

THE ECONOMIC VALUE OF UNLICENSED SPECTRUM

A study commissioned by WifiForward

The logo consists of a red square containing the text "Wi-Fi" in white, "NOW" in white, and "2018" in black.

**Wi-Fi
NOW
2018**

Raul L. Katz

A solid yellow rectangle is located on the left side of the slide.

Telecom Advisory Services, LLC

Redwood City, CA – May 17, 2018

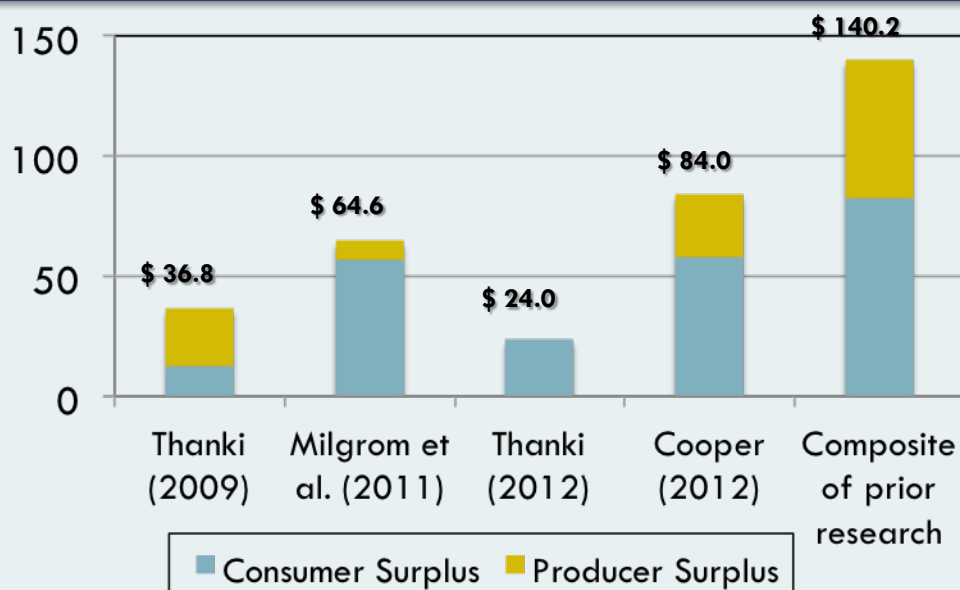
WHY IS IT IMPORTANT TO ASSESS THE ECONOMIC VALUE OF UNLICENSED SPECTRUM?

- Wireless communications traffic has increased at 26% yearly in the US since 2016; it is expected to grow by 27% yearly through 2023
- 48% of smartphone traffic is being channeled through unlicensed spectrum (Opensignal). Also unlicensed spectrum traffic represents 38% of all IP traffic at 2018 (Cisco)
- Some of the most important innovations in wireless have taken place in unlicensed spectrum
- Key question: How much spectrum should the government allocate to non-exclusive licenses?
- The value of licensed bands approximates the amount paid at auctions
- What is the value of unlicensed spectrum?

