



WiFi 6E

Expanding Wireless Access Opportunity

6 GHz Unlicensed Spectrum

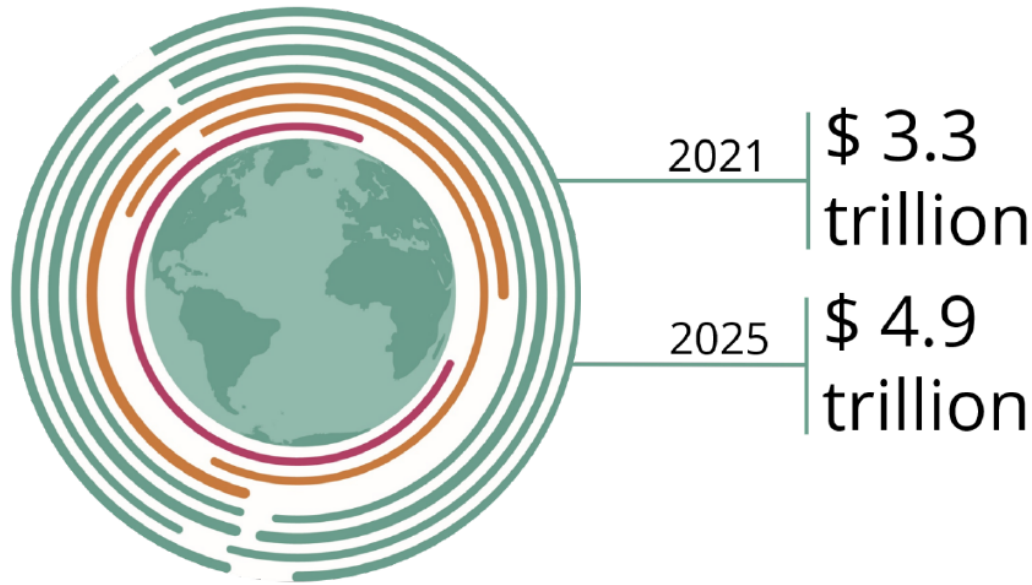
About us

The following companies are working together for 5 years to secure radio spectrum and technical rules similar or the same as adopted by the US FCC in Docket No 18-295 to allow 5925 – 7125 MHz for unlicensed use globally.

Apple, Inc., Broadcom, Inc., Cisco Systems, Inc., Facebook, Inc., Google LLC, Hewlett Packard Enterprise, Intel Corporation, Microsoft Corporation, Qualcomm Incorporated.

Economic Benefit

Global Value of Wi-Fi®



Telecom Advisory Services, Wi-Fi Alliance®

Global Value of Wi-Fi®

2021 **\$3.3 trillion** | 2025 **\$4.9 trillion**

AUSTRALIA		BRAZIL		COLOMBIA		EUROPEAN UNION	
2021	2025	2021	2025	2021	2025	2021	2025
\$35 billion	\$42 billion	\$105 billion	\$124 billion	\$19 billion	\$41 billion	\$458 billion	\$637 billion
FRANCE		GERMANY		JAPAN		MEXICO	
2021	2025	2021	2025	2021	2025	2021	2025
\$63 billion	\$104 billion	\$135 billion	\$173 billion	\$251 billion	\$325 billion	\$57 billion	\$118 billion
NEW ZEALAND		POLAND		SINGAPORE		SOUTH KOREA	
2021	2025	2021	2025	2021	2025	2021	2025
\$7 billion	\$10 billion	\$16 billion	\$22 billion	\$11 billion	\$12 billion	\$89 billion	\$140 billion
SPAIN		UNITED KINGDOM		UNITED STATES			
2021	2025	2021	2025	2021	2025		
\$40 billion	\$54 billion	\$99 billion	\$109 billion	\$995 billion	\$1.6 trillion		



www.valueofwifi.com

APAC Internet Growth and Trends

Key Digital Transformers

By 2023

More
Internet
Users



More
Devices &
Connections



Faster
Broadband
Speeds



2018

2023

2.1
Billion

3.1
Billion

8.6
Billion

13.5
Billion

62.8
Mbps

151.1
Mbps

Global Average Fixed Broadband Speeds

More than doubling in speeds from 2018–2023

In Mbps	2018	2023
Global	45.9	110.4
Asia Pacific	62.8	151.1

Technology transitions underway – every part of the network is speeding up

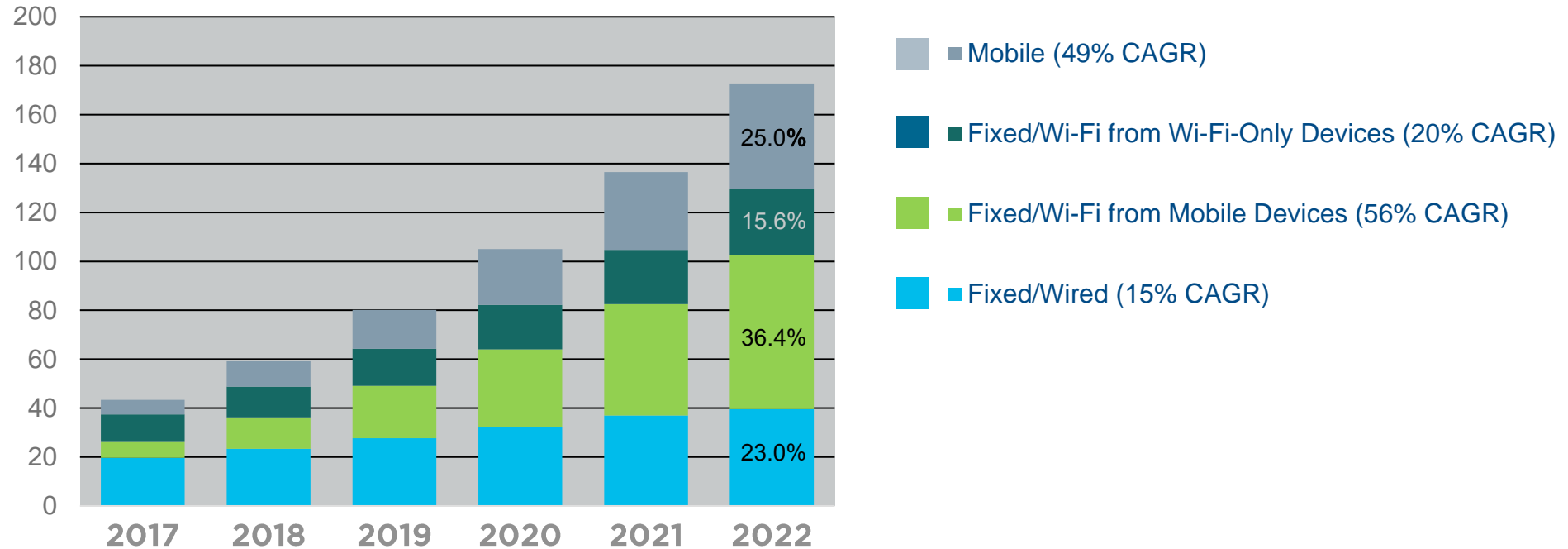
- Wi-Fi 5 to Wi-Fi 6. (standards work for Wi-Fi 7 underway)
- 4G to 5G (standards work for 6G being initiated)
- DOCSIS 3.1 to 4.0
- Continuous improvements in fiber optics

