

July 1, 2022

# The Path Beyond 5G

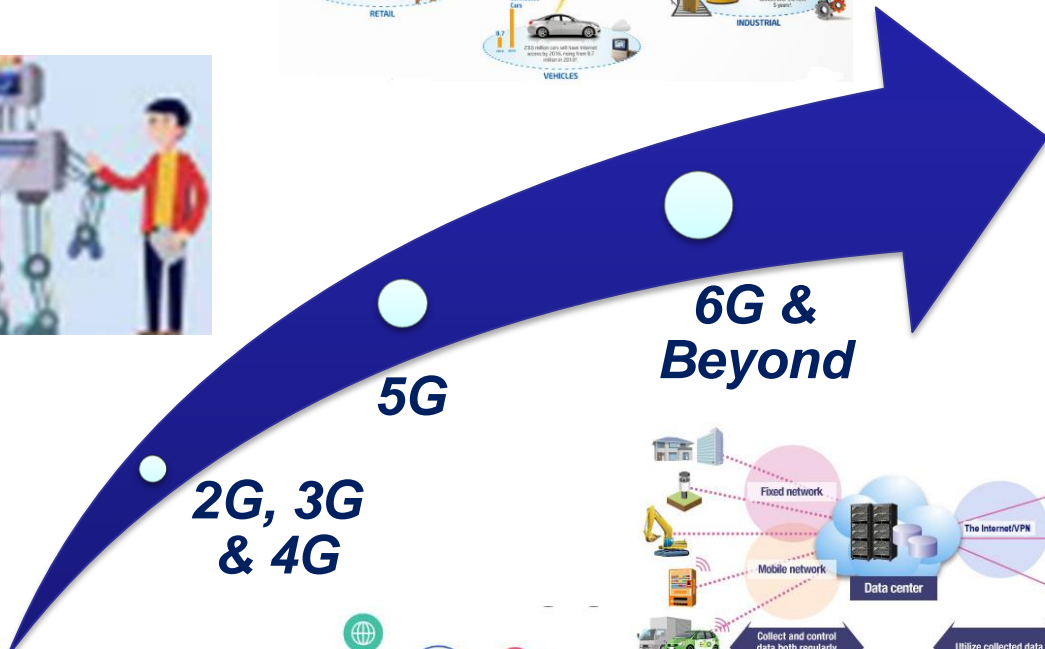
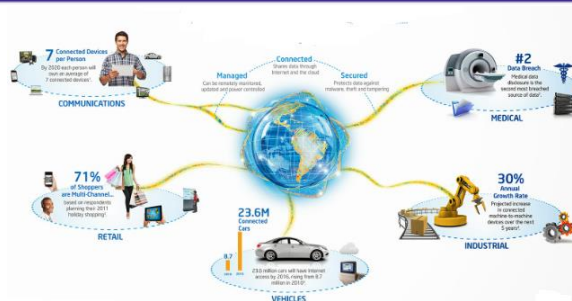
Spectrum approaches for new technologies  
and services

Mohamad Ayoub  
*Spectrum Manager*

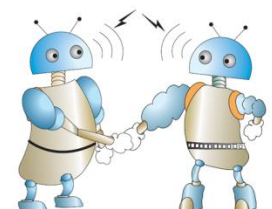
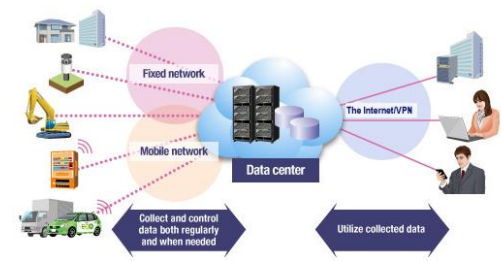
TELECOMMUNICATIONS REGULATORY AUTHORITY (TRA), LEBANON



