
Unlicensed and Unshackled

A Joint OET-OSP White Paper on
Unlicensed Devices and Their

Regulatory Issues

ET Docket No. 03-126

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Outline

- Overview
- Part 15 Rules
- Unlicensed Uses and Applications
- Market Survey (W-LAN)
- Regulatory Issues
- Summary

Overview

- Unlicensed Operation has been a huge success.
- Prominence of devices goes largely unnoticed in every day life
- Paper discusses:
 - Evolution of the rules authorizing unlicensed devices
 - Uses of unlicensed devices
 - Market penetration and economics of unlicensed devices
 - Regulatory issues

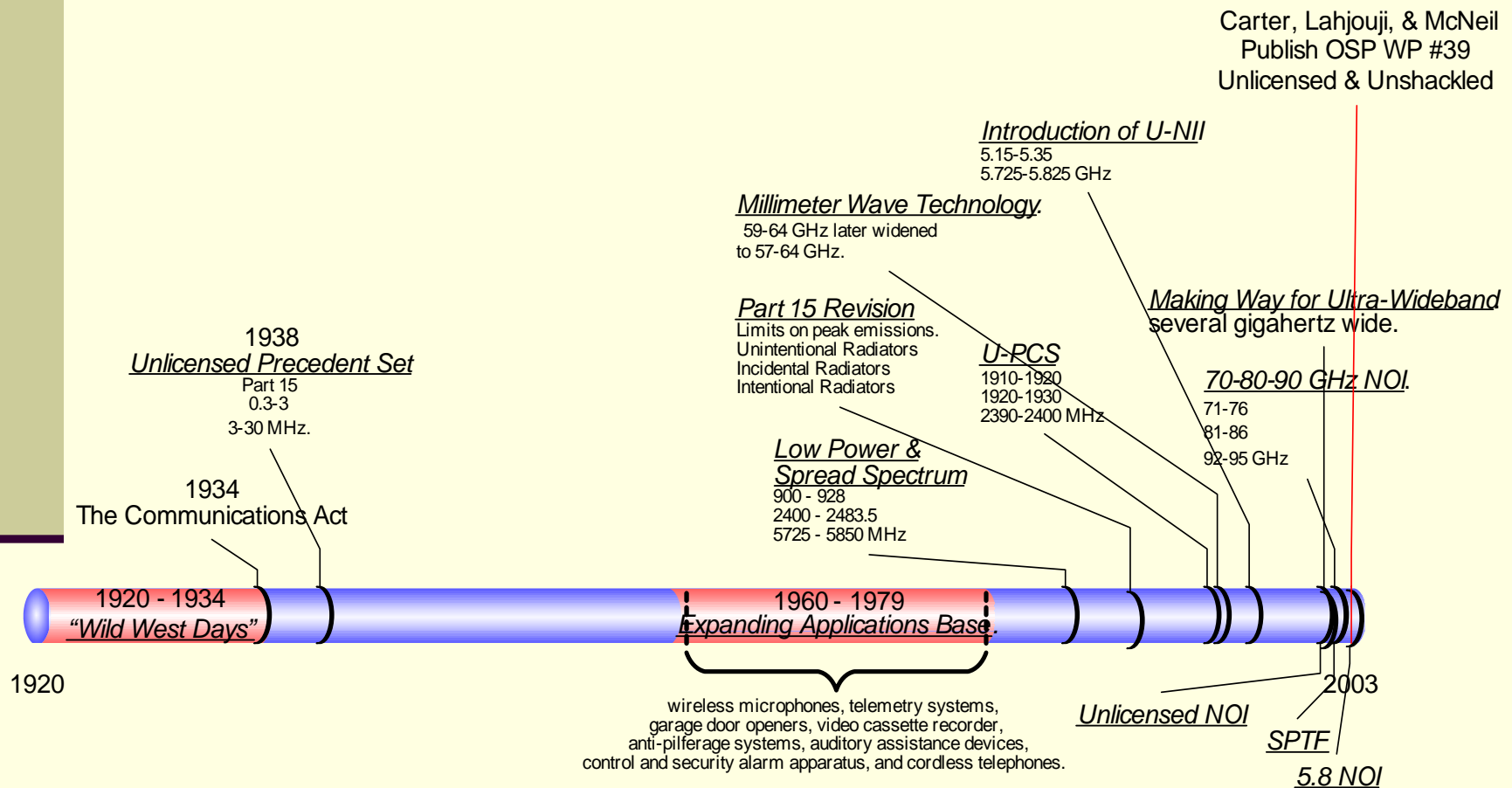
Part 15: Unlicensed Devices

- Provides for Low Power Transmitters
- Subpart C: Intentional Radiators
- Subpart D: Unlicensed Personal Communications Service Devices (U-PCS)
- Subpart E: Unlicensed National Information Infrastructure (U-NII)
- Subpart F: Ultra-Wideband Operation