MEASUREMENT OF ECONOMIC VALUE OF UNLICENSED SPECTRUM IS A COMPLEX TASK

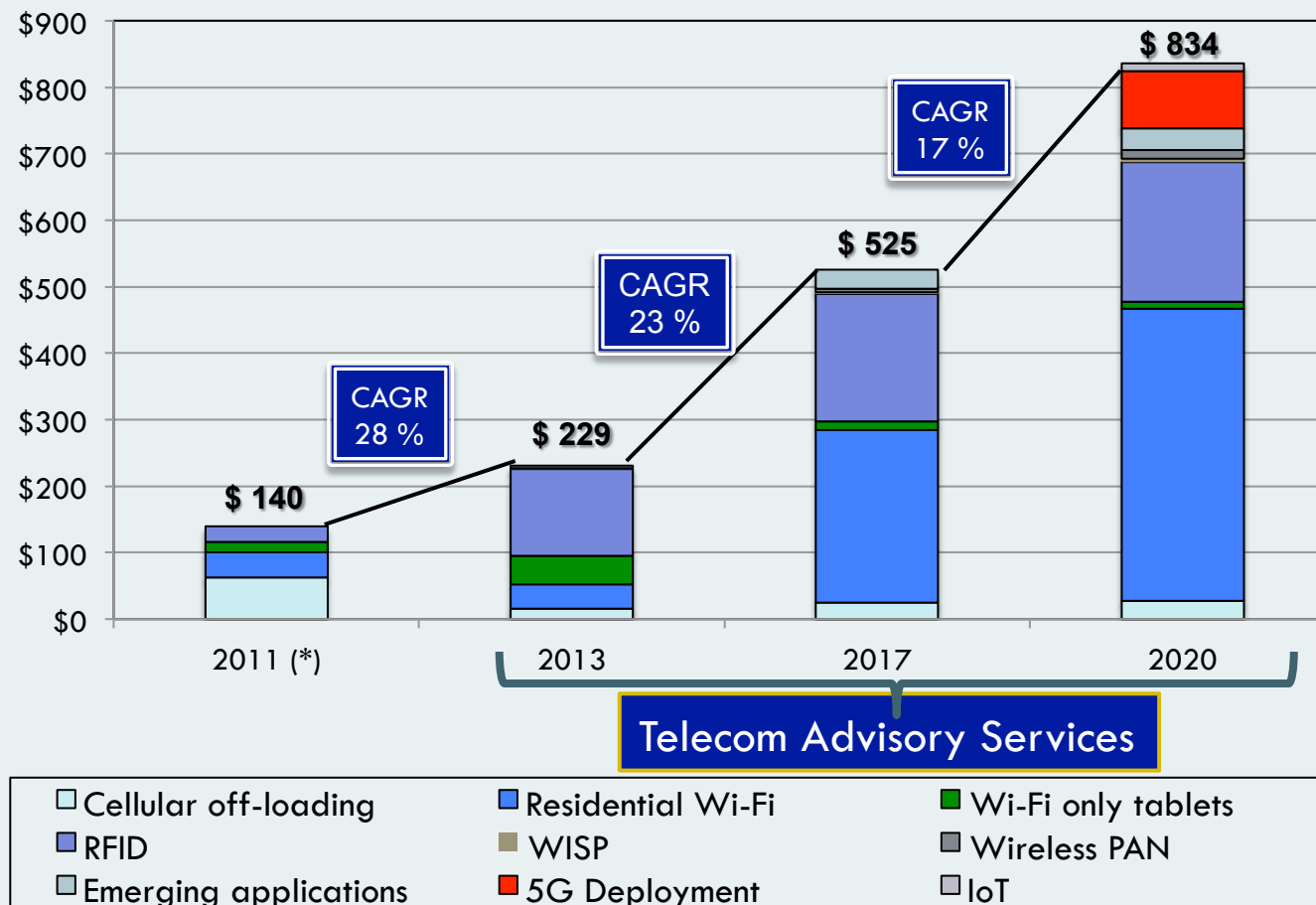
- Unlicensed spectrum is used by numerous devices and services
- In some cases, services are offered as a free good to consumer (how does one quantify the willingness to pay?)
- The diffusion of innovations relying on unlicensed spectrum is proceeding at an extremely fast pace, which renders studies obsolete after a few months
- When we did our first study, research on economic value was limited

PRIOR STUDIES ON VALUE OF UNLICENSED SPECTRUM



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: Telecom Advisory Services analysis