# What is 6G?



**2G, 3G & 4G**

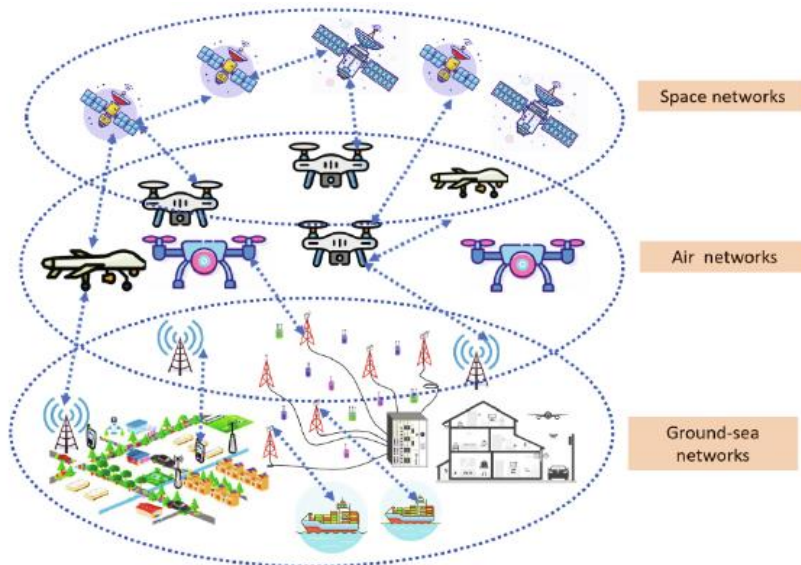


**6G is the technology that will shape the Future**

# Pre-requisites for evolution to 6G

Advanced technologies are needed for global inclusion, and 6G should support:

- ✓ Extended coverage: for VR/AR, hologram, and remote control of sensitive operations
- ✓ Extremely high data rate
- ✓ Near real-time latency
- ✓ Ultra reliable communication
- ✓ Massive cell-capacity



*3-D Network layers*



*Technical requirements*

# 6G spectrum will be a mix of low, mid & high bands as for 5G

## ➤ Frequency bands allocated for 5G to be re-considered for 6G

- ✓ Sub-1 GHz remains a coverage layer
- ✓ Mid-band to include 3.5 GHz, 4.5 GHz, and 6 GHz for coverage and capacity
- ✓ High Capacity bands in the mm-Wave range “24 -71 GHz”, such as 26/28 GHz or 40 GHz

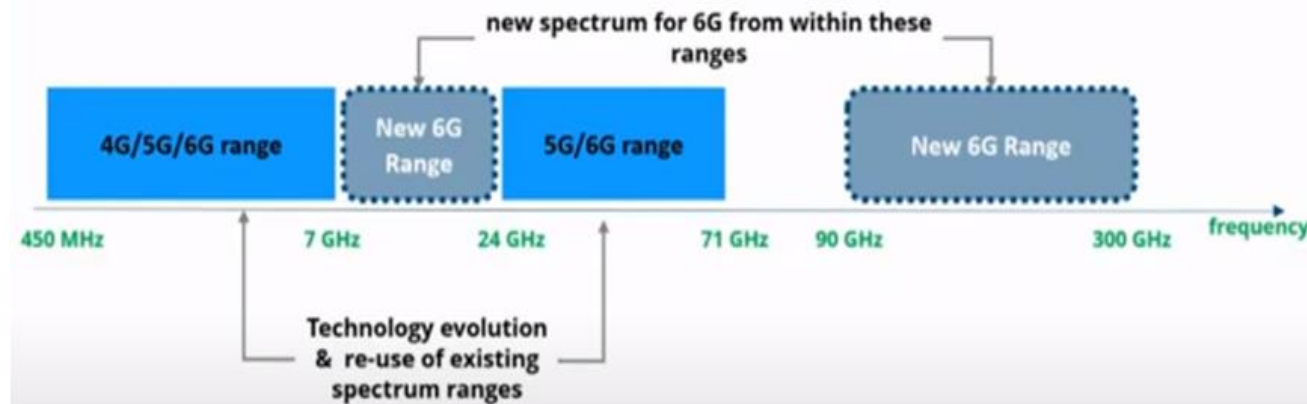


## ➤ 6G Spectrum: a combination of sub-1 GHz to Sub-THz + explore new bands

- ✓ Mid-band “7-24 GHz” new spectrum to be
- ✓ Sub-THz Band 92-300 GHz

## ➤ Spectrum Implications for 6G

- ✓ Low band refarming
- ✓ Mid-band extension
- ✓ High bands extending to THz
- ✓ Increasing occupancy



## Possible approaches for securing licensed spectrum for 6G

1. Allocate new bands
2. Develop spectrum sharing conditions
3. Spectrum clearing
4. Reconsider Spectrum refarming
5. Frequency harmonization

### Sharing for rural coverage

- Shared spectrum among multiple operators
- Shared radio equipment (open interfaces)
- Rural access network and spectrum slice using unlicensed / free spectrum allocation

Band \ Approach	New band exploration (NOTE 1)	Spectrum clearing	Spectrum refarming
Lower mid-band	✓	✓	✓
Upper mid-band	✓	✓	
Sub-THz band	✓		

(NOTE 1) including spectrum sharing approach.

Question: What sharing model is best suited?

How to address future network requirement from spectrum point of view?