Part 15 Operating Conditions

- May Not Cause Harmful Interference
- Must Accept Any Interference Received
- Operation Must Cease if Notified by FCC that Device is Causing Harmful Interference
- Must Receive Authorization before Marketing/Importation of Device

Part 15 Timeline



Uses and Applications

Grill Alert Talking Remote Thermometer



Source: Brookstone

Your steak is ready,
Mr. Marconi

Cordless Phone



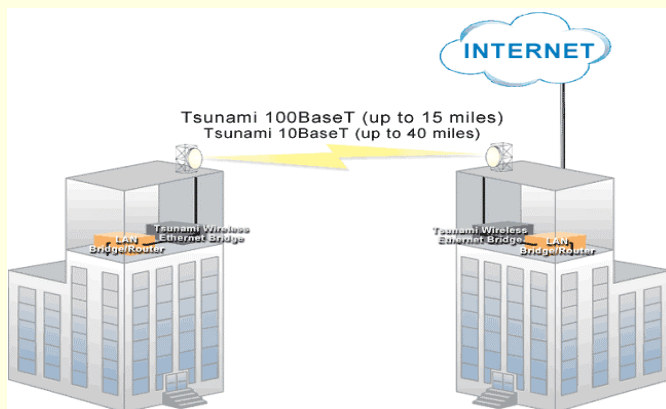
Source: Radio Shack

The M2A Pill

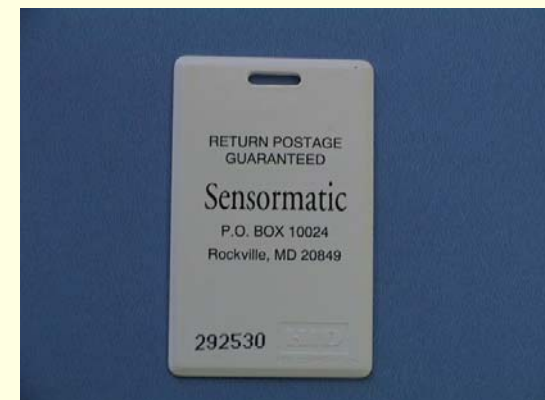


Source: Given

Wireless Ethernet Bridge



Source: Proxim



RFID Security System

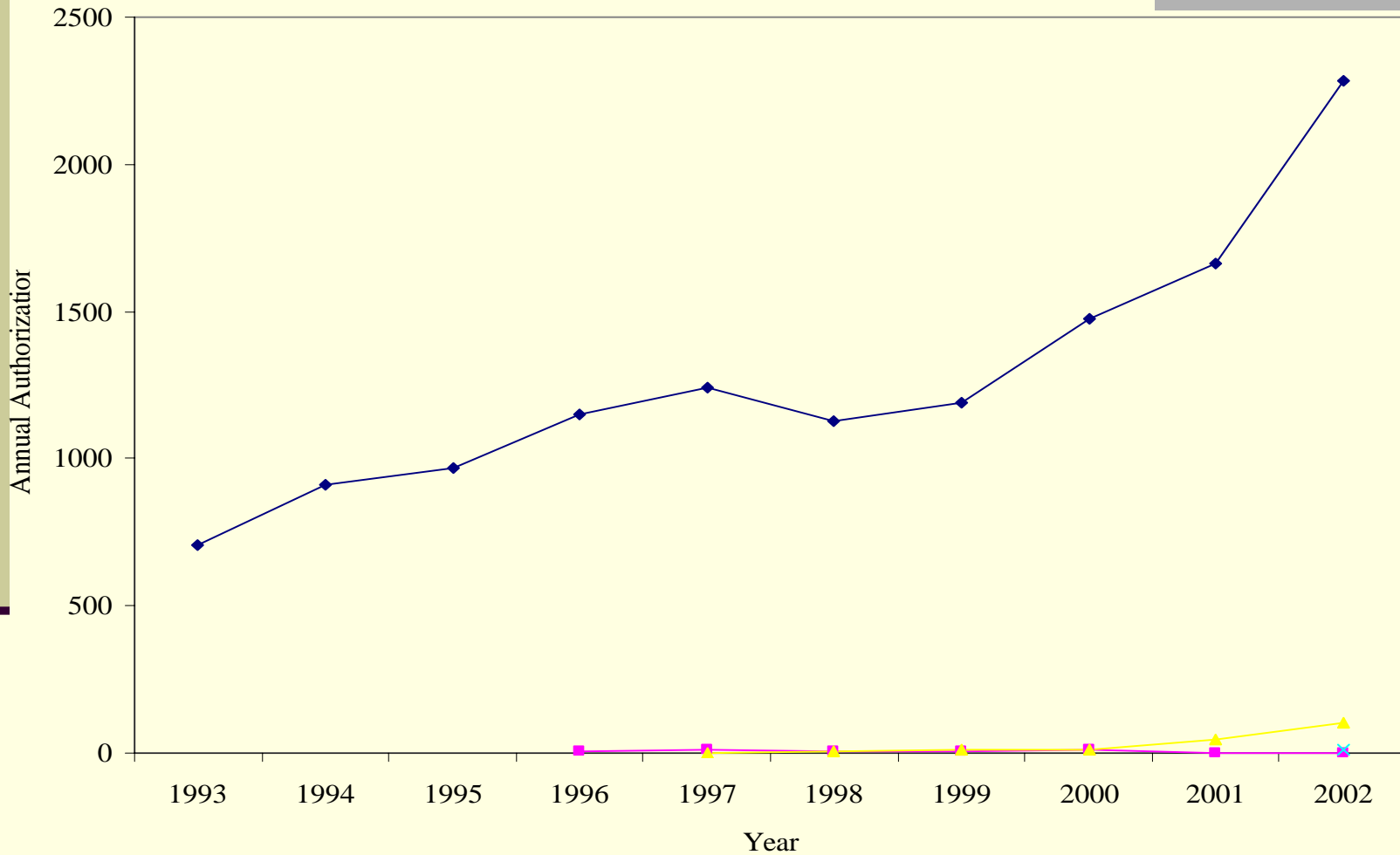
Uses and Applications

- Person to Person Communications
 - Cordless phones, paging devices, walkie-talkies, baby monitors, wireless microphones, and wireless headsets.
- Computer Networking and Peripherals
 - Computers can be networked to share resources such as printers, scanners, or a broadband connection.
- Fixed Wireless Communications
 - The radio equipment is a pure substitute for wires and employed when the cost of stringing wires is prohibitive.
- Monitoring and Identification
 - The low power and localized range makes unlicensed devices well suited for monitoring and tracking when objects are in motion or too numerous to be physically touched or counted individually.
- Sensation, Detection, and Imaging
 - Unlicensed spectrum can be used as a form of miniature radar to sense distance, motion, or the composition of materials causing the reflection.
- Telemetry
 - Wireless telemetry is finding applications in medicine such as wireless internal imaging.

Trends in Authorizations for Part 15 Devices

YEAR	Total Authorizations
1993	706
1994	914
1995	967
1996	1,156
1997	1,255
1998	1,139
1999	1,205
2000	1,501
2001	1,711
2002	2,398
Cumulative Total	12,952

