Practicalities of Deploying Wireless LANs In Healthcare

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Applications Engineer
AGENDA

✓ Wireless Market update and The BIG SIX Infrastructure Considerations

✓ How Wireless is Changing the Healthcare Industry

✓ Types of Wireless “Services” and “Networks” in Healthcare

✓ Unique Challenges Planning Wireless within the Healthcare Facilities

✓ Deployment of Wireless LANs - Policies, Standards, Procedures, Best Practices
Wireless Market Update
Wireless Networks

- Wireless PANs
  - Wireless MANs
    - Wireless WANs
      - Wireless GANs
        - Wireless LANs
          - Cellular or Mobile
Global Mobile Traffic 2016 Report

- Grew 63% in 2016
- Mobile offload to Wi-Fi exceeded cellular traffic by 60%
- Will increase nearly sevenfold between 2016 and 2021
- Per (CAGR) mobile data traffic will grow 47 percent each year for the next 4 years, reaching 49.0 Exabyte's per month by 2021
- By 2021 there will be 11.6 billion mobile-connected devices, including M2M modules—exceeding the world’s projected population at that time (7.8 billion)
- By 2021, 50% of traffic will be Wi-Fi, 30% Wired, and 20% Mobile

Source: Cisco VNI 2021 Forecast
Updated Feb 2017
• Wi-Fi and mobile are growing faster than fixed
• Fixed traffic will fall from 52% to 33% by 2020
• Mobile and offload from mobile will account for 47%
• WiFi traffic from mobile and Wi-Fi only devices, 49%

Source: Cisco VNI Mobile, Feb 2017
Global Mobile TRAFFIC Growth by Device Type

Figures in parentheses refer to 2016, 2021 device share.

Source: Cisco VNI Mobile, 2017
Market share of Wireless Technology in Healthcare

- Unlicensed and Licensed Spectrums

- Unlicensed technologies are rapidly becoming dominate.

- Cell based offloading is quickly becoming inevitable, and requires Medical grade of service

Source: Kalorama Information
Wireless Technologies in Healthcare
Growth of Wi-Fi Hot Spots

- Wi-Fi hotspots will grow six-fold from 2016-2021
- From 94 Million in 2016 to 541.6 Million by 2021

Homespots or community hotspots — significant part of the public Wi-Fi strategy.

Source: Maravedis, Cisco VNI Mobile, 2017
The

**BIG SIX**

Deployment Considerations

*While Planning for the Wi-Fi Infrastructure*
Standards are continuously Evolving

ONE

Access points will be physically replaced every 3-5 years.

- Emerging wireless (IEEE 802.11__) standards
- Improvements in signal processing technology (I.E MU-MIMO versus SU-MIMO)
- Improvements in throughput due to added unlicensed spectrum
Access Point Throughput is increasing

TWO

The access point’s throughput will increase by a factor of 10X every 7.5 years, based on history.

<table>
<thead>
<tr>
<th>Technology and Year</th>
<th>Data Rate (Mb/s)</th>
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<tbody>
<tr>
<td>802.11 1995</td>
<td>1</td>
</tr>
<tr>
<td>802.11b 2000</td>
<td>10</td>
</tr>
<tr>
<td>802.11a 2005</td>
<td>100</td>
</tr>
<tr>
<td>802.11n 2010</td>
<td>1000</td>
</tr>
<tr>
<td>802.11ac Wave 1 2015</td>
<td>10000</td>
</tr>
<tr>
<td>802.11ac Wave 2 2020</td>
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<tr>
<td>802.11ax 2025</td>
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</table>
### Power over Ethernet is increasing

#### THREE

WAP power is most often supplied by Power over Ethernet (PoE)

<table>
<thead>
<tr>
<th>Standard</th>
<th>Pairs</th>
<th>Power</th>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td>PoE IEEE 802.3af (802.3at Type 1)</td>
<td>2</td>
<td>12.95W</td>
<td>Exists today</td>
</tr>
<tr>
<td>PoE+ IEEE 802.3at Type 2</td>
<td>2</td>
<td>25.5W</td>
<td>Exists today</td>
</tr>
<tr>
<td>PoE++</td>
<td>4</td>
<td>49W</td>
<td>2016</td>
</tr>
<tr>
<td>Proposed IEEE 802.3bt Type 3</td>
<td>4</td>
<td>96W</td>
<td>2016</td>
</tr>
<tr>
<td>Proposed IEEE 802.3bt Type 4</td>
<td>4</td>
<td>96W</td>
<td>2016</td>
</tr>
<tr>
<td>Non PoE standards based Cisco UPOE</td>
<td>4</td>
<td>60W</td>
<td>exists today</td>
</tr>
<tr>
<td>HDBaseT (<a href="http://www.hdbaset.org">www.hdbaset.org</a>)</td>
<td>4</td>
<td>96W</td>
<td>exists today</td>
</tr>
</tbody>
</table>
Access Point Density is significantly Increasing

**FOUR**

The access point density will increase
Requiring additional cabling to new AP locations in the future

- “High density” Wi-Fi design is capacity-oriented, NOT coverage oriented

- Wireless is becoming a critical part of the network infrastructure
The wireless LAN will provide additional services in the future.

