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

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

Dr. Abdulhadi AbouAlmal

ASMG Representative

Arab Spectrum Management Group
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 filed of Spectrum Management and preparation to Radio Conferences.

- The twenty two Arab States utilize this platform for the following major activities:

  o Coordinate among the Member States on all issues related to the Spectrum Management, including sharing views on the emerging radio aspects.

  o Negotiating to develop **common Arab proposals** for the agenda items of World Radio Conferences (WRC) held every four years at the ITU.

  o 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
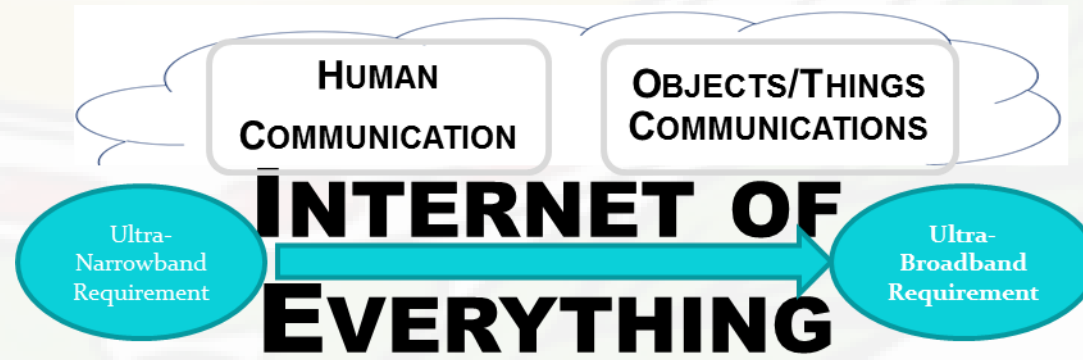
IoT-Enabled Smart City Use Cases
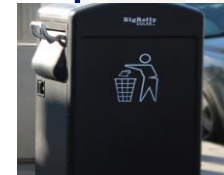
Buildings and Homes

- Smart lighting
- Security and Access Control
- Smart Utilities
- Energy Management
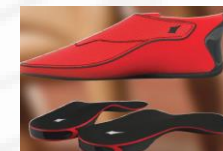- Safety and Security
- Smart BMS
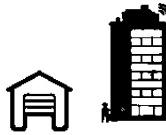
Environment

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

NB & BB IoT Use Cases

Transportation

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

Public Services

- Video Surveillance
- Remote Security Monitoring
- Smart wearables   - Health monitoring