Trends in Authorizations for Part 15 Devices



Source: FCC

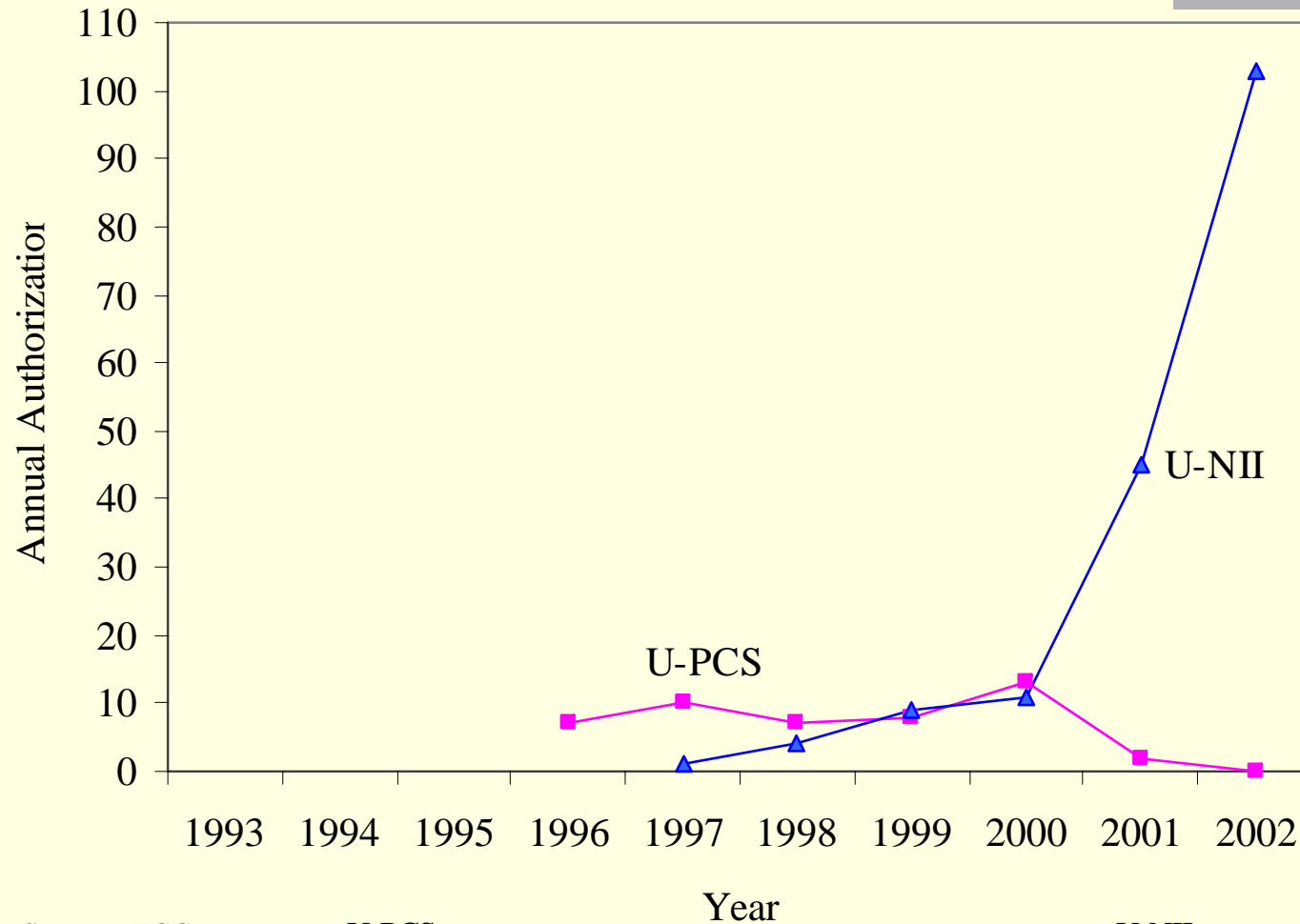
◆ General Part 15 Devices

■ U-PCS

▲ U-NII

× UWB

U-NII Authorizations Are Growing Comparably Faster than Initial Years of Part 15 Devices



Source: FCC

—■— U-PCS

—▲— U-NII

Time to reach the same level of Initial Year Ultra Wide Band authorizations:

- Spread spectrum 5 years
- U-PCS devices 5 years
- U-NII devices 4 years

Installed Base of Part 15 Devices

Product	Penetration	Number per HHD	Total Installed Base
Cordless Phones	81.00%	1.5	130.01
Garage Door Openers	40.80%	1.29	56.26
Wireless Routers	N/A	N/A	1.14
Remote control toys	19.50%	2.61	54.57
Toy walkie-talkies (not FRS)	15.10%	1.85	29.81
Baby monitors	10.50%	1.38	15.52
Home security systems	18.00%	1.1	21.21
Keyless entry systems for cars	26.50%	1.4	39.71

Number of US Households: 107 million

Source: Consumer Electronics Association

- Over 348 million devices (more than 1 per US citizen).

Cordless Phones

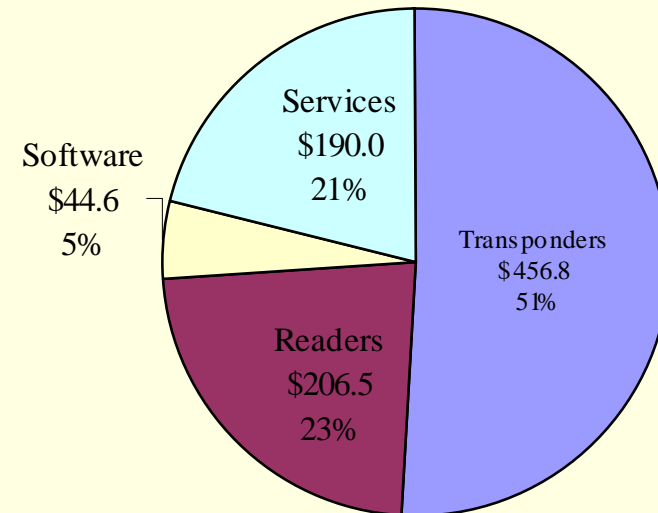
- Average Sale Price and Penetration of Cordless Phones 1997 - 2001

	1997	1998	1999	2000	2001
Avg. Price	\$59.38	\$55.82	\$45.59	\$37.25	\$37.79
HH%	68.00%	73.00%	78.00%	80.00%	81.00%

Source: Consumer Electronics Association eBrain Market Research

Global Shipments of RFID Systems in 2000 (in millions)

- \$900 million in 2000
- \$1.2 billion by 2002 a 16% growth rate
- \$2.7 billion in 2005
- Of the world market in 2000, the Americas accounted for approximately 48%, or \$426.6 million.
- RFID helps retailers combat the \$31.3 billion of inventory lost in 2002
- Cost savings that are immediately recognizable to retailers



