



THE WFF SUMMIT

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UNLICENSED SPECTRUM: *Supercharging the U.S. Economy*



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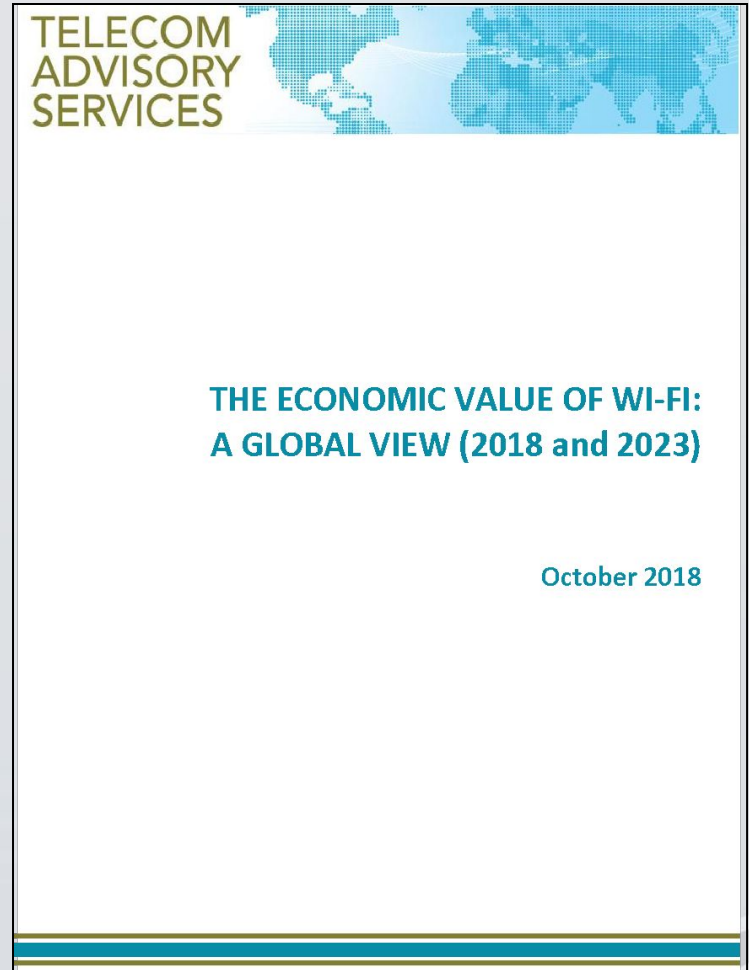
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Senior Policy Counsel
Public Knowledge

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In the past year, we have conducted two studies quantifying the *economic value of unlicensed spectrum* in the United States and around the globe:



- 75% of households

- 53%

- 1.7 million commercial
- 74.2 million community - based

WORLD

- UK: 85% of households
- France: 83% of households
- Germany: 80% of households
- Japan: 78% of households
- Korea: 96% of households

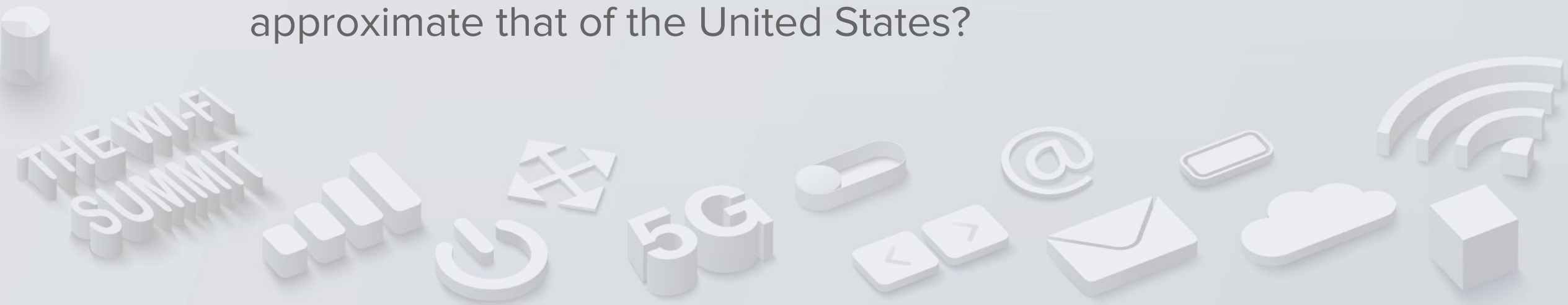
- 60% in UK
- 47% in France
- 62% in Germany
- 63% in China
- 58% in Brazil
- 51% in Australia