APAC IP Traffic by Local Access Technology

By 2022, 77% of total IP traffic will be wireless*

**32% CAGR
2017-2022**

Exabytes per
Month



Wi-Fi has succeeded despite little bandwidth

2.4 GHz Channels		80 MHz	
ISM Band	2407 + 5 X Ch. Number	Wavelength	12.5cm - 4.9" to 12.0cm - 4.7"
Qty	Channel	1	6
3	Center Freq	2,412	2,437
			2,462

5 GHz Channels		500 MHz	
Frequency	5000 + 5 X Ch. Number	Wavelength	5.8cm - 2.3" to 5.1cm - 2.0"
		DFS Channels	
		TDWR	
Radio Band	Center Freq	U-NII-1	U-NII-2a
		5.180	5.260
		5.200	5.280
		5.220	5.300
		5.240	5.320
		5.500	5.580
		5.520	5.600
		5.540	5.620
		5.560	5.640
		5.580	5.660
		5.600	5.680
		5.620	5.700
		5.640	5.720
		5.660	5.740
		5.680	5.760
		5.700	5.780
		5.720	5.800
		5.745	5.825
		5.765	
		5.785	
		5.805	
		5.825	
Qty			
25	20 MHz	36	40
		44	48
11	40 MHz	38	46
		54	62
5	80 MHz	42	58
		102	110
2	160 MHz	50	114
		106	122
		118	126
		124	128
		132	134
		136	138
		140	142
		144	144
		149	151
		153	155
		157	159
		161	
		165	
Qty			
25			
11			
5			
2			

“...ensure that sufficient spectrum resources are made available...”

*Wi-Fi operates in non-cleared spectrum (e.g. non-interference basis) and must move from channels when radars are operating.

6GHz will provide Wi-Fi room to grow

2.4 GHz Channels

80 MHz

ISM Band 2407 + 5 X Ch. Number Wavelength 12.5cm - 4.9" to 12.0cm - 4.7"

ISM Band	2407 + 5 X Ch. Number	Wavelength	12.5cm - 4.9" to 12.0cm - 4.7"
Channel	1 6 11		
Center Freq	2.412 2.437 2.462		

5 GHz Channels

500 MHz

Frequency 5000 + 5 X Ch. Number Wavelength 5.8cm - 2.3" to 5.1cm - 2.0"

Radio Band	DFS Channels				DFS Channels											Qty									
	U-NII-1				U-NII-2a				TDWR			U-NII-2c (Extended)					U-NII-3								
Center Freq	5.180	5.200	5.220	5.240	5.260	5.280	5.300	5.320	5.500	5.520	5.540	5.560	5.580	5.600	5.620	5.640	5.660	5.680	5.700	5.720	5.745	5.765	5.785	5.805	5.825
20 MHz	36	40	44	48	52	56	60	64	100	104	108	112	116	120	124	128	132	136	140	144	149	153	157	161	165
40 MHz	38		46		54		62		102		110		118		126		134		142		151		159		
80 MHz	42				58				106				122				138				155				
160 MHz	50								114								165 was ISM, now U-NII-3								

6 GHz Channels

1,200 MHz

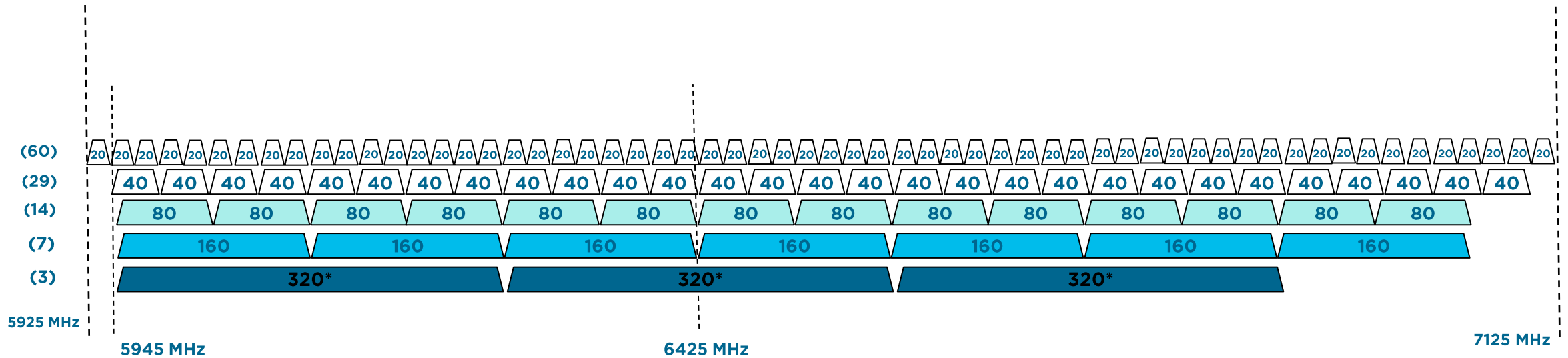
FCC - USA 5950 + 5 X Ch. Number Wavelength 5.1cm - 2.0" to 4.2cm - 1.6"

