

ITU POLICY AND ECONOMIC COLLOQUIUM FOR THE AMERICAS (IPEC-22) MEXICO CITY, 25-26 AUGUST 2022

Spectrum Management Challenges for Emerging Technologies

Joaquin RESTREPO

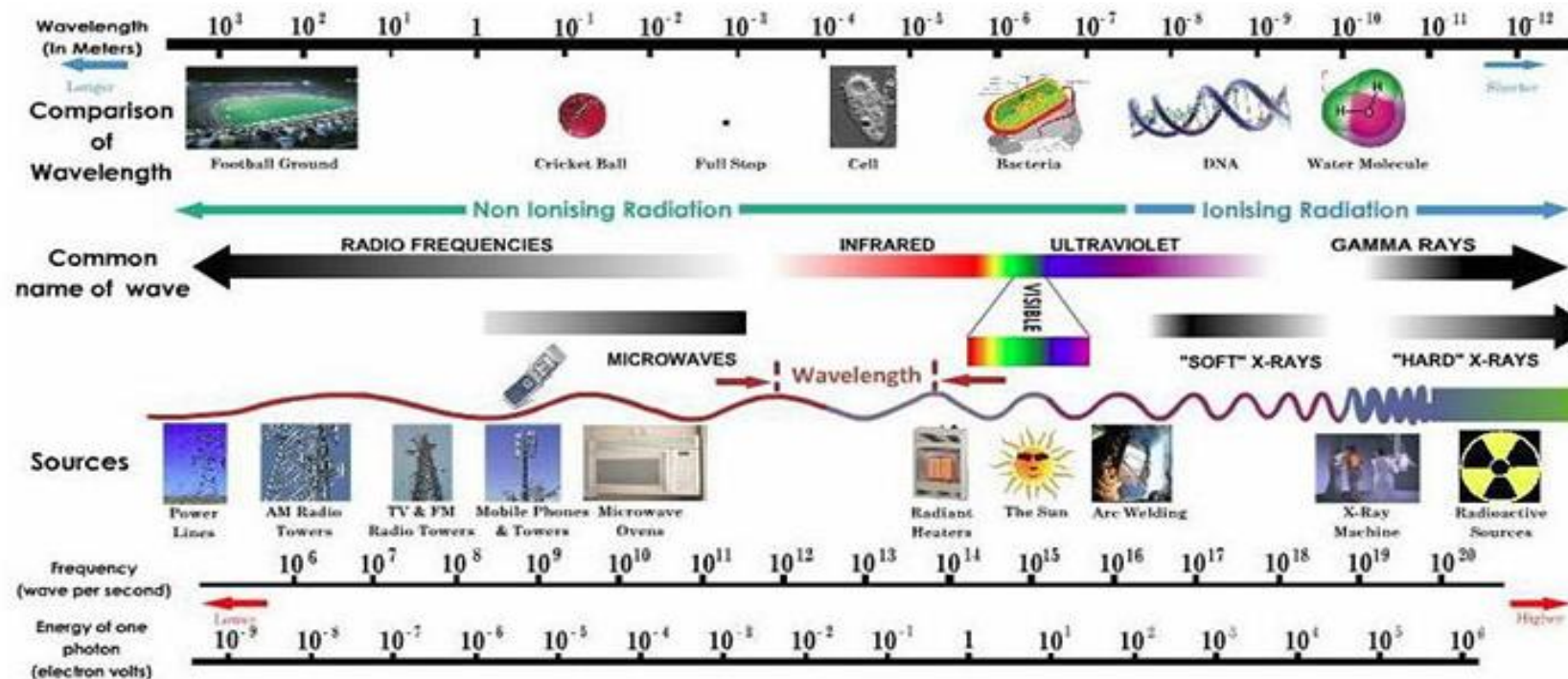
Capacity Building Coordinator; Study Groups Department (SGD);
Radiocommunications Bureau (BR); International Telecommunications Union, ITU

RADIOELECTRIC SPECTRUM

RR 1.3: Telecommunication: Any transmission, emission or reception of signs, signals, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems.

