

The economic contribution of license-exempt spectrum



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THE HISTORY AND STATE OF AFFAIRS OF UNLICENSED SPECTRUM

1938: The use of devices on unlicensed spectrum was authorized first on a case-by-case in the US

1985: US eliminated the process of case-by-case approval, set forth technical criteria, and opened up 900 MHz, 2.4 GHz, and 5.8 GHz bands

2003: ITU recommends the use of the 5 GHz band for unlicensed use

Countries that have allowed the full use of the 6 GHz band

Argentina, Brazil, Canada, Colombia, C. Rica, Dominican R., El Salvador, Guatemala, S. Arabia, Peru, S. Korea, United States

Countries that have allowed the lower part of the 6 GHz band

Australia, Bahrain, Belgium, France, Germany, Iceland, Ireland, Japan, Jordan, Malaysia, Mexico, Morocco, Netherlands, Pakistan, Philippines, Portugal, Singapore, S. Africa, Spain, Switzerland, United Kingdom

Countries that are considering extending unlicensed use to other bands

United States

Countries that are considering sharing the higher part of the 6 GHz band

Australia, Austria, Belgium, Brazil, France, Germany, Iceland, Ireland, India, Japan, Netherlands, Portugal, Spain, Switzerland, United Kingdom

INTRINSIC VALUE OF UNLICENSED SPECTRUM AND ITS ECONOMIC CONTRIBUTION

- Factor of production
- Complementary technology
 - A technology that enables the production of another one by lowering manufacturing and distribution costs
 - A technology that addresses bottlenecks in the diffusion and adoption of a second one
- Unlicensed spectrum provides the required environment to enable the development and introduction of innovations, rendering irrelevant any barriers to innovation caused by the need to use licensed spectrum
- Supports the development of innovative business models
- Address the digital divide in broadband coverage

THE ECONOMIC ASSESSMENT OF UNLICENSED SPECTRUM ENCOMPASSES AN ANALYSIS OF USE CASE VALUE BY AREA AND GEOGRAPHY

SOURCES OF VALUE

1. **Free Wi-Fi:** public Wi-Fi Internet access offered for free
2. **Residential Wi-Fi:** support of device connectivity at home
3. **Enterprise Wi-Fi:** support of device connectivity in enterprises
4. **ISPs:** public Wi-Fi sold for a fee and savings from Wi-Fi routing of cellular traffic
5. **Wi-Fi ecosystem:** profits from production of Wi-Fi enabled equipment

AREAS OF VALUE

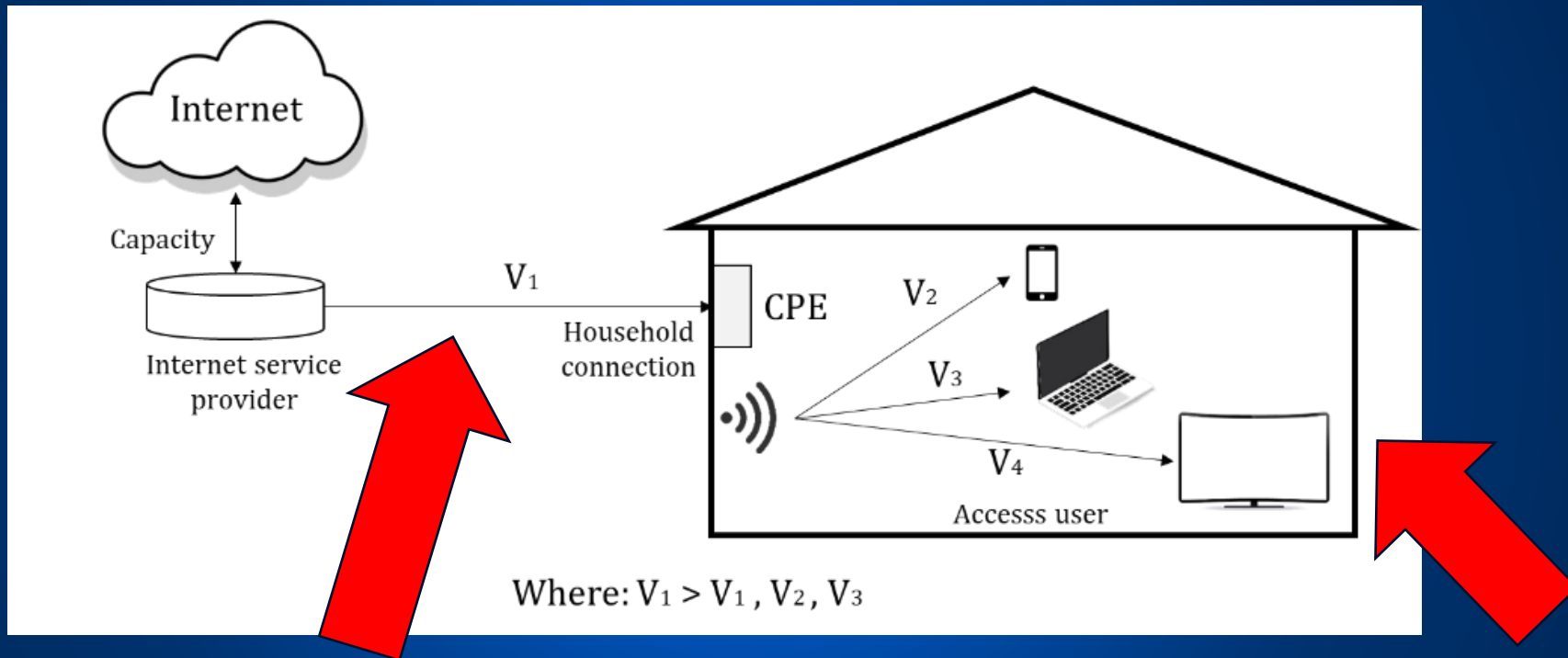
1. **GDP Contribution:** economic growth enabled by Wi-Fi, strictly considering the revenues added “above and beyond” what would have occurred had the Wi-Fi spectrum been licensed.
2. **Producer surplus:** economic profit producers earn by relying on Wi-Fi
3. **Consumer benefit:** amount consumers would be willing to pay to use the Wi-Fi service, compared to what they actually pay