**Note:** VoLTE and VoIP are mobile-specific; VoWiFi could be from any Wi-Fi connection. Circuit-switched mobile voice is excluded from the mix.

Source: Cisco VNI Mobile, 2016

Figures in parentheses refer to 2015, 2020 minutes of use share.
PHY and MAC Layer Standards are Evolving

SIX

Network PHY and MAC standards evolving

- 1 Gb/s (CAT5e/CAT 6) and 10 Gb/s (CAT6A) standards
- Link aggregation – more bandwidth, back up and redundancy
- NBaseT- Industry 2.5 Gb/s and 5 Gb/s Ethernet over existing (CAT5e or CAT6) cable plant

www.nbaset.org
How Wireless is Transforming the Healthcare Industry
• Healthcare Drivers - Demanding High Bandwidth WiFi Networks

• Growth in Wireless Healthcare Apps

• Use of wireless hand held mobile devices for clinic technicians

• Surge in Wireless medical devices
  - Infusion pumps, smart beds, Clinic monitors, etc

• Growth of wireless medical sensors

• Smart phones, laptops, tablets
• **Healthcare Wireless Drivers** cont...

- Wearable Wireless Devices (WWDs)
- Patient in-room monitors
- Patient and visitor use of the WiFi network
- Devices that interact with EMRs (Electronic Medical Records)
- Real-time access to X-Rays, MRIs
- RTLS (Real Time Location System)
• **Healthcare Wireless Drivers cont...**

  ➢ More and more devices are finding their way onto the WiFi Network

  ➢ Medical devices transitioning from proprietary networks to the WiFi Network

  ➢ Increases the number of devices that require a robust WiFi network

  ➢ Designers will face new challenges in wireless design and deployment
    - Network Capacity
    - Scalability
    - Device Coexistence
    - Mobility
    - Power consumption
• **Healthcare Wireless Drivers cont...**

Voice over Wireless – Will increase significantly

Source: Cisco VNI Mobile, 2016

- High growth in Consumer and Enterprise use of the wireless network
- Offloading from cell based networks to Wi-Fi is rapidly increasing

Requiring a robust WiFi network (with redundancy)
Healthcare Wireless Drivers cont...

The Increase of Wireless Mobility Technologies

- Telemetry
  (Wireless data transfer mechanisms, using radio, ultrasonic, or infrared systems.)

- Blue Tooth
  (Short distances/UHF radio waves.)

- Cellular

- Wireless LAN (WLAN), Wireless WAN (WWAN)

- RFID – Radio Frequency ID/Electromagnetic waves

- Ultra Wide Band (UWB) – Low energy, short range
  High bandwidth/large radio spectrum

(Source: WiFi Alliance)
• **Healthcare Wireless Drivers** cont...

Wireless Mobility - the Benefits

- Wearable Wireless monitoring devices
- More efficient communication with staff
- Real time monitoring of vitals
- Can help decrease re-admissions
- Fewer accessories requiring infection control
- Less wires

Transitioning from proprietary private networks, to the Wi-Fi network

(Source: WiFi Alliance)
WiFi Medical Telemetry Devices quickly emerging for Mobility

- Wireless cardiac monitors implanted or worn
- Physicians Wireless handheld PDAs
- RFID-RF identification
- Implanted micro-stimulator
- Body sensors used to monitor and control various patients' functions
- Body sensors w/remote monitoring - home

By the end of this year, 60% of the carrier network traffic will be offloaded to the WiFi Infrastructure
What these “Drivers” mean

• Transforming Patient Care
  – Promote Patient safety
  – Streamline Business Operations
  – Wireless technologies improve efficiency
  – Wireless technologies improve the patient experience
  – Lowers patient cost
What these “Drivers” mean

• Managing Staff Workflow

• Asset Management
  – Real time tracking of Wireless Medical Equipment, Staff and patients

• Automating Environmental Monitoring

• Increasing Security

• Monitoring Hand Hygiene Compliance
Summary

• The Healthcare Wi-Fi infrastructure must accommodate many users, much greater densities and be more robust.