- 12 million commercial
- 329 million community-based



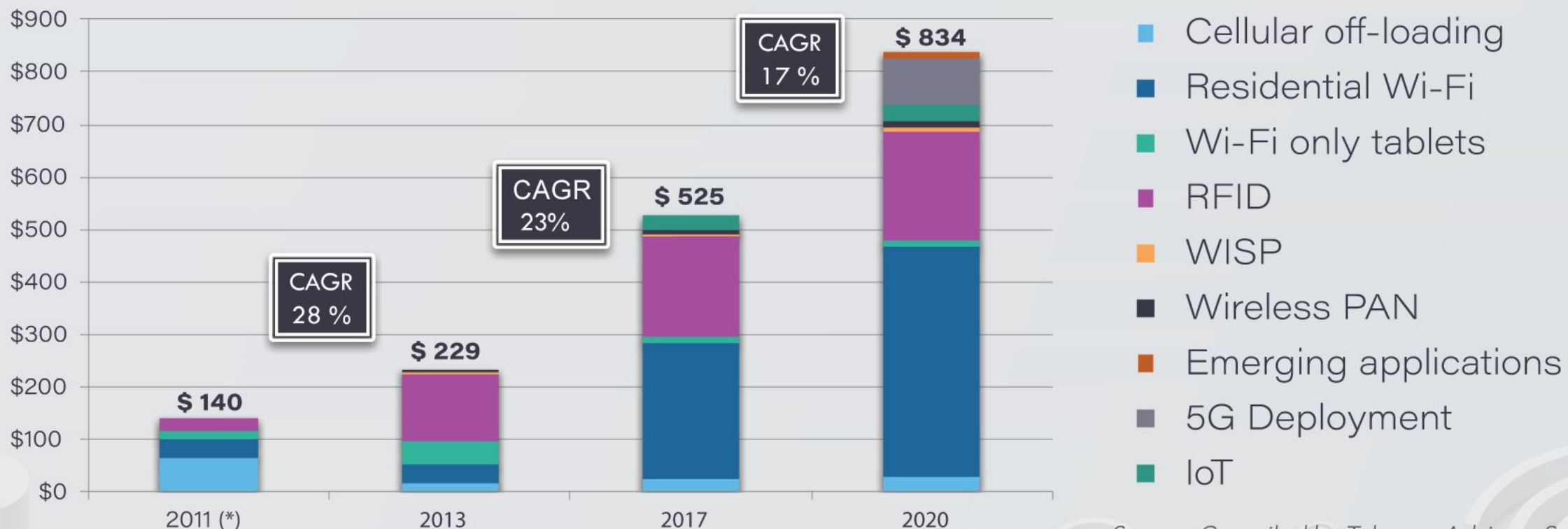
UNLICENSED SPECTRUM VALUE ESTIMATION *is critical to provide a context to key policy questions*

- How much spectrum should the government allocate to non-exclusive licenses?
- What is the value of unlicensed spectrum in the United States?
- Does the value of unlicensed spectrum in other countries approximate that of the United States?



