Hewlett Packard Enterprise

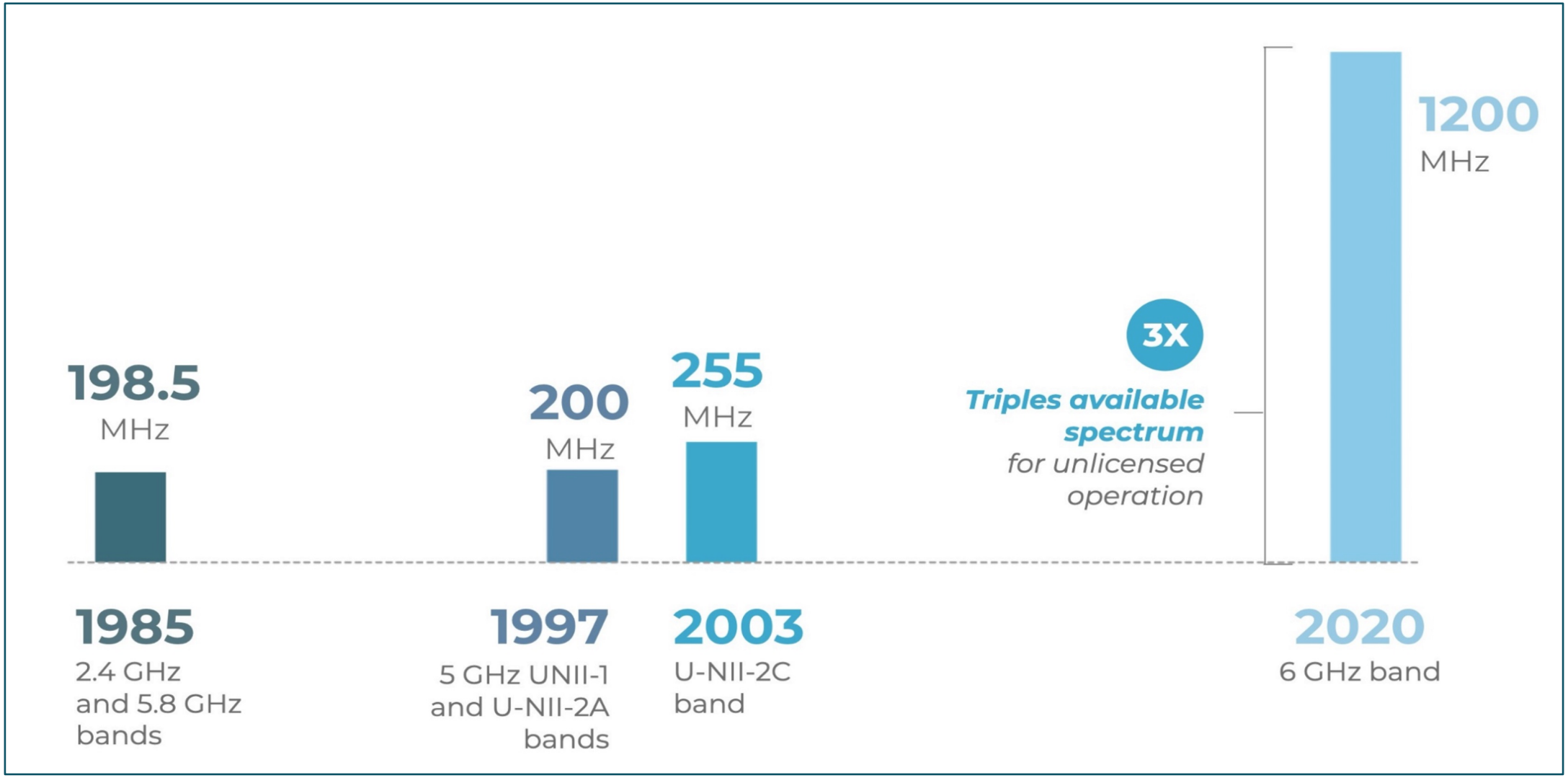
6 GHz Wi-Fi (Wi-Fi 6E)
Unlocking NextGen Broadband