RR 1.5: Radio waves (or hertzian waves): Electromagnetic waves of frequencies arbitrarily lower than 3000 GHz, propagated in space without artificial guide.” (usually refers as: “radio”)

RR. 1.6 Radiocommunication: Telecommunication by means of radio waves

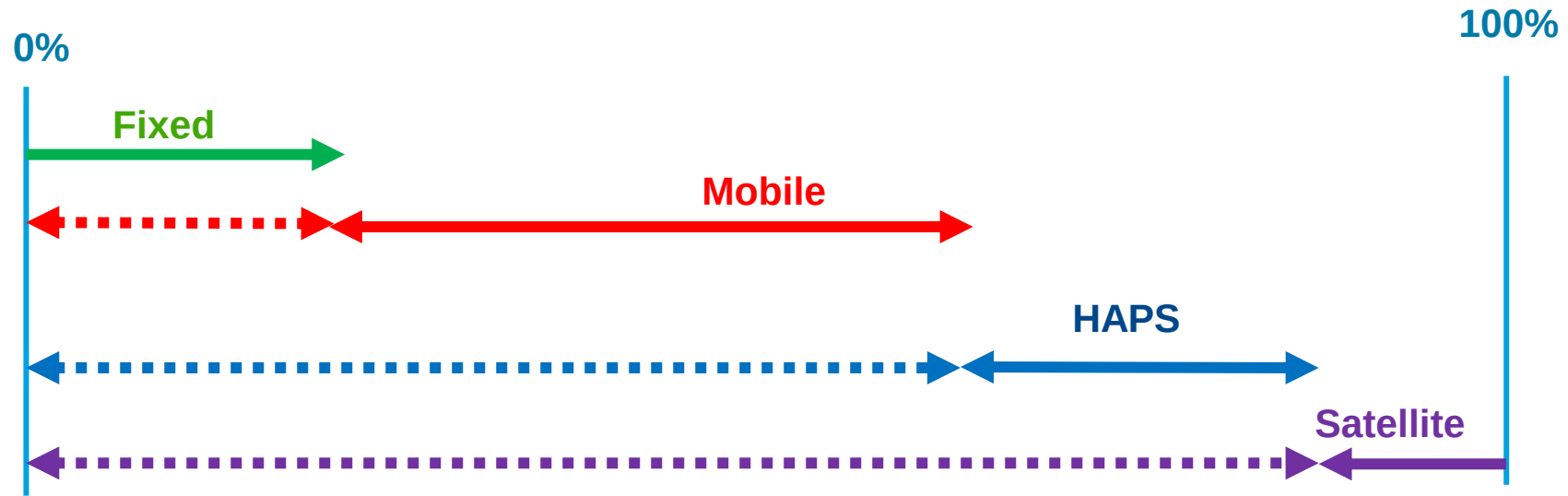


RADIOELECTRIC vs. ELECTROMAGNETIC SPECTRUM

- **Radioelectric Spectrum:** lower part of Electromagnetic Spectrum, used for Telecommunications
- Expression: “***Spectrum***” refers by default to Radioelectric Spectrum
- Communications systems that **DO NOT** use Spectrum (in red) may be regulated (National/International); but their regulatory framework is different than Spectrum Regulations

	Frequencies < 3.000 GHz?	Free Propagation?	Radioelectric Spectrum?
Infra-red Wireless link	NO	YES	NO
Cable TV (Coaxial)	YES	NO	NO
Optical Fiber	NO	NO	NO
Broadcasting TV	YES	YES	YES