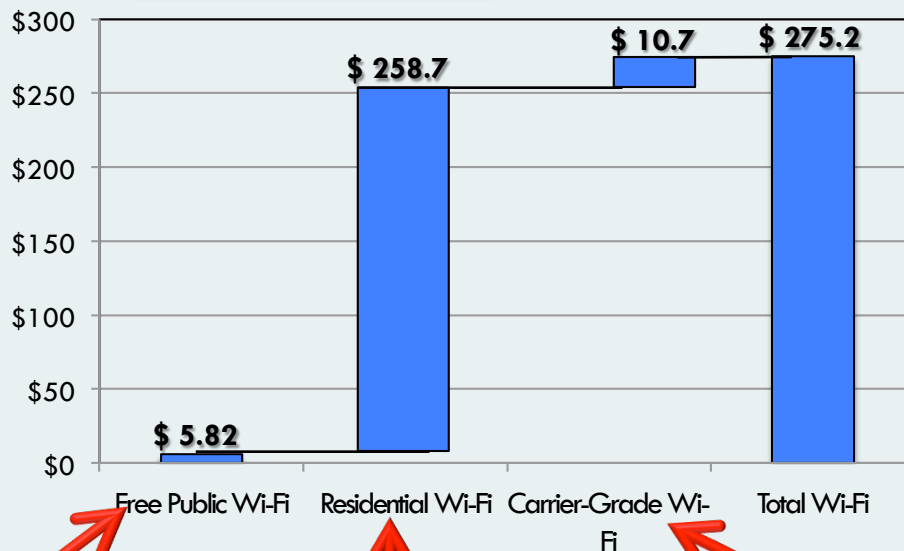
VALUE GROWTH OF UNLICENSED SPECTRUM IS DRIVEN BY THREE SOURCES

		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 and Wi-Fi services			
	IoT and M2M			
	Agricultural automation			
	Smart city deployments			

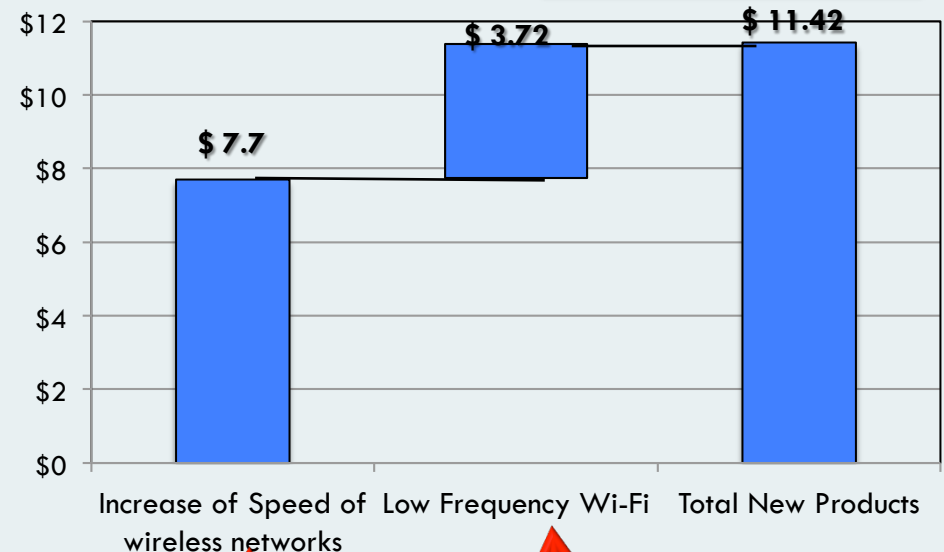
WI-FI TECHNOLOGY GENERATES AN ECONOMIC SURPLUS OF \$275.2 BILLION, AND CONTRIBUTES \$11.4 BILLION TO THE US

ECONOMIC VALUE OF WI-FI (2017) (in \$ billions)

Economic Surplus



GDP Contribution



• Value of Free Public Wi-Fi

• Internet access for devices lacking wired port
• Avoidance of investment in in-house wiring
• Wi-Fi enabled equipment

• Total Cost of Ownership of Carrier Grade Wi-Fi deployed to complement cellular networks

