ITU Workshop on Spectrum Management for Internet of Things Deployment (Geneva, 22 November 2016)

Spectrum Challenges & Opportunities for Internet of Things & Smart City Development

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Spectrum Challenges & Opportunities
for Internet of Things & Smart City Development
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**ARAB SPECTRUM MANAGEMENT GROUP (ASMG)**

- The ASMG was established by the **Arab Ministerial Council for ICT** to cooperate and collaborate in the field of Spectrum Management and preparation to Radio Conferences.

- The twenty-two Arab States utilize this platform for the following major activities:
  - Coordinate among the Member States on all issues related to the Spectrum Management, including sharing views on the emerging radio aspects.
  - Negotiating to develop **common Arab proposals** for the agenda items of World Radio Conferences (WRC) held every four years at the ITU.
  - Preparing common contributions for the meetings of the ITU-R Study Groups and Working Parties.
**IoT & Smart City Development**

- ASMG contributes effectively and is chairing ITU-T Study Group 20: IoT and its applications including smart cities and communities,
- UN has new initiative of United for Smart Sustainable Cities (U4SSC)
- Internet of Things (IoT) technologies and services are main enabler for Smart City and economic development, in particular for developing countries
- Radiocommunication systems play a major role in offering Narrowband and Broadband IoT services
- Internet of Everything connects Human, Objects and Machine for connected world
**IoT-Enabled Smart City Use Cases**

**Public Services**
- Video Surveillance
- Remote Security Monitoring
- Smart wearables
  - Health monitoring

**Environment**
- Smart Waste Management
- Smart Irrigation
- Smart Agriculture
- Air/Noise pollution monitoring

**Utilities**
- Water Management
- Smart Grid
- Smart Metering
- Energy Consumption Monitoring

**Transportation**
- Connected vehicles
- Smart Parking
- Fleet Management
- Asset Tracking

**Buildings and Homes**
- Smart lighting
- Security and Access Control
- Smart Utilities
- Energy Management
- Safety and Security
- Smart BMS

**NB & BB IoT Use Cases**
Some forecasts show 28 Billion Connected Devices by 2021

Other forecasts showed growing number of connected devices above
IOT GLOBAL MARKET TRENDS

Internet of Objects (LPWA) makes up majority of Future IoT connections.
INTERNET OF OBJECTS (IoO) / LPWA

- Traditional cellular M2M referred to conventional 2G and 3G connectivity for M2M devices

- Today, Terrestrial LPWA Radiocommunication Solutions include:
  - Cellular 3GPP based technologies (NB-IoT, LTE-eMTC, EC-GSM-IoT)
  - Proprietary technologies (UNB, LoRa...etc)

- Future estimate of IoO connections is up to 80% of IoT (INOV360 Research)
# IoT / MTC Communication Technologies

<table>
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<tr>
<th>Terrestrial Cellular</th>
<th>Terrestrial Non-Cellular</th>
<th>Fixed Technology</th>
<th>Satellite</th>
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<td><strong>Wireless</strong></td>
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<td>Short Range:</td>
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<td>Long Range:</td>
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<td>- Proprietary LPWA</td>
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<td>Wire/Cable Technologies</td>
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<td>- Fiber (FTTX)</td>
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<td>(GPON, etc.)</td>
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- V-SAT Technology (e.g. remote areas)
- MSS Technology

- Ultra-Narrowband Requirement
- Ultra-Broadband Requirement
Radiocommunication as IoT Enabler

- ITU-R RA-15 has approved Resolution 66 on the “Studies related to wireless systems and applications for the development of the Internet of Things”
- Res. 66 resolved to conduct studies on the technical and operational aspects of radio networks and systems for IoT in collaboration with ITU-T and relevant standards development organizations
Radiocommunication as IoT Enabler

- WRC-19 agenda item 9.1.8, Issue (3), addresses IoT and Machine Type Communication (MTC)
- Resolution 958 (WRC-15) resolved to conduct urgent studies in preparation for WRC-19 on:
  - technical and operational aspects of radio networks and systems, &
  - spectrum needed, including possible harmonized use of spectrum
to support the implementation of narrowband and broadband machine-type communication infrastructures, in order to develop Recommendations, Reports and/or Handbooks, as appropriate, and to take appropriate actions within the ITU Radiocommunication Sector (ITU-R) scope of work.
**Terrestrial Radiocommunication Systems: Coverage vs. Performance/DR**

