



NOMAD “Cutting the Wires”

Wireless Standards



Paul Hill B.Sc.(Hons) MBCS

Local Government Team

phill@cisco.com

+44 (0)20 8824 8534

Contents

- 1 What are 'Standards'?
- 2 The Wireless Standards
- 3 IEEE 802.11 (Wi-Fi)
- 4 Key Takeaways



Standards Terminology

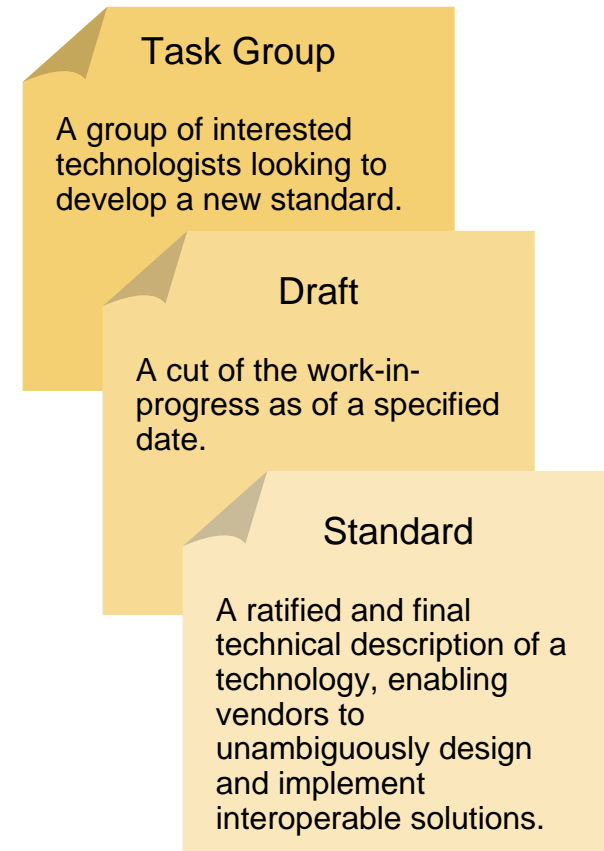
When is a Standard not a Standard?

- Does it have a completion date in the past?
- Does it use the word 'Ratified'?

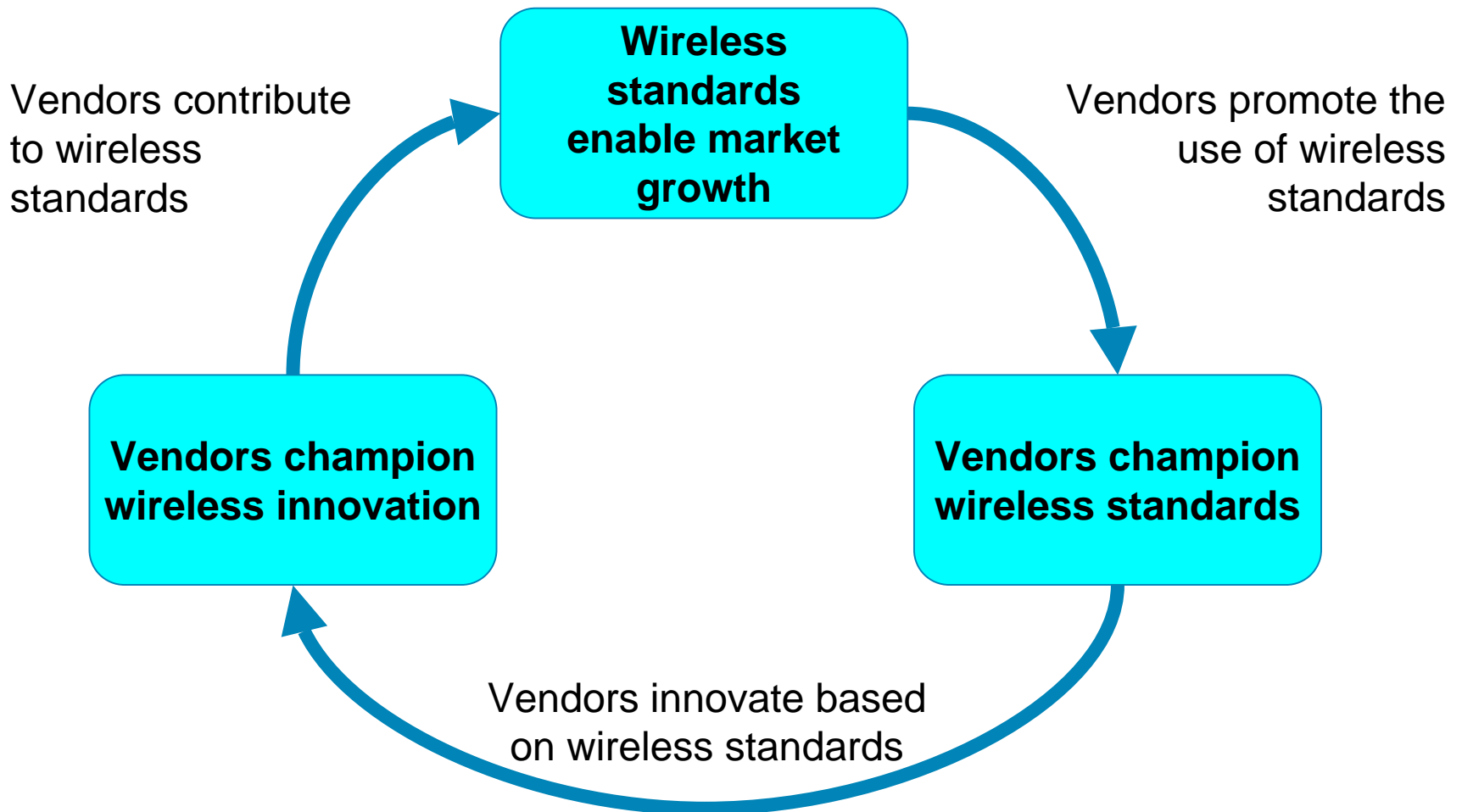
Look out for words like:

- Pre-standard
- Draft 'x'
- Expected to be compliant

- Caveat Emptor often applies to those phrases
- e.g. Is anyone here running 802.11n at home?



Wireless standards are a vital component of a virtuous circle



Wireless standards (and testing) enable market growth

Wireless is all about portability or mobility

Laptops, PDAs, phones, etc in homes, offices & public spaces

Mobility & portability are enabled by interoperability

Need to maximise the locations where wireless devices operate

Interoperability is enabled by standards (and testing)

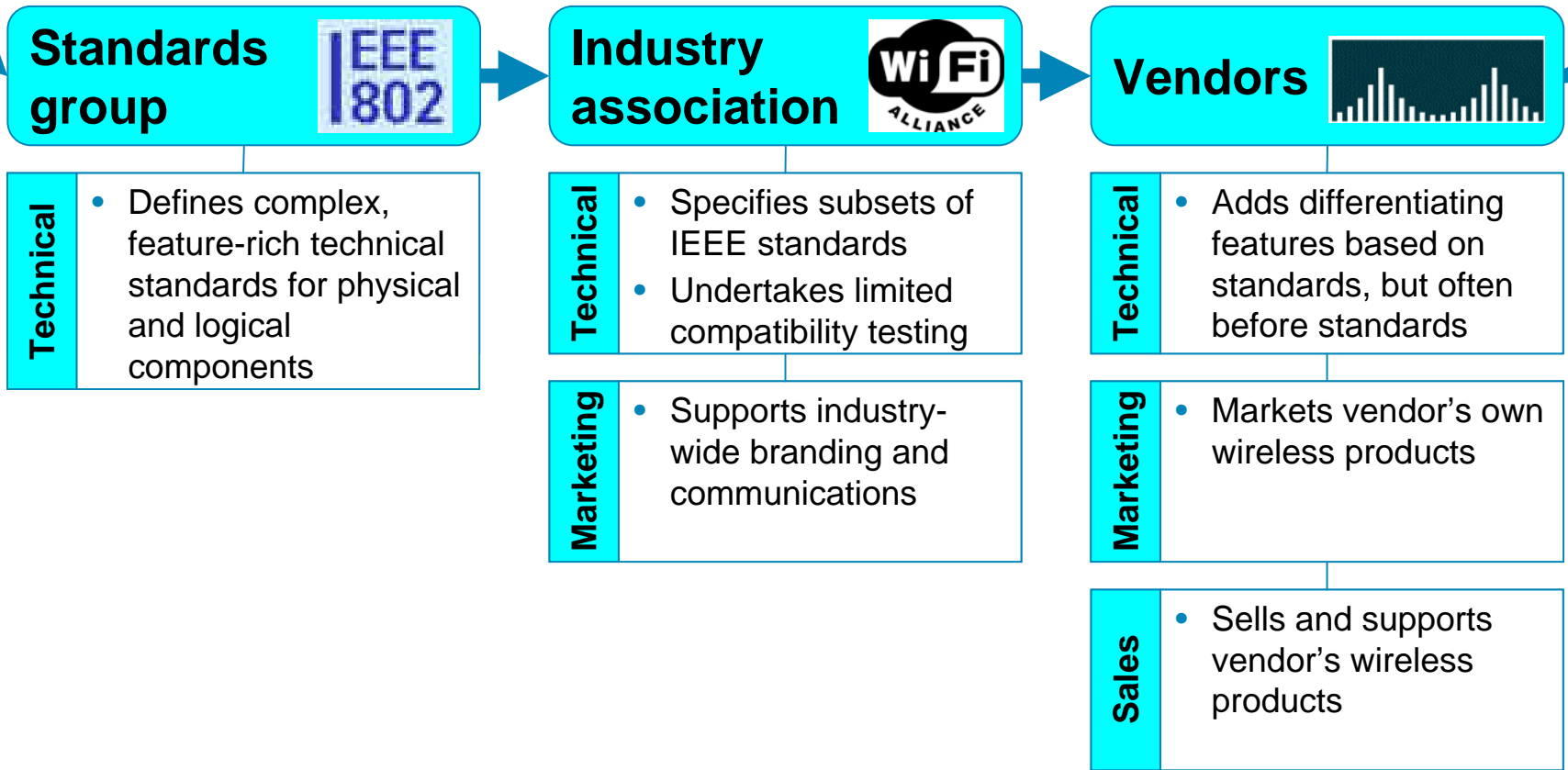
Standards also make enterprise customers “warm & fuzzy”