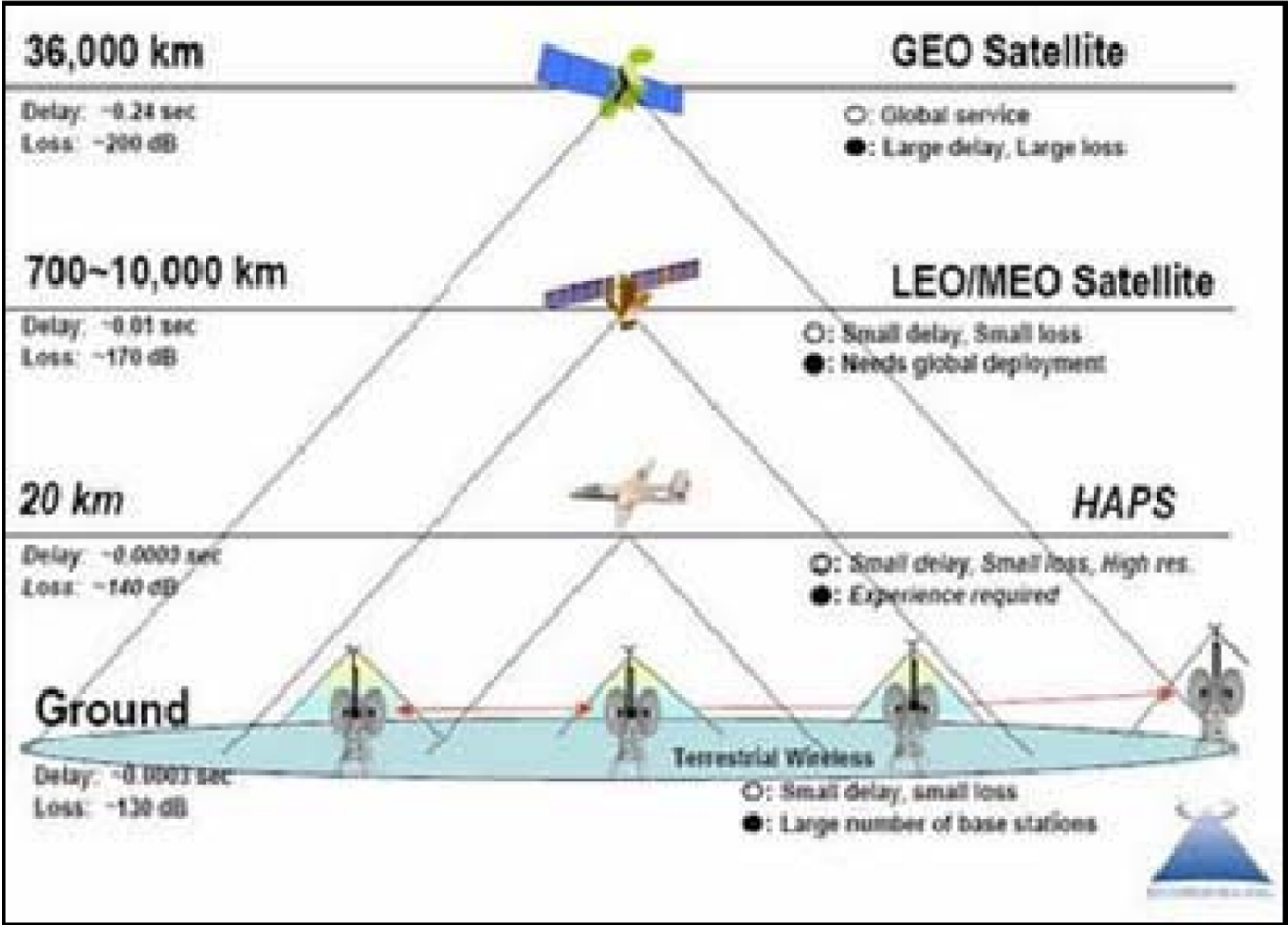
Broadband Access



Broadband services is supported by 3 types of infrastructure of networks (last km, last mile):

- Fixed: copper, coaxial, fiber
- Wireless (Terrestrial): cellular, Wi-Fi? , HAPS
- Satellite: GSO, Non-GSO

Broadband Access



	Link		
	Last Mile	Local Backhaul	Long Backhaul
Fixed			
<i>Copper</i>	Yes		
<i>Coaxial</i>	Yes		
<i>Fiber</i>	Yes	Yes	Yes
Wireless			
<i>Mobile</i>	Yes		
<i>WiFi</i>	Yes		
<i>TVWS</i>		Yes	
<i>HAPS</i>		Yes	Yes
<i>Microwave</i>		Yes	Yes
<i>Non-GSO</i>	Yes	Yes	Yes
<i>GSO</i>	Yes	Yes	Yes

WIRELESS BROADBAND TECHNOLOGIES

TERRESTRIAL:

Last mile

- Mobile Broadband: IMT-2000 (3G), IMT-Advanced (4G), IMT-2020 (5G)
- Unlicensed devices: WiFi