Low Power Indoor		5dBm/MHz - Net EIRP 18dBm		Qty																																																								
Radio Band	Center Freq	5.955	5.975	5.995	6.015	6.035	6.055	6.075	6.095	6.115	6.135	6.155	6.175	6.195	6.215	6.235	6.255	6.275	6.295	6.315	6.335	6.355	6.375	6.395	6.415	6.435	6.455	6.475	6.495	6.515	6.535	6.555	6.575	6.595	6.615	6.635	6.655	6.675	6.695	6.715	6.735	6.755	6.775	6.795	6.815	6.835	6.855	6.875	6.895	6.915	6.935	6.955	6.975	6.995	7.015	7.035	7.055	7.075	7.095	7.115
	20 MHz	1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69	73	77	81	85	89	93	97	101	105	109	113	117	121	125	129	133	137	141	145	149	153	157	161	165	169	173	177	181	185	189	193	197	201	205	209	213	217	221	225	229	233
	40 MHz	3		11		19		27		35		43		51		59		67		75		83		91		99		107		115		123		131		139		147		155		163		171		179		187		195		203		211		219		227		
	80 MHz	7				23				39				55				71				87				103				119				135				151				167				183				199				215						
	160 MHz	15								47								79								111								143								175								207										

Standard Power AP		36dBm with Automated Frequency Coordination (AFC)		Qty																																																										
Radio Band	Center Freq	5.955	5.975	5.995	6.015	6.035	6.055	6.075	6.095	6.115	6.135	6.155	6.175	6.195	6.215	6.235	6.255	6.275	6.295	6.315	6.335	6.355	6.375	6.395	6.415	6.435	6.455	6.475	6.495	6.515	6.535	6.555	6.575	6.595	6.615	6.635	6.655	6.675	6.695	6.715	6.735	6.755	6.775	6.795	6.815	6.835	6.855	6.875	6.895	6.915	6.935	6.955	6.975	6.995	7.015	7.035	7.055	7.075	7.095	7.115		
	20 MHz	1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69	73	77	81	85	89	93						117	121	125	129	133	137	141	145	149	153	157	161	165	169	173	177	181															
	40 MHz	3		11		19		27		35		43		51		59		67		75		83		91						123		131		139		147		155		163		171		179																		
	80 MHz	7				23				39				55				71				87								135				151				167																								
	160 MHz	15								47								79								143								175								207																				

Channel size is increasing (20, 40, 80, 160, 320 MHz)

5925 MHz to 7125 MHz IEEE Channel Plan



*320MHz channels are planned as part of IEEE 802.11be (Wi-Fi 7)



Wi-Fi in the 6GHz device ecosystem and market readiness


Wi-Fi 6E Ecosystem Has Arrived

“If spectrum is made available early this year [2020], we expect momentum of products that support operation in 6 GHz to ramp very quickly.”

Phil Solis, Research Director, IDC

- 316 million Wi-Fi 6E devices will enter the market in 2021
- Fourteen Wi-Fi 6E devices have already been certified.
- Netgear, TP-Link, Linksys, and ASUS have introduced APs
- Samsung GS-21 Ultra is first Wi-Fi 6E smartphone, and MediaTek and Intel introduced Wi-Fi 6E platforms for PCs



	Q1 2020	Wi-Fi Alliance: Introduced Wi-Fi 6E branding for 6 GHz Wi-Fi Broadcom: World's first Wi-Fi 6E infrastructure chips launched Launched BCM4389 — world's first Wi-Fi 6E phone chip Demonstrated 2 Gbps and 2 ms latency at FCC with Intel
	Q2 2020	FCC: Opened 1.2 GHz spectrum for SP & LPI
	Q3 2020	OFCOM: Opened 500 MHz spectrum; Set VLP rules ASUS: Announced world's first Wi-Fi 6E router powered by Broadcom
	Q4 2020	North America: FCC granted Broadcom BCM4389 + world's first authorization for 6 GHz Wi-Fi; Canada consultation EMEA: ECC decision opened 480 MHz, set VLP rules; Germany confirmed release; Jordan consultation; UAE became first ME country to open 5925-6425 MHz LATAM: Chile opened 1.2 GHz; Costa Rica, Peru, Mexico, Honduras, Brazil, Argentina and Colombia consultations issued
	Q1 2021	Product Momentum: Netgear, TP-Link, Linksys and ASUS introduce Wi-Fi 6E routers ; Broadcom & Samsung introduced first Wi-Fi 6E smartphone ; MediaTek and Intel introduce Wi-Fi 6E platforms for laptops FCC: Opens public notice on C2C communications in 6 GHz

Additional Developments in the device ecosystem

Broadcom	<p>Announced comprehensive portfolio of access point chips on 7 January 2020 and world's first Wi-Fi 6E chip for smartphones, the BCM4389 on 13 February 2020.</p> <ul style="list-style-type: none">The BCM4389 delivers over 2 Gbps of real-world speeds and up to five times better battery utilization, making it an ideal solution for flagship smartphones and future AR/VR devices.
Cisco	<p>Cisco is on the path to develop Wi-Fi 6E routers.</p>
Intel	<p>Intel® Wi-Fi 6E (Gig+) products kicked off production in Q4'2020 and received WFA and FCC certifications in Q1'2021. At CES'21, these solutions were highlighted as key ingredients for new Intel® notebook and desktop PC platforms that will ramp throughout 2021. Several manufacturers announced new Q1'21 PC models for commercial and gaming market segments that will include Intel® Wi-Fi 6E (Gig+) products. We expect to see similar announcements from additional PC vendors throughout 2021.</p> <p>Intel will continue technical collaboration with ecosystem partners to help ensure great end to end Wi-Fi 6E experiences.</p>
Qualcomm	<p>Qualcomm Technologies, Inc. launched the Qualcomm® FastConnect™ mobile connectivity subsystem and the Qualcomm® Networking Pro Series Wi-Fi Access Point platforms with Wi-Fi 6E operation using 6GHz spectrum in May 2020. There have been multiple OEM product announcements using these technologies and numerous Mobile Handset and Access Points Wi-Fi 6E product designs are currently under development</p>





