

Notes on Dahlmann, Parkvall, Skold's "5G NR"

Chapter 2 – "5G standardization"

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Type of organizations involved in creating technical specifications and standards, as well as regulations:

- ▶ Standards Developing Organizations (SDOs): 3GPP, ETSI, ATIS, etc;
- ▶ Regulatory Bodies and Administrations: control spectrum use, set licenses, regulate placing on the market, award certifications, *setting requirements*. Examples: ANATEL, ECC (Nationals), ITU (Global);
- ▶ Industry forums: promoting and lobbying for specific technologies. GSMA Association, Next Generation Mobile Networks, etc

The role of ITU-R:

- ▶ It's the radio communications sector of ITU;
- ▶ Aims at ensuring efficient and interference-free use of RF spectrum by all wireless devices;
- ▶ Composed of subgroups and working parties that produce reports and recommendations;
- ▶ Within ITU-R is the Working Party 5D (WP5D), which is responsible for the overall system aspects of International Mobile Telecommunications (IMT) systems
- ▶ Provides *Radio Interface Specifications* (RSPCs);
- ▶ Each recommendation contains *Radio Interface Technologies* (RITs);
- ▶ It does not create specifications, but maintains recommendations and reports for IMT;
- ▶ The actual specifications are maintained by an SDO and the RSPCs provide references to the specifications

- ▶ Examples of RSPC:
 - ▶ IMT-2000: (3G, WCDMA, etc);
 - ▶ IMT-Advanced: 4G/LTE
 - ▶ IMT-2020 (planned): will provide radio interface technologies for 5G.

IMT Process in ITU-R WP5D

1. Looks for future roles and trends;
2. Set future usage scenarios (eMBB, URLLC, mMTC)
3. At World Radio Conference (WRC) 2015 new bands for IMT were discussed;
4. Publication of technical requirements, evaluation guideline, submission template (for candidate technology)

Capabilities of IMT-2020

- ▶ 13 capabilities, in which 8 are *key capabilities*
- ▶ Key capabilities
 1. peak data rate (bandwidth times peak spectral efficiency)

2. user experienced data rate (95th percentile of the user data rate dist.) – around 1 Gbps at 5G
 3. spectrum efficiency
 4. area traffic capacity
 5. network energy efficiency
 6. latency
 7. mobility
 8. connection density
- ▶ The 5 first capabilities are very important for the Enhanced Mobile Broadband usage scenario
 - ▶ Additional capabilities
 1. spectrum and bandwidth flexibility
 2. reliability – high level of availability
 3. resilience – ability to work correctly after man-made or natural disturbance, such as loss of power
 4. security and privacy
 5. operational lifetime (energy capacity)

IMT-2020 performance requirements and evaluation

- ▶ test environments:
 - ▶ Indoor hotspot - eMBB - indoor isolated environment (offices, etc) with very high user density
 - ▶ Dense urban - eMBB - urban scenario with high user density
 - ▶ Rural - eMBB - wide coverage supporting pedestrian and high-speed vehicles
 - ▶ Urban macro - mMTC - coverage of high number of connected machine type devices
 - ▶ Urban macro - URLLC - urban macro scenario for ultra reliable and low latency comms.
- ▶ Evaluation methods
 - ▶ Simulation – system and/or link level simulations.
 - ▶ Analysis
 - ▶ Inspection

3GPP standardization

- ▶ Organization responsible for the specification of technologies that aim to achieve the IMT requirements

- ▶ 2G GSM, 3G WCDMA/HSPA, 4G LTE, 5G NR
- ▶ To understand how 3GPP works, it's important to understand the process of standard writing
 - ▶ Requirements – what to achieve with the specification?
 - ▶ Architecture – main building blocks defined
 - ▶ Detailed specifications
 - ▶ Testing and verification
- ▶ 3GPP (Project coordination group)
 - ▶ Technical Specification Groups - TSG (Radio Access Network, etc)
 - ▶ Working groups (WG) – (RAN WG1 - Radio layer 1)
- ▶ 3GPP technical specifications (TS) are numbered as TS XX.YYY where XX denotes the series and YYY its number within the series, ex:
 - ▶ 36-series: LTE
 - ▶ 38-series: NR