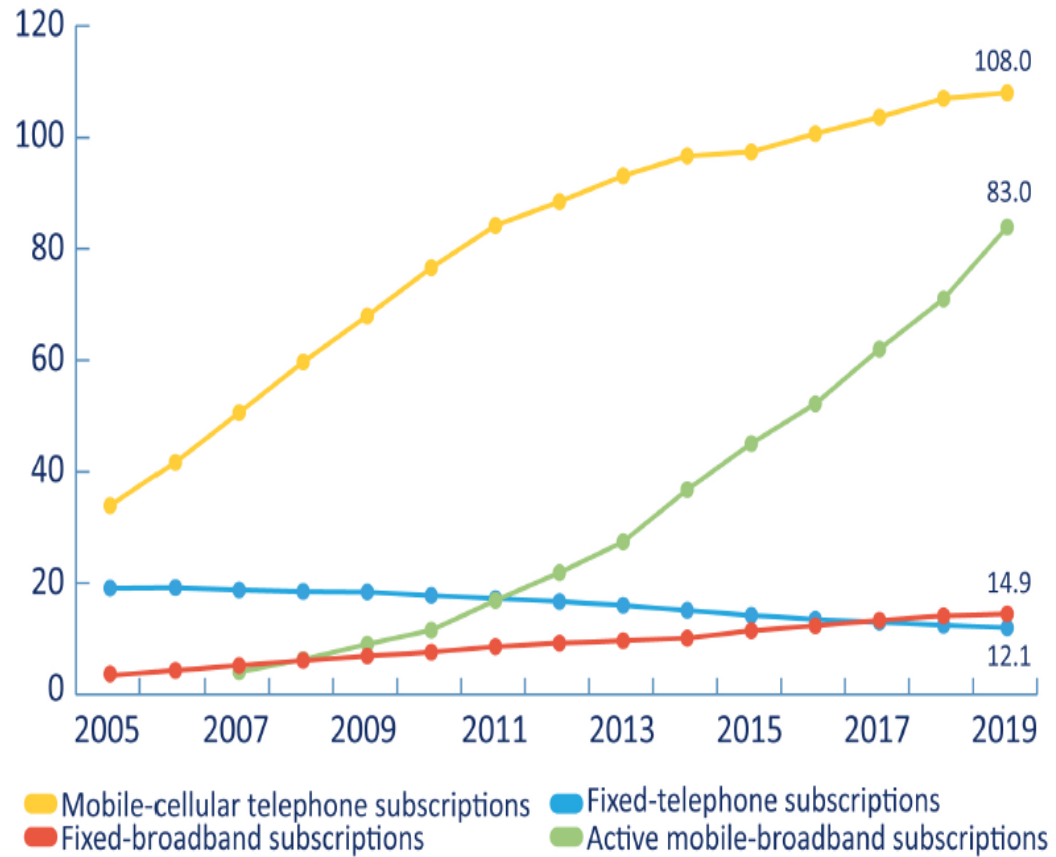
Local Backhaul

- Opportunistic Use: TV White Spaces
- HAPS
- **SPACE:** (both last mile and Backhaul)
- GSO: High Throughput (Density) Satellites: HTS, HDS
- Non-GSO: Satellite Constellations (BIG LEOs)

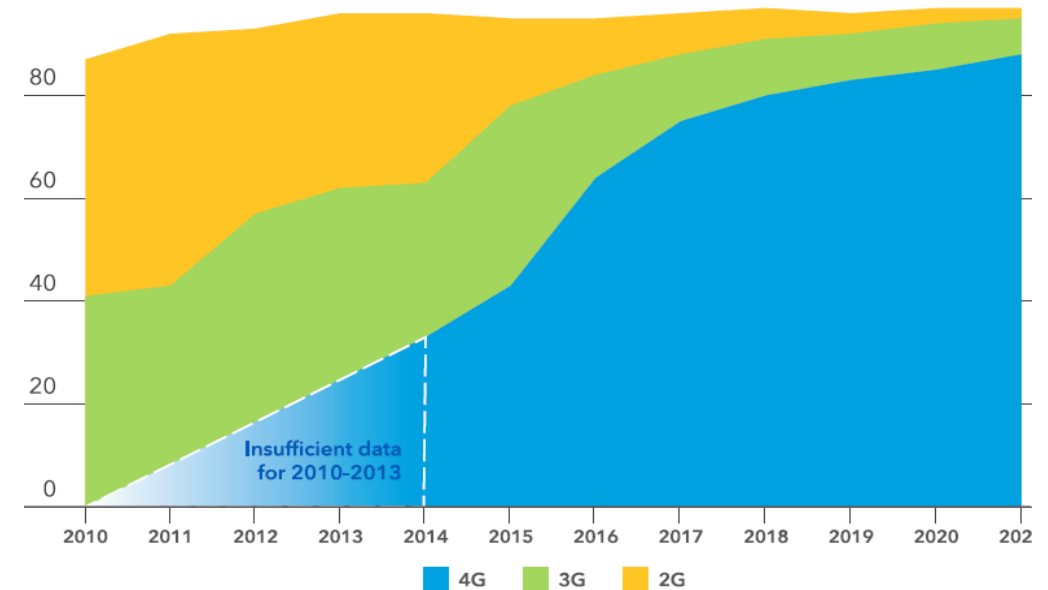
		Area					
		Dense			Remote		
	Link	Urban	Suburban	Rural	Urban	Suburban	Rural
Fixed							
Copper	Last Mile	Yes	Yes		Yes	Yes	
Coaxial	Last Mile	Yes			Yes		
Fiber	Last Mile/ Backhaul	Yes			Yes		
Wireless							
Mobile	Last Mile	Yes	Yes	Yes	Yes	Yes	
WiFi	Last Mile	Yes	Yes	Yes	Yes	Yes	Yes
TVWS	Backhaul						Yes
HAPS	Backhaul				Yes	Yes	Yes
Microwave	Backhaul	Yes	Yes	Yes	Yes	Yes	Yes
Non-GSO	Last Mile/ Backhaul	Yes	Yes	Yes	Yes	Yes	Yes
GSO	Last Mile/ Backhaul	Yes	Yes	Yes	Yes	Yes	Yes