Introducing
Wi-Fi 6E

Standards and regulatory considerations to enable the growth of Wi-Fi and incumbents in the 6 GHz band

Standardization



IEEE Standard	802.11a	802.11b	802.11g	802.11n	802.11ac	802.11ax
Year Released	1999	1999	2003	2009	2014	2019
Frequency	5Ghz	2.4GHz	2.4GHz	2.4Ghz & 5GHz	2.4Ghz & 5GHz	2.4Ghz & 5GHz
Maximum Data Rate	54Mbps	11Mbps	54Mbps	600Mbps	3.6Gbps	10-12Gbps

Old Naming Convention	New Naming Convention
802.11b	Wi-Fi 1
802.11a	Wi-Fi 2
802.11g	Wi-Fi 3
802.11n	Wi-Fi 4 
802.11ac	Wi-Fi 5 
802.11ax	Wi-Fi 6 

Status of 6GHz Standardization

IEEE 802.11 Standards

IEEE802.11ax (High Density Networking, a.k.a. Wi-Fi 6)

- Standard includes support and channelization for up to 7.125 GHz
- **Fixes** a problem with existing 2.4 / 5 GHz Wi-Fi of sometimes **excessive management overhead**
 - Support for 'Out of Band' discovery
 - Strict scanning rules (e.g. only on a subset of the 6GHz channels)
- Only support .11ax modes
 - No 'legacy' 11b, .11g, .11ac modes allowed
- Standard has been finalized and is awaiting publication (Friday, April 30th)

IEEE802.11be (Extreme High Throughput)

Targets:

- Maximum Throughput of **30 Gbps**
- Operating Band of 1-7.125 GHz
- Backward compatible to all 802.11 devices
- Some Features: 20/40/80/160/**320** MHz BW modes, Multi Link Operation, multi-RU operation (enabling the following BW modes: 6, 10, 60, 120, 140, 200, 240, 280 MHz), low latency enhancements, 1K + 4K QAM, Enhancements to 11ax MU features.

Taskgroup started in May 2019

- Draft 1.0 projected Q2 2021
- Projected completion 2024
- Projected WFA launch of an R1 program (Wi-Fi 7): **Late 2023 / early 2024**

Status of 6GHz Standardization

3GPP and ETSI BRAN

3GPP Standards Status

- 5G NR-U, including stand-alone NR-U, will be part of the 3GPP NR Rel-16
 - Functionality frozen in March 2016, and completed in June 2020
- The 3GPP air interface standards (RAN1/RAN2 family) support deployment in the 6 GHz band
 - This covers both LTE LAA and 5G NR-U
 - Covers the entire 1.2 GHz, band n96
- 3GPP RAN 4 progress on band support for the 6GHz band:
 - **6 GHz Unlicensed for the US (5925 - 7125 MHz) – Work Item completed**
 - **Lower 6 GHz Unlicensed in Europe (5925 – 6425) – Work Item proceeding**
 - In addition a placeholder Work Item has been created for 6GHz Licensed, however RAN4 will not start working on the definition of 6GHz licensed bands until **corresponding regulatory requirements exist (for a country/region) for a part of the 5925 – 7125 MHz frequency range**

European Standardization (with Global implications) ETSI BRAN EN 303 687

- This Harmonized standard will specify technical characteristics and methods of measurements for Wireless access systems including radio local area networks (WAS/RLANs) operating in the **band 5 925 MHz to 6 425 MHz** and as further described in ETSI TR 103 524 and ECC Report 302.
- Drafting activity started: Sep 2019, Stable draft: Sep 2020
- TB Approval: Feb 2021
- Publication: Nov 2021
- Citation in EU journal: March 2022
- Specifies common EDT's (Energy Detection Threshold) for all technologies.

Status of 6GHz Standardization

Wi-Fi Alliance

Wi-Fi Alliance Interoperability Programs covering 6 GHz

- Wi-Fi CERTIFIED Wi-Fi 6E
 - Interop certification program for implement 802.11ax in the 6 GHz band
 - All features of the 'regular' Wi-Fi 6 program applied to the 6GHz band
 - Additional features such as 'Out of band' discovery
 - Program launched in January 2021
- Wi-Fi CERTIFIED Wi-Fi 6 (release 2)
 - Additional features from the 802.11 ax specification
 - E.g. Uplink Multi-User MIMO
 - Requirement to support these features in the 6 GHz band, if the product supports 6 GHz
 - Projected to launch late 2021
- Wi-Fi Automatic Frequency Coordination (AFC) Compliance for 6GHz Standard Power
 - WFA AFC TG is focusing on developing recommendations compliance test specification for on testing AFC system for 6GHz Standard Power mode for US and Globally
 - AFC TG Formed in July 2019
 - Main Specifications: AFC System Reference Model, AFC System- AFC Device Interface, AC System and AFC Device Compliance Specifications

Proposed 6 GHz Operating Class



Different Unlicensed Devices/ Operating Classes in 6 GHz



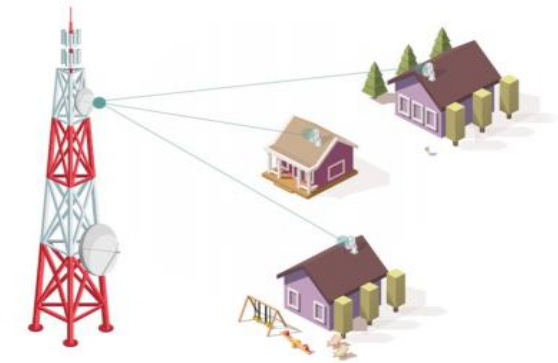
LOW POWER INDOOR (LPI)