Dave Wright
Head of Global Wireless Policy

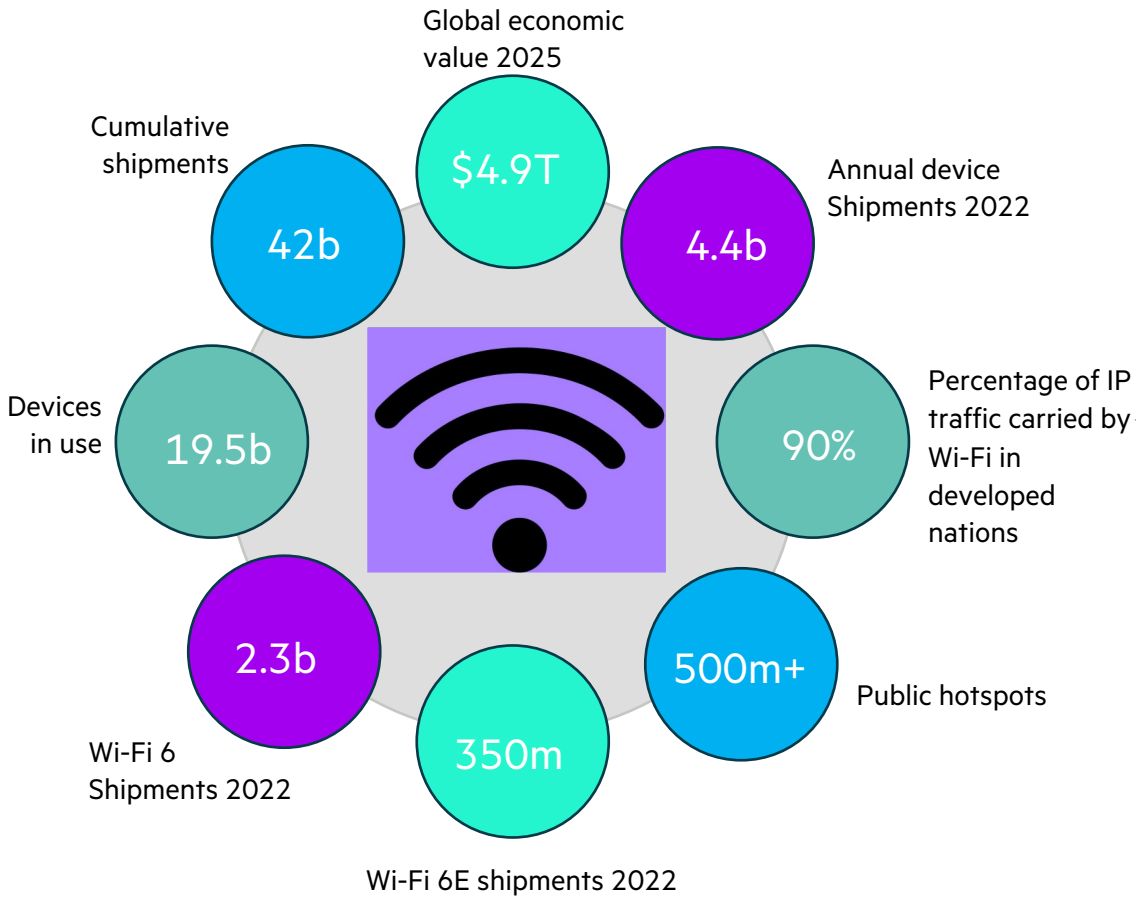
March 28, 2023

Wi-Fi: We've done so much... with so little... for so long

There had been no significant mid-band spectrum allocations for almost 20 years



Wi-Fi: The World's Most Successful Wireless Technology



Wi-Fi sits at the edge of EVERY type of broadband connection – fiber, cable, fixed 5G, satellite, enterprise ethernet

Sources: Dynamic Spectrum Alliance, Wi-Fi Alliance

Wide Channel Bandwidths

Critical to both Next Generation Wi-Fi and Cellular

IEEE

Wi-Fi 4 Maximum Channel Bandwidth

40 MHz

Wi-Fi 5, 6, and 6E Maximum Channel Bandwidth*

160 MHz

Wi-Fi 7 Maximum Channel Bandwidth

320 MHz

*While the Wi-Fi 5 and 6 standards support 160 MHz channels, they are impractical [for enterprise deployments] in the 2.4 GHz and 5 GHz bands.

3GPP A GLOBAL INITIATIVE

4G LTE Maximum Carrier Bandwidth

20 MHz

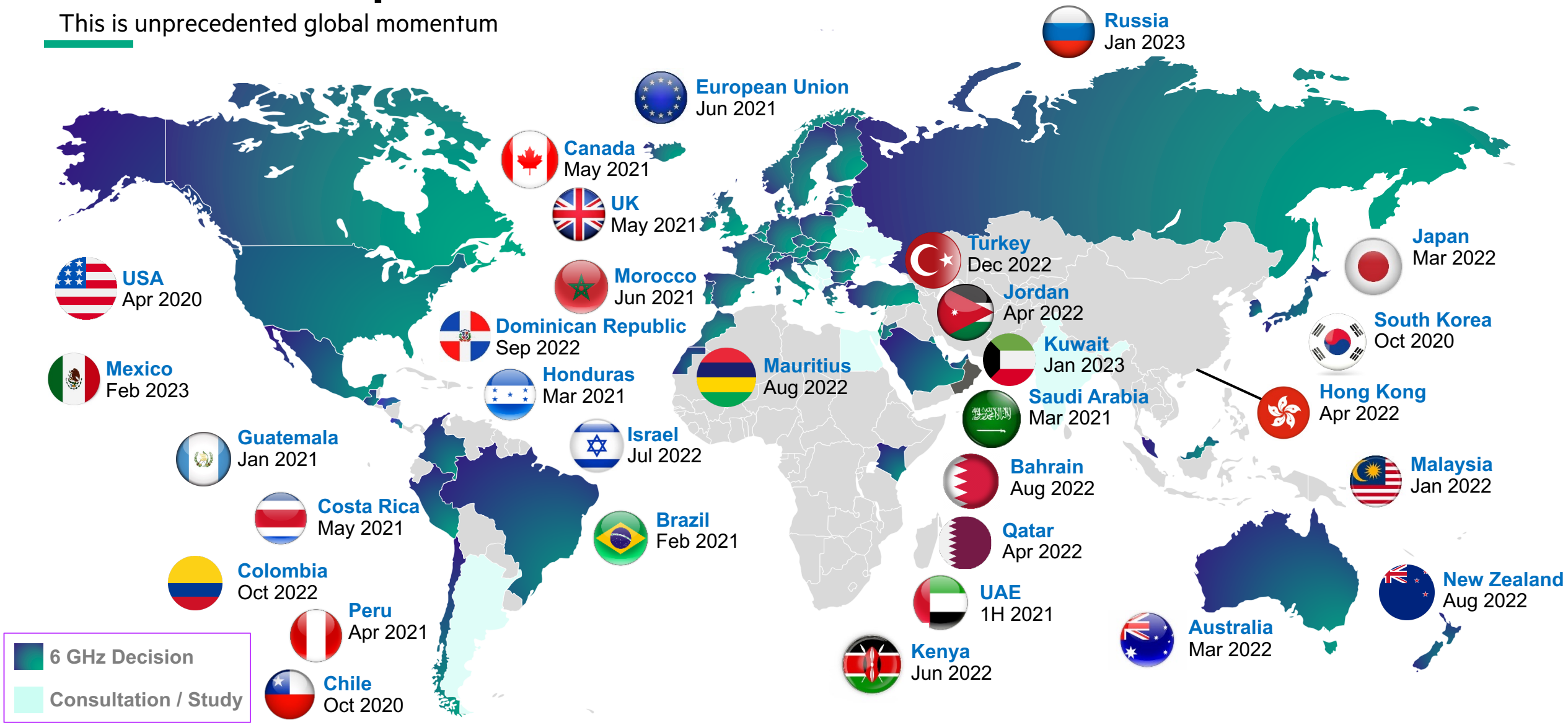
5G NR Maximum Carrier Bandwidth

100 MHz

"Regulators should aim to make available 80-100 MHz of contiguous spectrum per operator"
5G and the 3.3-3.8 GHz Range in Latin America, GSMA, November 2020