Broadband Access: Accessibility vs Affordability

Evolution of mobile and fixed subscriptions, 2005-2019*

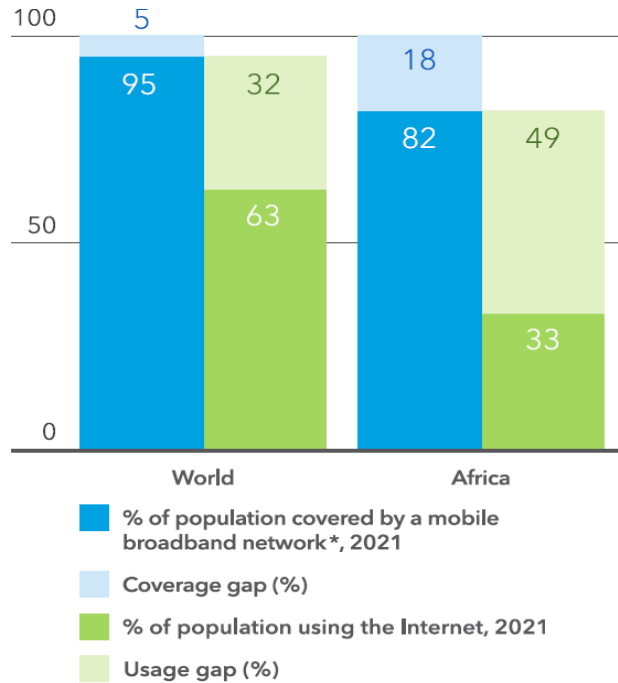


% of Population (worldwide) covered by Mobile Networks



	Region	% Prepaid
Developing	<i>Africa</i>	96%
	<i>Asia</i>	91%
	<i>Latinamérica</i>	89%
Developed	<i>Asia</i>	15%
	<i>Norteamérica</i>	22%
	<i>Europa</i>	33%

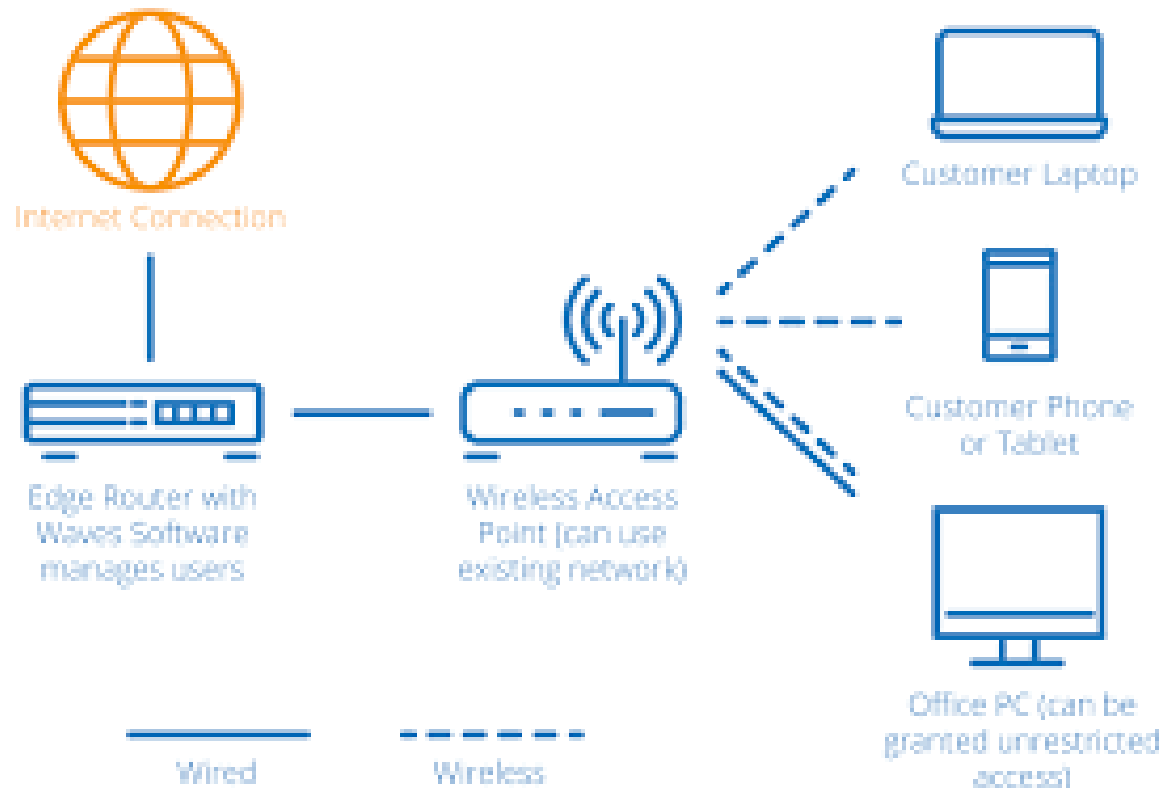
Broadband Access: Accessibility vs Affordability