• Many areas require High Density implementations.

• Considerations for Hospital Enterprise Wireless and Consumer Wireless.

• Considerations for Cell based offloading to the Wi-Fi Infrastructure.

• Moves, adds, changes, and maintenance s/b low cost, quick, and easy.
Types of Wireless Services and Networks

Within Healthcare Facilities
Consider “Grades” of Hospital Wireless Services

- **Medical Grade – Life Critical**
  - Support clinical devices and apps to collect and share life critical medical info

- **Enterprise Grade – Mission Critical**
  - Support health devices and apps that inform and direct

- **Consumer Grade – Inform**
  - The wireless service that supports consumer devices and apps to inform

All requiring a robust wireless system that is ready for future technologies quick upgrades, and possibly redundancy in certain areas

**Five Measures That Define Assurance**

<table>
<thead>
<tr>
<th></th>
<th>Coverage</th>
<th>Signal</th>
<th>Capacity</th>
<th>Security</th>
<th>Certainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>Maximum</td>
<td>100%</td>
</tr>
<tr>
<td>Enterprise</td>
<td>95%</td>
<td>95%</td>
<td>95%</td>
<td>High</td>
<td>95%</td>
</tr>
<tr>
<td>Consumer</td>
<td>90%</td>
<td>90%</td>
<td>Best Effort</td>
<td>Limited</td>
<td>90%</td>
</tr>
</tbody>
</table>

Source: BICSI-Medical Grade Wireless Utility Supplement
Consider Various Wireless Networks

- **Wireless Clinical Data Network (WCDN)**
  - The *logical* network that uses the physical assets of the broadband (DAS) and Wi-Fi
  - Medical Devices – Life critical monitoring – Telemetry, Infusion pumps
  - Includes both licensed and unlicensed radio frequency bands

*The WCDN requires a Medical Grade Wireless Service*
Consider Various Wireless Networks

- **Wireless Local Area Network (WLAN)**
  - The *physical* network – uses unlicensed frequencies
  - Services could include Wi-Fi, Zigbee, USB, etc – Depends on client device
  - Wi-Fi – 802.11xx – The Medical 802.11 network supports data, voice, and video across clinical, enterprise, and consumer applications and devices

*Could require Consumer, Enterprise or Medical Grade Wireless Service*

Source: BICSI-Medical Grade Wireless Utility Supplement
Consider Various Wireless Networks

- **Wireless Local Area Network (WLAN) cont...**

  - A layered Wi-Fi design is key to the Medical Grade Wireless
  - Enables dedicated channels for Wi-Fi enabled Devices
  - Enables separation of Medical Enterprise, and Consumer grade networks
  - Key principals of Unified Wireless architecture
    - Scalability
    - Roaming
    - Mobility
    - Manageability
    - Security

*Sample of a Layered Wi-Fi design*

Source: BICSI - Medical Grade Wireless Utility Supplement
Consider Various Wireless Networks

- **Wireless Wide Area Network (WWAN)**
  - The *physical* network – intended for both inside and outside the facility
  - Services could include WiFi, Cellular, Paging, life safety radio, etc

Example of a WWAN Healthcare Application

**Requires Consumer and Enterprise grade services at this time**

Source: BICSI-Medical Grade Wireless Utility Supplement
Consider Various Wireless Networks

• Location Local Area Network (LLAN)
  - A logical network – will use the physical assets of the other Networks and Technologies to send traffic
  - Services could include location of people and assets within the facility (RTLS)
  - Assets could include Wi-Fi Access Points, Zigbee, infrared, ultrasound, RFID

Requires Enterprise grade service at this time

Source: BICSI-Medical Grade Wireless Utility Supplement
Summary

Wireless “Networks” and “Services”

• *Wireless is evolving as a critical utility in Healthcare*

• *WiFi is dominating*

• All requiring a robust wireless system that is physically protected, secure, ready for future technologies and permits quick upgrades
Planning for the Wireless Network

Unique Challenges and Considerations Within Healthcare Facilities
Medical facilities may be made up of:

- Multiple building types, interconnected structures, campus of structures
- Multiple types of wireless users – different levels of priority and performance
- Multiple uses of wireless services
  Legacy, new deployments
- Multiple types of functional areas and departments

Source: BICSI - Medical Grade Wireless Utility
Challenges include Structural Environments in Hospitals

- Hospital **Wall and Floor** building construction is unique to the healthcare facilities
  - Ducted HVAC supply and return
  - Rated fire walls with smoke departments
  - Separate exhaust systems for many rooms
  - Led Lined walls – X-ray, MRI, CAT

- Requires larger structural steel, thicker floor slabs, thicker walls

- Older buildings – Terra cotta block and lathe

Contributing to the challenges of providing effective coverage

Source: BICSI – Medical Grade Wireless Utility
Structural Environments in Hospitals cont...