6 GHz License Exempt Decisions

This is unprecedented global momentum



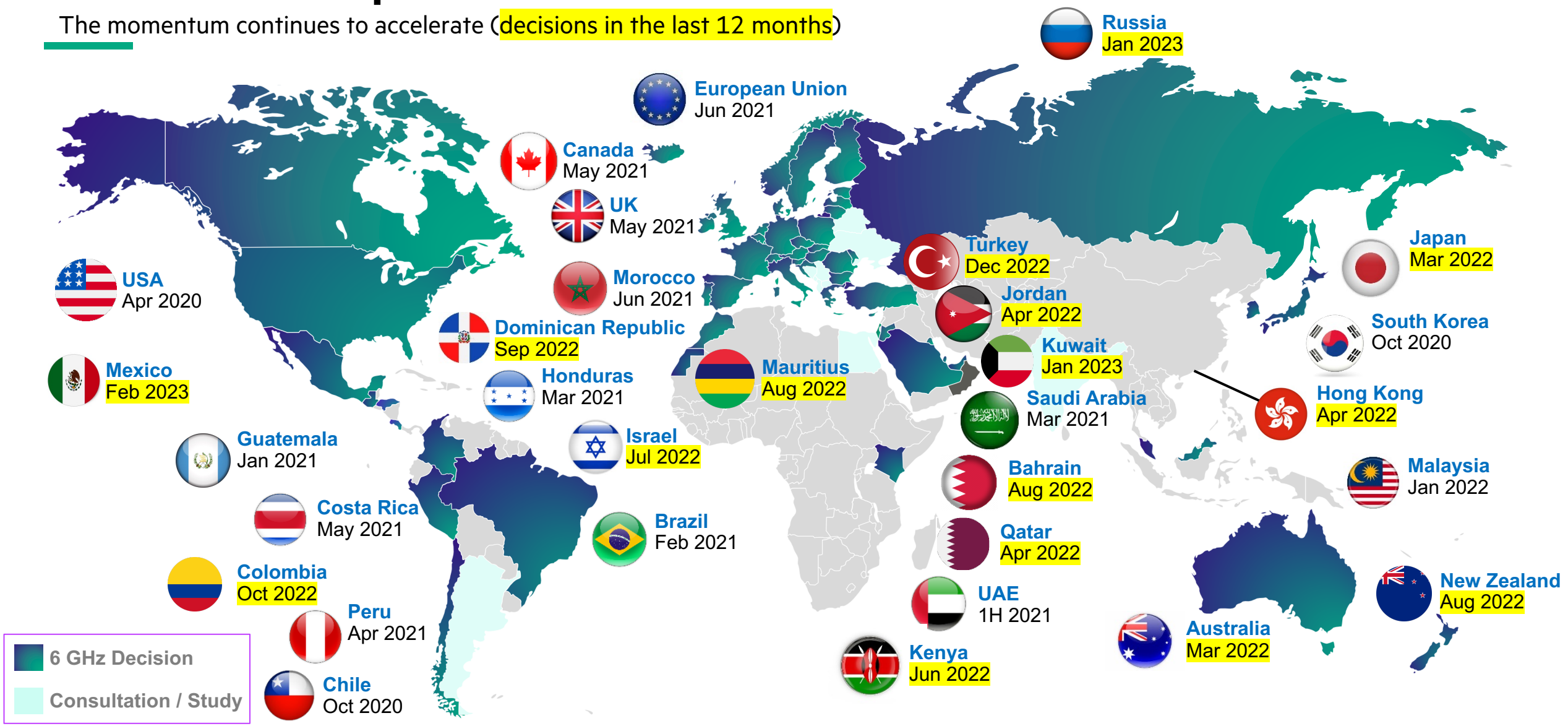
62 Countries

As of 22 March 2023

over 2B Citizens

6 GHz License Exempt Decisions

The momentum continues to accelerate (decisions in the last 12 months)



62 Countries
As of 22 March 2023

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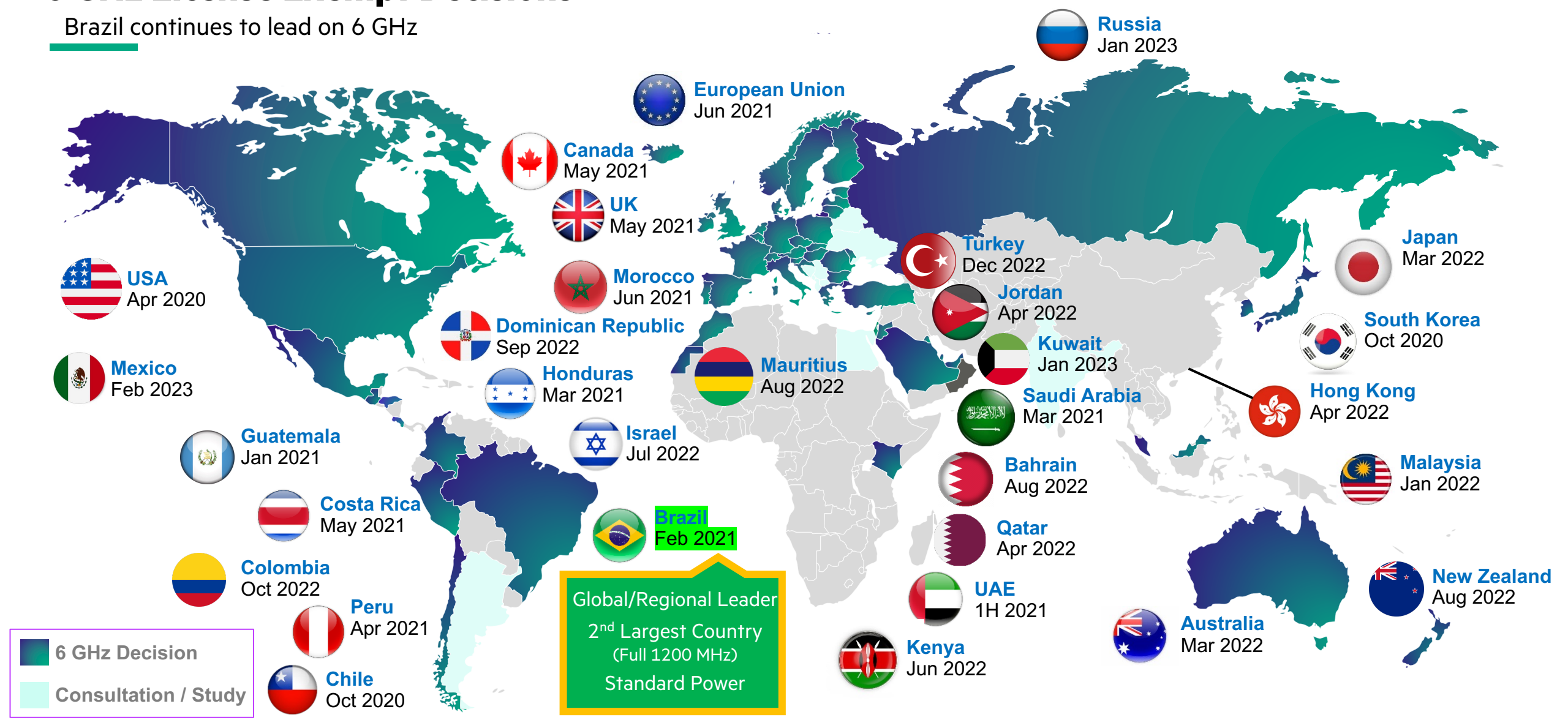
6 GHz License Exempt Decisions