Standards (and testing) enable market growth

e.g. GSM standard enabled cellular penetration around the world

Vendors innovate and 'add value' to existing wireless standards

Vendors feed the tested features back into standards



“Feature bloat”

“Minimal features”

“Differentiated features”

Where pre-standard adoption has a place

Brand new feature or function is developed by a particular vendor

The feature is submitted to the relevant standards' body for review.

The feature is added to industry-wide software supplicants

Hardware agnostic, software specific. Usually available in 3-6 months after launch.

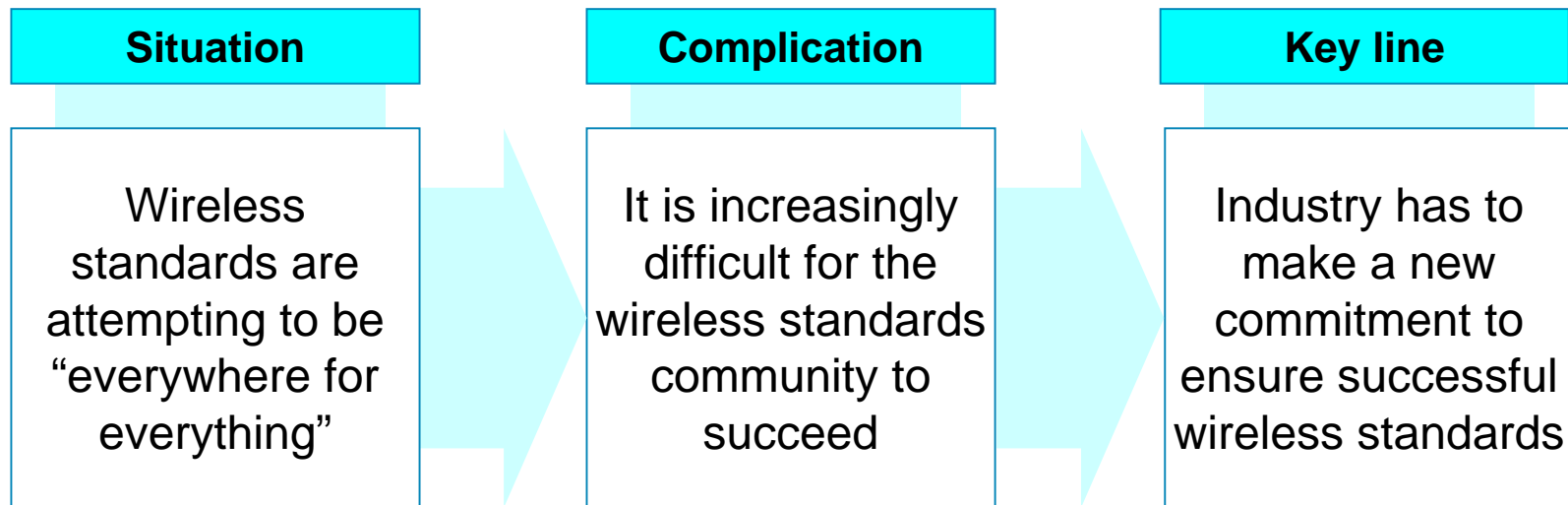
The feature is added to industry-wide hardware implementations

Hardware specific, software agnostic. Usually available 12-18 months after launch.

The standard for the feature is ratified for wide adoption

Hardware agnostic, software agnostic. Usually available 2-3 years after submission.