- 6 GHz delivers **1.4 Gbps** at 7m distance even with obstructions
- **Use Cases:**
 - Residential Multi-AP / mesh networks
 - Multiple dwelling unit (MDU) Single-AP networks
 - High-density enterprise networks
 - Indoor public venues
 - Industrial IoT



VERY LOW POWER (VLP)

- **Immersive applications** can be achieved via Very Low Power Portable (VLP) devices that can operate indoors and outdoors and Client to Client communications that operate only indoor
- VLP Devices Protect Incumbent Operations by Operating at **Extremely Low Powers**
- CEPT, UK, and S. Korea allow **14 dBm EIRP**, which is far below any level that might lead to harmful interference to incumbent operations
- Additionally, dynamic power control will force the VLP devices to operate at the minimum power level necessary to extend battery life



STANDARD POWER (SP)

- Up to **20 gigabit per second** outdoor coverage (e.g., parks, stadiums, LinkNYC)
- Provides multigigabit **point-to-multipoint rural connectivity**
- Can deliver **low-latency Wi-Fi calls**, and next-gen fan experiences with **AR/VR**
- Protect Incumbent Operations with **Automated Frequency Coordination**

Agreement: Differentiated device classes support use cases and protect incumbents



CEPT Access Point Classes

	Indoor Low Power	Very Low Power
E.I.R.P.	23	14
PSD	10 dBm/MHz	10 dBm/MHz
Access Requirement	Indoor Use Only	N/A



US FCC Access Point Classes

	Indoor Low Power**	Very Low Power*	Standard Power
E.I.R.P.	30 dBm for 320 MHz	14 dBm	36 dBm
PSD	5 dBm/MHz	1 dBm/MHz	23 dBm/MHz
Access Requirement	Limited to Indoor	N/A	Under Control of AFC

* Proposal under public consultation

** US LPI Rules based on 5 dBm/MHz PSD so that the larger the bandwidth, the greater the total power. FCC is now evaluating whether to increase LPI PSD to 8 dBm/MHz and 33 dBm total power for 320 MHz channel.

6 GHz Regulatory Status

6 GHz (5925 – 7125 MHz) Thailand Frequency Allocation

5 570-7 250 MHz Allocation to services		
Thailand		Remark
5 570-5 650	MOBILE except aeronautical mobile 5.446A 5.450A RADIOLOCATION 5.450B MARITIME RADIONAVIGATION 5.452	T-LPD/SRD
5 650-5 725	FIXED 5.453 MOBILE 5.450A 5.453 RADIOLOCATION Amateur Space research (deep space) 5.282	T-Amateur T-LPD/SRD
5 725-5 830	FIXED 5.453 MOBILE 5.453 RADIOLOCATION Amateur 5.150	T-Amateur T-LPD/SRD
5 830-5 850	FIXED 5.453 MOBILE 5.453 RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150	T-Amateur T-LPD/SRD
5 850-5 925	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation 5.150	T-LPD/SRD
5 925-6 700	FIXED FIXED-SATELLITE (Earth-to-space) 5.457A Mobile 5.149 5.440 5.458	T-Fixed Wireless System
6 700-7 075	FIXED FIXED-SATELLITE (Earth-to-space) (space-to-Earth) 5.441 Mobile 5.458 5.458A 5.458B	T-Fixed Wireless System T-FSS Planned Band
7 075-7 145	FIXED MOBILE 5.458	T-Fixed Wireless System
7 145-7 190	FIXED MOBILE SPACE RESEARCH (deep space) (Earth-to-space) 5.460 5.458	T-Fixed Wireless System
7 190-7 235	EARTH EXPLORATION-SATELLITE (Earth-to-space) 5.460A 5.460B FIXED MOBILE SPACE RESEARCH (Earth-to-space) 5.460 5.458	T-Fixed Wireless System
7 235-7 250	EARTH EXPLORATION-SATELLITE (Earth-to-space) 5.460A FIXED MOBILE 5.458	T-Fixed Wireless System

5 570-7 250 MHz การกำหนดให้ใช้กิจการ		
ประเทศไทย		เชิงอรรถประเทศไทย
5 570-5 650	กิจการเคลื่อนที่ ยกเว้น กิจการเคลื่อนที่ทางการบิน 5.446A 5.450A กิจการวิทยุภาคพื้นดิน 5.450B กิจการวิทยุคมนาคมทางทะเล 5.452	T-General use
5 650-5 725	กิจการประจำที่ 5.453 กิจการเคลื่อนที่ 5.450A 5.453 กิจการวิทยุภาคพื้นดิน กิจการวิทยุสมัครเล่น กิจการวิจัยอวกาศ (อวกาศห้วงลึก) 5.282	T-Amateur T-General use
5 725-5 830	กิจการประจำที่ 5.453 กิจการเคลื่อนที่ 5.453 กิจการวิทยุภาคพื้นดิน กิจการวิทยุสมัครเล่น 5.150	T-Amateur T-General use
5 830-5 850	กิจการประจำที่ 5.453 กิจการเคลื่อนที่ 5.453 กิจการวิทยุภาคพื้นดิน กิจการวิทยุสมัครเล่นผ่านดาวเทียม (อวกาศทั่วโลก) 5.150	T-Amateur T-General use
5 850-5 925	กิจการประจำที่ กิจการประจำที่ยานดาวเทียม (โลกสู่อวกาศ) กิจการเคลื่อนที่ กิจการวิทยุภาคพื้นดิน 5.150	T-General use
5 925-6 700	กิจการประจำที่ กิจการประจำที่ยานดาวเทียม (โลกสู่อวกาศ) 5.457A กิจการเคลื่อนที่ 5.149 5.440 5.458	T-Fixed Wireless System T-General use
6 700-7 075	กิจการประจำที่ กิจการประจำที่ยานดาวเทียม (โลกสู่อวกาศ) (อวกาศทั่วโลก) 5.441 กิจการเคลื่อนที่ 5.458 5.458A 5.458B	T-Fixed Wireless System T-FSS Planned Band T-General use
7 075-7 145	กิจการประจำที่ กิจการเคลื่อนที่ 5.458	T-Fixed Wireless System T-General use
7 145-7 190	กิจการประจำที่ กิจการเคลื่อนที่ กิจการวิจัยอวกาศ (อวกาศห้วงลึก) โลกสู่อวกาศ 5.460 5.458	T-Fixed Wireless System T-General use
7 190-7 235	กิจการสำรวจวิทยุคมนาคมผ่านดาวเทียม (โลกสู่อวกาศ) 5.460A 5.460B กิจการประจำที่ กิจการเคลื่อนที่ กิจการวิจัยอวกาศ (โลกสู่อวกาศ) 5.460 5.458	T-Fixed Wireless System T-General use
7 235-7 250	กิจการสำรวจวิทยุคมนาคมผ่านดาวเทียม (โลกสู่อวกาศ) 5.460A กิจการประจำที่ กิจการเคลื่อนที่ 5.458	T-Fixed Wireless System T-General use