Brazil continues to lead on 6 GHz



62 Countries
As of 22 March 2023

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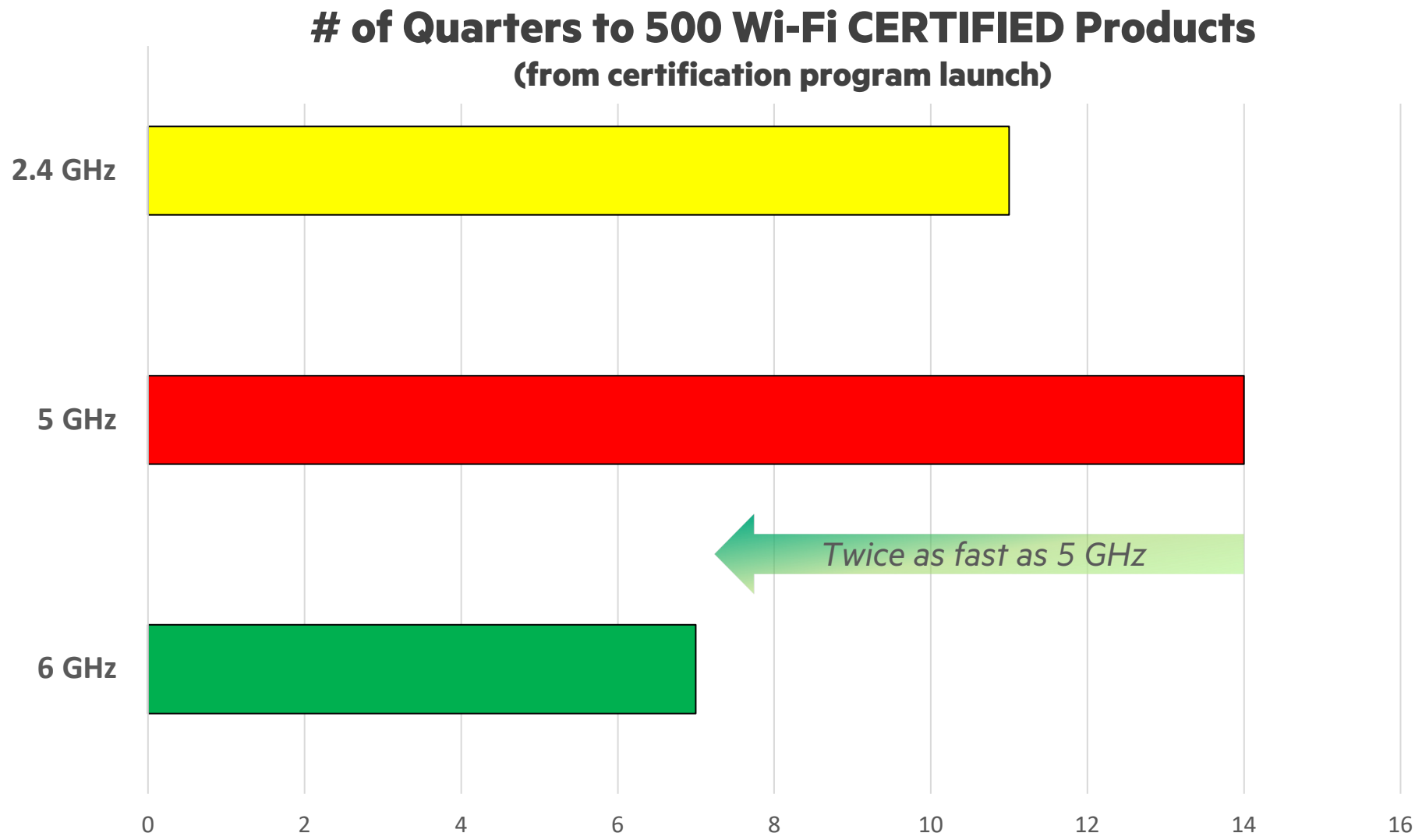
Wi-Fi 6E Equipment Ecosystem

