Wi-Fi in Healthcare: from Good to Great

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WIRELESS DESIGN

The term “mission critical” takes on a whole new meaning when dealing with life critical mobile devices in healthcare. These can range from mobile voice devices that are paramount for immediate communication to mobile medical devices that are helping sustain and report on patient health. Lately, mobile centric patient engagement has been in the headlines and ultimately the goal is to provide a digital concierge experience to guest and patients and reduce their level of stress and anxiety as they receive care. It is not surprising that Wi-Fi has been at the center and forefront of mobile initiatives in healthcare. The low chipset costs along with the ease of integration into new and existing devices have made Wi-Fi the preferred medium for many device manufacturers.

A simple google search on “Wi-Fi design in healthcare” or “Wi-Fi enabled Healthcare” will yield a number of good whitepapers, articles, and blogs on the topic. The focus is on the design process and in some cases on configuration best practices. If we were to boil these down to five best practices they would be

- Healthcare is a dynamic environment so design for capacity, keeping in mind that the system may be used for Real Time Location Services. There should be very few access points that have direct line of sight to each other with the majority installed inside patient rooms.

- Gather detailed requirements including, specific use cases, device types, and Wi-Fi cards that intend to use the network. It’s not unusual for a hospital Wi-Fi network to support Employee, Guest, BYOD, Voice, and Medical Device access.

- Conduct an AP on a Stick design, taking real readings onsite with the access point intended for use and a standard wireless card. It’s not as important which device is used to capture the data as it is to ensure that the same Wi-Fi card model is used consistently. The survey tools can mimic the RSSI for other typical device types.

- Conduct the RF design for 5 GHz keeping in mind the typical requirement of -65dBm/-67dBm based on preference for voice. The 2.4 GHz radios can be disabled as needed if the density does not allow for a clean channel plan. Do not blindly rely on dynamic radio management. A static channel plan is much more stable and predictable.

- Steer end users away from using 2.4 GHz, disable lower 802.11b data rates, and leverage channel bonding very carefully, if at all, in the 5 GHz space.

There is a vibrant Wi-Fi engineering community thanks to organizations like the CWNP and Wireless LAN Professionals with Wi-Fi experts that openly share their knowledge and experience. A key concept to keep in mind is that the Wi-Fi design is based on a series of static measurements captured over time, but RF is a very dynamic medium and its behavior is heavily dependent on its surroundings. RF propagation in an empty room looks very different from one with 10 doctors and bulky medical mobile X-Ray units. The initial network design can be effective, but over time as the facility changes its efficacy can diminish.   Wi-Fi does not abide by the "set it and forget it" mentality that often works well for wired networks. We design for the lowest common denominator with this in mind, but no one has a crystal ball to predict what is coming down the pipe in the next several years.

There are three factors that can help transform a stagnant design from good to great: Competent Ongoing Operational Maintenance, Staff Qualifications, and maintaining a clean RF environment.

Competent Ongoing Operational Maintenance

- Capacity Management
- Change Management
- The right RF toolsets
- Two RF validation surveys per year
- Formal device onboarding and testing

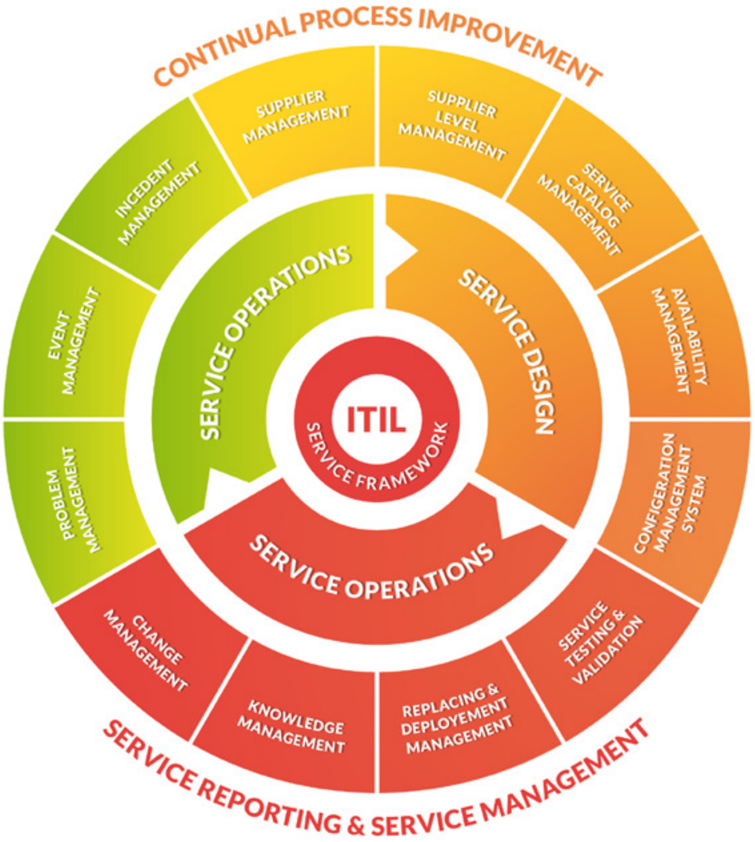
Staff Qualifications

- Important to be plugged into the community
- Certified/Experienced
- In tune with the latest developments and trends