Increasing wireless standards complexity requires a new commitment from industry



Contents

- 1 What are 'Standards'?
- 2 The Wireless Standards
- 3 IEEE 802.11 (Wi-Fi)
- 4 Key Takeaways



The Types of Standards Bodies

Organisation

Primary Activity

Institute of Electrical and Electronics Engineers (IEEE)
www.ieee.org

Development of Hardware Standards

Internet Engineering Task Force (IETF)
www.ietf.org

Development of Software Standards

Wi-Fi Alliance
www.wi-fi.org

'Marketing' of Technical Standards

FCC / ETSI / OFCOM etc.
www.fcc.gov www.etsi.org
www.ofcom.org.uk

Define and Enforce Regulatory Standards and Spectrum Allocation

The IEEE Wireless Standard Families

Designation

Better Known As / Used For

802.11

Wi-Fi

802.15

Personal Area Networks (e.g. Bluetooth)

802.16

WiMax

802.18

Regulatory Issues

802.19

New Wireless Technology Coexistence Testing

802.20

High Speed Data for Mobile Devices (Dormant)

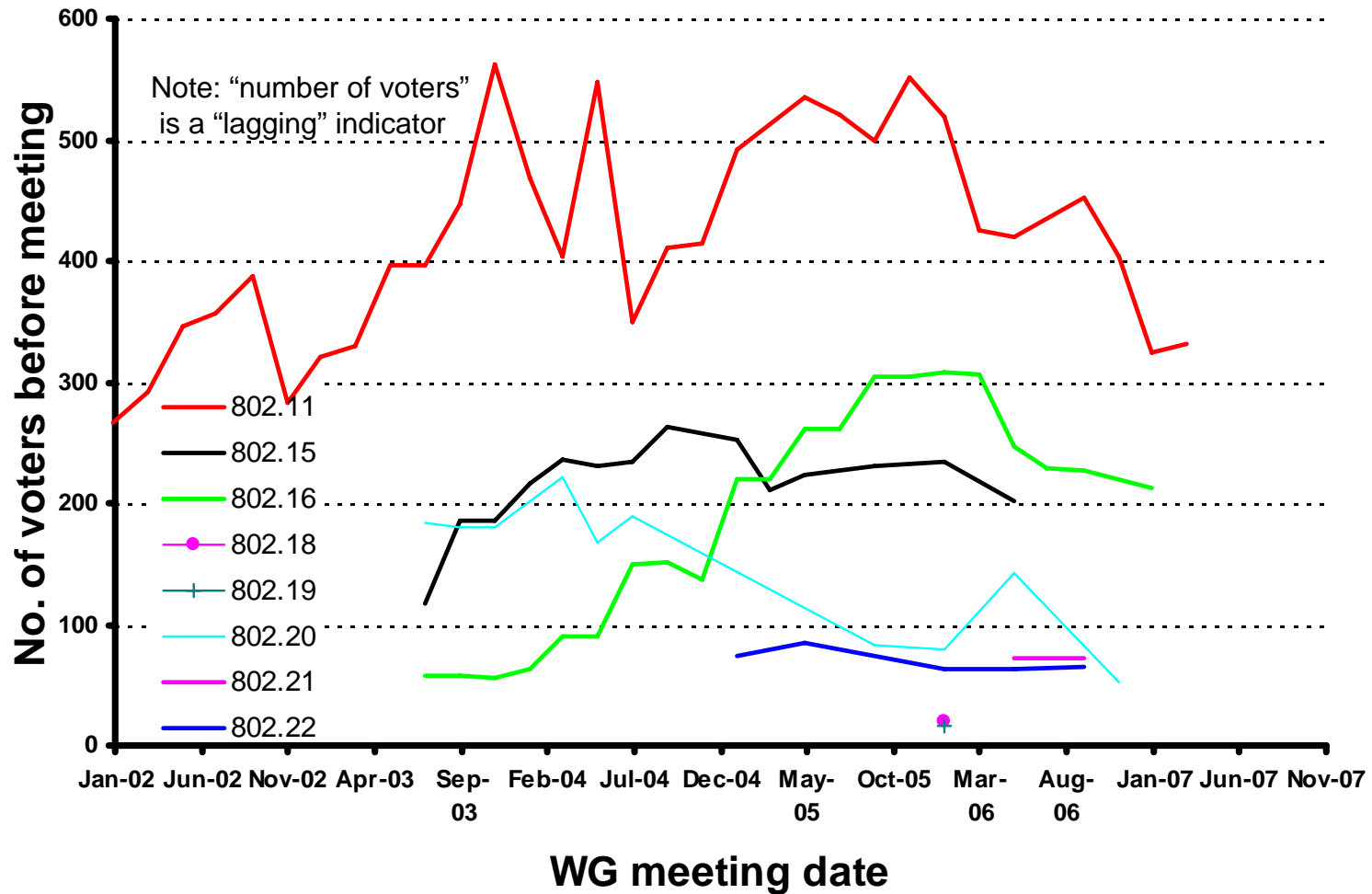
802.21

Inter-Technology Handover / Handoff

802.22

Data Usage of TV Frequencies

IEEE Wireless Groups' Popularity



New Mobile Internet Market

	Old World Mobile Voice/Data	New World Mobile Internet
Service	Voice Centric	Data Centric
Spectrum	<2GHz 5-15 MHz FDD	>2GHz >40 MHz TDD
System	Closed	Open
Base Station I/F	Non IP	IP
Access	CDMA, TDMA	S-OFDMA
Technology	EVDO Rev. A HSDPA	WiFi 2000 WiMax 2008 LTE 2010 EVDOorC 2010