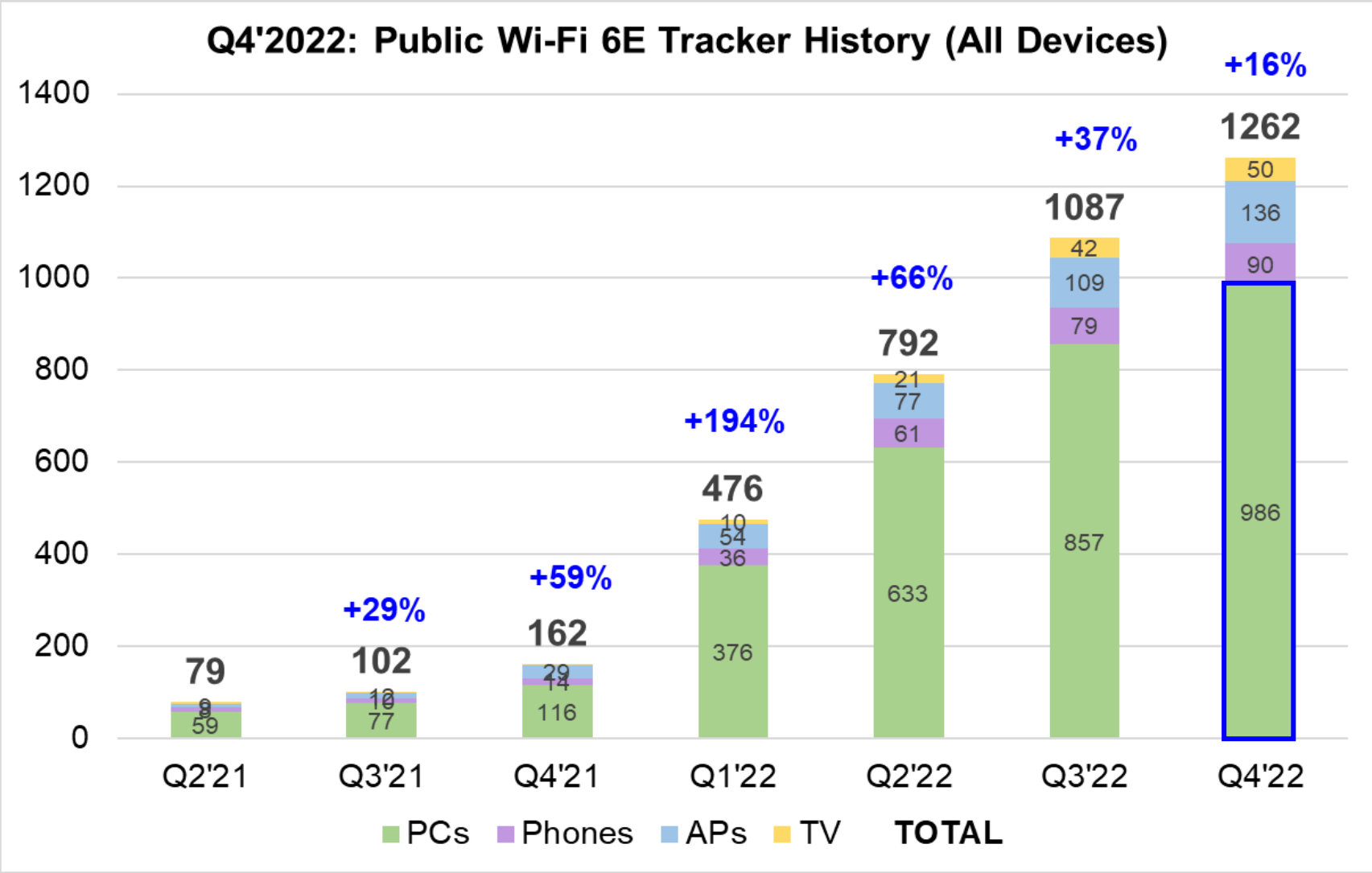
Growing far faster than predecessors



Source: Wi-Fi Alliance®

Wi-Fi 6E Equipment Ecosystem

New devices coming to market quickly



"The Wi-Fi 6E device tracking summary is public information compiled by Intel from vendor websites, press releases, and third-party device reviews. Intel provides this assessment for informational purposes only, does not guarantee its accuracy, and it is subject to change without notice."

Aruba AP Portfolio – Indoor, Outdoor, Specialty

6 GHz (Wi-Fi 6E) Indoor Family available now, 6E Outdoor and Specialty coming when Standard Power/AFC approved

Wi-Fi 6E Indoor (6 GHz)

610 Series

630 Series

650 Series

Wi-Fi 6 Indoor

500 Series

510 Series

530 Series

550 Series

Wi-Fi 6 Hospitality

500H Series

Wi-Fi 6 Outdoor & Hazardous Locations

518 Series

560 Series

570 Series

560EX Series

570EX Series

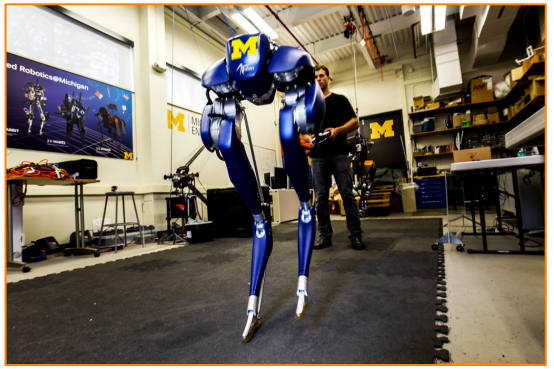
580 & 580EX Series

Some Significant Wi-Fi 6E Deployments and Use Cases

The University of Michigan has deployed more than 16,000 Wi-Fi 6E APs across two campuses. The University now has the “ability to move an enormous amount of data, the ability to have 400 or 500 students in a classroom potentially connected via Zoom, sharing their screens and recording movies and all the projects they need to do simultaneously.”

Dr. Ravi Pendse, Vice President and Chief Information Officer

UNIVERSITY OF MICHIGAN



HENRY FORD HEALTH℠

At Henry Ford Health Wi-Fi 6E opens ”a whole new highway for advanced applications”, using all new technology (no legacy Wi-Fi) and technology that is “inherently more secure” than prior generations. Wi-Fi 6E opens the door to “the hospital at home” where hospital beds can be physically in a patient’s home, new uses of voice technology in the hospital, and a much richer and more intense use of video technologies in the clinical setting, including patient monitoring.

Ali Youssef, Director of Medical Devices and IoT Security

“The Warriors are obsessed with creating world class experiences, and providing fast, reliable connectivity for sold out crowds of 18,000+ fans at games and events at Chase Center is an incredibly important part of that. With the addition of Wi-Fi 6E Access Points in the arena bowl, we can provide fans a more immersive experience that we believe is unmatched by any other professional sporting venue.”

Brandon Schneider, Warriors President and Chief Operating Officer

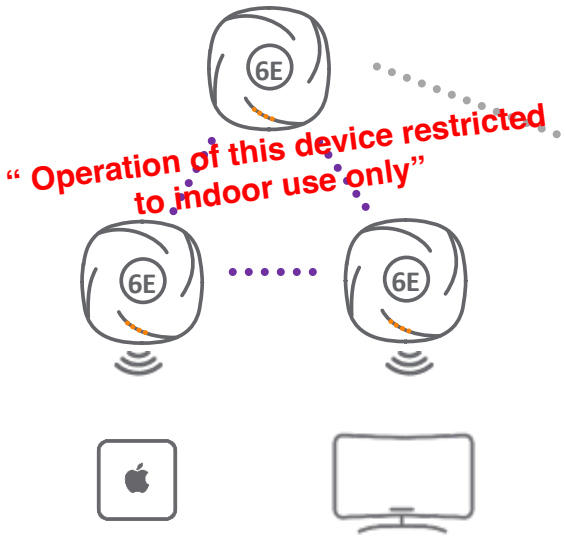
CHASE CENTER

Wi-Fi 6E Device Classes

Different use cases and methods to protect incumbents

Low Power Indoor (LPI) AP

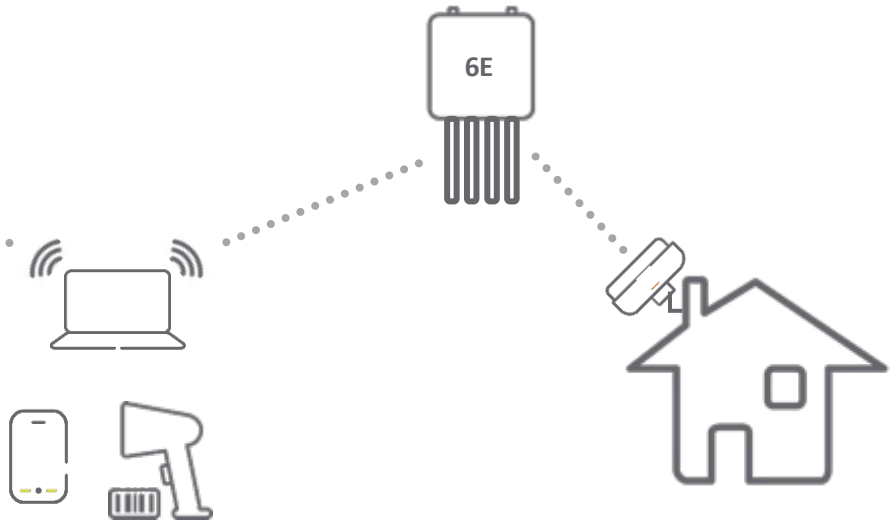
- Fixed indoor only
- **250mW EIRP** for 80 MHz Ch*
  - Up to 63X lower energy (than SP)
- Integrated antennas
- No weatherproofing
- Wired power, labeled for Indoor Use Only



