

# CHANGING WIRELESS TECHNOLOGIES

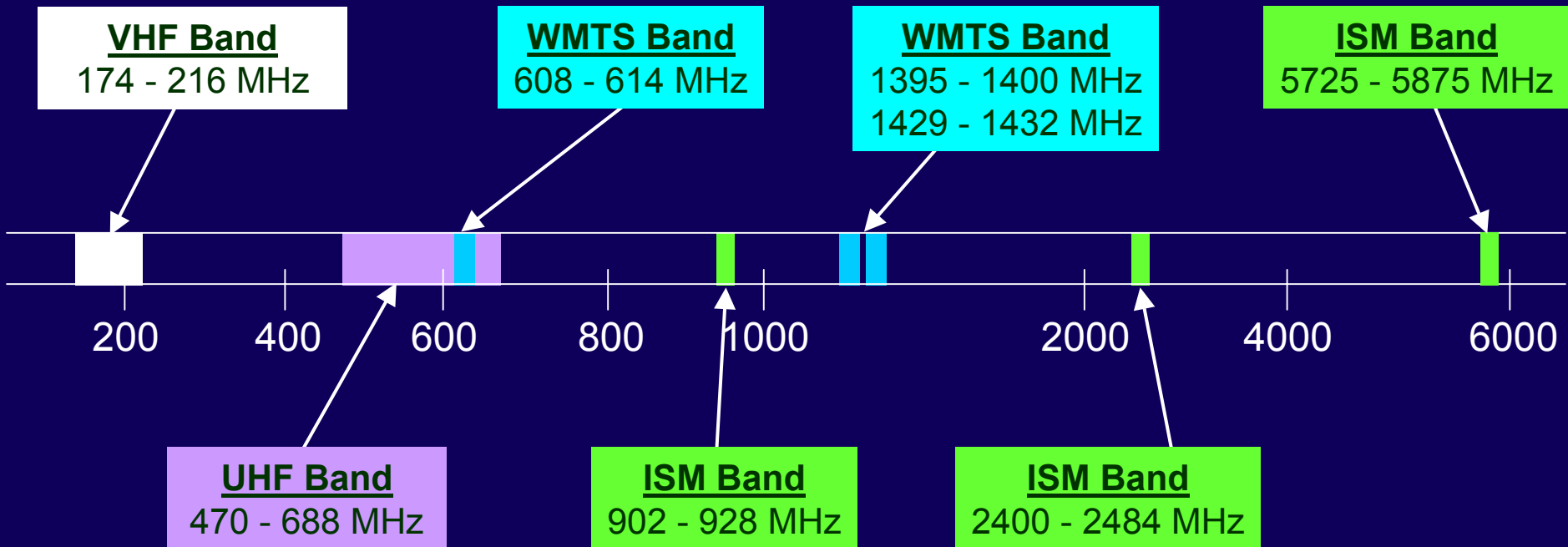
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San Diego, CA

# Technology Basics: Where the Waves Are (Spectrum)



kHz = 1000 Hz  
MHz = 1000 kHz  
GHz = 1000 MHz

# Refarming Status

- Janet Jackson
- April 16<sup>th</sup>
- Draft Proposal

# California Medical Instrumentation Association

Adobe Acrobat - [Pages from ASHE.pdf]

File Edit Document Tools View Window Help

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### Primary Users of Medical Telemetry Spectrum

Band	Primary Users	Nationwide Statistics (As of November 2002)
174-216 MHz, 470-608 MHz, 614-668 MHz	TV Channels 7-36 & 38-46 PLMRS Paging Auxiliary Broadcast	643 licensed DTV stations 1045 potential future DTV stations 28,000 PLMRS licenses
450-460 MHz	PLMRS Paging Auxiliary Broadcast Maritime Mobile Personal Radio Service	230,000 PLMRS licenses 4,000 Paging licenses  Note: The average number of PLMRS license grants per year is 41,000
460-470 MHz	PLMRS Personal Radio Service	622,000 PLMRS licenses  Note: The average number of PLMRS license grants per year is 102,000
608-614 MHz	<b>WMTS</b> Radio Astronomy	13 Radio Astronomy Sites
1395-1400 MHz	<b>WMTS</b> Government Radar	17 Radar Sites
1427-1432 MHz	<b>WMTS</b> Government Radar	14 Radar Sites

From ASHE WMTS Users Guide [www.ashe.org](http://www.ashe.org)

# IEEE 802.11: Introduction

- A successful WLAN standard that is cost effective, easy to install, and notably ~~still evolving~~
- Originally developed as “wireless Ethernet”
- New applications require additional support:
  - Quality-of-service
  - Spectrum and Power Management
  - Hand-off and Roaming
  - Enhanced security
  - Higher rates
- IEEE 802 standards body has formed Task Groups (TGs) to develop extensions to the standard
- Compliance to the standard certified by Wi-Fi



## 802.11 whatever

- 802.11 refers to a family of specifications developed by the IEEE for wireless LAN technology. 802.11 specifies an over-the-air interface between a wireless client and a base station or between two wireless clients. The IEEE accepted the specification in 1997.
- 802.11 FH - Frequency Hopping in 2.4
- 802.11 b - Direct Sequencing in 2.4
- 802.11 g - Higher Speed version of 11b
- 802.11 a - HiperLan (OFDM) in 5 G range
- 802.15 - Blue Tooth in 2.4

Already lost? ... hang in there.