SPECTRUM BANDS

1. **2.4 GHz – 5 GHz:** value in original unlicensed bands and equipment in the Wi-Fi4 and Wi-Fi5 generations
2. **6 GHz:** 1200 MHz used by Standard power access points, Low Power indoor devices, and Very Low Power devices
3. Even launch of additional channels in the 7 GHz band

ONE OF THE CRITICAL SOURCES OF VALUE OF Wi-Fi IS THE ABILITY TO DELIVER CONNECTIVITY TO DEVICES WITHIN THE RESIDENCE

DRIVER OF RESIDENTIAL Wi-Fi VALUE



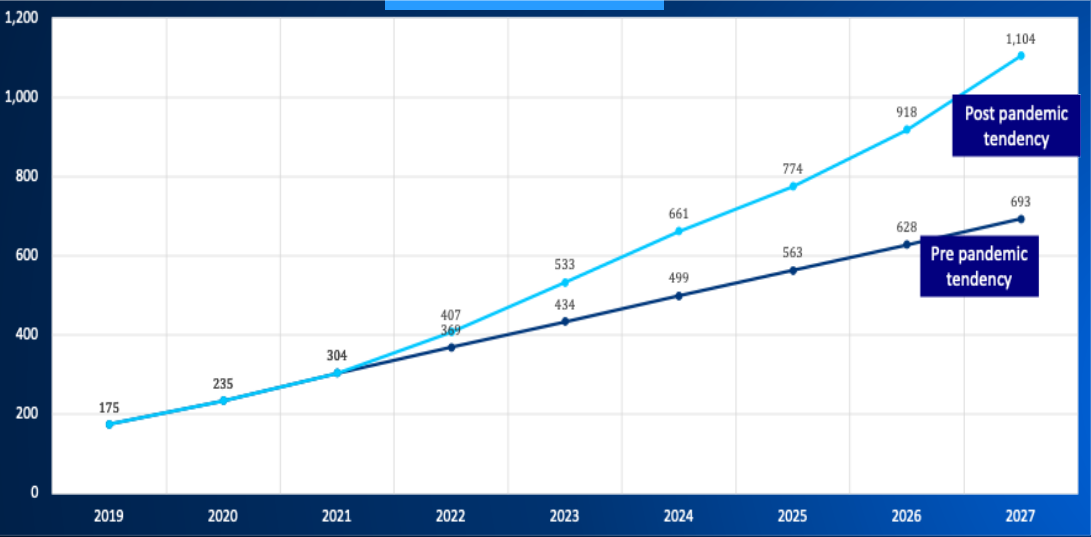
The faster the fixed broadband connection, the more valuable becomes the Wi-Fi CPE (router) that interconnects with user devices

The more user devices that require interconnection, the more valuable becomes the Wi-Fi CPE (router)

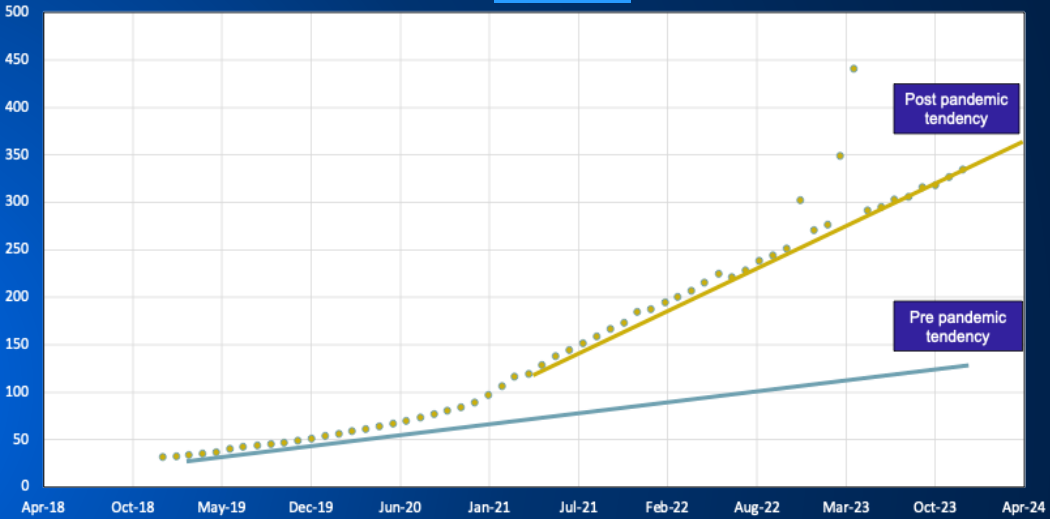
GROWTH IN VALUE OF WI-FI HAS DRIVEN BY AN INFLEXION POINT IN FIXED BROADBAND ADOPTION CAUSED BY THE PANEMIC