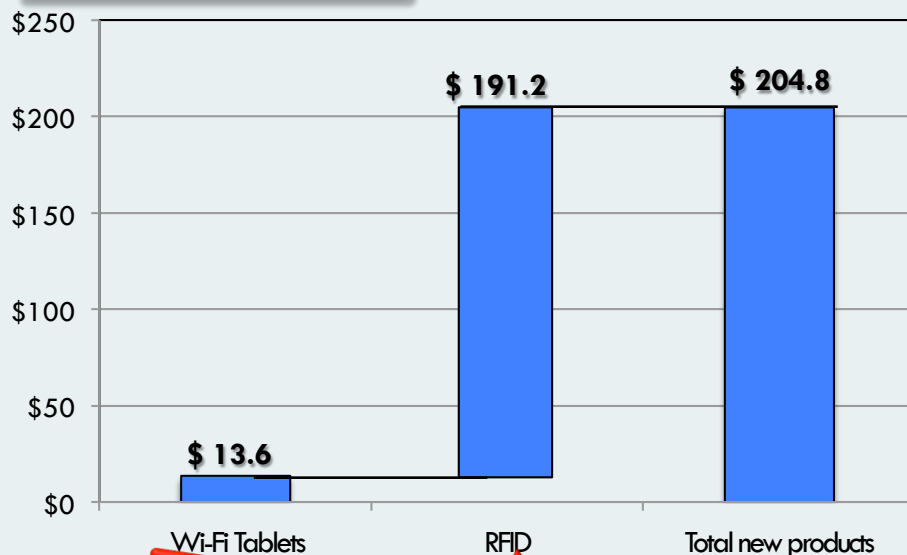
• Impact on GDP of faster wireless broadband networks

• Rural adoption
• Reduction of digital divide

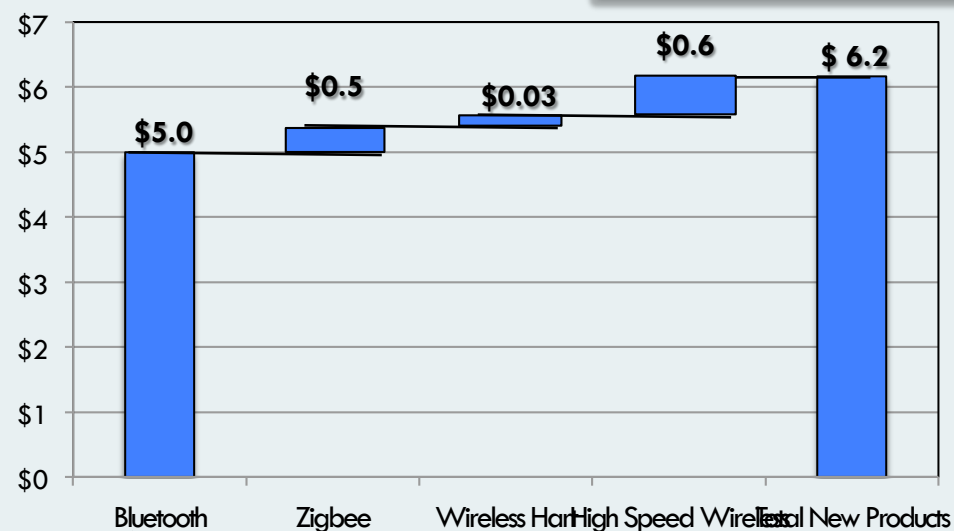
NEW PRODUCTS RELYING ON UNLICENSED SPECTRUM GENERATE AN ECONOMIC SURPLUS OF \$204.8 BILLION, AND CONTRIBUTE \$204.8 BILLION TO THE US GDP

ECONOMIC VALUE OF NEW PRODUCTS (2017) (in \$ billions)

Economic Surplus



GDP Contribution



Willingness to pay
Margins of US
manufacturers

- Retailing (reduction in labor costs, shrinkage losses, inventory write-offs, shipment errors)
- Health care (reduction in counterfeit, efficient sample mgmt, enhanced inventory turns)