WiMax vs. 3G

Attribute	1xEVDO Rev A	HSDPA/HSUPA (HSPA)	Mobile WiMAX
Base Standard	CDMA2000/IS-95	WCDMA	IEEE 802.16e-2005
Duplex Method	FDD	FDD	TDD ³
Downlink	TDM	CDM-TDM	OFDM
Uplink Multiple Access	CDMA	CDMA	OFDMA
Channel BW	1.25 MHz	5.0 MHz	Scalable: 5, 7, 8.75, 10 MHz
Frame Size	DL	1.67 milliseconds	2 milliseconds
	UL	6.67 milliseconds	2, 10 milliseconds
Modulation DL	QPSK/8PSK/16QAM	QPSK/16QAM	QPSK/16QAM/64QAM
Modulation UL	BPSK,QPSK/8PSK	BPSK/QPSK	QPSK/16QAM
Coding	Turbo	CC, Turbo	CC, Turbo
DL Peak Over the Air Data Rate	3.1 Mbps	14 Mbps	46 Mbps, DL/UL=3 ⁴ 32 Mbps, DL/UL=1 (10 MHz BW)
UL Peak Over the Air Data Rate	1.8 Mbps	5.8 Mbps	7 Mbps, DL/UL=1 ³ 4 Mbps, DL/UL=3 (10 MHz BW)
H-ARQ	Fast 4-Channel Synchronous IR	Fast 6-Channel Asynchronous CC	Multi-Channel Asynchronous CC
Scheduling	Fast Scheduling in the DL	Fast Scheduling in the DL	Fast Scheduling in DL and UL
Handoff	Virtual Soft Handoff	Network Initiated Hard Handoff	Network Optimized Hard Handoff
Tx Diversity and MIMO	Simple Open Loop Diversity	Simple Open & Closed Loop Diversity	STBC, SM
Beamforming	No	Yes (Dedicated Pilots)	Yes

Table 3: Summary of Comparative Features

WiMax Has 3 Primary Usage Cases

Fixed Wireless Broadband Access

Target Customers:

- Consumers
- Small / Medium Businesses

Target Regions:

- Emerging markets

Time To Market (Production Networks):

- 2007

Competing Technologies:

- DSL/FTTH/HFC



- Not likely to be seen in the UK any time soon as we have rich fixed line coverage already.

Backhaul

- Cellular service providers
- Mesh/WiFi Council networks

- Worldwide

- 2007

- MMDS/E1



- Already happening in rural areas of the UK, but on a small scale.

Mobile Internet Access

- Consumers

- Worldwide

- 2009

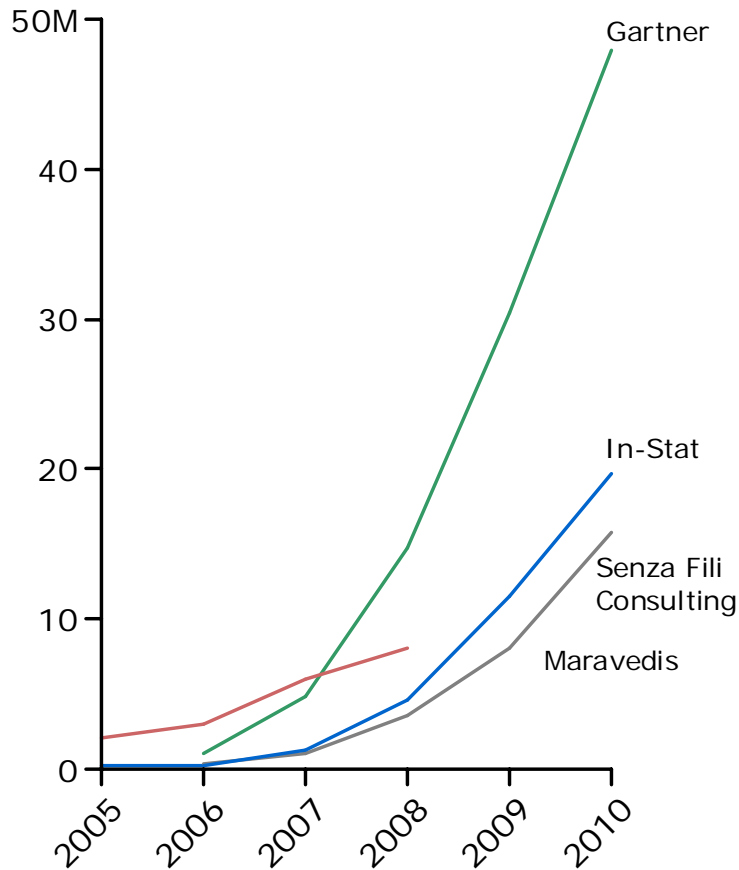
- 3G Cellular



- 2-3 years off being delivered, but something to keep an eye on.