Utilities

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

2021 FORECAST OF CONNECTED DEVICES

- **Some forecasts shows 28 Billion Connected Devices by 2021**

- **Other forecasts showed growing number of connected devices above**

PC/Laptop/Tablet
1.8B devices, 7%

Fixed Phones
1.4B devices, 5%

IoT
15.7B Devices
57%

Mobile Phones,
8.6B devices
31%

Ericsson, June 2016

HUMAN COMMUNICATION

OBJECTS/THINGS COMMUNICATIONS

Ultra-Narrowband Requirement

Ultra-Broadband Requirement

INTERNET OF EVERYTHING
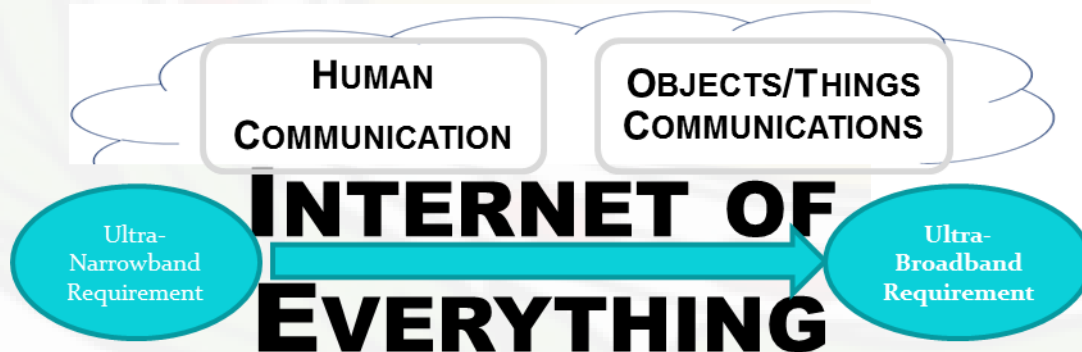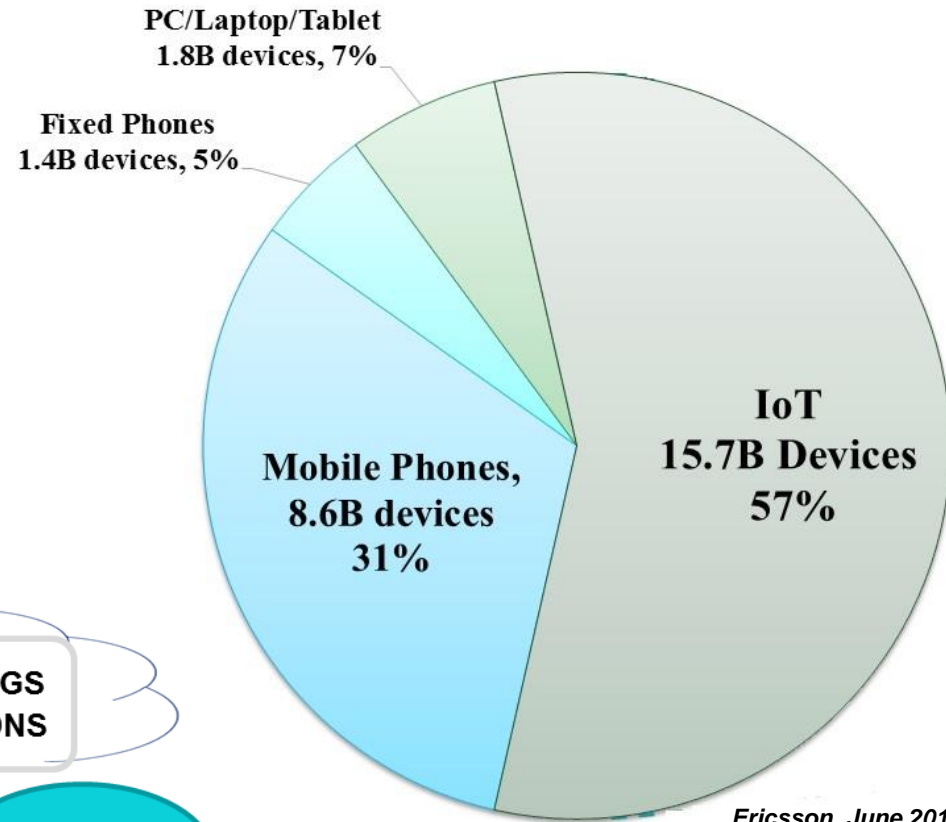
IoT Global Market Trends

Global IOT connections 2013 - 2023

Legend:
- Car
- Cities
- Health
- Industry
- Living & Working - Building Automation
- Living & Working - Building Security
- Living & Working - Consumer Electronics
- Living & Working - Smart Metering
- Living & Working - White Goods
- Living & Working - Other
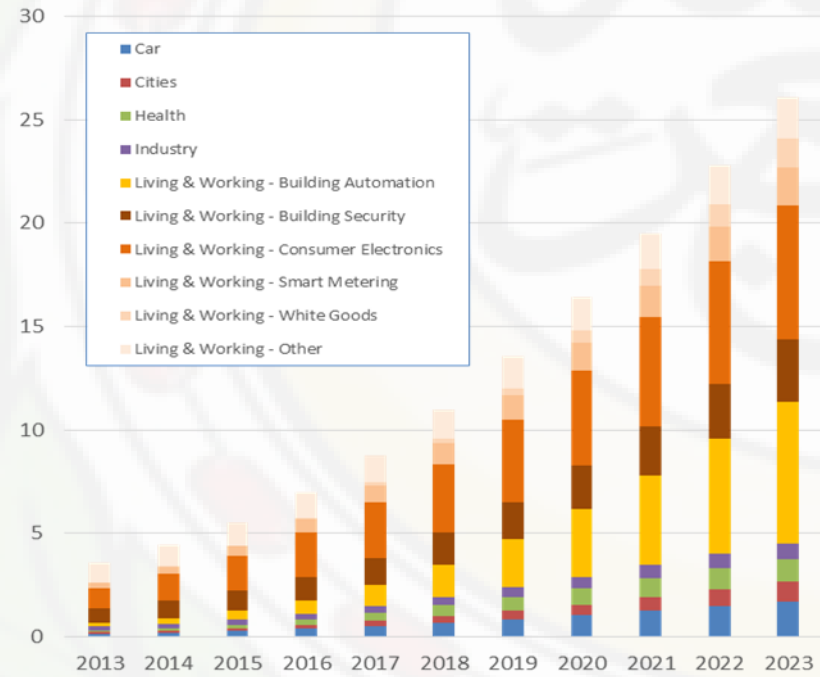
Source: Machina Research M2M Forecast Database, 2015