- Fixed Networks are mainly deployed on dense urban areas; in slight decline
- Mobile Networks in high growth, near saturation
- Internet users in urban areas twice as high as in rural areas
- Increasing Gap between developed and developing world
- Increasing Gap between urban and rural/remote
- Broadband Universal Service in developing world:
Mobile & Prepaid

- **100% of worldwide Population (and surface) is covered by a satellite network (GSO, Non-GSO)**
- **95 % of Population (worldwide) is covered by a Mobile Broadband Network (3G and upper)**
- 30-50% of population in developing world
 - Covered by a Mobile Broadband Network
 - Not using it
- **CHALLENGE: less and less ACCESIBILITY, more and more AFFORDABILITY**

WiFi



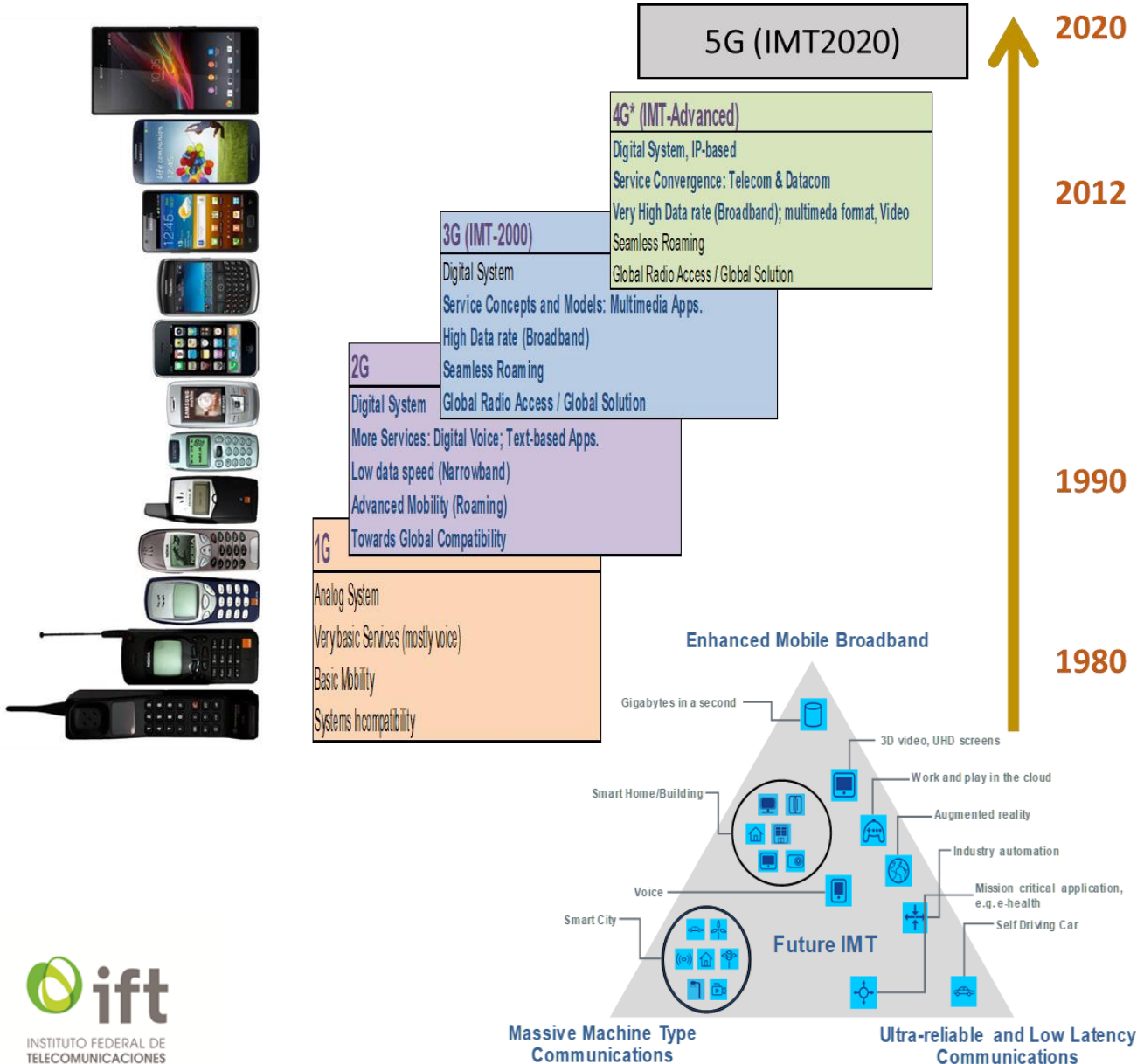
Designed as a wireless LAN connection

For Indoor short range coverage