*LPI EIRP is a function of channel width (fixed 5 dBm/MHz PSD)

Standard Power (SP) AP

- Fixed indoor / outdoor
- Up to **4W EIRP** (pending)
- Coordinated by AFC database
- Requires geolocation
- Elevation angle restriction

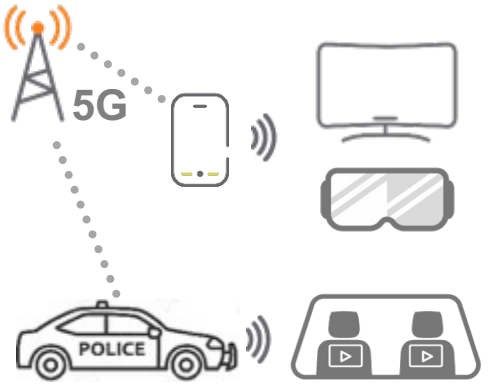


Client Devices

- Indoor / outdoor
- 4X less power than connected AP

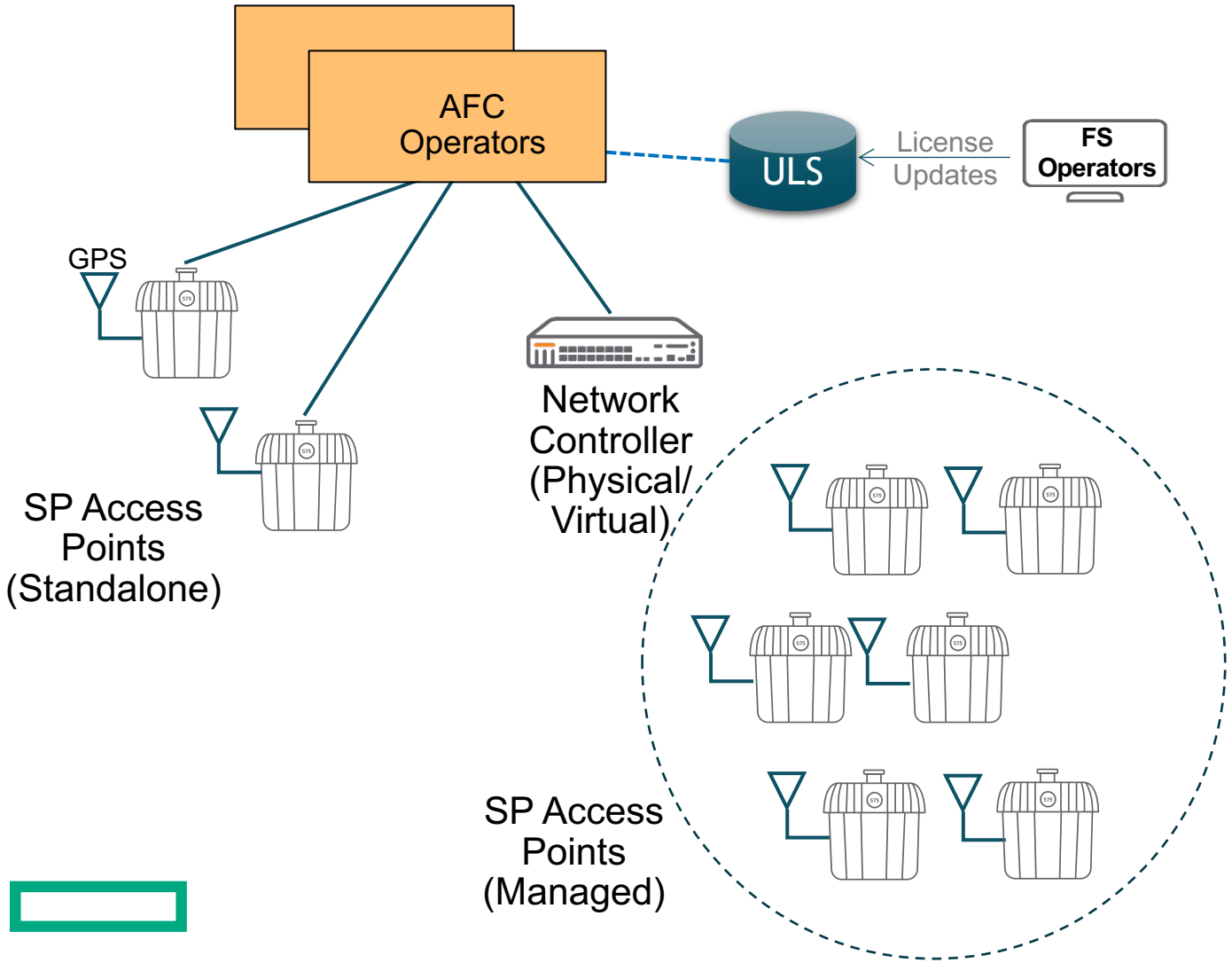
Very Low Power (VLP) AP

- Mobile indoor / outdoor
- **50mW EIRP**
  - 80X lower energy (than SP)
- Personal Area / In-Vehicle