WiMax Subscriber Forecasts

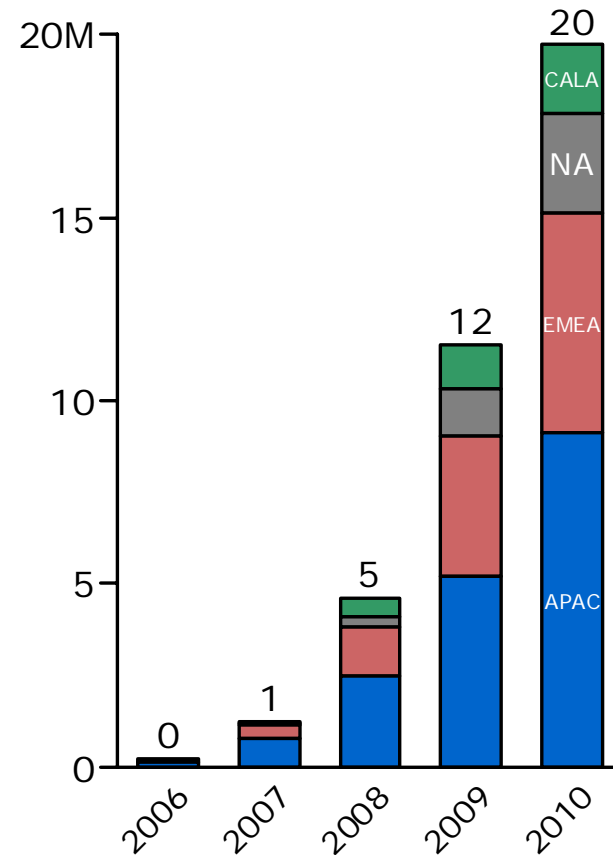
Worldwide Wimax Subscribers



Source: Gartner - Oct 06, Instat - Oct 06; Senza Fili Consulting - June 06; Maravedis 06