‘unlicensed device’ : NI/NP to/from

- Other services
- Other WiFi Hotspots
- Best Effort: No guarantee of bandwidth
- Too many Hotspots: Tragedy of commons

MOBILE BROADBAND



- **Radio Regulations:**

IMT: Application of MOBILE Service

International Mobile Telecommunications IMT encompasses **all** IMT Versions:

IMT-2000, IMT-Advanced, IMT-2020

Some bands allocated to **MOBILE**, were identified for IMT

- **ITU-R Publications:**

SG5/WP5D : ITU-R Series M

Publications for:

IMT Systems (large scope)

IMT-2020

TVWS

Opportunistic Use of Spectrum

Bands allocated to BROADCASTING (TV, Primary)

In remote areas, some TV channels are not (yet!) used/covering it (TV White Spaces)

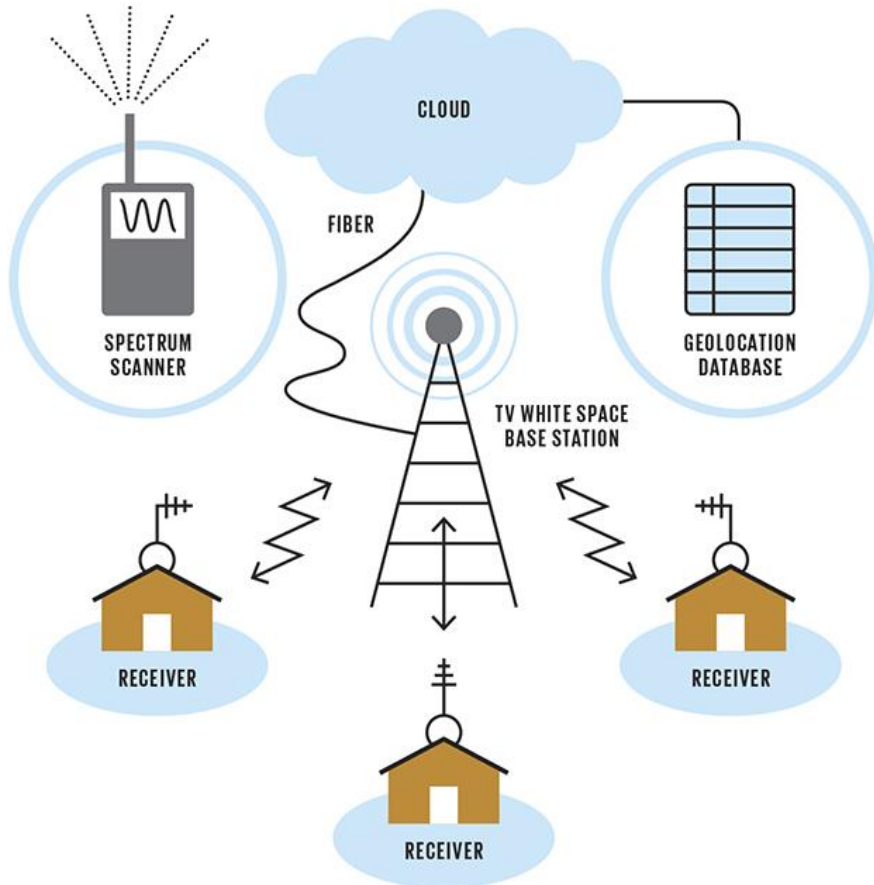
Those channels could be used as long as they are not used by Primary Operator (or refarmed)