THE VALUE OF UNLICENSED SPECTRUM HAS INCREASED *129% since 2013* AND IS PROJECTED TO *grow 59% through 2020*

UNITED STATES: VALUE OF UNLICENSED SPECTRUM (2011-2020)



Source: Compiled by Telecom Advisory Services

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VALUE GROWTH OF UNLICENSED SPECTRUM

is driven by three sources:

	Consumer Surplus	Producer Surplus	GDP Contribution
Wi-Fi Technology	Free Public Wi-Fi	✓	
	Residential Wi-Fi	✓	
	Cellular Off-Loading	✓	
	Faster Wireless		✓
	Low Frequency Wi-Fi		✓
New Products	Wi-Fi Only Tablets	✓	
	RFID Technology	✓	
	Bluetooth Products		✓
	ZigBee Products		✓
	WirelessHART		✓
	High-speed Wireless		✓
New Business Models and Applications	WISPs & Wi-Fi Services		✓
	IoT & M2M		✓
	Agricultural Automation	✓	
	Smart City Deployments	✓	

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THE ECONOMIC VALUE OF UNLICENSED SPECTRUM IN 2017 IS COMPOSED OF \$496.13 billion IN ECONOMIC SURPLUS AND \$29.06 billion in GDP

	Consumer Surplus	Producer Surplus	GDP Contribution
Wi-Fi Technology	Free Public Wi-Fi	\$ 5.82	
	Residential Wi-Fi	\$ 236.95	\$ 21.75
	Cellular Off-Loading	\$ 10.70	
	Faster Wireless		\$ 7.70
	Low Frequency Wi-Fi		\$ 3.72
New Products	Wi-Fi Only Tablets	\$ 4.08	\$ 9.48
	RFID Technology	\$ 84.94	\$ 106.31
	Bluetooth Products		\$ 5.00
	ZigBee Products		\$ 0.50
	WirelessHART		\$ 0.03
	High-speed Wireless		\$ 0.63
New Business Models and Applications	WISPs & Wi-Fi Services		\$ 3.87
	IoT & M2M		\$ 6.82
	Agricultural Automation	\$ 1.00	
	Smart City Deployments	\$ 15.10	

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GOING FORWARD, THE ECONOMIC VALUE OF UNLICENSED SPECTRUM *will increase as a result of several drivers*

- Future adoption of technologies
(e.g. Smartphone installed base will increase from 282 million to 330 million)
- Increase of mobile device usage
- Growth in US Wi-Fi households (from 71% to 85%)
- Increasing gap between Wi-Fi and cellular speeds
- Explosive growth in Wi-Fi enabled devices
- Growth of wearables installed base and the automotive Bluetooth market
- Increased RFID penetration
- Growth in Low Power WAN adoption
- Deployment of emerging technologies (such as 5G)