- **Performance / Data Rates**
  - Cellular 5G Technologies
  - Cellular 4G/3G/2G
  - WiFi, LiFi
  - Bluetooth, Zigbee, etc.
  - Cellular LPWA (NB-IoT, LTE-eMTC, EC-GSM)
  - Proprietary LPWA

- **Coverage**
  - Short Range
  - Long Range
Challenges for IoT Spectrum in Developing Countries

- Spectrum Fragmentation provides real challenges for the introduction of efficient and cost effective IoT ecosystem for enabling development of developing countries on a timely manner.
- Various terrestrial Radiocommunication spectrum available for IoT broadband and narrowband communication:
  - IMT Frequency bands
  - ISM band
- Majority of IoT use cases / connections have Narrowband LPWA IoT requirement including:
  - Cheap / Low cost devices to provide cost effective solutions for Billions of IoT connections
  - Wide coverage
  - Low power consumption
OPPORTUNITIES FOR IoT SPECTRUM
POSSIBLE SPECTRUM HARMONIZATION

• Transformation to Smart Nations becomes essential for efficient development of several aspects of our life
• Harmonization has potential for achieving fast development of Smart nations
• Usage harmonization of already identified IMT spectrum for IoT deployment has several advantages, including:
  ▪ IMT systems are widely deployed worldwide and are further developed
  ▪ New IMT based technologies were standardized by June 2016 and being commercialized, (in 3GPP Release 13 Specs) to cater Narrowband IoT requirement, such as:
    □ NB-IOT (200KHz): is a new radio added to the LTE platform, optimized for the low end of the market. The 9 months standardization after the study period shows the rapidly growing demands for various IoT capabilities.
    □ LTE-eMTC (1.4MHz): is delivering further LTE enhancements for Machine Type Communications, building on Release-12 (new PSM)
**Possible Harmonization of Spectrum Use (2x3MHz in 700 MHz Band) for Narrowband IoT**

- **2x3MHz within 700MHz band (Between APT700 lower duplexer and CEPT800 bands)**

- **A9 Arrangement in ITU-R M.1036**

- **ITU-R WD towards PDNR Report of “IMT Arrangement” of 700MHz Band included A9 arrangement (2 x 3MHz) for IMT Narrowband Communications**
- **Studied and supported by UAE industry group as well**

![Diagram showing possible harmonization and arrangement of spectrum use for Narrowband IoT](https://via.placeholder.com/150)
**Possible Harmonization of Spectrum Use (2x3MHz in 700 MHz Band) for Narrowband IoT**

Possible arrangement of the 2x3MHz within 700 band:

- **NB-IoT**: 200KHz BW
- **LTE-eMTC**: 1.4MHz BW
- **Multiple 200KHz blocks** can be aggregated for 1.4MHz blocks
CAPABILITIES OF IMT BASED TECHNOLOGIES FOR NARROWBAND LPWA IoT

- Doc. TD 494 of ITU-T SG20 emphasized on the potential of utilizing new IMT based technologies for Narrowband IoT requirement (NB-IoT, LTE-eMTC and EC-GSM-IoT), due to the following:
  - Backward compatibility with widely implemented cellular networks
  - Higher immunity to interference by operating in the licensed spectrum
  - Up to 20 dB Coverage improvement compared with existing technologies, which is very promising for wide coverage areas and indoor penetration with feasible costs.
  - Enhanced battery life for multiple years, exceeding 10 years depending on the transmission modes and operation scenarios.
  - Enhanced security features, measures and mechanisms
CONCLUSIONS & RECOMMENDATIONS

• IoT market is growing fast and will play significant role in the digital transformation and economic development of the world, in particular developing countries
• Several systems and spectrum resources can be utilized for developing the IoT ecosystems
• Majority of IoT connections will be Narrowband LPWA IoT
• Harmonization is a key factor for developing countries to enable cost effective IoT solutions, particularly for NB IoT requirement
• Harmonization of usage of already identified IMT spectrum is recommended for deploying the optimized IMT based systems for Narrowband LPWA IoT connectivity (e.g. operating with 200KHz (NB-IoT) and 1.4MHz (eMTC))
• Broadband IoT requirement can be managed through existing and future radiocommunication broadband systems
THANK YOU!