# IEEE 802.11: Extensions

- Original 802.11 Standard defined in 1997
  - a single MAC and multiple physical layers
- These extensions are already defined: a, b, d, ...
  - 802.11a: High-speed Physical layer in 5 GHz band
  - 802.11b: Higher-speed Physical layer in 2.4 GHz band
- These are being defined in TGs: e, f, g, h, i, j, k...(ongoing)
  - 802.11e: Quality-of-Service, QoS
  - 802.11g: High rate Physical layer in 2.4 GHz band
  - 802.11h: Spectrum and transmit power management
  - 802.11i: Enhanced security mechanisms
  - 802.11k: Radio resource measurement
- The next extension/Task Group is High-Throughput: n

## 3 Classes of Devices

- WiFi Certified
- Enterprise Device
- Medical Specific



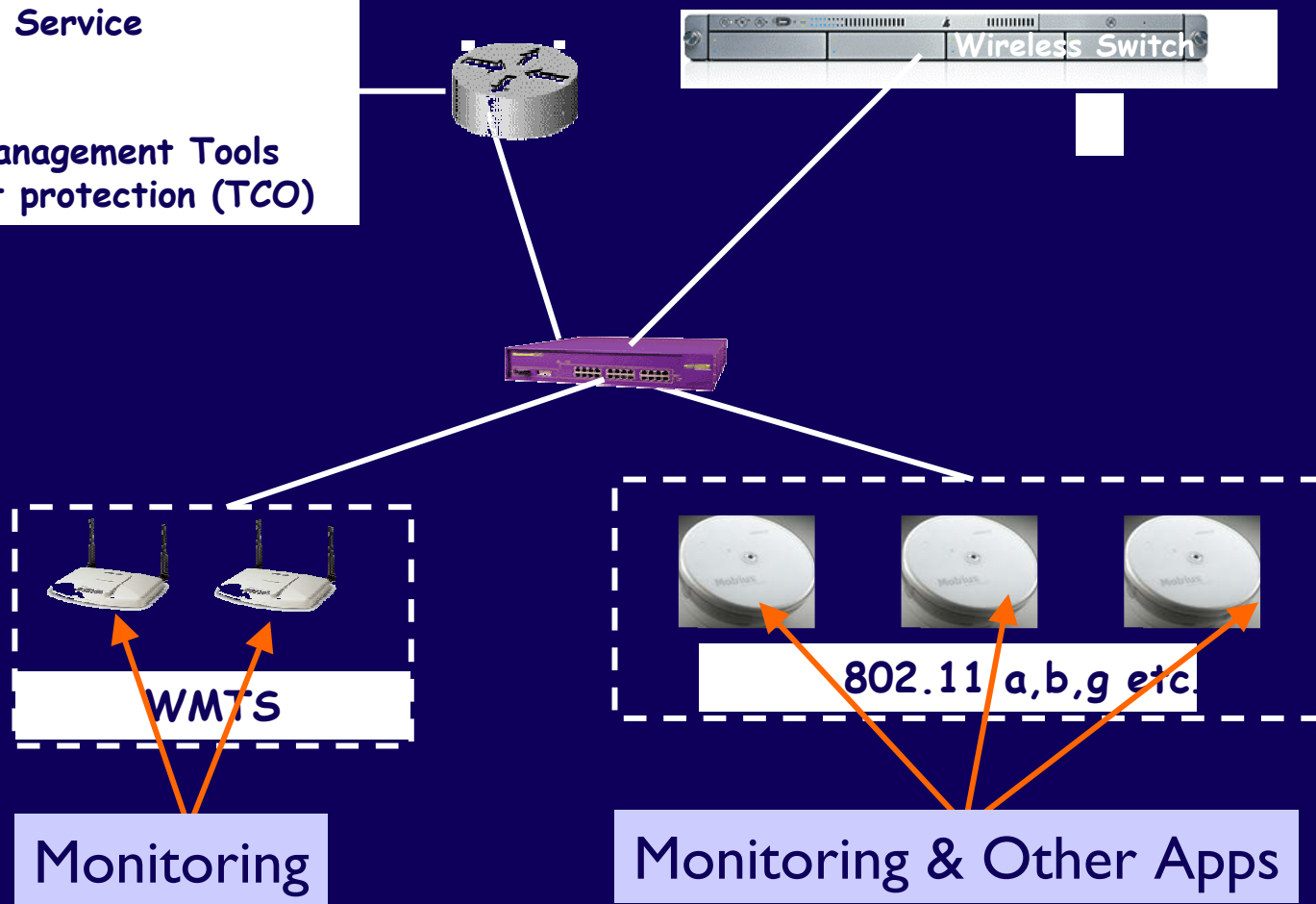
# Wireless Modalities

- Ambulatory Patient
- Mobile, low acuity monitor
- Intermediate/ Flexible monitoring
- Transportable, high acuity monitor
- Common Wireless Infrastructure
- High throughput wireless infrastructure
- Clinician Access to information

# Common Wireless Infrastructure

## Key System Characteristics

- ØQuality Of Service
- ØSecurity
- ØScalability
- ØCommon Management Tools
- ØInvestment protection (TCO)



## Decision Criteria

- Bandwidth
- Latency
- Data/Packet size
- Data loss
- Scalability
- Co-existence
- Security

## Trade Offs

- Having to plug in a device in for power has an impact on how you use wireless connections
- Having to operate on battery power has a profound impact on how you use wireless connections
- Sleeping on standby is how most radios deal with power management
- If you really want to make sure the data gets through plug it in

## RFID

- Still @ 40-50 cents/chip
  - Radio .15
  - Antenna .05
  - Assembly .20
- Passive/Active
- Need to redesign processes to prevent choke points
- Smart shelves \$2000/4'
- Standard shelves \$100/4'
- Fluidic self assembly
- Infrastructure will not exist until 2010 if ever

# Ultra Wideband

- Too cool to believe
- Unfortunately the big dogs are fighting
  - Intel/Motorola
- Faster and cheaper than BT
- Location tracking
- Police/Fire applications
- Replace BT and Infrared- High speed

## Bluetooth 802.15

- Cable replacements
- Ubiquitous
- Fast hoppers
- Co-exist at present
- Zigbee
- Now, soon, later, never
- Failed technology
- 2 Million BT chips a year
- 90+% go into phones

## Voice over IP Phones

- A category of hardware and software that uses the Internet as the transmission medium for telephone calls.
- Internet telephony products are sometimes called IP telephony, Voice over the Internet (VOI) or Voice over IP (VOIP) products.
- For users who have free, or fixed-price Internet access, Internet telephony software essentially provides free telephone calls anywhere in the world