Clean RF Environment

- Manual Channel/Power plan
- Ongoing Spectrum analysis

If there is one constant in a hospital, it is change. Departments are constantly relocating, and renovating. This is especially apparent in older hospitals where one can run into lead lined walls in locations that no longer require it. To ensure that the original design continues to meet coverage requirements, the low hanging fruit is to perform an RF validation survey once or even twice per year. Abiding by ITIL V3.0 standards for change management and capacity management can also help tremendously. More often than not, IT departments cause inadvertent outages and connectivity issues by making undocumented or unplanned knee jerk reaction changes to the wireless infrastructure. From a capacity standpoint, what started as high density areas can change over time and it is crucial to keep track of system capacity over time. Patients watching Netflix on the guest network is a good example of a capacity requirements that may not have been part of the initial design requirements.


CONTINUAL PROCESS IMPROVEMENT
SUPPLIER MANAGEMENT
SUPPLIER LEVEL MANAGEMENT
SERVICE CATALOG MANAGEMENT
AVAILABILITY MANAGEMENT
CONFIGERATION MANAGEMENT SYSTEM
SERVICE TESTING & VALIDATION
REPLACING & DEPLOYEMENT MANAGEMENT
KNOWLEDGE MANAGEMENT
CHANGE MANAGEMENT
PROBLEM MANAGEMENT
EVENT MANAGEMENT
INCEDENT MANAGEMENT
SERVICE OPERATIONS
SERVICE DESIGN
SERVICE OPERATIONS
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Ultimately, the Wi-Fi network is designed to meet specific business, or departmental needs which change over time. Supporting an EKG device is very different from an Ultrasound unit capturing and transmitting HD video. Keeping a regular line of communication open with the business can help ensure that the Wi-Fi network continues to meet their needs.

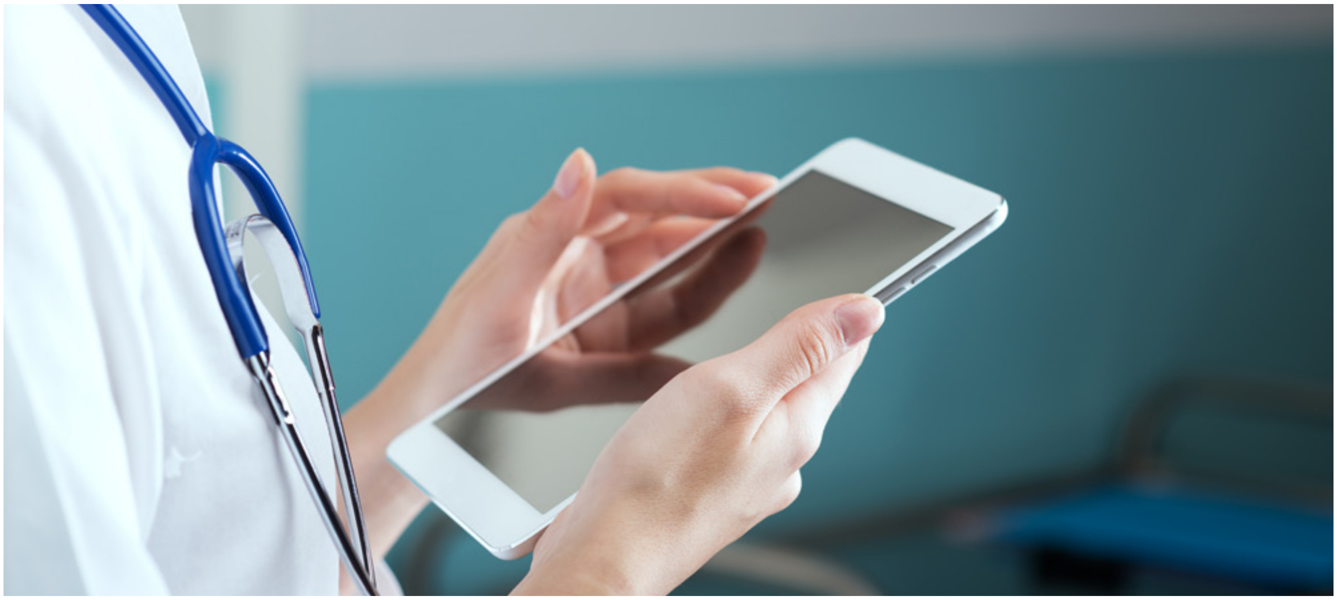
The typical lifecycle of a corporate PC is around 3 years, but other networked equipment can have lifecycles upwards of 10 years. If one factors in the design process, there could be Wi-Fi capable devices that are over 10 years old that need to be supported on the Wi-Fi network until they are refreshed. The Staff can help ensure that any new hardware being introduced into the system meets a minimum baseline.

