The Wireless Challenge

Understanding the Wireless Spectrum in a Healthcare Facility

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About the Author

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Air. There's so much of it out there. There must be plenty of space for everything, especially those little wireless signals from medical devices. But that's not the case when physics dictates the amount of data and waveforms that can be transported via electromagnetic waves. There's only so much space for radio waves to coexist and not cause interference between devices. Management of this airspace in the healthcare environment is a requirement in order for medical devices to be used in a safe and effective manner.

Beginning in 1934, the Federal Communications Commission (FCC) was empowered with regulating interstate and international communications. Part of its responsibility is managing the electromagnetic spectrum needed by wireless devices to communicate. The wireless spectrum is divided up in blocks of frequencies to support different purposes. The majority of medical equipment is communicating primarily in four of these blocks. Most wireless patient monitoring systems communicate on 608-614 MHz, the 1.4 GHz region, and some manufacturers use 2.4 and 5.8 GHz. There are clinical systems that may use frequencies around 450 and 900 MHz for associated system devices. Examples of these nonmedical devices in hospital settings include pagers used with patient monitoring systems; pagers handed out to visitors and family; two-way portable radios used by hospital staff and law enforcement; and other systems that a visitor or patient might bring in.

The Role of a Spectrum Manager

Our task in the healthcare technology management (HTM) arena is to help manage the use of the wireless spectrum in a manner in which one device does not unintentionally affect the performance of another. A challenging frequency block to manage is the 2.4 GHz range, in which many devices operate for medical, enterprise, and consumer use. The 802.11b and 802.11g wireless protocol operating on 2.4 GHz is in wide use by computers, in-house telephones, infusion pumps, electrocardiogram (EKG) carts, pulse oximeters, and some physiological monitoring systems. There are magnetic resonance imaging (MRI) patient monitoring and MRI infusion pump systems designed to communicate between the magnet field and the control room on stand-alone 2.4 GHz systems. These stand-alone wireless networks may compete with the hospital's enterprise wireless network.

Identifying a wireless spectrum manager for your healthcare system is important. Our organization manages a wireless frequency

inventory divided into worksheets for each of our geographic facilities. This inventory is intended to record every type of device that is using wireless communication on a campus. It provides a good starting point when there is a question around the purchase of a device to avoid possible conflicts with existing installations. In this inventory, we have rows documenting frequency, RF generator, power, comments, end user contact, device vendor, vendor contact, and other telephone and e-mail information for each existing RF device on campus. We even inventoried local television station frequencies back when the patient monitoring telemetry systems shared those same airwaves. We had to pick an unused frequency on which to operate our telemetry (television channels 7-13 174-216 MHz and 14-46 470-668 MHz).

The 'Baylor Event'

Many will remember the related "Baylor Event" in 1998 that ultimately led to the creation of the protected Wireless Medical Telemetry Service (WMTS) bands. Over a weekend of trying to figure out why several of our telemetry floors lost all monitoring, we finally determined that a local television station was testing their new digital television transmitter on the same frequency that we were operating telemetry. This event and similar situations around the nation led to the creation of dedicated medical device wireless frequencies, rather than relying on locally unused channels. A completely inoperable telemetry system is one example of devices conflicting with each other. There are many devices, such as cellphones, that can possibly interfere with each other at low power and close proximity. Maintaining an inventory of radio frequency (RF) generators for your facility and knowing about other frequencies in use near your facility can help avoid a problem.

When problems do arise, we just can't throw our hands up in despair or point fingers at each other's teams. There must be collaboration from the start. The HTM wireless spectrum manager should communicate with the hospital information technology (IT) network team during planning for equipment procurement. Such interaction will pay off—achieving the hospital's objective for each system coexisting with effective wireless communications. In my organization, this communication is made easier since HTM reports through Information Services.