Source: VDC

Wireless LAN and Computer Networking Devices

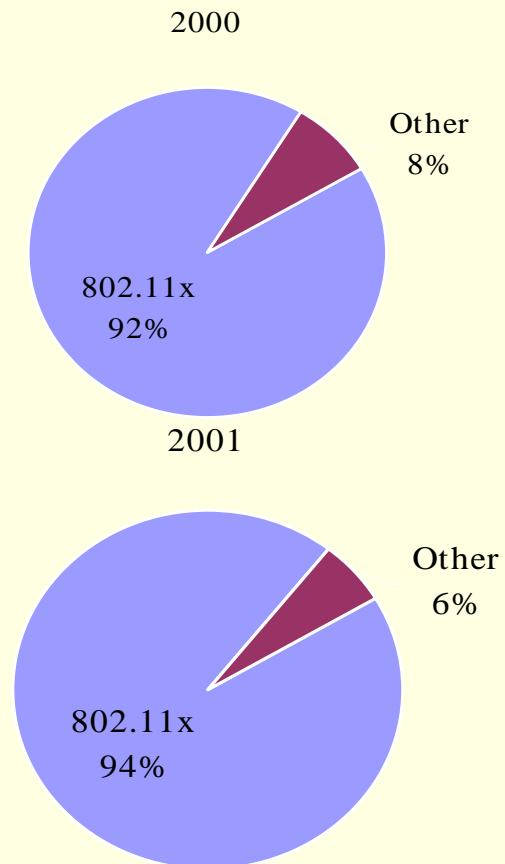
- One of the fastest-growing applications
- An alphabet soup of standards
- Wi-Fi is likely to top \$1.3 billion In 2003.
- Wi-Fi sales will eclipse cordless telephones within the next year



Bluetooth, Wi-Fi, and Home RF

Sales of Wireless Chipsets

- Several industry standards in the 2.4 and 5 GHz bands.
- IEEE's 802.11x protocols known as "Wi-Fi". is the *de facto* standard.
- Bluetooth and HomeRF are other widely adopted standards
- Wi-Fi, Bluetooth, and HomeRF are incompatible
- Based on strengths and weakness, each are best geared towards different type of applications.



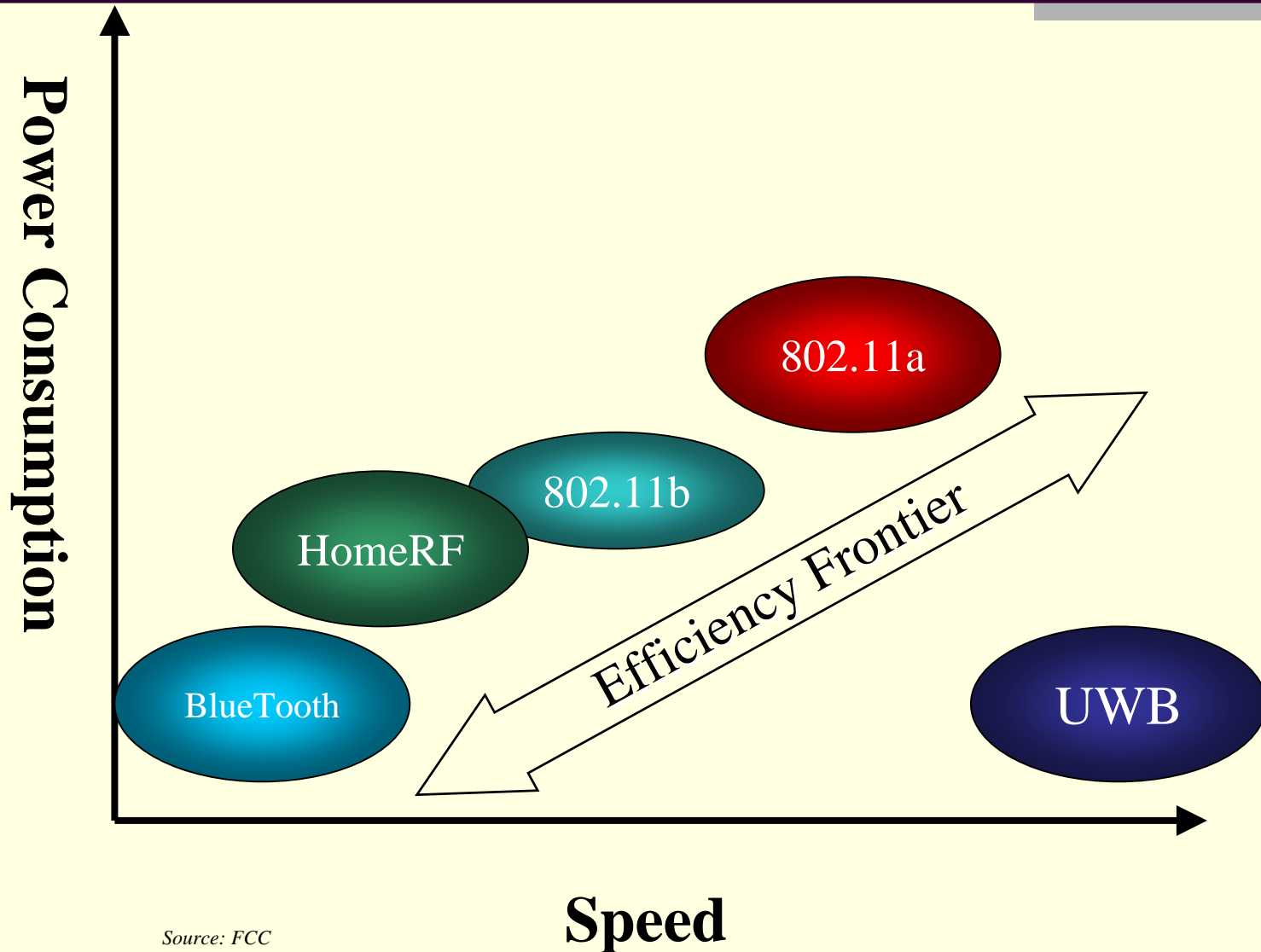
Source: International Data Corporation.