Policy-makers and national regulators to develop:

- Clear vision and policy on future networks
- Develop national collaboration strategy and framework between sectors
- Clear Spectrum Roadmap that includes:
  - ✓ Harmonization mandates
  - ✓ Flexible spectrum regulations that include:
    - Clear authorization process for the different services and bands
    - Sharing, Coordination and Mitigation conditions
    - Spectrum pricing
    - Information on future spectrum releases
  - ✓ Ease spectrum authorization for R&D and experimental use to understand new technology requirements
- On regional basis, new collaboration and coordination framework for MENA countries will help in:
  - ✓ Integration of networks and services
  - ✓ Better spectrum harmonization
  - ✓ Reducing the digital divide
  - ✓ Exchange of knowledge

Question: Can MENA countries migrating from 3G to 4G with no 5G planned catch-up on the next wave of evolving technology and at what cost?

# Lebanon - Mid-bands use and occupancy

- Fixed network includes: VDSL, FTTH and FTTC network; WLL for rural (Later LTE); public WiFi
- 2 NMOs (Alfa, Touch) with 2G, 3G and 4G
- 10 FWA data service providers
- 48 ISPs

- 5G planned by all 3 networks,
- MNOs run pilot with 100MHz for each one on 3.5 GHz successful (2019), new test planned for this year.
  - Speeds achieved varies between 900 Mb/Sec and 1.575 Gb/sec

## Mobile, FWA and PMP Bands :

Most bands over 4-28 GHz heavily used for backhaul

### DSP bands:

- 1900 – 1920 MHz
- 2300 – 2400 MHz
- 2500 – 2700 MHz
- 3400 – 3600 MHz
- 3600 – 3800 MHz
- 5 GHz Band
- 24.5 – 26.5 GHz
- 28 GHz

### MVDS operation:

- PMP: 11.7 – 12.5 GHz;
- P2P : 13.5 – 14.5 GHz

Band	Service	Band (GHz)	P2P/PMP
4.9 GHz	PMP	4.9 - 5.2 GHz	13
5 GHz	P2P, PMP	5.2 - 5.8 GHz	213
6 GHz L	P2P	5.9 - 6.4 GHz	26
6 GHz H	P2P	6.4 - 7.1 GHz	45
7 GHz	P2P	7.1 - 7.4 GHz	50
11 GHz	P2P	10.7 - 11.6 GHz	104
12 GHz	MVDS, PMP	11.7 - 12.5 GHz	
13 GHz	P2P	12.7 - 13.2 GHz	70
14 GHz	MVDS P2P	13.5 - 14.5 GHz	29
15 GHz	P2P	14.5 - 15.3 GHz	649
18 GHz	P2P	17.7 - 19.6 GHz	301
23 GHz	P2P	21.5 - 23.5 GHz	552
26 GHz	P2P, PMP	24.7 - 26.1 GHz	148
28 GHz	P2P, PMP	28.1 - 29.4 GHz	102
38 GHz	P2P	37 - 39.2 GHz	346
42 GHz	P2P	40 - 43 GHz	6

## Challenges and issues to resolve telecom hurdles:

- Political Instability
- Economic crisis and collapse of the financial and banking system, and restoring confidence
- Lack of interest from international investors

## Technical challenges and Issues:

- Fragmentation in spectrum bands
- Lack of infrastructure “fiber” deployment especially in rural areas with the absence of alternatives
- Complex market structure, different market players: National, Local, Private, illegal

## Possible actions:

- Reassessment of: regulatory framework, Telecom law, occupancy of bands
- Establishment of National Spectrum Advisory Committee
- Refarming; Plan for new bands. Reduce authorization procedures
- Speed-up deployment of infrastructure plans and plan for deployment of alternative infrastructure
- New flexible automated licensing regime; development of new sharing models
- Engage and encourage Academia in the development and adoption of solutions
- Adoption of intelligent Spectrum Management system



## What new requirements for spectrum management?

- Assignment of unused frequencies in real time based on needs
- Continuous sharing, coordination based on needs and services
- Ensure adoption of sharing and mitigation
- Ensure protection of existing services
- Take appropriate actions in the event of violations

## Question:

Can we still manage spectrum in future in a static or semi-dynamic way?

## New intelligent Spectrum Management is required:

- AI/ML for managing the spectrum of future networks, new frequency management systems
- Intelligent spectrum management is key for handling:
  - ✓ Coordination and dynamic sharing process between MNOs, Verticals and NTN networks to address instantaneous coverage and services for each operator in any region
  - ✓ Manages the frequency assignment process dynamically and in real time.

Spectrum Regulatory Sandbox may ease solving spectrum sharing and licensing issues

Thank you.