Note: The 2021 version added the footnote on T-General Use which allow the use of frequency for general public use subjected to the NBTC announcement (ie. WiFi 6E)

6 GHz Incumbent Services

Utilities (MG)

Public Safety (MW)
TV Pickup (TP)

Railroads (MG)

Public Safety (MW)
TV Pickup (TP)

Operators



5 925

UNII-5

UNII-6

UNII-7

UNII-8

7 125

Incumbent Services



Coexistence studies

- Current licensed incumbent operations in the **6 GHz band are largely the same globally** as those studied in the US and Europe
 - Some distinction density of use and/or on the exact frequency location of incumbent operations within the 6 GHz band
- US and European coexistence studies have **demonstrated that very low power portable (VLP) RLANs, Low Power Indoor (LPI) RLANs and Standard Power (SP) RLANs can operate in the 6 GHz band without creating harmful interference to incumbent operations**
 - US FCC 6 GHz Report and Order
 - ECC Report 302, ECC Report 316
- Countries increasingly moving forward to designate VLP, LPI and SP operations in the 6 GHz band

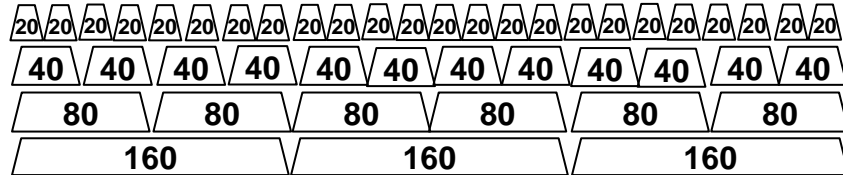
6 GHz Channel Plan

5 925/45 MHz

6 425 MHz



24 x 20 MHz
12 x 40 MHz
6 x 80 MHz
3 x 160 MHz



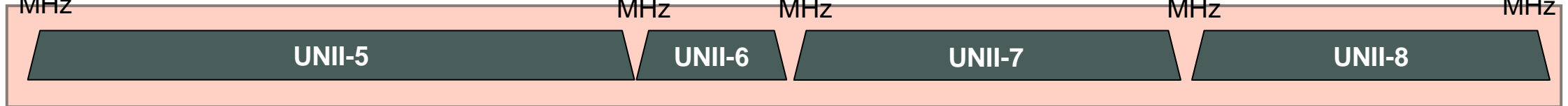