Wireless LAN and Computer Networking Devices

System Type	Channel Bandwidth	Channel Capacity	Typical Data Rate to Customer	Range
802.11b	22 MHz (2.4 GHz band)	11 Mbps	5.5 Mbps**	250'
802.11a	40 MHz (5.7 GHz band)	54 Mbps	32 Mbps**	75'
802.11g	40 MHz (2.4 GHz band)	54 Mbps	32 Mbps**	150'
Bluetooth	1 MHz (2.4 GHz band)	1 Mbps	721 kbs**	30'
HomeRF	1-5 MHz (2.4 GHz band)	10 Mbps	***	150'
HomePlug (802.11b)	4.3 – 20.9 MHz (powerline) (2.4 GHz band wireless)	14 Mbps	11 Mbps	250' (wireless link)

**If WEP (Wireless Equivalent Privacy) security protocol is activated, it may use an additional 10% of the channel capacity.

Speed vs. Power Consumption for Wireless Networking Protocols

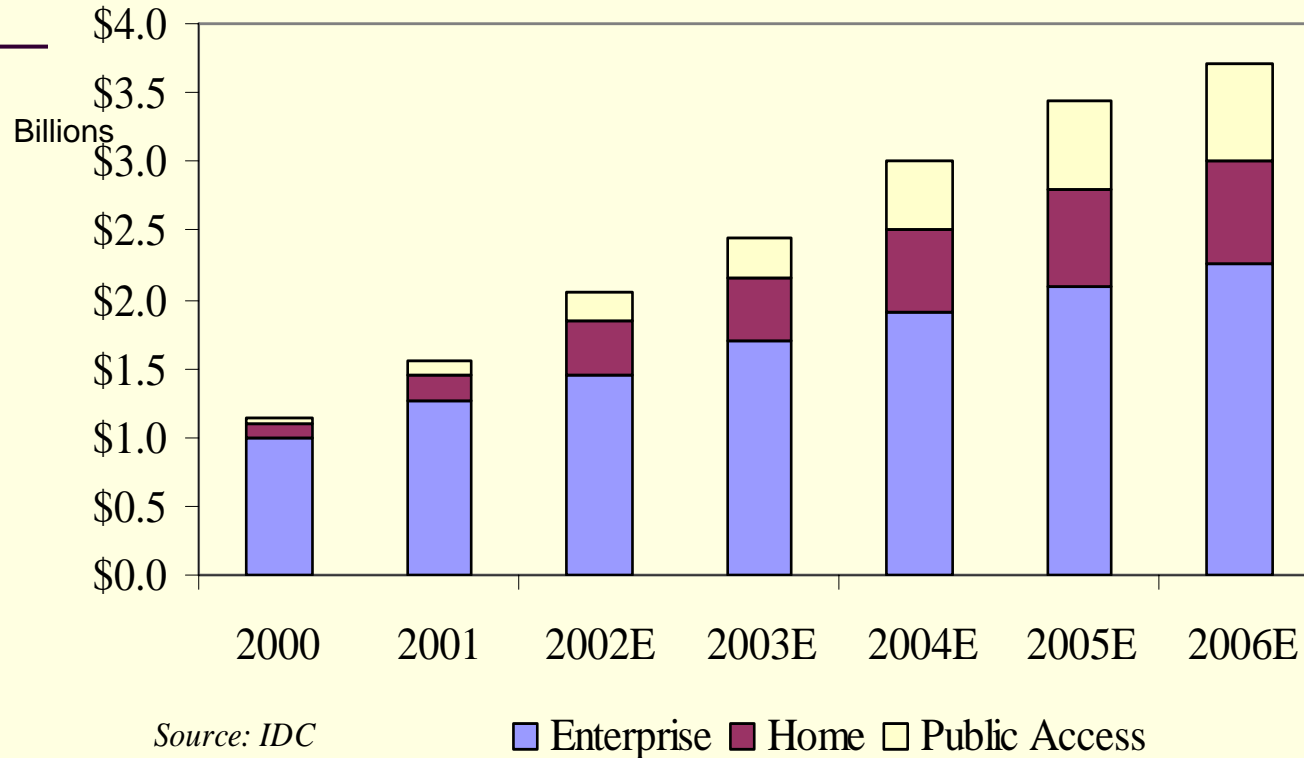


Source: FCC

Sales of Wireless Networking

- 8 consecutive quarters of double-digit growth - over 150 percent from 2000.
- 5 million W-LAN adapters were shipped in 2001.
- Sales of Wi-Fi access points and cards are likely to top \$1.3 billion in 2002.
- Worldwide W-LAN shipments will be 15.5 million units, a 73% growth over 2001.
- Revenues from W-LAN shipments will increase 26% to \$2.1 billion, projected to rise to \$2.8 billion in 2003.
- This growth will taper off in 2007.