- Hospital construction *Above Ceiling* is a system-dense environment which includes:
  - Mechanical
  - Medical gas distribution
  - Ventilation Systems
  - Chilled water plumbing

Source: BICSI – Medical Grade Wireless Utility
Challenges with WLAN Access Point (AP) Deployment

- Cat 6a – thicker cable – Need a better way to get the cable installed to the AP
- Eliminate the need for sealant
- Stow excess cable slack
- Satisfying Healthcare codes, compliances, and procedures
- Ensuring the full performance of the AP
- Providing a solution for quick and easy Migration and upgrades
- Better aesthetics, and security
WLAN Challenges include Area Specific Requirements

Hospital facilities have unique wireless design and implementation considerations which include:

- Office and patient areas; Impact of low E-glass, Restriction of devices/antennas, use of metals in walls, age of building, etc.

- Diagnostic equipment and operating areas

- Reception, hospitality, food services

- Parking structures – Security requirements
  - Triages are emerging

*Each area will require different Types of Wireless Networks and Grades of Service*

Source: BICSI – Medical Grade Wireless Utility
WLAN Challenges cont...

- The burgeoning connected health ecosystem, including BYOD
- Engineering a future ready Wi-Fi infrastructure
- A Wireless infrastructure that involves no above ceiling modifications
- The increasing use of Wireless medical devices
  - May require high density areas
- Enabling a higher quality of care and patient safety at a lower cost

Source: BICSI – Medical Grade Wireless Utility Supplement
Considerations for Deployment of the Wireless LANs

*Healthcare Wireless Standards, Codes, Compliances and Recommendations*
Infectious Control Risk Assessment (ICRA)

Lifting or removing ceiling tiles requires the installer to:

- Use Negative Air Pressure Enclosure (NAPE), or “tent off” the work area
- Use a HEPA air filter
BICSI-Medical Grade Wireless Utility Supplement

• Wireless Design Guide for the Healthcare Industry

- Wireless communications is a unique type of “Utility” in hospitals

- MGWU brings an engineered process-based approach to wireless network design and implementation

The implementation of a wireless infrastructure should not require costly and disruptive above ceiling change management.
BICSI-Medical Grade Wireless Utility Supplement

• Implementation of Wireless

  - Below ceiling installation of Wi-Fi access points is a better alternative to above ceiling

  - They should be installed in a cabinet flush with or below the ceiling, or wall mounted

MGWU can help prepare the hospital for the changing healthcare IT environment and future wireless technologies
Recommendation: Ceiling Tile Cabinets

- Helps to satisfy ICRA procedures
- No need to lift ceiling tiles for maintenance and upgrades
- Eliminates the hole in the tile to get the cable attached to the WAP
- Eliminates the need to use sealant in the holes and gaps
- WAP re-location made easy – preserving the original tile
- Aesthetics – A more professional installation
- Lockable doors that can help meet security requirements
**Additional Benefits of a Ceiling Tile Cabinet**

- Satisfies *National Electric Code* compliance (Plenum rated)
  - Solid back box
  - Stow Non-plenum patch cords
  - Stow excess horizontal cable
  - Biscuit jacks

- Makes upgrades easier and faster

- Simplify Hospital ICRA procedures
Recommendation for Hard Ceiling

- Plenum rated back box helps simplify ICRA procedures
- Simplifies deployment in hard ceilings
- Trims can be exchanged with AP upgrades
- Has enough room for cords, cables, biscuits
• TIA 1179 – Healthcare Facility Telecommunications Infrastructure Standard

- Once ceiling tiles are closed, adding or changing cabling could jeopardize infection control measures.

- Restrictions on removing ceiling tiles impacts adds, moves and changes, and adds significant cost when the need arises to access the ceiling.

- It is recommended that the wireless environment be characterized prior to design and installation of cabling.

- Policies and procedures to mitigate Airborne Infectious Disease.
• **HIPPA Compliance – Physically Secure the Endpoints**

- This rule sets national standards for protecting the confidentiality, integrity, and availability of electronic protected health information.

- Physically lock access points for security

164.301(a)(1) implement policies and procedures to limit physical access to its electronic information systems... while ensuring that properly authorized access is allowed.
Thank you for your time!