5 925 MHz

6425 MHz

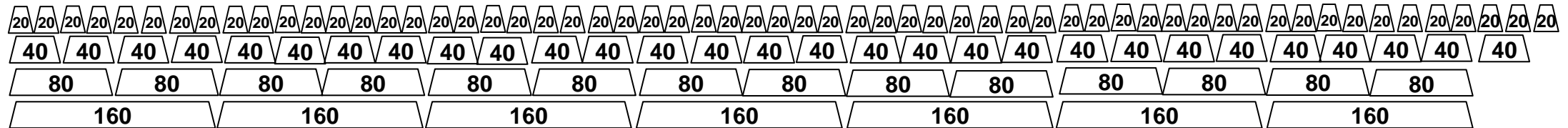
6525 MHz

6875 MHz

7 125 MHz

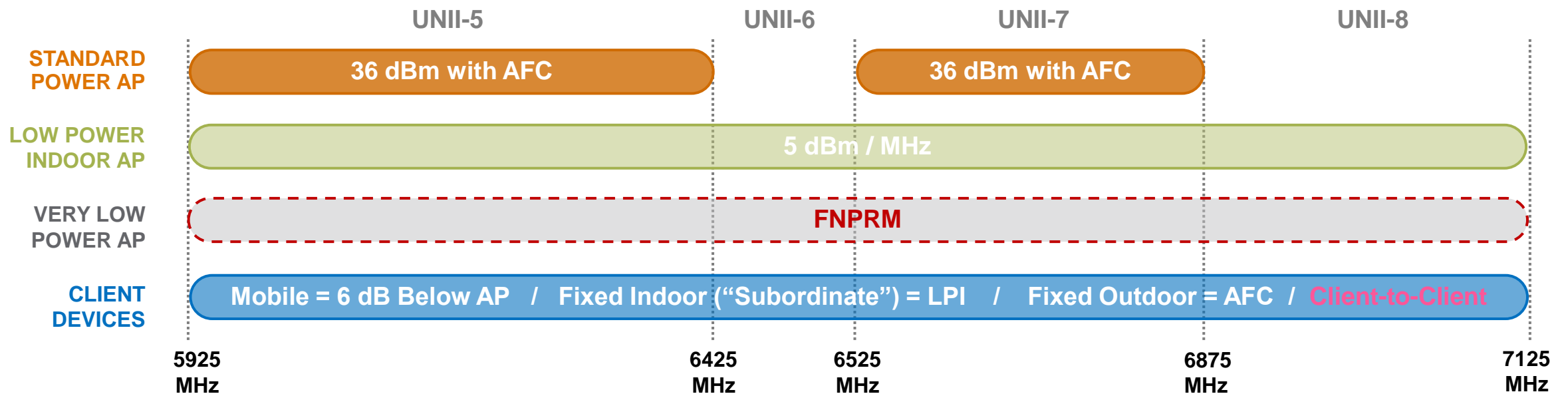


59 x 20 MHz
29 x 40 MHz
14 x 80 MHz
7 x 160 MHz



6 GHz Rules in United States

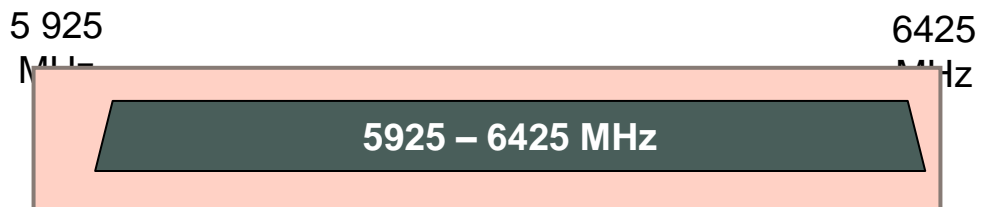
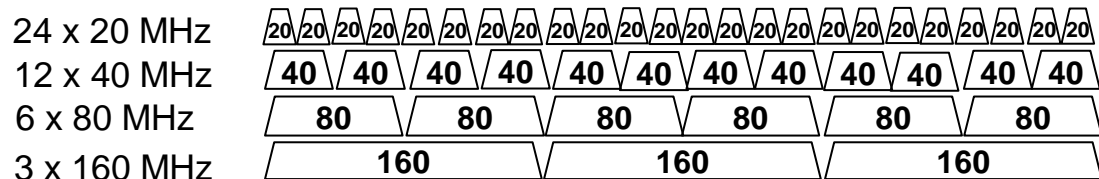
- Indoor low power across the entire band without AFC @ 5 dBm/MHz; Prohibition on connectors
- Automated Frequency Coordination (AFC) required in UNII-5/7 for “full” power indoor and all outdoor APs
- FNPRM on “Very Low Power” class for portable APs and short-range applications, 14 dBm proposed
- Public Notice on Client-to-Client communications



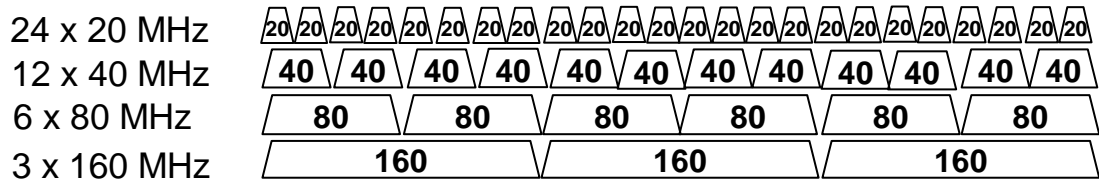
Europe and UK 6 GHz Spectrum & Channel Plan



ECC Decision Q4 2020
EU Decision April 2021

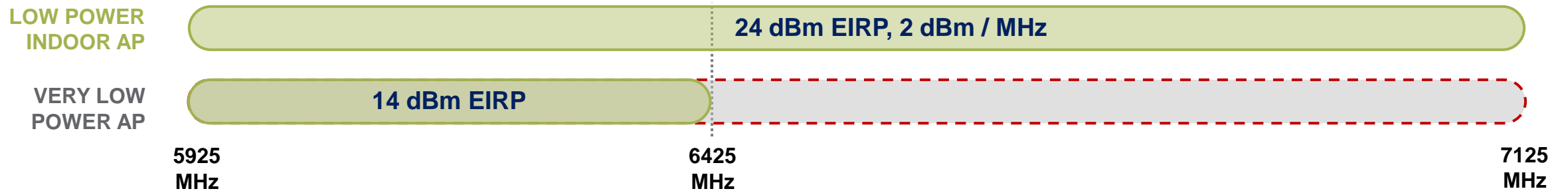


UK Ofcom Decision July 2020
Low Power Indoor 250 mW EIRP
Very Lower Power 25 mW EIRP



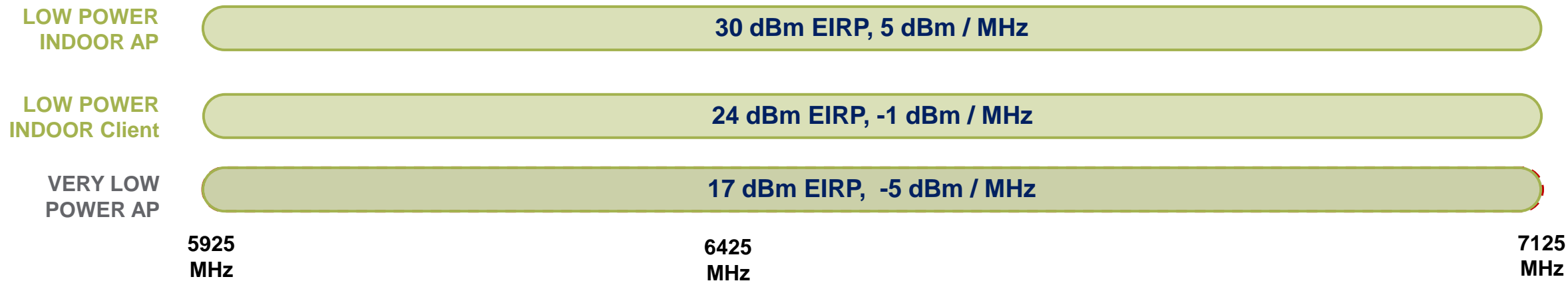
Korea

- Low Power Indoor across the entire band (5925 – 7125 MHz) at 24 dBm EIRP and 2dBm / MHz PSD
- Very Low Power in lower portion of band (5925 – 6425 MHz) at 14 dBm EIRP
- Further study for VLP in 6425-7125 MHz, higher power LPI, and Standard Power with KFC