W-LAN Revenue Forecast



- Sale of wireless LAN equipment expected to increase from \$1.1B in 2001 to \$5.2B in 2005.
- For 2002, Wi-Fi represented roughly 65% – 76% of the market.
- Estimates range from \$2.3 to \$2.8 billion in sales in 2003.

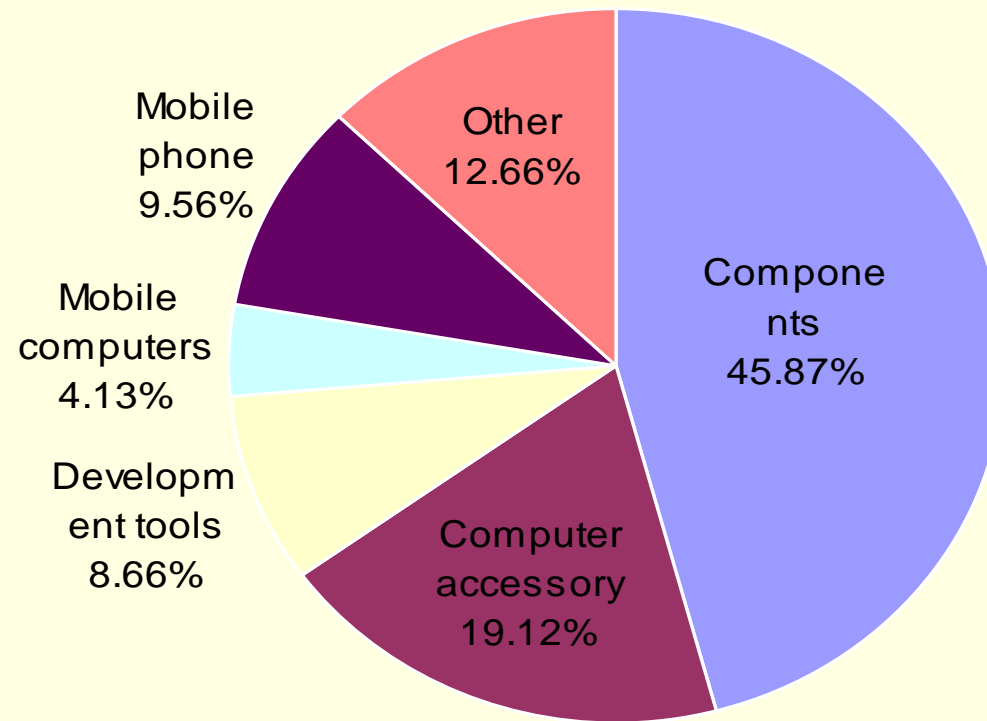
Impressive Growth, Staggering Predictions

- By 2003, more than 5.4 million people worldwide are expected to use W-LANs regularly.
- The number of wireless networks available is expected to top 15,000 by the end of 2003, up from 1,100 in 2001.
- It has also been predicted that 21 million Americans will be using W-LANs by 2007.
- The sale of W-LAN equipment is expected to grow from \$1.1 billion in 2000 to \$5.2 in 2005.

Challenges for Manufacturers

- Making a turnkey product,
 - Most home networks require a certain level of technical sophistication and time to set-up and install.
- Many manufactures view Wi-Fi as consumer electronics
 - which may limit the availability of carrier class equipment necessary for commercial hotspots.
- Major shakeout of equipment manufacturers
 - room for projected 6 to 7 manufacturers of wireless computer networking gear.

Bluetooth Qualified Product Devices by Category



Wireless Semiconductor Market Share

	2000	2001	% growth
Intersil	132.9	122.4	-8%
% of total	73%	58%	
Agere	14.6	33.2	127%
% of total	8%	16%	
Philips	7.5	17.1	128%
% of total	4%	8%	
Cisco	9.0	12.0	33%
% of total	5%	6%	
Proxim	13.4	10.5	-22%
% of total	7%	5%	
Other	5.1	16.0	214%
% of total	3%	8%	
Total	182.5	211.2	16%

Source: International Data Corporation.

Downstream Implications

- Wi-Fi creates opportunities for pull-through revenue, generating demand for wireless devices, operating systems, and content.
- If Wi-Fi penetration achieves between 5-10% of residential and SOHO broadband connections, it implies a market of \$5 to \$6 billion annually.
- Wi-Fi generates laptop sales. Laptops are generally higher margin items than their desktop equivalents.
- Cable modem and DSL will be equipped with Wi-Fi. Cable companies may benefit at the expense of ILECs since cable modem technology is already a stronger competitor to DSL.

Emerging Business Opportunities

- Hotspot Service Provider
- Wireless ISP
- Carrier Class Equipment Providers
- UWB
- Cognitive Radio

Hot Spot Business Plans

Complementary



Would you like
Wi-Fries with that?