AVERAGE FIXED BROADBAND DOWNLOAD SPEED (Mbps)

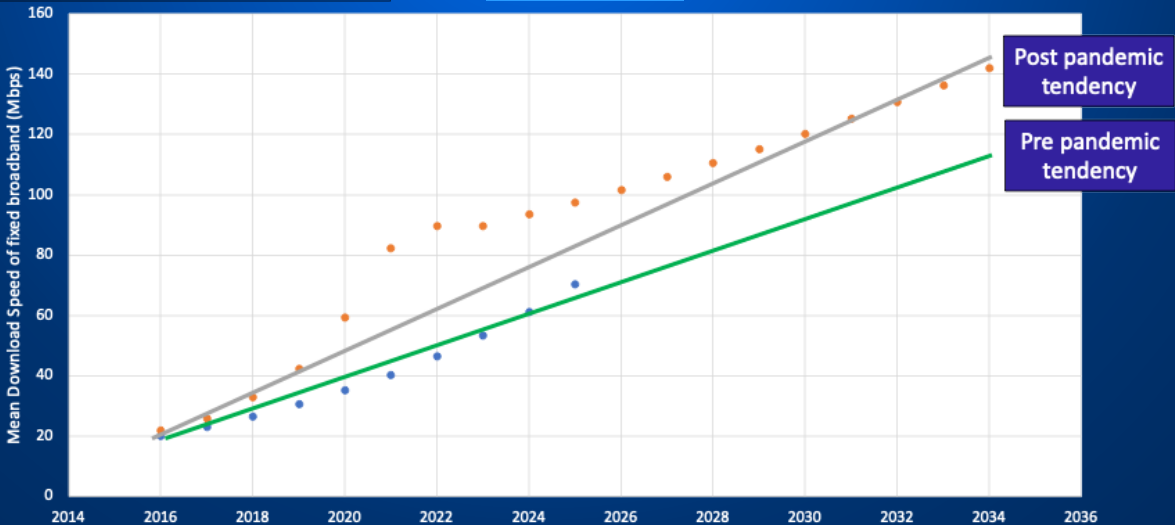
United States



Brazil

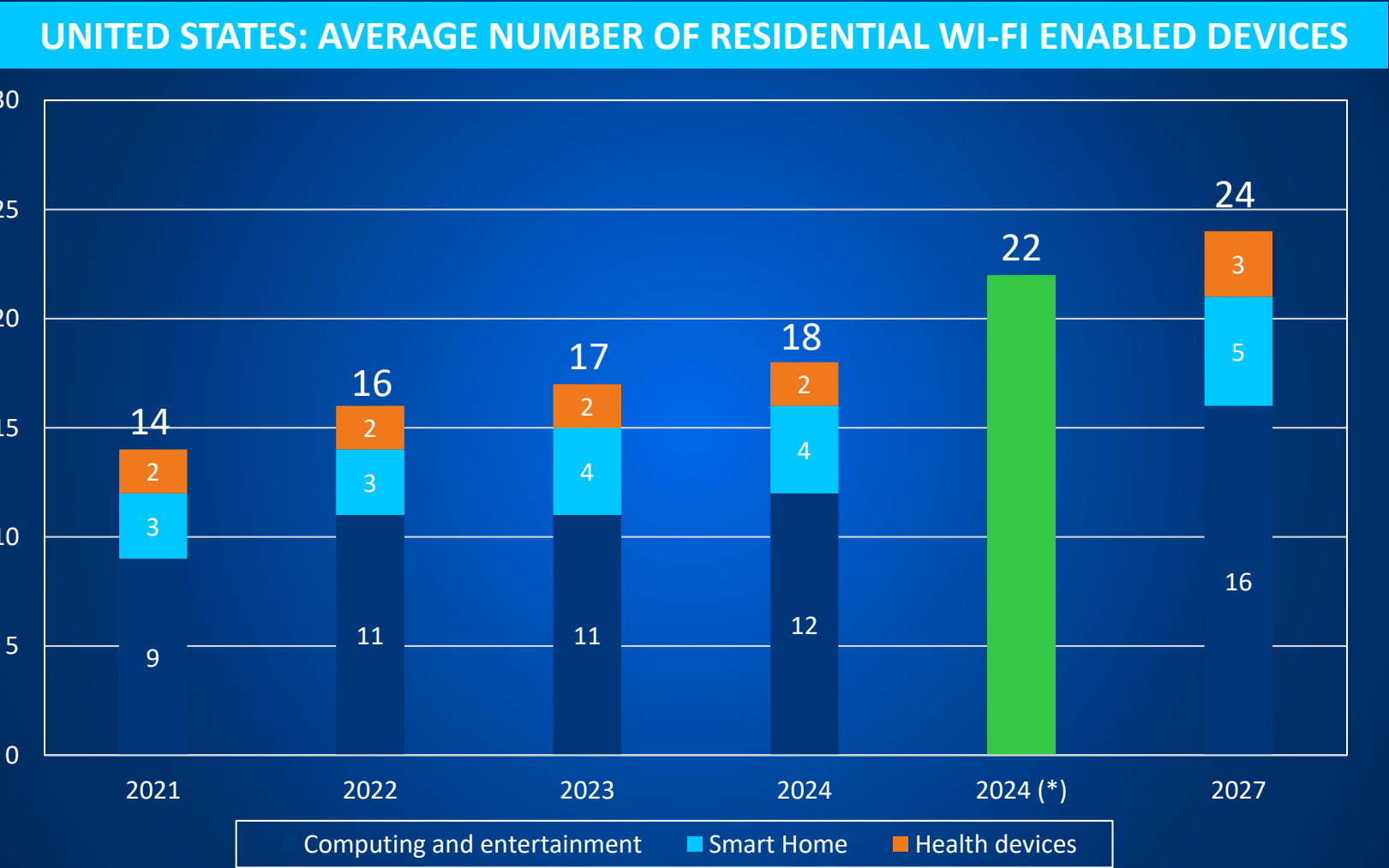


Australia



Sources: FCC; Anatel; ACMA; Telecom Advisory Services analysis