Wide area IOT connections by technology, 2014 - 2024

Legend: Cellular — Fixed — LPWA — Satellite — MAN
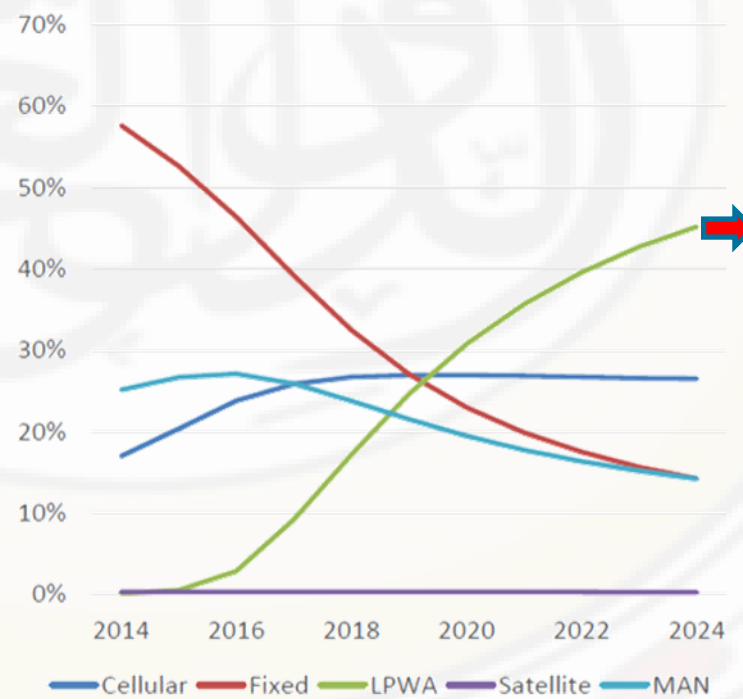
Source: Machina Research 2015

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)
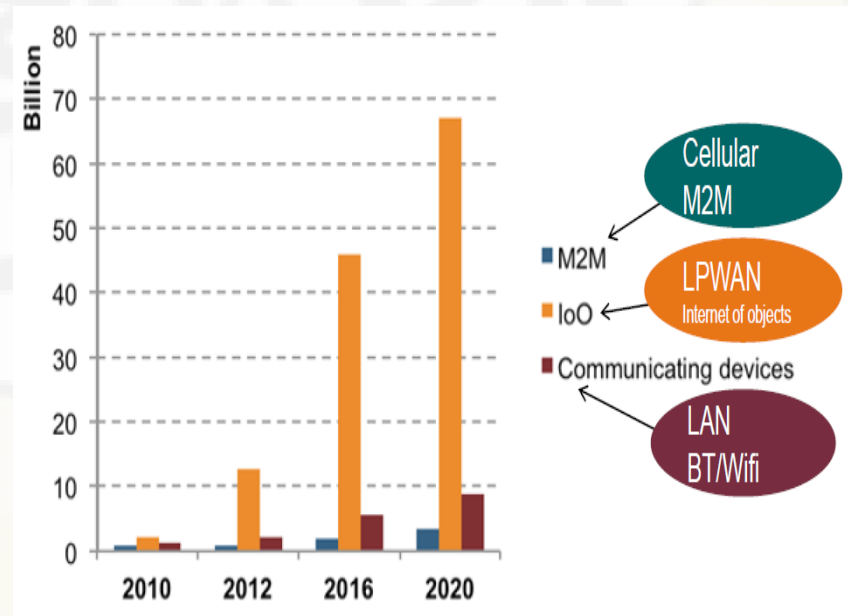
IoT / MTC
Communication Technologies