6 GHz Standard Power with Automated Frequency Coordination (AFC)

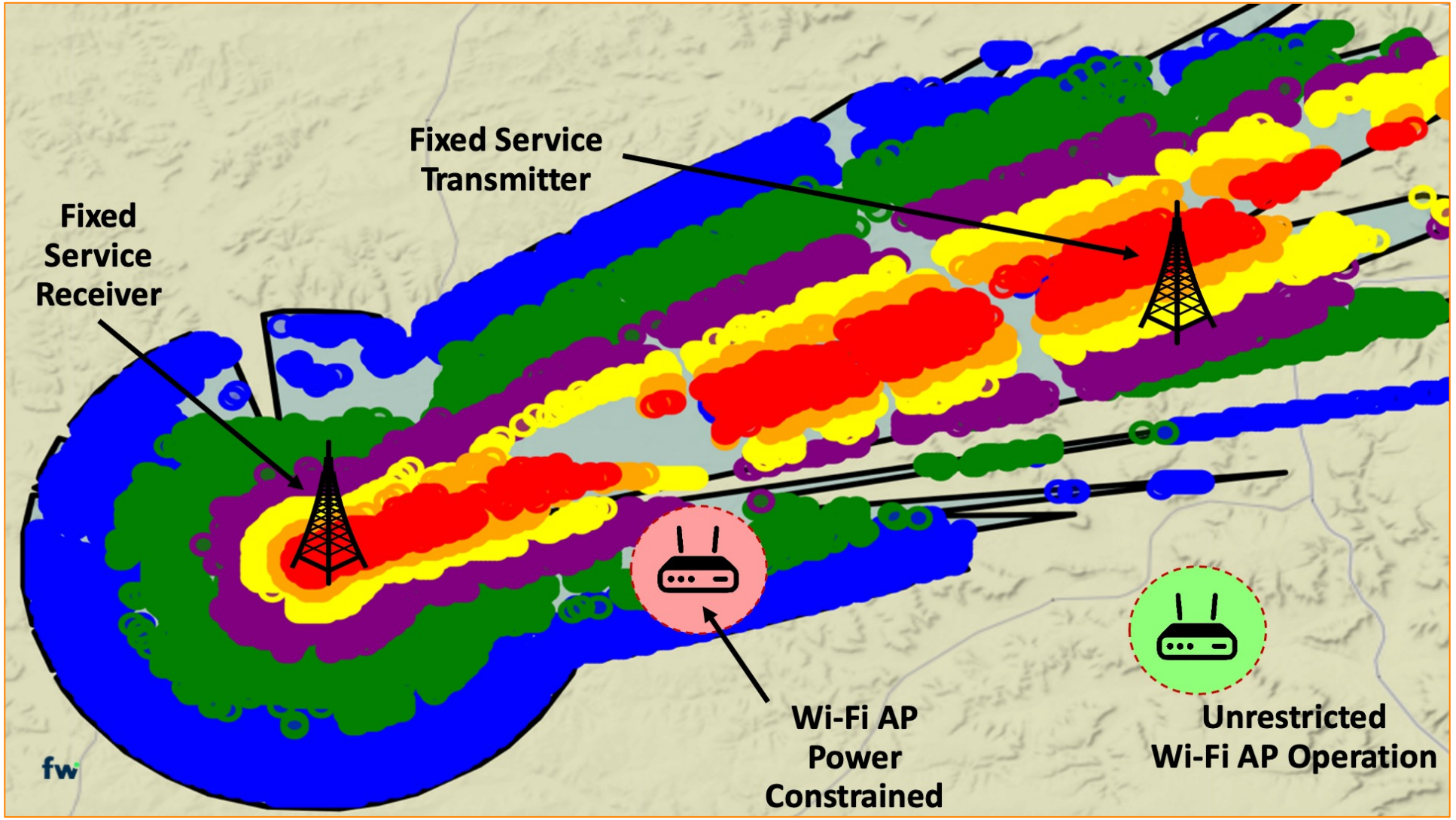
Dynamic Spectrum Management for License Exempt



- Standard Power (SP) Access Points under local or remote management and control
- SP Access Points must provide their geolocation to the AFC
- SP Access Points must request a list of available channels from AFC Operator periodically (every 24 hours in the US)
- Channel availability requests include AP geolocation (with uncertainty estimate), FCCID and AP serial number
- Access Point or Network Controller chooses operating channel(s) and configures APs under its control
- Specifications developed for both Wi-Fi and 5G NR-U Standard Power operations

Incumbent Protection Contours

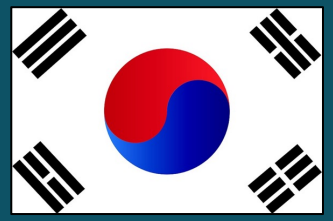
Calculated by AFC using regulatory parameters



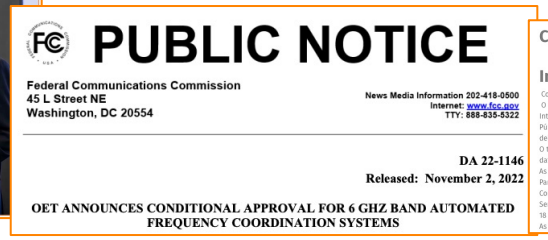
6 GHz Standard Power with AFC

Taking Dynamic Spectrum Management global

Automated Frequency Coordination (AFC)



ECC Work Item underway on Higher Power RLANs with Database coordination



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Internet: www.fcc.gov
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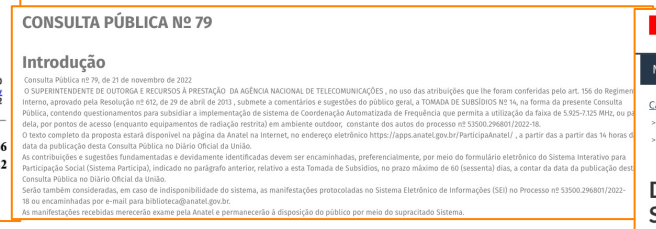
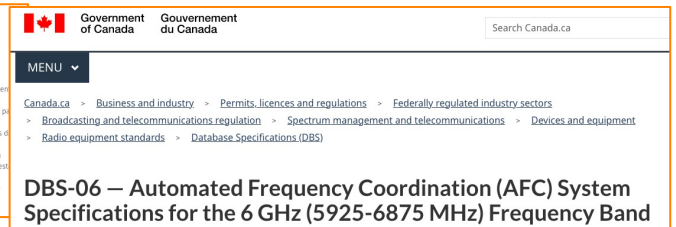
DA 22-1146
Released: November 2, 2022

OET ANNOUNCES CONDITIONAL APPROVAL FOR 6 GHZ BAND AUTOMATED FREQUENCY COORDINATION SYSTEMS



CONSULTA PÚBLICA Nº 79

Introdução



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MENU

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DBS-06 — Automated Frequency Coordination (AFC) System Specifications for the 6 GHz (5925-6875 MHz) Frequency Band

Recent Milestones

August 2022 - Riyadh, Saudi Arabia

Aruba and Federated Wireless conduct world's first end-to-end demonstration hosted by CST, KSA

November 2022

The US FCC conditionally approves 13 AFC operators for testing & certification

November 2022

Anatel, Brazil, issues consultation on AFC system and Standard Power device operation

