In-Building Wireless Coverage Eliminates Mobile Interference Concerns in Healthcare

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Healthcare providers continually want to improve the speed, accuracy, and efficiency of their services, and most have adapted wireless technology for medical telemetry, electronic records, and other applications.

At the same time, mobile phones and tablets have become the communications standard for patients, visitors, staff, and physicians alike. Hospitals teem with wireless signals, which causes legitimate concerns about interference impacting the operation of critical care devices.

Some hospitals and clinics ban the use of mobile phones by visitors or patients. Ironically, by implementing in-building distributed antenna systems, hospitals and clinics can eliminate concerns about mobile phone interference with other wireless medical information systems while providing vastly superior voice and data service for doctors, patients, and staff.

Wireless, Wireless Everywhere

Wireless networks provide healthcare facilities with the ability to monitor patients, provide services, and track the locations of equipment as never before. Wireless is now used for such diverse applications as monitoring patient vital signs (both inside and outside clinics and hospitals), charting, issuing prescriptions, billing, appointment queuing, and inventory management. Many of these systems use some form of 802.11 (Wi-Fi) radio connectivity, while others use cellular signals, and that connectivity must be maintained at all times.

In addition, mobile phones and tablets have become an important part of many healthcare operations. Smart phones have replaced pagers as a primary means of communicating with physicians, quickening care response time, and many organizations have mobile patient information systems that run on mobile device platforms over wireless networks. As carriers continue to enhance broadband wireless services, the increase in throughput speeds will foster new mobile applications.

There are two key problems facing hospital and clinical IT and communications managers seeking to implement or expand mobile applications:

- **Interference**—None of the wireless devices can interfere with any of the others. Information must be secure and reliable.
- **Access**—Wireless networks must provide coverage throughout every area where service is desired. Hospitals in particular tend to have thick walls with an above-average density of individual rooms, and it is often difficult for wireless signals to penetrate walls, either from internal wireless antennas or from outdoor cellular towers. This is particularly true in medical imagery areas where walls are lined to mitigate radiation exposure. Data-driven 4G wireless services often use higher frequencies that have even more difficulty penetrating walls or traveling long distances.

Unfortunately, meeting both challenges at the same time has been difficult in the past due to the nature of wireless and mobile devices.

Poor Coverage Aggravates Interference Issues

To understand why mobile phones/tablets may interfere with wireless medical equipment, we need to touch on RF power levels and electromagnetic field (E-field) strength. Industry standards require that all medical equipment must operate properly when exposed to 3 V/m (volts per meter) of applied E-field power. Typically, medical equipment is designed to operate properly under the higher exposure level of 10 V/m. This maximum exposure level is called the immunity level – the level of exposure the device can tolerate before its communication may be disrupted by interference.

Mobile phones/tablets emit varying amounts of E-field power (measured in Watts (W) or milliwatts (mW), depending on the transmit power of the specific device and the distance between the mobile device and the medical equipment. Although the transmit power of a mobile device varies somewhat depending on the underlying wireless network technology in use (i.e., W-CDMA, LTE, TD-LTE, etc.), most mobile devices emit as much as 1 W of power. At this rate, RF transmissions from a mobile phone/tablet can reach the 3 V/m immunity level for medical equipment when the device is less than ten feet from the medical device. As a precaution against such interference, many hospitals have banned the use of mobile phones/tablets near medical equipment, and some hospitals discourage all mobile device use by visitors and patients.

Using DAS to Reduce Interference

Given the ubiquity of mobile phones and tablets and their benefits to patient care, healthcare facilities must find a better way to accommodate use of these mobile devices use by doctors, staff, patients and visitors, and that means finding ways to eliminate the threat of interference that mobile phones/tablets pose for wireless medical devices. There are two factors that determine a mobile phone's E-field power:

1. **The distance from the phone to the device—** Like other types of radio energy, mobile E-field signals attenuate over any given distance, so the farther a phone is from a device, the lower the power of the E-field when it reaches the device.
2. **The strength of the signal between the phone and the nearest mobile network antenna—** Most phones automatically increase\their output power as needed to ensure the strongest possible connection, but they also reduce power output whenever possible (if there's a strong signal nearby) to improve battery life.

Since the growing use of both mobile phones/tablets and wireless medical devices will make it increasingly difficult for healthcare facilities to control the distance between mobile phones and medical devices, it's logical to address the interference challenge by reducing mobile phone output power. Although mobile phones may transmit up to 1 W, they can produce as little as 3 mW of power if there is strong signal source nearby. Happily, 3mW is also the immunity level for wireless medical devices.

To reduce mobile phone output power and mitigate interference concerns, many hospitals and clinics have deployed distributed antenna systems (DAS). A DAS is composed of distributed amplifier and antenna pairs placed at various locations throughout the building. These units connect back through cabling to a central distribution hub that, in turn, connects to the serving RF source (a small cell, base station, or repeater).

A DAS takes a wireless service provider's signal and distributes it throughout a building. This brings the signal closer to any prospective mobile user, provides strong and uniform coverage throughout the building, and allows mobile phones/tablets to operate at minimum power levels. In addition, the use of DAS systems also allows the creation of "micro-cells" inside of a building that can support large numbers of users without impacting the capacity of the outdoor mobile network.

However, the DAS itself is a new source of RF emissions, so it is important to also consider the E-field strength produced by the DAS. Mobile network architects should check the rated output power of any DAS to ensure that it is not high enough to cause interference. Output power is measured as the output power of one remote antenna times the number of remotes, so if one remote outputs 1 mW, and the system has 10 remotes, the overall output is 10 mW.

In addition to the overall characteristics of the DAS, output power can be impacted by the type of antenna used. For example, assuming that the remotes transmit their signals through a standard 3 dBi omni-directional dipole antenna, the E-field in the direction of maximum antenna gain would drop below the 3 V/m immunity level at a distance of six inches or more. Remotes are normally mounted in the ceilings, so the distance between a remote and any medical equipment will never be less than six inches and the DAS itself will never cause interference to medical equipment.

Mobile Phones, DAS, and Wireless Equipment: Peaceful Coexistence

By deploying DAS solutions, medical facilities can not only eliminate the potential for mobile phone/tablet interference with critical medical devices, they can enable enhanced productivity through higher call capacity and quality supporting calendaring, e-mail, and other mobile applications that help physicians and staff operate more efficiently.

As carriers move from 4G services to the use of higher frequencies and ultimately to 5G, it will be increasingly difficult to provide consistent, high performance wireless service inside hospitals and clinics. DAS solutions make it possible for healthcare facilities operators to accommodate mobile phone and tablet use while continuing to expand their use of wireless medical devices for greater efficiency.

Zinwave's UNItivity in-building wireless platform has been deployed in healthcare facilities around the world. For more information, please visit www.zinwave.com.