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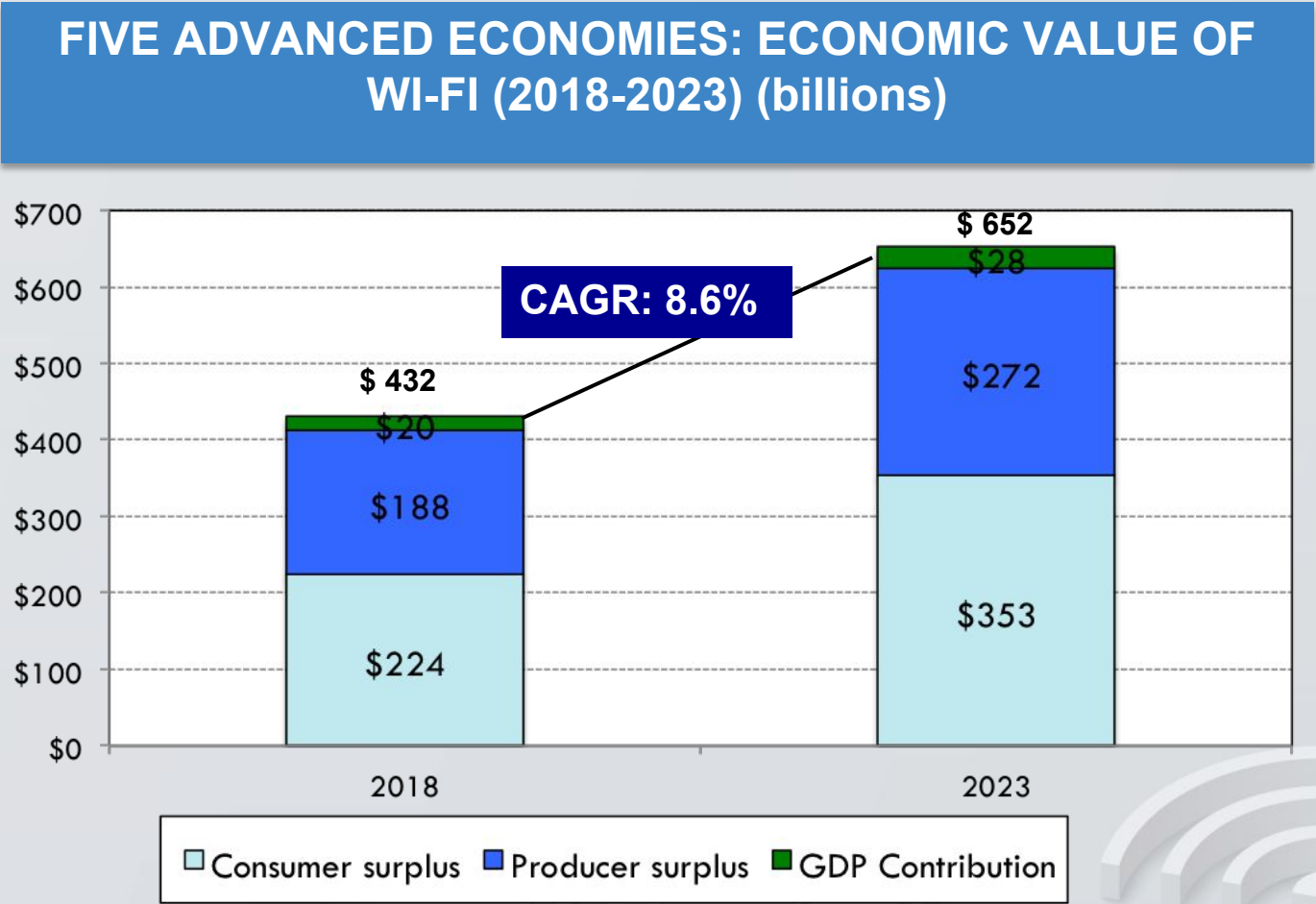
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THE ECONOMIC VALUE OF UNLICENSED SPECTRUM IN 2020 WILL REACH \$792.08 billion IN ECONOMIC SURPLUS AND \$42.40 billion IN GDP CONTRIBUTION

		Consumer Surplus		Producer Surplus		GDP Contribution	
		CURRENT	2020	CURRENT	2020	CURRENT	2020
Wi-Fi Technology	Free Public Wi-Fi	\$ 5.82	\$ 5.87				
	Residential Wi-Fi	\$ 236.95	\$ 385.92	\$ 21.75	\$ 53.88		
	Cellular Off-Loading			\$ 10.70	\$ 96.3		
	Faster Wireless					\$ 7.70	\$ 9.76
	Low Frequency Wi-Fi					\$ 3.72	\$ 3.72
New Products	Wi-Fi Only Tablets	\$ 4.08	\$ 0.86	\$ 9.48	\$ 9.16		
	RFID Technology	\$84.94	\$ 48.44	\$ 106.31	\$ 161.92		
	Bluetooth Products					\$ 5.00	\$ 9.78
	ZigBee Products					\$ 0.50	\$ 0.50
	WirelessHART					\$ 0.03	\$ 0.07
New Business Models and Applications	High-speed Wireless					\$ 0.63	\$ 1.65
	WISPs & Wi-Fi Services					\$ 3.87	\$ 5.75
	IoT & M2M				\$ 12.51	\$ 6.82	\$ 10.38
	Agricultural Automation			\$ 1.00	\$ 2.11		
	Smart City Deployments	\$ 15.10	\$15.11				