Questions to proactively pose as part of the onboarding process:

- Is the wireless capable device designed to be mobile, or stationary?
- Does the device operate in the unlicensed RF Spectrum?
  - Is it IEEE 802.11a/b/g/n/ac or any subset there-of compliant?
  - If not, what RF frequencies does it utilize?
  - Any restrictions on DFS or 802.11h channel announcement?
  - Can the device use a hidden SSID?
  - Any restriction with channel bonding?
  - Is it Wi-Fi certified?
  - What PHY rates are supported?
  - Can the device be set to a specific frequency band?
  - Is the wireless capability provided by a bolt-on bridge or an integrated wireless card?
  - What model of wireless card and chipset are used?

- Is the device IEEE 802.11i compliant?
    - Does the device support WPA-2 (Wireless Protected Access) AES (Advanced Encryption Standard) with Enterprise Authentication EAP-TLS (Extensible Authentication Protocol/ Transport Layer Security)?
    - Does the Wi-Fi adaptor / device support SHA-2 (256 bit) certificates for network authentication?
    - Can the device be added to a Windows domain within Active Directory?

- Is the device IEEE 802.11e compliant?
- Is the device IEEE 802.11r compliant?
- Does the device support 802.11k?
- Does the device support 802.11v?
- Can the device firmware be updated as wireless authentication and encryption mechanisms evolve in the industry?
- Does the device support DHCP, or does it require a static IP address?
- What type of information is transmitted via the wireless medium?
    - What does the device need access to on the corporate network. Can you list all appliances, and necessary TCP/UDP ports?
    - Does the device transmit ePHI (electronic protected health information)?
    - What is the network bandwidth requirement for the device?
    - Can the MTU size be manually modified on the device if needed?



A packet capture of the traffic introduced by the device can help create custom fingerprints that can be uploaded into analytic platforms to allow the Wi-Fi network to proactively identify different device types.

IT departments often rely on wired network engineers and architects to manage their wireless network and roadmap. It is not a coincidence that many wireless engineers and architects have migrated into the space from other specialties. Although it may help to have a solid wired architecture background, it can also be a hindrance in some cases. Being a Wireless engineer and architect requires a unique skillset which includes an understanding of RF and physics that is not a part of the traditional network engineering curriculum. It is important for Healthcare IT departments to staff a wireless team and provide the team with access to the appropriate tools, and training. Wireless hardware vendors have bundled analytics and NAC platforms into their Wi-Fi offerings allowing wireless engineers to collect and analyze capacity planning data, and pro-actively receive alerts for power/channel/spectrum issues. In many cases an IPS platform is bundled into the system allowing staff to locate and isolate rogue wireless access points. All of this functionality is useless in the hands of someone who does not understand the underlying concepts behind it. Seasoned wireless staff will be connected with the larger community and aware of the latest IEEE standards, Wi-Fi Alliance, FDA, and FCC guidance as well as the nuances of the specific products deployed.

An area that is taken lightly in office deployments is actively monitoring the health of the RF spectrum. In a healthcare environment, having an RF spectrum manager in charge of keeping track of all the RF spectrums in use is important to avoid issues arising from RF interference and coexistence. In the Wi-Fi space, the 2.4 GHz frequency is especially susceptible to co-channel interference - due to the limited number of non-overlapping channels. When you compound that with the number of devices and standalone patient monitoring networks using that frequency, it becomes almost unusable. There are many other RF based devices in hospitals that leverage ISM spectrum, ranging from 13.5 MHz all the way to 5.8 GHz. It is critical to maintain an inventory of these types of devices and to log the exact frequencies that they use.

For example, the 902-928 MHz space can include pagers, cordless phones, nurse calls, as well as RFID. It is not unusual for a wireless key access system to interfere with a wireless ventilator using RF. This becomes especially complex and difficult to troubleshoot when devices are in close proximity to each other. A spectrum manager can mitigate some of the risks by ensuring that devices that can cause RF interference are not brought on to the network. If the cause of the interference is an adjustable setting, like a channel or power setting, the spectrum manager can help reconfigure and resolve the issue. This is in line with the AAMI IEC 8000-1 requirement. The Wi-Fi space is quickly transforming into a mobility space that involves licensed as well as unlicensed spectrum.

In conclusion, a great Wi-Fi network is not only about a solid initial design, but depends equally on ongoing maintenance, the appropriate toolsets/training and having a competent staff managing the network.

About Ekahau

Ekahau is the global leader in solutions for enterprise wireless network design, optimization and troubleshooting. More than 15,000 customers, including 30% of Fortune 500 companies, run their networks with Ekahau's Wi-Fi planning and measurement solutions.

Our software and hardware solutions design and manage superior wireless networks by minimizing network deployment time and ensuring sufficient wireless coverage across all industries, project sizes, building infrastructures and levels of complexity. We are recognized for delivering the easiest-to-use, most reliable solutions for Wi-Fi planning, site surveys, troubleshooting and optimization. Whether a corporate office, hotel, hospital or university – if the Wi-Fi works well, it has likely been built using Ekahau's Wi-Fi Design solutions.

Learn more about Ekahau's solutions to design, optimize and troubleshoot Wi-Fi networks at **www.ekahau.com** or contact us at **1-866-435-2428.**

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