SIMULTANEOUSLY, THE NUMBER OF CONSUMER DEVICES PER HOUSEHOLD HAS JUMPED REFLECTING AN INCREASE IN THE NUMBER OF USDE CASES

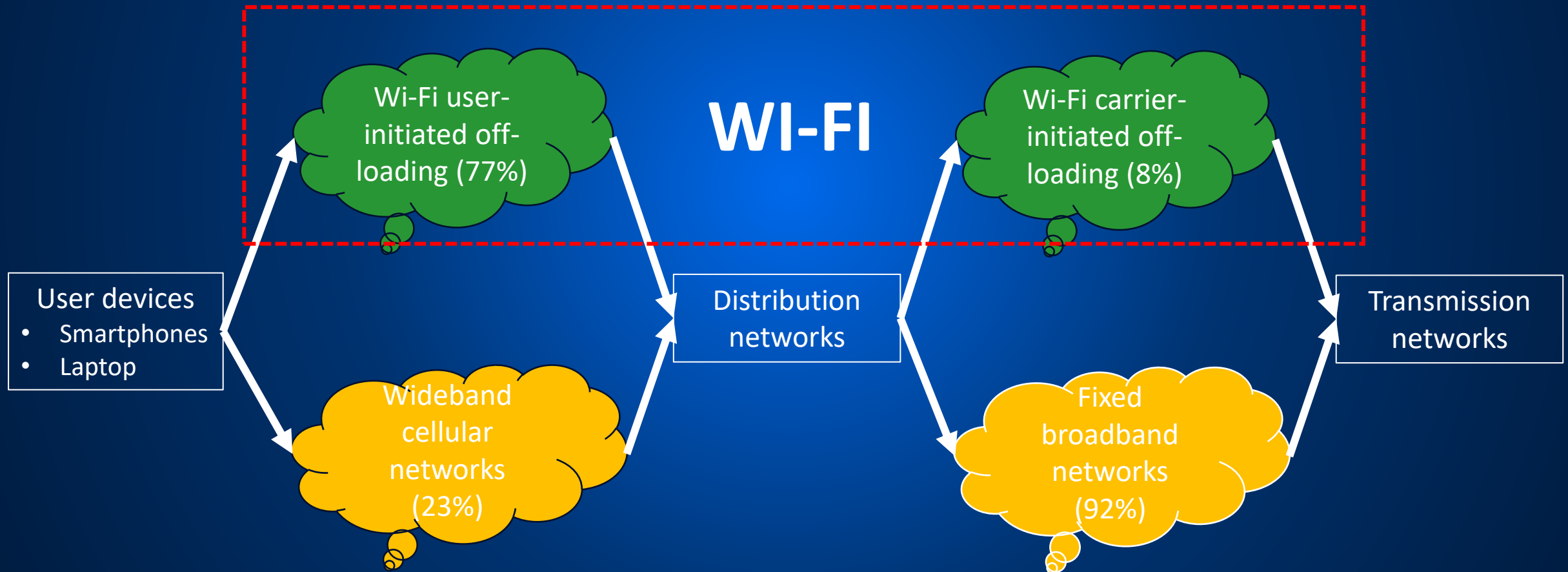


2024 (*) Reported by cable operators

Source: Gruenwedel, E. (2023). “Parks: 92% of U.S. Internet Households Use Wi-Fi at Home”. Media Play News.