- To date, Internet telephony does not offer the same quality of telephone service as direct telephone connections
- Many Internet telephony applications are available.  
Some, like CoolTalk and NetMeeting, come bundled with popular Web browsers. Others are stand-alone products.



# Wireless Security in a Nutshell

- Protect the enterprise
- Protect the data
- Protect the devices

# Wireless Security

- It really isn't
- As wireless becomes ubiquitous extensions of wired networks, rogue access points go away to be replaced by accidental associations and attacks against mobile PC's
- 2/3rds of attacks are against mis-configured servers
- Social Engineering

# Wireless Security

- Rogue access points
- Hot spots
- Wirelessness knows no borders and respects no one
- Power on passwords
- Encrypted data
- Data wipes/Remote Wipes

# TGe: Quality of Service

Scope: Enhance the 802.11 MAC to expand support for applications with QoS requirements

- Prioritized QoS:

- Traffic classes defined for audio, video, ftp etc.
- Contention-based access used (E-DCA),
- Higher priority traffic classes contend more aggressively

- Parameterized QoS:

- Streams request service based on parameters: rate, delay, etc.
- Polling-based access used (access grants time bounded)
- Streams served such that their rate, maximum delay (jitter) guarantees are met, under nominal wireless medium conditions

# TGe: Quality of Service

- Application to medical
  - Mission critical data is both delay and loss sensitive
    - Regulation mandates acceptable delay and loss rates
  - Spectrum scarce: only three non-overlapping channels available
    - Due to popularity of ISM bands, these channels heavily loaded
  - Mission critical applications need QoS mechanisms to be viable
- Philips has participated in TGe since its inception
  - Philips, an active member: has made ~ 100 proposals
  - e.g. “Schedule Element” based on Philips proposal
- Current status
  - Letter ballot passed in January 2003
  - Currently in Comment Resolution phase (85% comments resolved)
  - Expected to be a Standard in 2004

# TGg: Higher Rate Physical Layer

- Scope: Higher rate (20+ Mbps) Physical Layer Extensions in the 2.4 GHz band
  - Backward compatible with 802.11b
  - Mandatory modes based on OFDM (same as in 802.11a)
  - Optional modes based on PBCC and CCK-OFDM
    - can go up to 54 Mbps, in theory
- Application to medical
  - Provides greater capacity in 2.4 GHz channels
- Current status
  - In Sponsor (re-circulation) ballot
    - Standard (expected) published by July 2003
  - Products claiming 11g compliance in marketplace