10-30M Wimax Subs in 2009

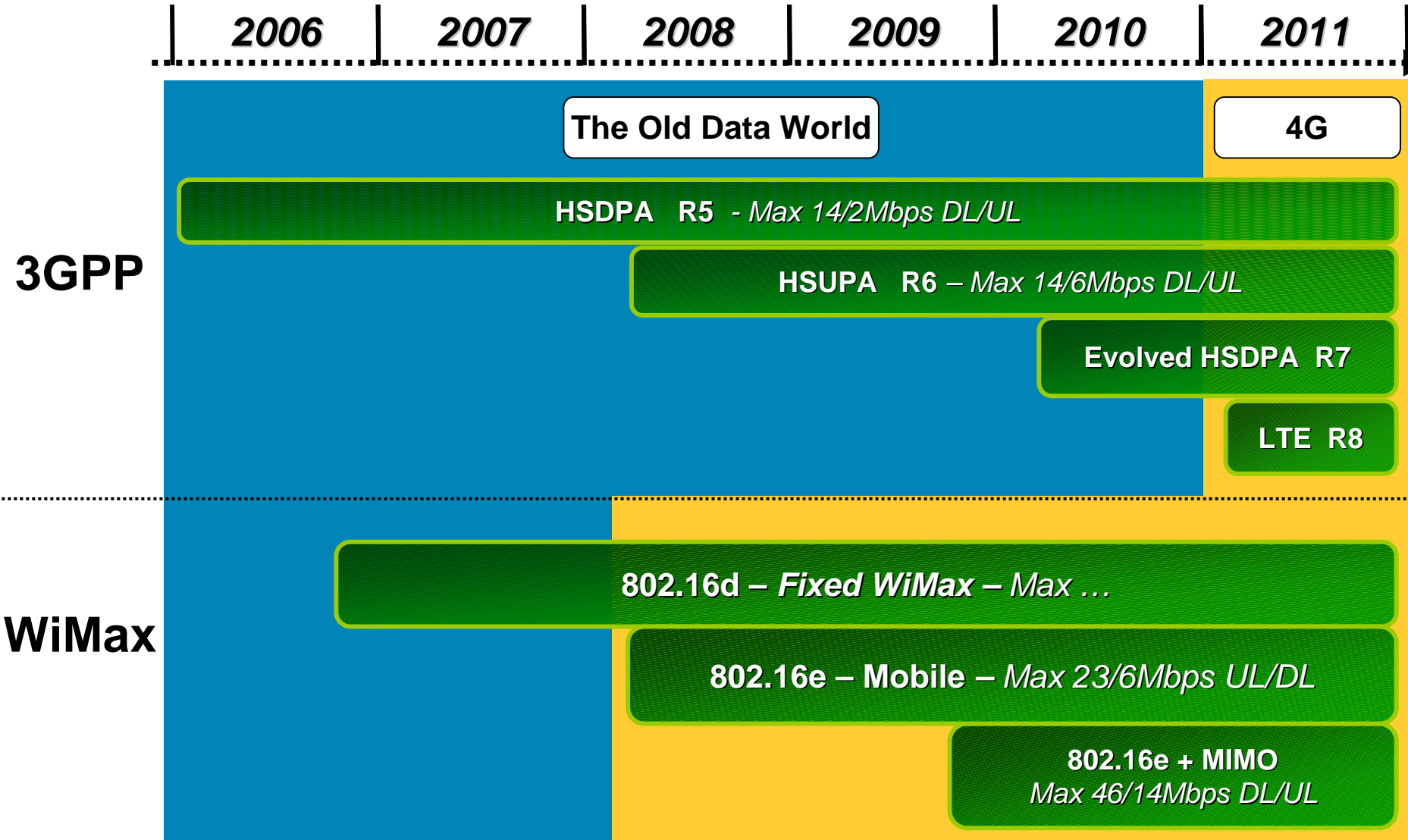
Wimax Subscribers By Region



Source: Gartner - Oct 2006

~75% of Wimax Subs to come from APAC and EMEA

Two Primary Migration Paths Exist To 4G

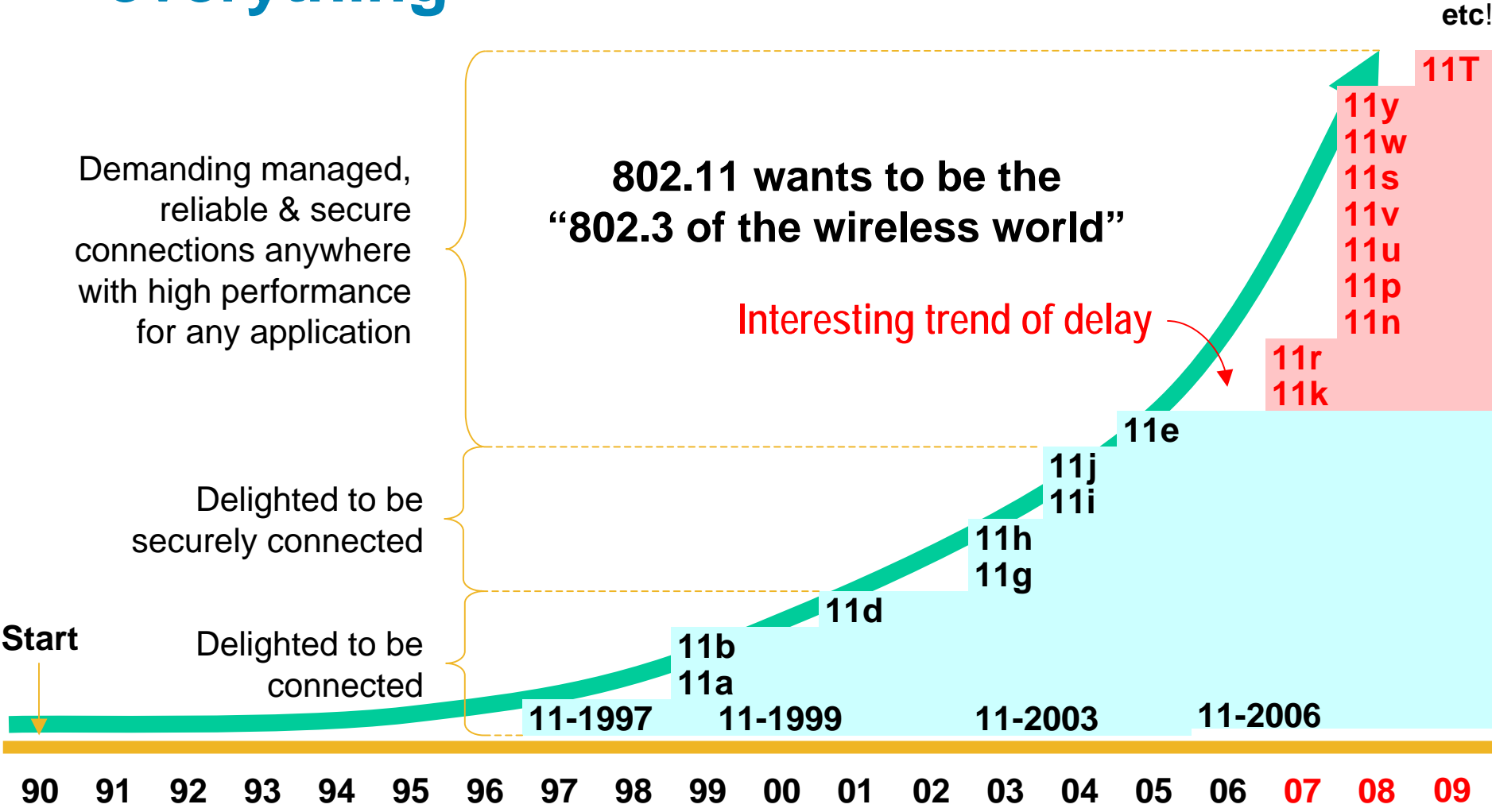


Contents

- 1 What are 'Standards'?
- 2 The Wireless Standards
- 3 IEEE 802.11 (Wi-Fi)
- 4 Key Takeaways

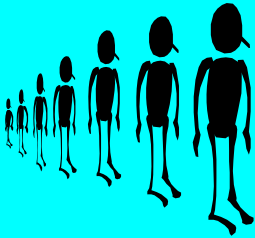


The explosion of 802.11 activities reflects the demand for it to be “everywhere for everything”



802.11 Alphabet Soup

QoS



802.11e

Voice & Video



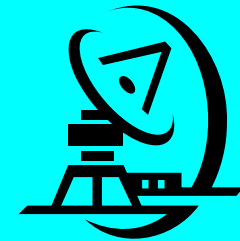
802.11e / r / u

Security



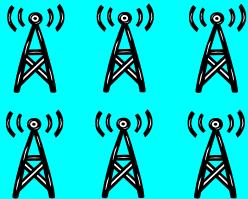
802.11i / w

Compliance



802.11h

Mesh



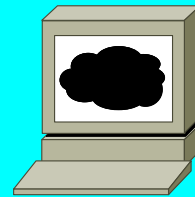
802.11s

Faster Radios



802.11n

Management



802.11k / v / T

**Interoperability
with other 802**



802.11u

Task Groups not relevant to Europe excluded

802.11 Ratified Standards (as of Mar 07)

Task Group	Description	Ratified
802.11	Base MAC and PHY Specifications	1999
802.11a	5GHz OFDM PHY (Radio)	1999
802.11b	2.4GHz DSSS PHY (Radio)	1999
802.11d	Additional Regulatory Domains (World Mode)	2001
802.11e	QoS Extensions	2005
802.11F	Inter Access Point Protocol (IAPP) [Withdrawn]	2003 [2006]
802.11g	Data Rate Extension for 2.4GHz	2003
802.11h	Spectrum Management for 5GHz in Europe	2003
802.11i	Data Plane Security Extensions	2004
802.11j	4.9-5.0GHz Operation in Japan	2004

802.11 Task Group Status (as of Mar 07)