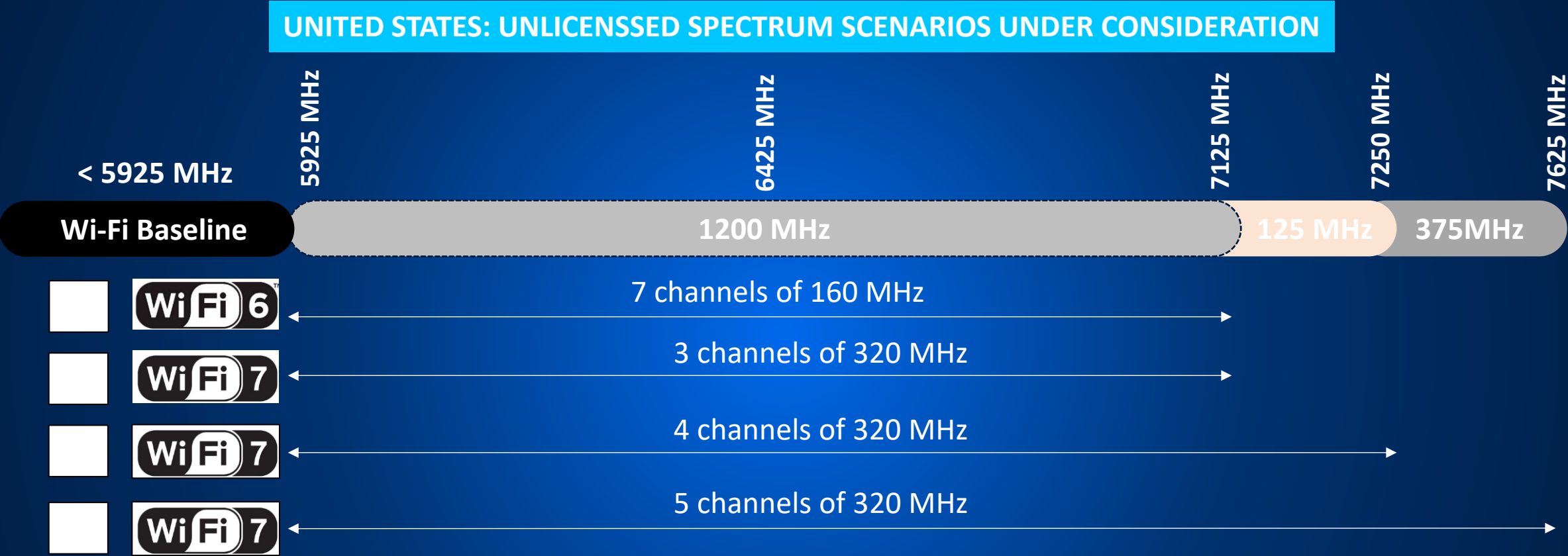
COINCIDENTALLY, WI-FI IS BECOMING A CRITICAL COMPONENT OF TELECOMMUNICATIONS NETWORK ARCHITECTURES

UNITED STATES: WI-FI OFFLOADING RATIOS



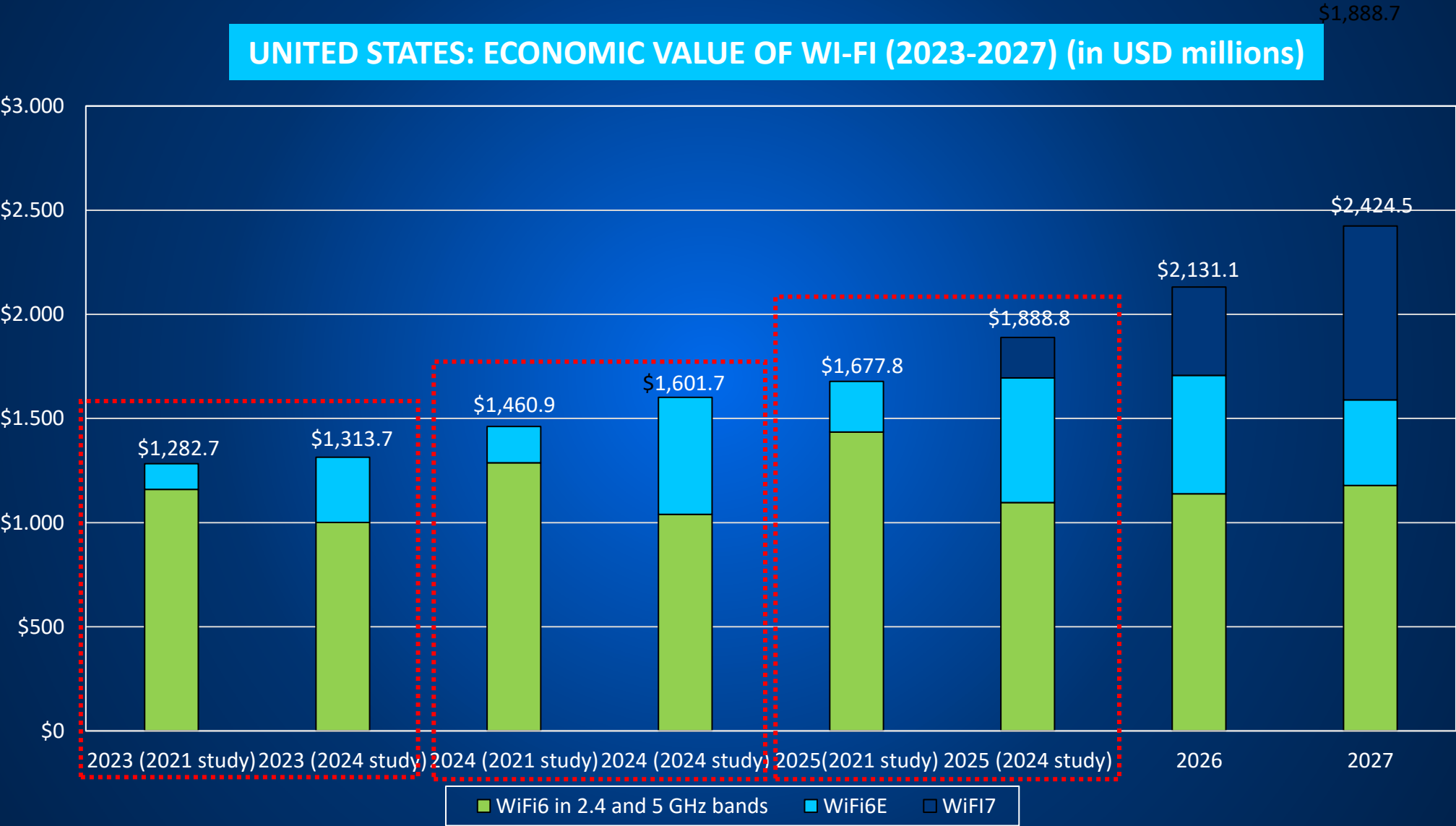
Source: Telecom Advisory Services

RECOGNIZING THE VALUE OF Wi-Fi, REGULATORS HAVE BEEN EXPLORING WI-FI ALLOCATION
OPTIONS: THE UNITED STATES IS CONSIDERING MOVING FROM 6 GHz INTO 7 GHz