TERRESTRIAL CELLULAR	TERRESTRIAL NON-CELLULAR	FIXED TECHNOLOGY	SATELLITE
Narrowband (eg. LPWA) & **Broadband**: - NB-IoT / LTE-eMTC / EC-GSM - 5G / 4G / 3G / 2G	**WIRELESS** **Short Range**: - WiFi - Bluetooth - Zigbee **Long Range**: - Proprietary LPWA technologies	**Wire/Cable Technologies** - Fiber (FTTX) technology (GPON, etc.)	- V-SAT Technology (e.g. remote areas) - MSS Technology

Ultra-Narrowband Requirement → Ultra-Broadband Requirement
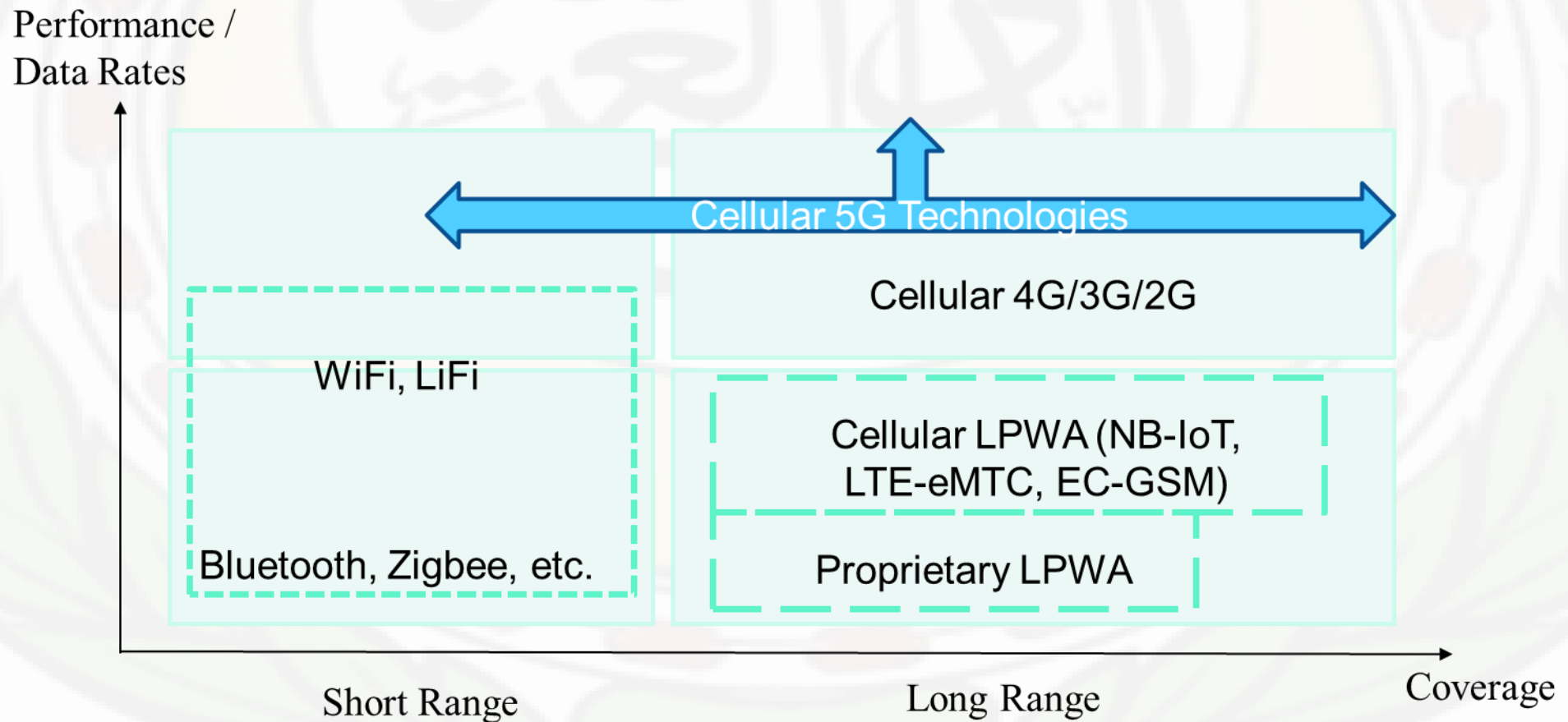
RADIOCOMMUNICATION AS IoT ENABLER

