Achieving Higher Energy Efficiency and Greener With 5G Technology

Qi Shuguang
China Academy of Information and Communication Technology

November, 2017
Content

1. Development Background
2. Standardization Activity
3. Testing and Application
4. Achieving higher EE and Greener
1. Development Background

Mobile Internet and IoT is the main driving force

Communication market trends in 2010~2030

Mobile business traffic growth

Mobile device networking growth
1. Development Background

Mobile Internet User Needs

Different kinds of connection devices

1 Gbps speed experience

Mobile Network business
Without delay

High speed and densely populated place

IoT User Needs

Global IoT devices

Mobile Terminals (Billion)  M2M (Billion)

2010  2020  2030

5.3  10.8  17.1  2.1  71.6  97.4

5.3  10.8  17.1  2.1  71.6  97.4

Endless possibilities

Terminals

Crowded area

HS train

Metro

Car
1. Development Background

**Low Cost**

- Performance
- Price

**Safety**

- Mobile payment, Medical, Safe driving, Security

**Green**

- Improve terminal life time
- Support Ultra-Low Power Consumptions
2. Standardization Activity

- **2G** (1990 ~)
  - GSM
  - TD-SCDMA
- **3G** (2000 ~)
  - WCDMA
  - cdma2000
  - TD-LTE enhancement
- **4G** (2010 ~)
  - FDD LTE enhancement
  - Global
- **5G** (2020 ~)
  - Multi-key competencies
  - Mobile Internet → Internet of things

- Voice and low-speed data services
- Mobile multimedia business
- Mobile broadband business
- 802.16e
- 802.16m

*Images of 3GPP, 3GPP2, IEEE*
2. Standardization Activity

**ITU:** 5G Vision to be completed in June 2015, 5G Technology Program to be launched by the end of 2017 and 5G standard to be completed in 2020;

**3GPP:** Launched 5G standard research in early 2016, formed the first draft of 5G standard in the second half of 2018, completed the full version of 5G standard meeting ITU requirements by the end of 2019;

**IEEE:** Launching next generation WLAN (802.11ax) standard in early 2014, expected to be completed in early 2019.
2. Standardization Activity

- Study on System Architecture and Key Technology for the 5G Network
- Study on High Spectrum for 5G Systems: 30-43.5GHz
- Study on New Radio (NR) Access Technology
- Study on the 5G Security Technology
- 5G mmWave Compliance Assessment Requirements
- Study of 5G Transport Network Technology
- PON-based 5G Mobile Front Haul Technology Research

China Communication Standardization Association (CCSA)
2. Standardization Activity

- Electromagnetic Compatibility (EMC)
- Electromagnetic Fields (EMF)
- Resistibility
- Energy Feeding and Efficiency

ITU-T SG5 Environment, climate change and circular economy
3. Testing and Application

5G test already started in China, and it will be put into business in 2020

- **Step 1: Key performance**
- **Stage 1: 5G research and development test**
  - Step 2: Program verification
  - Step 3: System verification
- **Stage 2: 5G product development test**

### Timeline

- **2016**
  - Step 1: Key performance
  - Stage 1: 5G research and development test
  - Step 2: Program verification
- **2017**
  - Step 3: System verification
- **2018**
  - Stage 1: 5G research and development test
  - Step 2: Program verification
- **2019**
  - Stage 2: 5G product development test
- **2020**

### Technologies

- **2017**
  - eMBB
  - IoT
  - V2X
- **2018**
  - 3D MIMO...
  - NB-IoT / eMTC
- **2019**
  - 5G Evaluation
  - 5G Evaluation
- **2020**
  - 5G new air interface
  - 5G Evaluation
- **2021**
  - 5G Evaluation
- **2022**
  - NR V2X

---

**CAICT 中国信通院**

http://www.caict.ac.cn/
3. Testing and Application

Stage 1
1. Network Slicing
2. Mobile Edge Computing
3. Network reconstructing functions
4. Separation of control and bearer

Stage 2
1. Continuous wide area coverage
2. Low latency and high reliability
3. Low-power multi connections

1. 5G network architecture and key technologies testing
2. 5G network platform verifications

Lab testing
Field testing

Operators Manufacture Chip companies Instrument Co.
3. Testing and Application

- Smart City: Yingtan, China;
- 962 NB-IoT BS put into use until July, 2017;
- NB-IoT coverage range is up to 95%;
- Multi-scenarios application such as smart pipe, smart parking, fire protection etc.
4. Achieving higher Energy Efficiency and Greener

- **Green ICT**
  ICT equipments and supporting infrastructure should be green and have high energy efficiency.

- **Green by ICT**
  ICT technology used in other area, achieving higher efficiency and greener.
4. Achieving higher Energy Efficiency and Greener

Green ICT

ITU-T L.1331 Assessment of mobile network energy efficiency

Mobile network data energy efficiency ($EE_{MN,DV}$) is the ratio between the performance indicator ($DV_{MN}$) and the energy consumption ($EC_{MN}$) when assessed during the same time period.

$$EE_{MN,DV} = \frac{DV_{MN}}{EC_{MN}}$$

ITU-T L.1350 Energy efficiency metrics of a base station site

SEE = ($EC/ETS$) × 100%

the ration between total energy consumption of telecommunication equipment and total energy consumption on site.

http://www.caict.ac.cn/
4. Achieving higher Energy Efficiency and Greener

Green by ICT

- Efficient coordination
- Eliminate security risks
- Promote development of car networking industry

- Factory network optimization
- Collaborative manufacturing and management
- Quality and efficiency improvement

- Collaborative energy platform
- More efficient power system
- Greener environment

- Remote medical applications
- Remote surgery

Industrial area
Smart car area
Energy area
Medical area
Thank You!