- Scenario a:** Improvement due to Wi-Fi 6E (effect already ongoing)
- Scenario b:** Improvement due to technological change from Wi-Fi 6E to Wi-Fi 7 on the same band
- Scenario c:** Enhancement by increasing spectrum (125 MHz)
- Scenario d:** Improvement by a second increase in spectrum (375 MHz)

TWO CONVERGING VALUE CREATION EFFECTS ARE HAPPENING IN THE UNITED STATES: (1) THE VALUE OF LEGACY BANDS IS INCREASINGLY AND (2) VALUE ACCUMULATES WITH ADDITIONAL SPECTRUM ALLOCATED



Source: Telecom Advisory Services

AFTER ALLOCATING THE FULL 6 GHZ SPECTRUM TO WI-FI, BRAZIL IS CONSIDERING GOING BACKWARDS

BRAZIL: 6 GHz SCENARIOS UNDER CONSIDERATION

	Indoor	Outdoor
Lower part (500 MHz)	A	
Upper part (700 MHz)	B	C

ALTERNATIVE 1: FULL BAND TO WI-FI

Keep the entire band for WiFi, that expands the potential for WiFi 6E and Wi-Fi 7 development indoors and outdoors, enhancing their transmission capacity

A + B + C

ALTERNATIVE 2: 500 MHZ TO WI-FI

Divide the band between Wi-Fi and IMT (International Mobile Telecommunications), that would enable a new auction for the development of 5G and 6G

A

ALTERNATIVE 3: FULL INDOOR AND 500 MHZ OUTDOORS

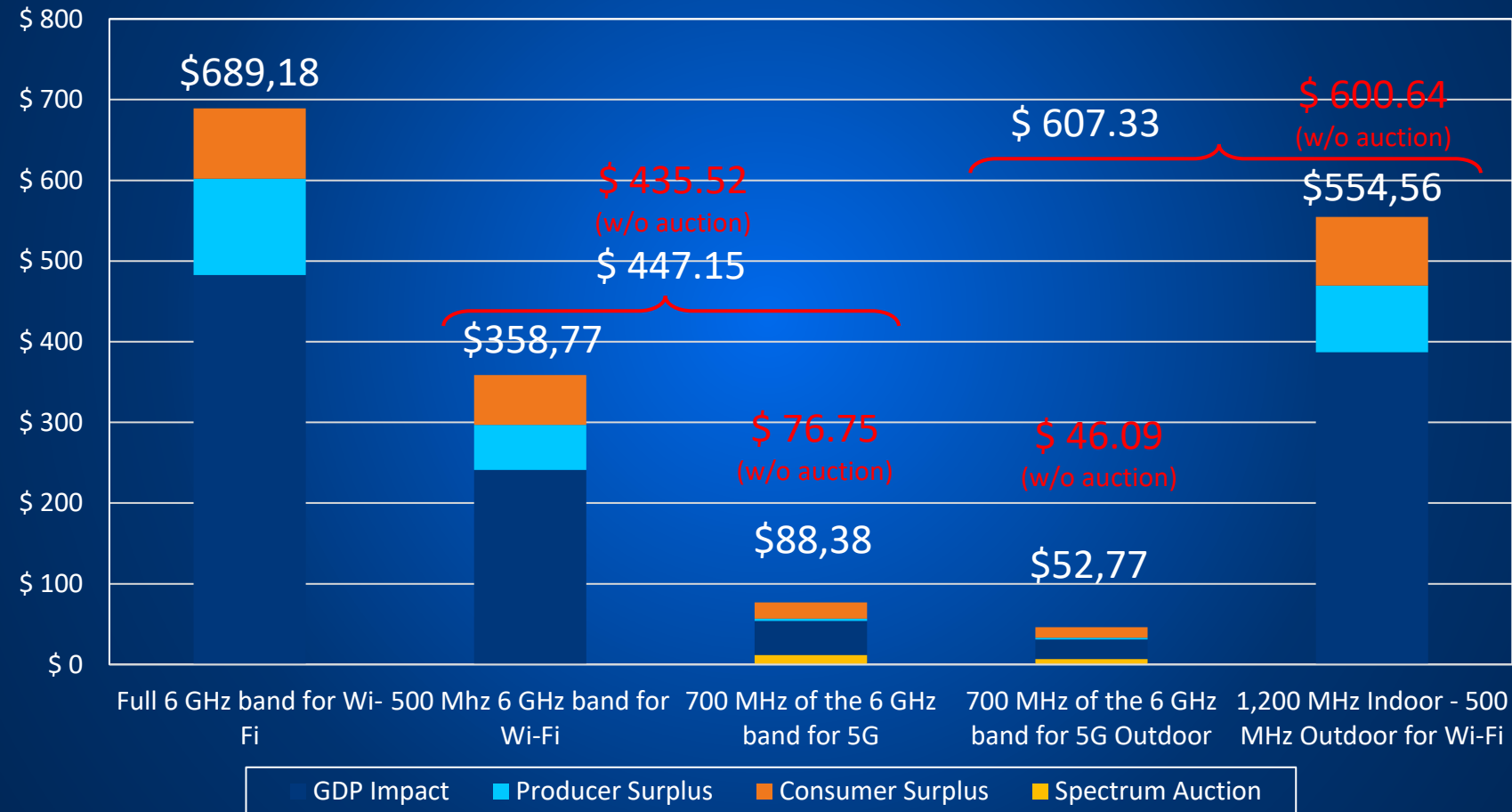
Divide the band between WiFi and IMT, but allowing full use for WiFi indoors, which would restrict its use outdoors, thus it's a possibility that requires further studies