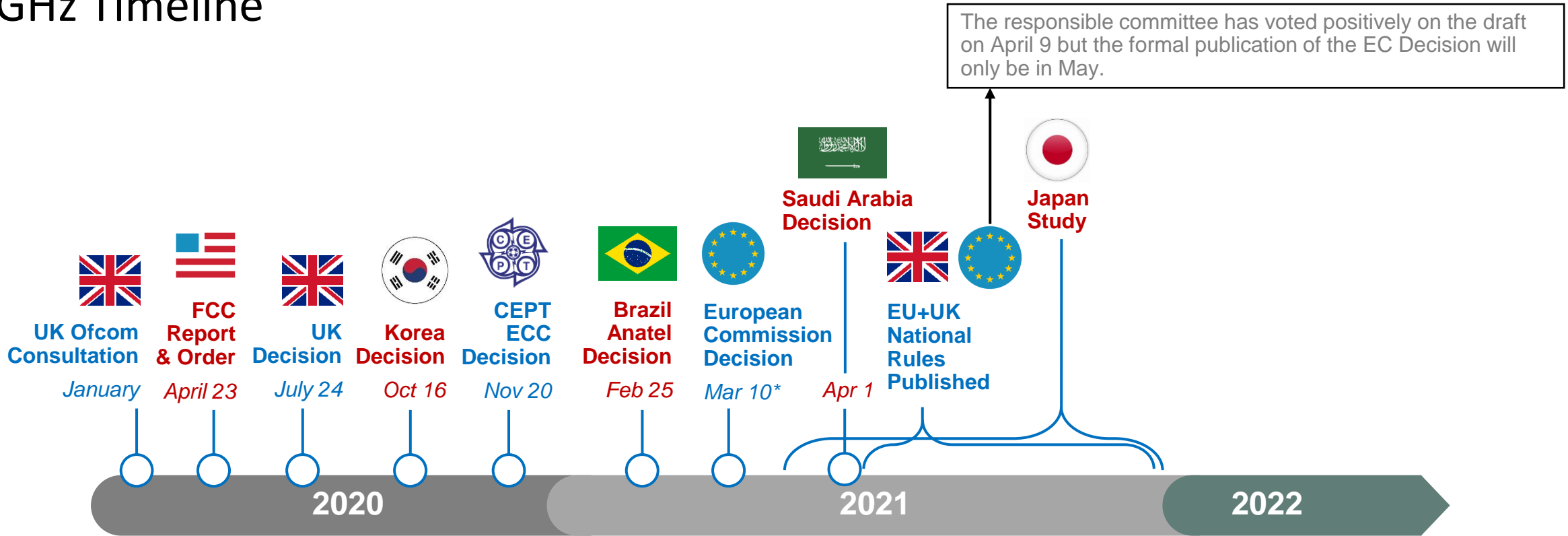


Brazil

- Low Power Indoor across the entire band (5925 – 7125 MHz) at 30 dBm EIRP and 5 dBm / MHz PSD
- Very Low Power across the entire band (5925 – 7125 MHz) at 17 dBm EIRP and -5 dBm / MHz PSD
- Further study for Standard Power



6 GHz Timeline



Other country decisions:

- Chile
- Guatemala
- United Arab Emirates

Public Consultations / RFIs Issued By:

- Australia
- Canada
- Colombia
- Costa Rica
- Honduras
- Japan
- Jordan
- Mexico
- Peru
- Qatar
- Taiwan

Rationale for 1200 MHz

1. Global Harmonization
 - US, Korea, Brazil and several other countries have **already decided to make 5925 – 7125 MHz available for license exempt usage**
 - No possibility for a globally harmonized IMT band for 6425 – 7125 MHz (WRC 19 & WRC 23)
2. Spectrum Needs studies project that mid-band unlicensed spectrum shortfalls of between 700 and 1500 MHz will occur in the 2025 timeframe
3. The current 802.11ax standard (basis for Wi-Fi 6E) defines bandwidth modes of 160 MHz; Providing sufficient spectrum for **7 non-overlapping 160 MHz channels** greatly enhances the opportunity for innovative usages (low latency, high throughput) that drive increased consumer value
4. In many countries / geographies license exempt RLAN usage can be regulated to accommodate effective sharing with incumbents (typically FS and FSS) to **realize the full economic benefit NOW.**
5. 6 GHz capable Wi-Fi equipment (e.g. Wi-Fi 6E equipment) will most likely ship with capabilities to cover the entire band (up to 7125 MHz). Products will not operate in those portions of the band not permitted for any country that only open a subset of the band; **the consumer value generated will be reduced.**

Brief History of IMT 6 GHz

APG19-5 IMT 6 GHz

At APG19-5, the following proposal was proposed on new IMT related agenda item for WRC-23

- Studies on frequency-related matters for identification of International Mobile Telecommunications in the frequency range of 5 925-7 125 MHz, or part thereof, for the future development of International Mobile Telecommunications for 2020 and beyond.



At APG 19-5, APT Members carefully examined this proposal and agreed this proposal in the frequency range **7025 - 7125 MHz** on WRC-19 Agenda Item 10.

WRC-19

- **Declined the proposal for IMT in 6 GHz**
- **WRC -23 Agenda Item 1.2 only allow the study as follow:**
 - Consider the identification for IMT of the following frequency bands:
 - 3 300-3 400 MHz(sub-Reg.1 & Reg.2),
 - 3 600-3 800 MHz(Reg.2),
 - 6 425-7 025 MHz(Reg.1),
 - 7 025-7 125 MHz(globally) and
 - 10.0-10.5 GHz(Reg.2)



THANK YOU

Worapat Patram