Task Group	Description	Latest Draft	Expected Completion
802.11k	Radio Resource Management	#7.0 (Jan 07)	Jun 07
802.11ma	Maintenance of the 802.11 standard	#9.0 (Jan 07)	Mar 07
802.11n	High Throughput	#2.0 (Feb 07)	Sep 08
802.11p	Applications for the Vehicular Environment	#2.0 (Nov 06)	Mar 09
802.11r	Fast Roaming	#4.1 (Jan 07)	Mar 08
802.11s	Mesh	#1.0 (Nov 06)	Sep 08
802.11T	Wireless Performance and Prediction	#0.12 (Mar 07)	Jun 09
802.11u	Wireless Interworking with External Networks	#0.03 (Jan 07)	Feb 09
802.11v	Wireless Network Management	#0.08 (Jan 07)	Sep 09
802.11w	Control Plane Security Extensions	#1.0 (Oct 06)	Sep 08
802.11y	Contention Based Access to 3.6GHz (U.S.)	#1.0 (Nov 06)	Feb 08

'Marketing' Names for 802.11 Standards

Wi-Fi Alliance Interoperability Tested Name

IEEE 802.11 Name

Wi-Fi Certified™

802.11 / a / b / g

Wi-Fi Protected Access™ (WPA v1 & v2)

802.11i

Wi-Fi MultiMedia™ (WMM)

802.11e



Contents

- 1 What are 'Standards'?
- 2 The Wireless Standards
- 3 IEEE 802.11 (Wi-Fi)
- 4 Key Takeaways



Summary – Key Takeaways

1 Standards are the bedrock of sustainable industry development.

2 However, standards will always be 'late' compared to commercial availability.

3 Think of the application first, then choose the most appropriate radio technology.

4 Consider what access device(s) the user base have already or will want to use.

5 Wi-Fi and WiMax are complementary, not competitive; and keep an eye on 4G in the long term for further coverage choices.