THE VALUE OF UNLICENSED SPECTRUM, *particularly Wi-Fi*, IS ALSO *increasing at similar rates in other advanced countries*

<div>GERMANY</div> <div>20182023</div> <div>\$94\$132</div> <div>billionbillion</div>	<div>JAPAN</div> <div>20182023</div> <div>\$171\$248</div> <div>billionbillion</div>
<div>UNITED KINGDOM</div> <div>20182023</div> <div>\$54\$71</div> <div>billionbillion</div>	<div>SOUTH KOREA</div> <div>20182023</div> <div>\$68\$138</div> <div>billionbillion</div>
<div>FRANCE</div> <div>20182023</div> <div>\$44\$64</div> <div>billionbillion</div>	

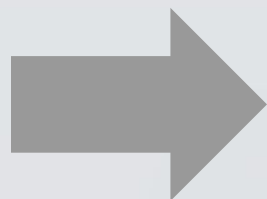


Source: Telecom Advisory Services analysis

WI-FI IS ALSO A VERY IMPORTANT CONTRIBUTOR TO *employment*

GDP contribution

- **Additional broadband lines**
- **Faster wireless networks**
- **Development of a Wi-Fi service provider industry**



Employment

- **Direct jobs** (telecommunications industry, telecom equipment manufacturing)
- **Indirect jobs** (suppliers to the telecom industries, such as construction, business services)
- **Induced jobs** (consumption of direct and indirect jobs)

GDP Contribution (\$ Billion) (2018)

Country	GDP
United States	\$ 20.16
Japan	\$ 7.83
South Korea	\$ 0.86
United Kingdom	\$ 1.52
France	\$ 3.88
Germany	\$ 5.82

Employment (2018)

Country	Jobs
United States	119,000
Japan	50,000
South Korea	12,000
United Kingdom	17,000
France	29,000
Germany	65,000

NOTE: According to the ITU, FTEs for telecommunications operators in the six countries is approximately 1,400,000

Source: Telecom Advisory Services analysis

5G DEPLOYMENT WILL INCREASE THE *value of cellular off-loading*

Investment without Wi-Fi – Investments announced = Wi-Fi CAPEX savings

- The upcoming flexible, radio-neutral 5G environment will be intrinsically supported by the next wave of 802.11 Wi-Fi standards (802.11n/ac, 802.11ax, WiGig), and short-range wireless technologies operating in unlicensed bands
- Announced 5G investments (UK: \$56.94 billion; Japan: \$ 45.5 billion; Germany: \$ 43.9 billion)
- Investment assumes savings derived from Wi-Fi technology

Wi-Fi Economic value as resulting from 5G deployments (2023)		
	Wi-Fi Economic Value (CAPEX)	Wi-Fi Economic Value (CAPEX & OPEX)
United States	\$ 22.47 Billion	\$ 85.6 billion
Japan	\$ 7.60 Billion	\$ 29.02 billion
South Korea	\$ 3.08 Billion	\$ 11.76 billion
United Kingdom	\$ 2.12 billion	\$ 8.12 billion
France	\$ 3.74 billion	\$ 14.31 billion
Germany	\$ 3.07 billion	\$ 11.75 billion