- Automotive applications
- Mobile telephony
- Peripherals

- Smart home
- Smart lighting
- Zigbee 3.0

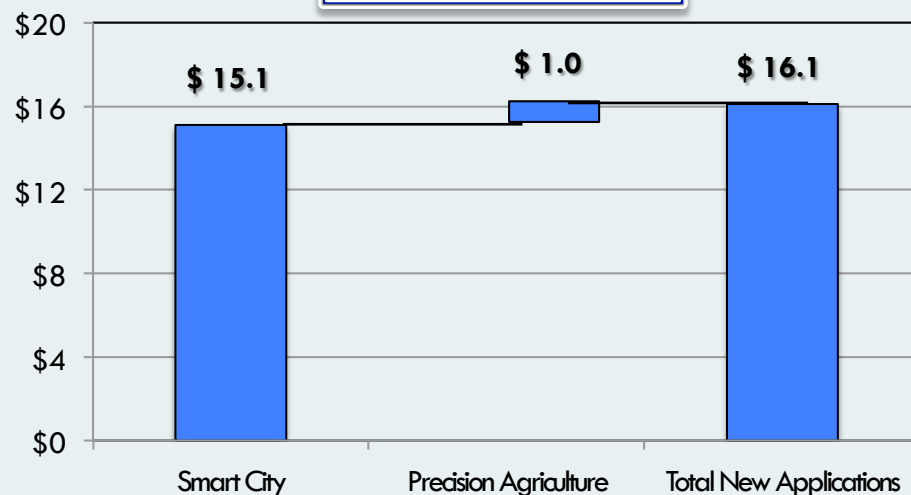
- Process control automation devices

- WirelessHD
- WiGig

NEW BUSINESS MODELS AND APPLICATIONS RELYING ON UNLICENSED SPECTRUM GENERATE AN ECONOMIC SURPLUS OF \$15.1 BILLION, AND CONTRIBUTE \$11.5 BILLION TO THE US GDP

ECONOMIC VALUE OF NEW BUSINESS MODELS AND APPLICATIONS (2017) (in \$ billions)

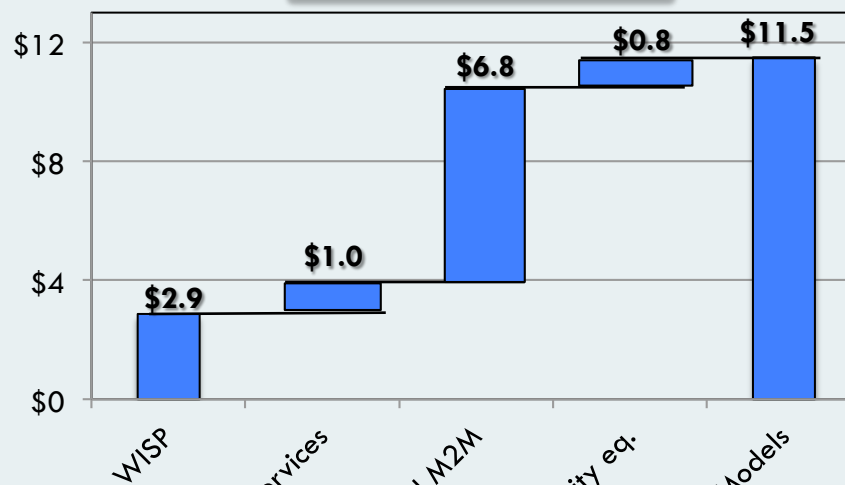
Economic Surplus



- Pollution control
- Public services
- Traffic control

- Optimization of labor
- Timeliness of operations
- Efficient use of fertilizers

GDP Contribution



- Broadband providers

- Public places
- Airlines

- Advanced meter infrastructure
- Security
- DSM
- Telehealth
- Wearables

- Sensors

SUM UP, THE ECONOMIC VALUE OF UNLICENSED SPECTRUM IN 2017 IS COMPOSED OF \$ 496.13 BILLION IN ECONOMIC SURPLUS AND \$ 29.06 BILLION IN GDP CONTRIBUTION