# TGh: Spectrum Management

- Scope: Enhance the 802.11 MAC to provide Spectrum and Power management support
  - Originally defined for 5GHz band for Europe
    - 802.11 devices have a secondary user status
    - If 802.11 devices detect radar, they vacate that channel
  - Two mechanisms defined:
    - DFS: Dynamic frequency selection
    - TPC: Transmit power control
  - Industry alliance defining “Spectrum Etiquette” based on DFS and TPC
    - Between two (or more) secondary user status devices
  - Conceivably, these mechanisms can be used for interference management in 2.4 GHz band

# TGh: Spectrum Management

- Application to Medical
  - Inter-BSS interference minimization using TPC
    - Higher frequency re-use, therefore higher system capacity
  - Interference avoidance using DFS (e.g. microwave)
- Philips has participated in TGh since its inception
  - The Standard based on Philips proposal (with two other companies)
- Current status
  - Currently in sponsor ballot
  - Standard will be published soon



# TGi: Security Enhancements

- Scope: Enhance the current 802.11 MAC to provide improvements in security
  - Original 802.11 MAC Security (WEP) is vulnerable
  - Security goals:
    - Authentication
    - Privacy
    - Data integrity
  - TGi defining mechanisms for improved security
    - Privacy: using TKIP (short-term) and AES (long-term)
    - Authentication: using 802.1x for authentication and key management
  - TGi formed from TGe

# TGi: Security Enhancements

- Application to medical
  - Secure authentication to prevent DoS attacks
  - Patient data privacy an important consideration
- Current status:
  - Letter ballot passed in January 2003
    - Currently in re-circulation ballot
  - Standard to be published in 2004
  - Pre-standard products appear in the marketplace
    - Wi-Fi protected access (WPA)
    - Based on TKIP (privacy) and 802.1x/EAP (Authentication)
    - Forward compatible with 802.11i

# TGk: Radio Resource Measurement

Scope: Define Radio Resource Measurement enhancements to provide mechanisms to higher layers for radio and network measurements

- For use in hotspots and enterprise networks
- Tools for measurement of radio environment
  - “control” outside standard
- Measurements also used for fast-handoff

# TGk: Radio Resource Measurement

- Application to medical
  - Measurements for interference management
    - From 802.11 and other devices
  - Roaming or Fast-handoff
    - Goal is to reduce hand-off latency
    - Monitor hands-off from one AP to the next w/o loss of QoS
- Philips active since inception of the Task Group
  - One of (three) major contributors to TGk
  - e.g. Fast-handoff based on Philips proposals
- Current status
  - Letter ballot by end of 2003

## Conclusions

- IEEE 802.11 Standards continue to evolve
  - New extensions being defined
- As these Extensions get published, medical applications will benefit
  - As will CE, PC and Teleco. applications
- Patient monitoring applications are both delay and loss sensitive, it is important to
  - Understand radio environment (possibly dynamically)
  - Understand traffic needs in the network
  - Choose the right tools/extensions
    - If QoS cannot be met in ISM band, use WMTS band

## Acronyms

- QoS = Quality of Service
- EDCA = Enhanced Distributed Co-ordination Access
- HCF = Hybrid co-ordination function
- DoS = Denial of Service
- TKIP = Temporal Key Integrity Protocol
- EAP = Extensible Authentication Protocol
- AES = Advanced Encryption Standard
- WEP = Wired Equivalent Privacy
- Wi-Fi = Wireless Fidelity, 802.11b
- WPA = Wi-Fi Protected Access
- OFDM = Orthogonal Frequency Division Multiplexing
- PBCC = Packet Binary Convolutional Code
- DFS = Dynamic Frequency Selection
- TPC = Transmit Power Control

## What the future holds

- For the time being- an extension of wired networks
  - 30% of the time- loss of wireless network or connection
- Pervasive connectivity
  - 802.16e WiMax 15 Mbs Slow moving
  - 802.20 1 MBS Fast moving
- 2008 90% of all laptops will have embedded wireless cards

## To ponder

- The future will arrive late in a fashion we did not expect
- The future has already arrived. It is just not evenly distributed
- 2/3rds of all mission critical data is not backed up – all too often it is on a laptop
- Never believe a user that says, “that’s really all I want”
- No single wireless technology will meet all the needs of a major organization



## Remember this

- Delivered data rate is never as good as promised- expect  $1/3$  to  $1/2$  actual
- No one technology is uniquely better than any other, it is just a series of trade offs
- You can no longer build system to last, instead you must build them to change

# PHILIPS

*Let's make things better.*