A + B

Source: Telecom Advisory Services

A COMPARISON OF ECONOMIC VALUE OF THREE ALTERNATIVE SCENARIOS IN BRAZIL CONFIRMS THAT ALLOCATION OF THE ENTIRE 6 GHZ BAND YIELDS THE HIGHEST ECONOMIC VALUE

BRAZIL: ECONOMIC VALUE OF WI-FI (2024-2034) (in USD millions)



Source: Telecom Advisory Services

AUSTRALIA IS CONSIDERING THE OPTION OF MOVING FROM A 500 MHz SCENARIO TO A 1200 MHz ALLOCATION SCENARIO

AUSTRALIA: 6 GHz SCENARIOS UNDER CONSIDERATION

	Indoor	Outdoor
Lower part (500 MHz)	A	
Upper part (700 MHz)	B	C

ALTERNATIVE 1: FULL BAND TO WI-FI

Keep the entire band for Wi-Fi, that expands the potential for Wi-Fi 6E and Wi-Fi 7 development indoors and outdoors, enhancing their transmission capacity

A + B + C

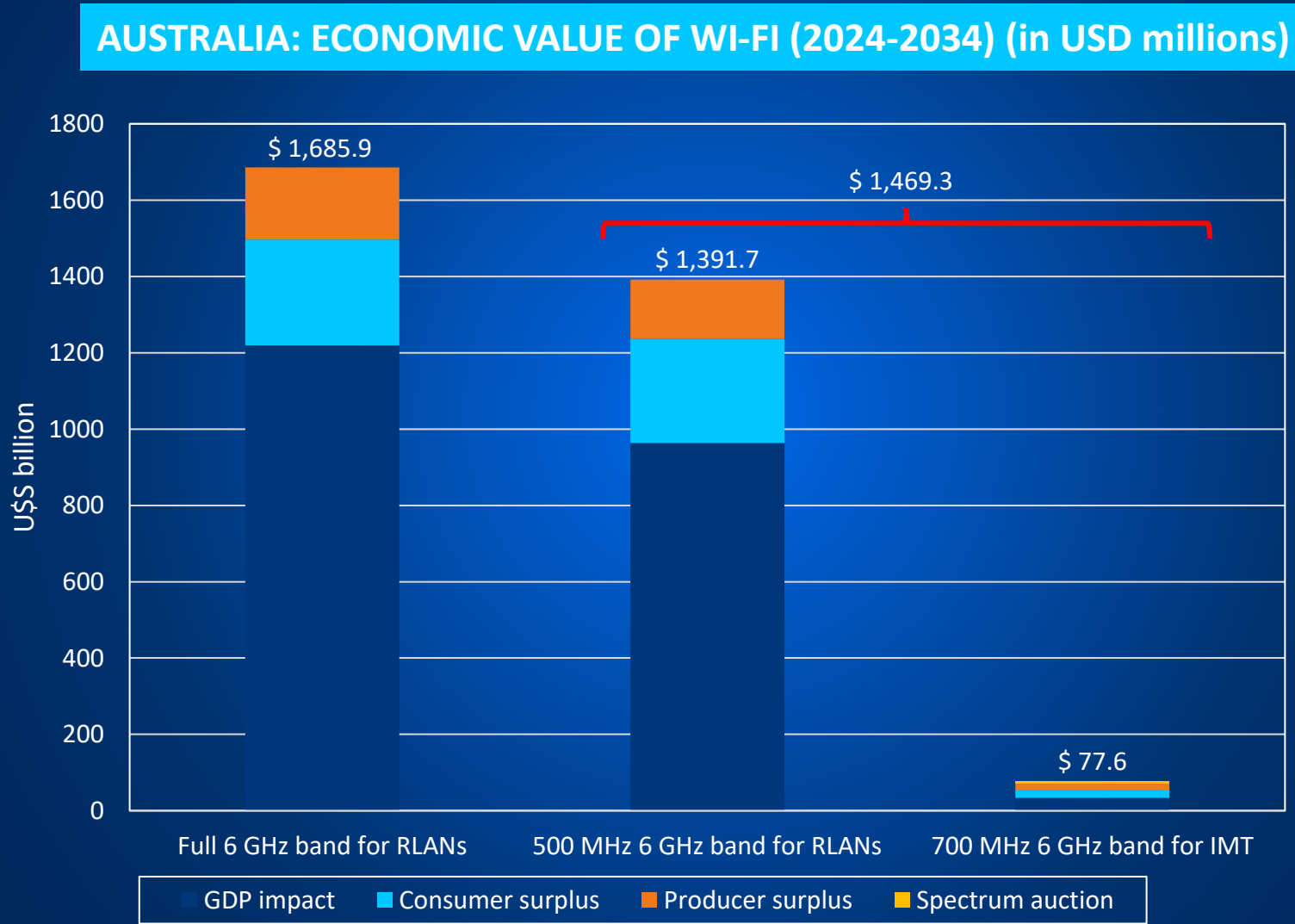
ALTERNATIVE 2: 500 MHz TO WI-FI

Divide the band between Wi-Fi and IMT (International Mobile Telecommunications), that would enable a new auction for the development of 5G and 6G