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Rather than having to react to a situation in which a medical device or computing system is not working as desired, it is much better to plan for implementation prior to purchase. Creating a pre-purchase approval process that guides networked and wireless devices through appropriate staff in the HTM and IT groups will identify conflicts in design between systems. Even though most medical equipment designs have been in place much longer than today's wireless computing, wireless patient monitoring is relatively new—other than traditional telemetry. Introducing a stand-alone medical device wireless network may conflict with the hospital's enterprise network as there may not be enough available channels for the different wireless networks to coexist. When manufacturers suggest such setups, work with them to place their devices on the hospital network so that a stand-alone wireless access point is not discovered after the fact. If incorporating the vendor's system into the enterprise network is not possible, facilitate interaction between the vendor and the network team to come to a possible solution for both wireless systems to coexist.

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New Developments

The WMTS bands were created in 2000 and protected medical telemetry lived happily ever after, or so the story goes. But there is an insatiable consumer demand for wireless devices independent of the healthcare setting. In February 2012, the FCC gave notice that the 608-614 band may be needed for broadband purposes. This reallocation would require healthcare facilities operating in the 608-614 band to replace their patient

monitoring systems by 2020. But, based on compelling data from the WMTS database managed by the American Society for Healthcare Engineering (ASHE), the FCC tentatively concluded in November 2012 that systems operating in the 608-614 band may not have to relocate. ASHE estimated that it would cost up to $1.4 billion for healthcare facilities to implement replacement systems. The $300 million that was slated to help facilities migrate away from the channel 37 WMTS band would not meet the demand.

This regulatory back-and-forth demonstrates on a large scale the value of understanding the scope of wireless systems in operation. Healthcare facility wireless spectrum managers must understand what they have operating in the WMTS frequencies and register these through ASHE. Registration is a requirement of the FCC rules for systems installed utilizing WMTS bands. The FCC 608-614 MHz band reallocation proposal and the subsequent tentative reversal show another advantage of registering your WMTS systems. This situation is very dynamic, and HTM professionals should stay informed in order to properly plan for long-term wireless equipment management.

There have been other similar frequency reallocations over the years that have affected medical devices. Some telemetry systems operated in the same bands around 450MHz that public service and private radio operators transmitted. The FCC changed the rules in this band, allowing higher-powered devices to operate. Medical device owners and manufacturers had to change their systems to operate outside of the private land mobile radio system (PLMRS) bands. The FCC did not approve medical devices operating in this frequency after 2002.

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Another PLMRS-related change may affect pagers associated with medical devices. Effective Jan. 1, 2013, devices operating in the 150-512 MHz radio bands were required to change their technology to operate in a more efficient 12.5 kHz range (originally 25 kHz). Some devices may be able to be reprogrammed to meet this new narrow banding specification, but others may have to be replaced. A complication of this change is the potential reduction in power of paging systems after the narrow banding change. This issue may require redesign of local nursing floor paging systems associated with patient monitoring installations.

A new frequency "kid on the block" is the medical body area network (MBAN), which supports wearable sensors. MBANs will operate in the range of 2360 – 2400 MHz. Healthcare providers will have to register and coordinate the use of this equipment. This registration cannot be completed until the FCC appoints a frequency coordinator to manage the operations. Manufacturers are urging the FCC to have its MBAN coordination system in place by June 2013.

In summary, it's important to understand the radio frequencies within which your facility's medical devices operate, and the coordination that is required to avoid issues with their operation. Development of a wireless spectrum inventory and processes that encourage communication between all RF users in a facility will help systems operate effectively. ■

For More Information

A chart showing U.S. frequency allocations:
www.ntia.doc.gov/files/ntia/publications/spectrum_wall_chart_aug2011.pdf

FCC background about the Wireless Medical Telemetry Service (WMTS):
www.fcc.gov/encyclopedia/wireless-medical-telemetry-service-wmts

The American Society for Healthcare Engineering and its WMTS registration process:
www.ashe.org/resources/WMTS