Source: Telecom Advisory Services analysis

WI-FI ENABLED EQUIPMENT MARKETS *will exceed \$132 billion by 2023*

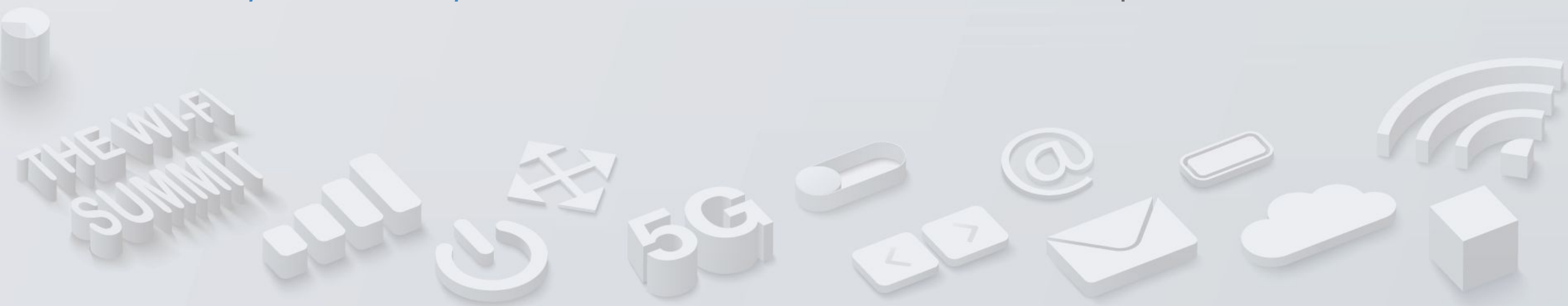
WORLDWIDE UNLICENSED SPECTRUM ENABLED EQUIPMENT MARKET (2018-2023) (billions)

Equipment	2018	2023
Consumer Wi-Fi Access Points	\$ 11,651	\$ 11,170
Wi-Fi External adapters	\$ 0.46	\$ 0.22
Wi-Fi Routers	\$ 6,389	\$ 6,134
Wi-Fi Gateways	\$ 6,389	\$ 6,134
Enterprise Wi-Fi access points	\$ 5,398	\$ 6,228
Enterprise Wi-Fi controllers	\$ 1,025	\$ 1,322
Wi-Fi and Bluetooth speakers	\$ 11,000	\$ 27,000
Home security Markets	\$ 45,580	\$ 74,750
Total	\$ 87,432	\$ 132,738

Sources: Research and Markets; Arizton; ABI Research; Telecom Advisory Services analysis

THE POLICY IMPLICATIONS OF THIS EVIDENCE *are self-explanatory*

- Unlicensed spectrum, as an enabling resource, is a *critical driver of innovation and value creation*
- These effects, as proven through the evidence generated in the study, support a policy that *preserves unlicensed spectrum*
- Furthermore, given the exponential growth in utilization of technologies such as Wi-Fi, it is reasonable to consider the *potential expansion* of the amount of unlicensed spectrum



CONSIDERING THE GROWING IMPORTANCE OF UNLICENSED SPECTRUM USAGE, REGULATORS AROUND THE WORLD NEED TO *pay increasing attention at allocating bands in this space*

THE TRENDS

- Wi-Fi traffic in the US is growing at 26%
- Wi-Fi households, currently at 75%, are forecast to reach 85% by 2020
- Smartphone penetration, currently at 86%, are estimated to reach 92% by 2020
- While 52% of retailers already implemented or piloted RFID within their organization, 23 % are considering launching pilots in the near future
- Wi-Fi traffic in the Germany is growing at 19% annually, 15.5% in the UK, and 36% in Japan
- Wi-Fi households, currently at 80%, are forecast to reach 93% by 2023 in Germany, 95% in the UK, and 88% in Japan
- Smartphone penetration, currently at 95%, is estimated to reach 99% million by 2023 in most advanced economies
- Wi-Fi Business traffic is growing at 24% annually in Germany. 25% in Japan and Korea



THE RISKS

- Average Wi-Fi speed does not increase, but stays at current levels
- Wi-Fi becomes bottleneck in ultra-broadband households
- Difficulty in migrating to 5G
- Limited availability of spectrum to foster new innovative applications