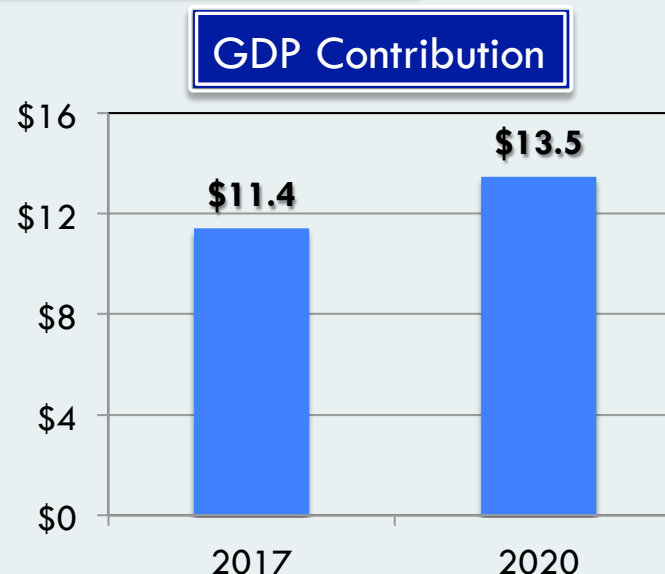
		Consumer Surplus	Producer Surplus	GDP Contribution
Wi-Fi Technology	Free Public Wi-Fi	\$5.82		
	Residential Wi-Fi	\$ 236.95	\$ 21.75	
	Cellular off-loading		\$ 10.70	
	Faster wireless			\$ 7.7
	Low Frequency Wi-Fi			\$ 3.72
New Products	Wi-Fi only tablets	\$ 4.08	\$ 9.48	
	RFID technology	84.94	106.31	
	Bluetooth products			\$ 5.00
	ZigBee products			\$ 0.50
	WirelessHART			\$ 0.03
	High-speed wireless			\$ 0.63
New Business Models and Applications	WISPs and Wi-Fi services			\$ 3.87
	IoT and M2M			\$ 6.82
	Agricultural automation		\$ 1.0	
	Smart city deployments	\$ 15.1		

ING 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
- Increasei RFID penetration
- Growth in Low Power WAN adoption
- Deployment of emerging technologies (such as 5G)

2017, WI-FI TECHNOLOGY IS EXPECTED TO INCREASE ITS TOTAL ECONOMIC SURPLUS TO \$291.6 BILLION , WHILE CONTRIBUTING \$7.0 BILLION TO THE GDP

ECONOMIC VALUE OF WI-FI (2017-2020) (in \$ billions)



- Increase in diffusion of devices without wireline connectivity
- Growth in traffic generated per device
- Decline in cellular pricing is not enough to neutralize Wi-Fi economic advantage

- Growth of revenues generated by providers of Wi-Fi services in public places
- Contribution to GDP of increase in average wireless speed resulting from Wi-Fi off-loading

SUM UP, 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	
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					\$ 7.7	\$ 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
	High-speed wireless					\$ 0.63	\$ 1.65
New Business Models and Applications	WISPs and Wi-Fi services					\$ 3.87	\$ 5.75
	IoT and M2M				\$ 12.51	\$ 6.82	\$ 10.38
	Agricultural automation			\$ 1.0	\$ 2.11		
	Smart city deployments	\$ 15.1	15.11				

E STUDY YIELDS TWO KEY CONCLUSIONS

- **The economic value of unlicensed spectrum increases over time**
 - A factor of production
 - Complements other technologies
 - Promotes innovation
- **While economic value continues to grow, the sources of value vary over time**
 - Value of some technologies declines as a result of product substitution (tablets)
 - Other products grow (home based networking devices, wireless devices)

E 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**

THE TRENDS

- **Wi-Fi traffic in the US is growing at 26%**
- **Wi-Fi households, currently at 75%, are forecast to reach 100% by 2023**
- **Smartphone penetration, currently at 86%, are estimated to reach 99% million by 2023**
- **While 52% of retailers already implemented or piloted RFID within their organization, 23 % are considering launching pilots in the near future**

THE RISKS

- **Average Wi-Fi speed does not increase, but stays at current levels (37.03 Mbps), erasing \$ 42.4 billion of the Wi-Fi speed return over five years**
- **Wi-Fi becomes bottleneck in ultra-broadband households**
- **Difficulty in migrating to 5G**
- **Limited availability of spectrum to foster new innovative applications**



TELECOM ADVISORY SERVICES, LLC

For further information please contact:

Raul Katz, raul.katz@teleadv.com, +1 (845) 868-1653

Telecom Advisory Services LLC
182 Stissing Road
Stanfordville, New York 12581 USA