- Opportunistic Window : area and time

FIXED service (Broadband access to Internet) Local Backhaul (Point to Point, Point to Multi Point)

Base Station can be WiFi or any other last mile broadband solution

Pioneer Curse?



HIGH-ALTITUDE PLATFORM STATION (HAPS)



- **Radio Regulations:**

Some bands allocated to **MOBILE** or **FIXED**, were designated (or identified) to allow the use of HAPS Stations

Some bands identified for **IMT** allow the use of **HIBS**

HAPS: radio stations located on an object at an altitude of 20-50 kilometers and at a specified, nominal, fixed point relative to the Earth.

(HAPS is a Station, NOT a Service)

HAPS might be used as IMT base stations (HIBS) as part of IMT networks.

HIGH THROUGHPUT SATELLITE: HTS (or HDS)

Broadband connectivity via High Throughput Satellites (HTS)



Increasing demand for:

- 4G/ 5G backhaul,
- HD/ UHD TV (4K, 8K),
- interactive TV,
- high-speed Internet access to individual homes/ offices,
- enterprise networking

Demand for capacity will grow by 27%
in the next 10 years*

HTS capacity 100-300 Gbit/ s,
increasing to more than 1 Tbit/ s by 2020*

* According to NSR (Northern Sky Research)

• Radio Regulations:

Allocations to Fixed-Satellite Services, **FSS**

Footnotes to High-Density FIXED-SATELLITE SERVICES (HDS) and STATIONS (Satellite, ES)

Earth Station in Motion (**ESIM**):

Use of Mobile Earth Stations (airplanes, ships, trains, cars) within FSS

Different from MSS (personal satellite terminals)

BIG LEOs (Broadband Non-GSO Constellations)



The expression FIXED or MOBILE refers to the user terminal NOT to the Station motion

FSS, MSS etc can be provided through:
GSO satellites
Non-GSO Satellites

Radio Regulations:

Allocations to Fixed-Satellite Services, **FSS**
Footnotes to **Non-GSO Satellites Systemss**)

Main Spectrum Management-relate Challenges

	<i>WiFi</i>	<i>IMT</i>	<i>TVWS</i>	<i>HAPS</i>	<i>Non-GSO</i>	<i>GSO</i>
RR (& NTFA) Allocations	NOT a Service Authorized use NI/NP (unlicensed)	PRIMARY MOBILE Identified to IMT	PRIMARY BROADCASTING (TV) Opportunistic use NI/NP (unlicensed?) Fixed (Secondary?)	Station Designated/Identified FIXED, MOBILE	PRIMARY FSS Footnotes	PRIMARY FSS Footnotes

CHALLENGES	Spectrum Allocation	MORE! (but all Spectrum is already allocated) --> Sharing allocations: International (WRCs, ITU-R SGs), then National (NTFA)					
	Interferences	How to Share allocations? (WRCs, ITU-R SGs, NTFA)					
	Licensing	Unlicensed but protected (?)	Commercial vs Non-Commercial (verticals)	Unlicensed but protected (?)		Global Licensing Campaigning	Global Licensing Campaigning
	Infrastructure (Sharing, Agile Rules)	Outdoor Wi-Fi	High	Low	Low	Low	Low
	Business Model	Tragedy of Commons (lower QoS?)	4G to 5G Auctions (winner curse)	Not Long-Term Spectrum Tenure (Closing Opportunistic Window); Pioneer Curse	Still Pilots?	USF Leverage	USF Leverage
	Regulator Tasks	Outdoor WiFi Unlicensed vs Licensed?	Auctions? Coverage Obligations? Verticals Ruling?	Spectrum Use Database short time licensing (hours, days) Spectrum Release (Closing Opportunistic Window)	Air Space rules	Use of Outer Space COPUOS, Nal. Rules Landing Rights Space Debris	Use of Outer Space COPUOS, Nal. Rules Landing Rights

THANKS 😊
GRACIAS 😊

Further info:
joaquin.restrepo@itu.int