Lower frequencies to be used for macro-area coverage, included deep indoor
- Higher frequencies to be used in a complementary approach for extreme traffic capacity in dense scenarios

*Picture source: Ericsson*
Candidate radio access technologies for 5G

New radio Access components
► New Radio interface (FBMC for example, addressing also low cost M2M);
► New duplexing modes (i.e. full duplex)
► Ultra-lean signalling

Innovative deployments
► Mesh networks
► Massive use of direct communication

Technologies for flexible use of spectrum
► Use of frequencies above 6 GHz (up to 100 GHz)
► Opportunistic access to spectrum, including use of unlicensed bands

Virtualized access network with base band pooling
(towards Virtual – RAN)
and radio access dynamic re-configuration

Reinforce LTE-A techniques
► Network densification and HetNet
► Massive MIMO (>> than 8x8 antennas)
► Advanced receivers and interference coordination
► Enhanced multi-RAT coordination
► Wireless back/fronthaul; enhanced fronthaul (innovative split BBU-RRH)
5G – A Chameleon Technology

- Use case driven dedicated Architecture optimized for specific service scenarios / customers (Network slices – based on Network Function Virtualization Technology)
- Combination of functions available in a catalogue, through the NFV Orchestration Platform
3GPP: timeline driven by ITU-R IMT-2020

**ITU-R IMT-2020**

- **WRC15 700 MHz**
- **WRC19 mmWaves**

**Requirements**

- **2015**
  - Pre-5G activity in RAN (e.g. massive MIMO)
- **2016**
  - Early 5G RAT (e.g. 60 GHz radio, LTE evo)

**Submission**

- **2017**
  - Initial 3GPP submission to ITU
- **2018**
  - Start of activities on 5G Radio access
- **2019**
  - Final 3GPP submission to ITU

**Evaluation**

- **2020**

**Specs**

- **3GPP Release 13**
  - Requirements
  - Approved Study Item “SMARTER”
- **3GPP Release 14**
  - Architecture
- **3GPP Release 15**

**Spectrum auctions**

- **TELECOM ITALIA**
- **TIM**
• EVOLUTION IN THE RADIO

• REVOLUTION IN THE CORE

• 5G: ONE NETWORK FOR A SEAMLESS ENRICHED CUSTOMER EXPERIENCE

Shoot for the moon. Even if you miss, you'll land among stars!

(LES BROWN)
Thanks

NGMN White Paper
https://www.ngmn.org/uploads/media/NGMN_5G_White_Paper_V1_0.pdf

For questions: luigi.licciardi@telecomitalia.it