Aggregator



Subscription



..T..Mobile HotSpot

STARBUCKS

Not sure (pay per flight)



Coffee, Tea, or Wi-Fi?

Hotspots are not just for airports anymore...

Potential Regulatory Issues

As unlicensed use spreads, what types of issues will the Commission face while attempting to ensure the continued viability of unlicensed operation?

Allaying Potential Interference Concerns

- Spectrum Solution
 - Provide additional spectrum for unlicensed devices
 - Technical rules
 - Permit unlicensed devices to operate in once forbidden bands
- Receiver Solution
- Cognitive Radio
 - Interference Temperature

Summary

- Unlicensed devices have grown to fill a role as an enabler of important business and personal communication needs.
- Regulatory flexibility gives unlicensed devices continuing promise.
- Unlicensed devices will continue to offer benefits where they can provide solutions not achievable with wires or where such devices can tolerate operating in an unprotected environment.
- In supervising existing or new unlicensed spectrum, the FCC's rules should be as clear as practicable, strictly enforced, and provide maximize flexibility.

Well Received

- Cited in Kevin Werbach, *SUPERCOMMONS: Toward a Unified Theory of Wireless Communication (aka, Taking Open Spectrum Seriously)* at note 60 (presented at the 31st TPRC Research Conference on Communication, Information and Internet Policy) (September 2003).
- Cited in Wireless Communications Association International, *FCC White Paper Prompts Commentary*, Weekly Bulletin (citing Paul Kirby, *Wireless Industry Still Wary Of Use Of Spectrum 'Underlays'*, TRDaily (August 25, 2003)) (September 4, 2003).
- Cited in Paul Kirby, *Wireless Industry Still Wary Of Use Of Spectrum 'Underlays'*, TRDaily (August 25, 2003).
- Quoted in Sherrie Conroy, *FCC: An Unshackled View of Unlicensed Spectrum*, Compliance Engineering (July/August). Cited in *8th Annual CMRS Competition Report* (June 2003).
- Cited in *In the Matter of Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993 Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services Eighth Report*, WT Docket No. 02-379, at 79-80 (rel. July 14, 2003).
- Quoted in Sarah Lai Stirland, *Beyond WiFi: Airwaves used in creative, lucrative — and unregulated — ways*, The Seattle Times (Monday, June 9, 2003).
- Cited in *In the Matter of Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band*, ET Docket No. 03 122 RM 10371 __ FCC Rcd. __ (June 4, 2003).
- Cited in Jack Loo, *US study concludes unlicensed wireless devices represent growing and vital market*, eBizAsiaLink (Friday, May 30, 2003).
- Quoted in *Industry Developments: FCC Builds Case for More Rural Unlicensed Wireless Services White Paper Suggests Ways to Lower Urban Interference and Raise Rural Coverage* NRTC Update, Vol. 1, No 21 at 4 – 6 (Wednesday, May 28, 2003).
- Quoted in Tim Horan, *FCC Staff Urges Balancing Unlicensed Spectrum Interest*, CIBC World Markets DATATIMES (May 23, 2003).
- Quoted in Mary Greczyn, *Market Growth Touted: FCC Staff Urges Agency to Balance Unlicensed Band Interests*, Communications Daily Vol. 23 No. 99 at 2 (May 22, 2003).

ET Docket 03-126 Comments in Response to Unlicensed and Unshackled

■ **The Cellular Telecommunications & Internet Association**

- "The Commission should focus on completing a proceeding to allocate an additional 255 megahertz of spectrum in the 5 gigahertz band for unlicensed devices, the trade group said. That allocation "may provide enough spectrum, at least in the near-term, for unlicensed devices, and make moot the need for plans that may cause interference to licensed CMRS devices."

■ **AT&T Wireless Services, Inc.**

- "The FCC "should not undermine the benefits of the exclusive use, flexible rights model by overemphasizing a need to promote unlicensed operations." "The non-interference condition imposed on part 15 unlicensed devices "must remain a bedrock principle." "Indeed, the Commission must first determine whether the interference temperature concept is sound policy."

■ **Cingular Wireless LLC**

- The FCC lacks authority under section 301 of the Communications Act of 1934 to permit unlicensed operations. "as a matter of policy, the FCC must not continue to view unlicensed devices as a panacea and the cure-all for its spectrum-management policies - particularly at the expense of licensed services." "permitting unlicensed operations on an underlay basis is inconsistent with sound policy and technical reality." The use of an interference temperature a "similarly flawed" idea.

■ **WebLink Wireless I LP**

- "Accommodating competing uses is not appropriate for paging and messaging spectrum." "Because of their narrow channels and restricted bandwidth, paging and messaging networks are very susceptible to interference, but do not have a great deal of capacity to recognize it."

■ **Itron, Inc.**

- supported the adoption of "rules of etiquette" for unlicensed operations, including limitation on duty cycles.

■ **Professor Reza Dibadj, University of Miami's School of Business Administration**

- "Prescient."



Thank you!

Office of Strategic Planning and Policy Analysis
Office of Engineering and Technology
Federal Communications Commission