A

Source: Telecom Advisory Services

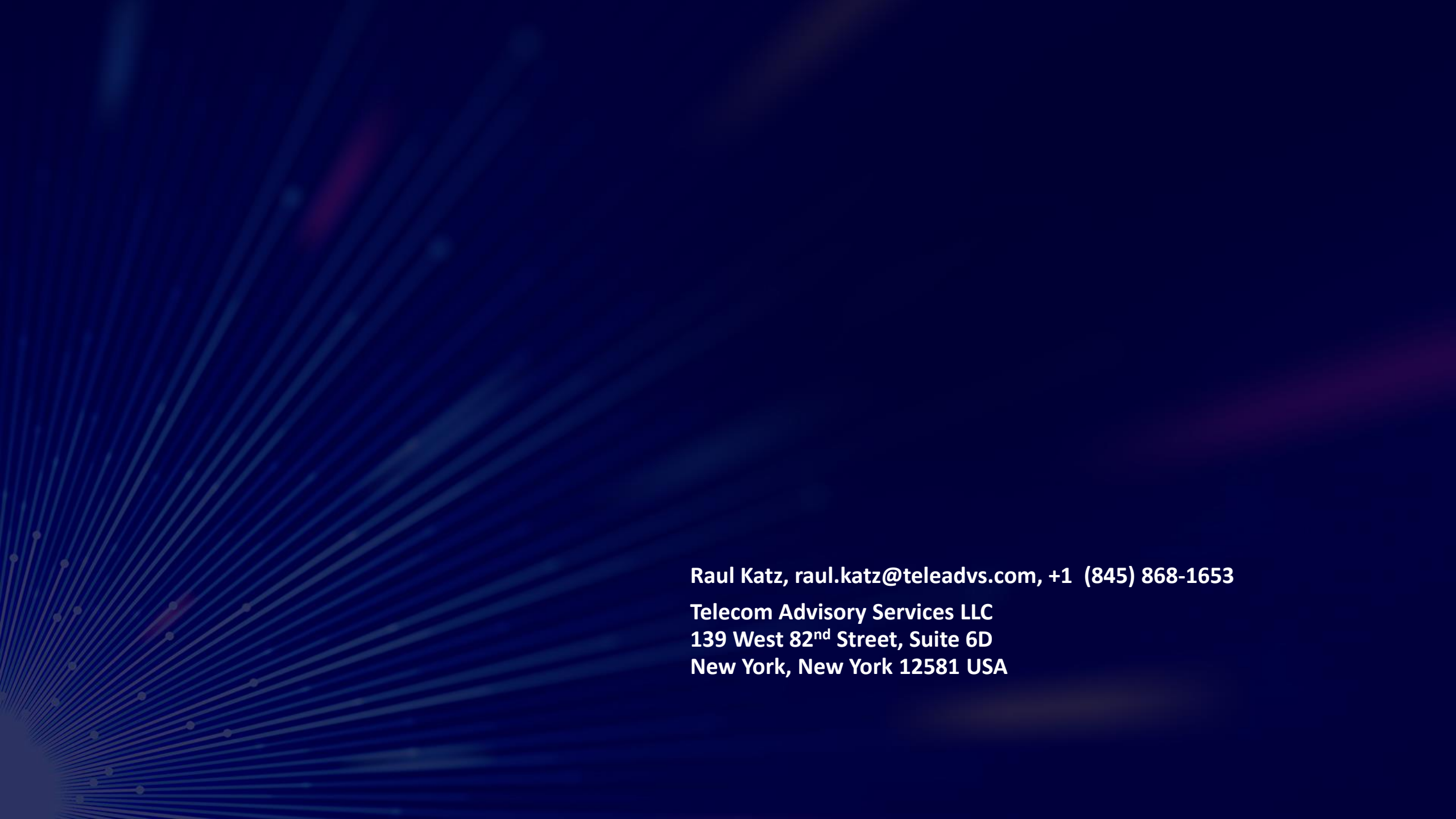
A COMPARISON OF THE TWO REGULATORY SCENARIOS INDICATES THAT THE HIGHEST ECONOMIC IMPACT IS ASSOCIATED WITH THE FULL ALLOCATION OF THE 6 GHZ BAND FOR USE BY WI-FI



Source: Telecom Advisory Services

CONCLUSIONS

- The current regulatory approach to unlicensed spectrum is still undergoing changes in multiple directions: 1) increase the allocation of spectrum in the 7 GHz band (United States), 2) consider the allocation of the upper part of the 6 GHz band to unlicensed use under a sharing agreement (Europe), 3) re-consider the full allocation of the 6 GHz band (Brazil)
- These moves are prompted by the fact that regulators are recognizing the intrinsic value of unlicensed spectrum as a factor of production
- This value has been ascertained in multiple studies as Wi-Fi has become the key response to deal with exponential changes in connectivity (growth in fixed broadband, multiplication of devices requiring connectivity)
- More importantly, we believe that, through user-induced and carrier induced offloading, Wi-Fi has become a critical component of network architectures
- These changes confirm that full allocation of the 6 GHz band to unlicensed use is a value-maximizing regulatory approach – furthermore, the increasing value of unlicensed spectrum raises the need to explore even new bands to be considered under this framework



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