- 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

Short Range

Long Range

Coverage

# 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
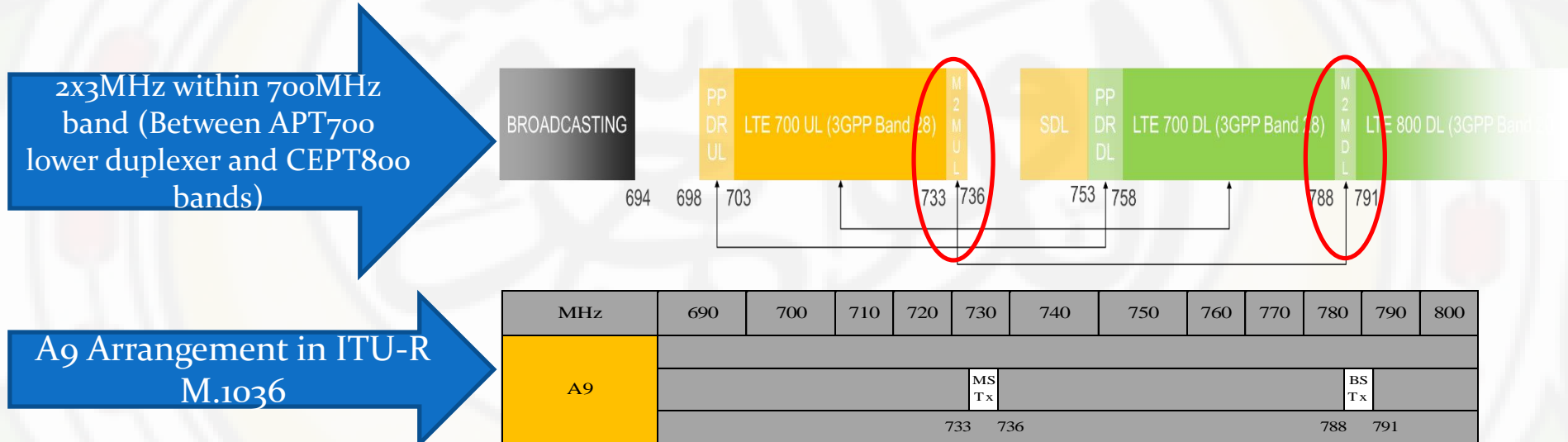

- ITU-R WD towards PDNR Report of "IMT Arrangement" of 700MHz Band included A9 arrangement (2 x 3MHz) for IMT Narrowband Communications
- Studied and supported by UAE industry group as well

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
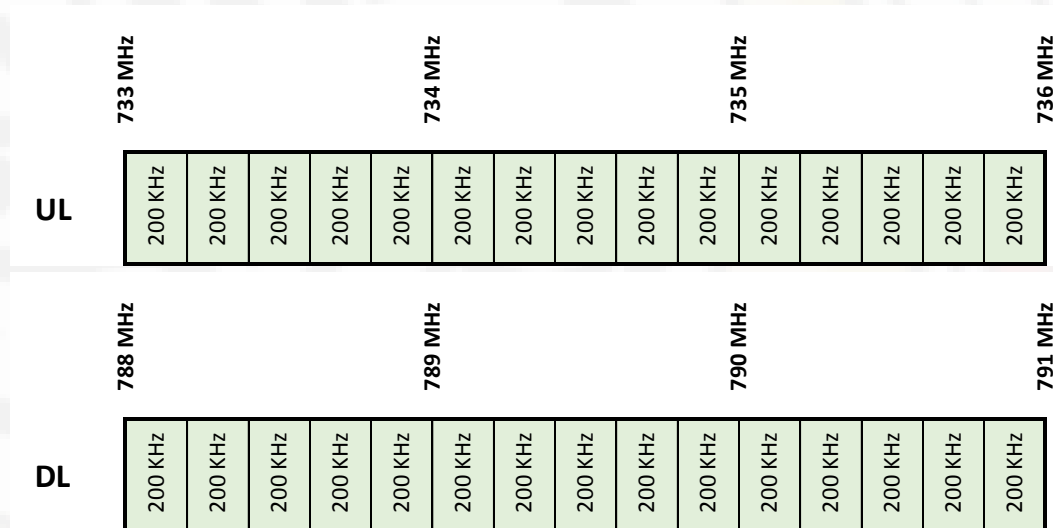
Capabilities of IMT Based Technologies for Narrowband LPWA IoT

- 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!