December 2022

ISED, Canada, issues specifications for AFC operation and Standard Power devices

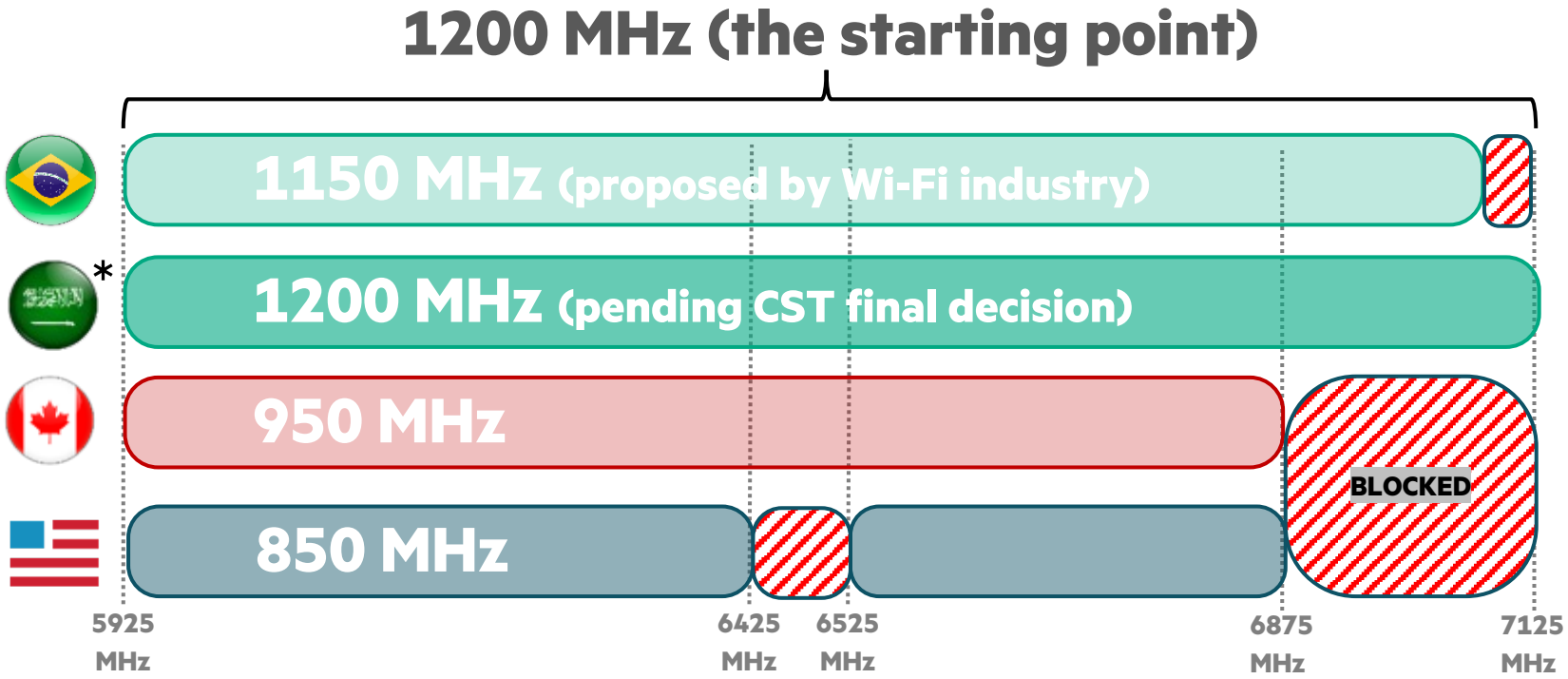
March 2023

FCC OET issues draft rules for Standard Power equipment approval process

Standard Power needs 1200 MHz

All of the countries that are acting on Standard Power allocated the full band

Automated Frequency Coordination (AFC) determines RLAN channel/frequency & power availability from an overall range or “pool” – while protecting incumbent operations. In any location some channels within this range will likely be blocked or constrained by incumbent uses.



Essential for:

Enhanced Indoor Broadband Coverage, Transport/Logistics, Manufacturing, Agricultural, Rural Broadband, Campus (Education, Hospitality, Enterprise), and Municipal.

*CST Saudi Arabia used the entire 5925-7125 MHz range for the AFC demonstration that Aruba and Federated Wireless conducted on 3 August 2022. The final rules for Standard Power in the Kingdom of Saudi Arabia are forthcoming.

6 GHz Standard Power with AFC

Industry Specifications – Wi-Fi Alliance

Compliance Specification/Harness	Description https://www.wi-fi.org/file/afc-specification-and-test-plans
AFC System to AFC Device Interface Specification	Provides interface specifications between an AFC System (SUT) and an AFC Device (DUT), including the generic message structure which can accommodate both vendor-specific extensions and future standardized extensions to baseline signaling protocols.
AFC System Under Test (SUT) Compliance Test Plan	Provides a compliance test program for the AFC System (SUT) that uses location information reported from an AFC Device, cross referencing it against a universal licensing system database and delivers instructions back to the AFC Device on allowable channels and maximum permissible power levels it may use.

• **AFC SUT Test Vectors**
  • **Requests available**
  • **Response TBD**
	Provides the AFC System Test Vectors to complement Wi-Fi Alliance AFC System (SUT) Compliance Test Plan (SUT Test Plan). These test vectors have been developed to validate compliance with regulatory requirements associated with Test Cases described in the SUT Test Plan.

AFC Device Under Test (DUT) Compliance Test Plan	Provides a compliance test program/methodology for an AFC Device (Access Point) communication with an AFC System, including location information it must report to the AFC System, and in turn implement the instructions received from the AFC System.
• **AFC DUT Test Vectors**	AFC Device Compliance Test Vectors to complement Wi-Fi Alliance AFC Device (DUT) Compliance Test Plans. The test vectors are developed to cover compliance relevant to different test groups as identified with Test Case IDs and listed in the SUT test plans.
AFC DUT Test Harness (SUT by WInnForum)	Command line utility for testing AFC device; Implements mandatory and conditionally required SDI protocol primitives.

6 GHz Standard Power with AFC

Industry Specifications – Wireless Innovation Forum (WInnForum)

The WInnForum 6 GHz Committee has developed standards and reports related to:

- Defining:
  - Interference Protection Criteria
  - Propagation Modeling
  - Spectrum Occupancy Determination
- Developing a Security Threat Assessment
- Identifying AFC Requirements for Incumbent Protection

https://6ghz.wirelessinnovation.org/baseline-standards

Note: Not all unlicensed technology in the 6 GHz band will be based on IEEE 802.11. WinnForum has addressed that gap for non-Wi-Fi technologies (e.g. 5G NR-Unlicensed [NR-U])

6 GHz Standard Power and AFC Resources

Aruba and Federated Wireless blog posts:

Aruba Leads the Way on Wi-Fi 6E Standard Power!
The Global Race to Authorize Wi-Fi 6E Standard Power and AFC
Automated Frequency Coordination is Ready to Launch High Power Wi-Fi 6E Globally

Video:

Automated Frequency Coordination (AFC) for Wi-Fi 6E in Action

Other Resources:

Intel AFC Whitepaper
Wi-Fi Alliance AFC System-to-Device Interface (SDI) Specification

Obrigado!

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