Optimizing RTLS Battery Life

By Steve Cormier

Wireless devices requiring batteries are ubiquitous in the hospital environment. From traditional wireless devices such as pagers, cell phones, smoke detectors, and laptops to continuously emerging wireless technologies such as EKG monitors, pacemakers, infusion pumps, and real time location systems (RTLS), the list goes on and on. A 2013 study found that one hospital purchased 97,000 small batteries in a single year,1 putting the number of batteries used by that facility over a 5-year period at close to half a million. Since the American Hospital Association reports there are 5,686 hospitals in the United States,2 the number of batteries used and discarded in the US health system over that same period could be astounding.

Many wireless medical device technologies used in the hospital environment typically rely on either alkaline or lithium thionyl batteries. As end users consider these technologies, they are tasked with understanding and weighing the advantages and drawbacks of each battery type in terms of cost, life, reliability, and disposal. The proliferation of these wireless devices, along with healthcare providers' increasing reliance on these technologies to be more effective and productive, means that more is riding on this choice than ever before.

But the responsibility cannot fall to end users alone. Companies developing wireless technologies for the healthcare industry must take battery life into account at the design stage. Hospitals should not be choosing between devices that use alkaline or lithium batteries, but between technologies that do not take battery life into account and those that do.

Impact of Batteries on Healthcare Workflow

Based on the volume used per year, batteries represent a significant expense for the average hospital. Technology selection based on battery type can also impact the hospital's bottom line by impeding workflow. Unexpected loss of battery power can drive the need for rush maintenance at a higher cost, needlessly occupy staff time, and, more concerning, cause gaps in care. Batteries with a longer lifespan can reduce the volume required and ultimately help hospitals significantly reduce costs.

With these challenges in mind, technologies powered by alkaline batteries are the optimal choice. While lithium

batteries cost 15 to 20 times more than their alkaline counterparts, they only have twice the charge capacity. Viewed in terms of cost-to-capacity, lithium batteries are eight times more expensive than alkaline batteries.

With these issues in mind, the real solution to battery life must come from upstream. Engineers must design and plan technologies that notify the user in advance of battery exhaustion, provide safe and reliable power, and, most importantly, conserve battery life.

Drawbacks of Lithium Batteries

The increasing adoption of real-time location systems (RTLS) to pinpoint equipment location, monitor staff actions such as hand washing, locate patient and caregivers, and take note of key patient milestones means that another invaluable battery-using technology has been added to the hospital ecosystem. Some RTLS manufacturers opt for lithium thionyl batteries for their power, a critical feature for RTLS performance that helps ensure delivery of range, accuracy, speed, and update rates. Yet these batteries can be costly to buy and dispose of, and may pose certain performance and risk issues compared to alkaline batteries.

For example, in order to plan for proper maintenance of medical devices, it is important to be able to predict battery life. If batteries are less predictable, power management becomes more challenging. And while they are certainly more powerful than alkaline batteries, lithium batteries carry the risk of a sudden voltage loss without warning. This possibility makes their uptime less predictable than standard alkaline batteries.

Another potential issue with lithium thionyl batteries is their limited availability. Currently, there are only two battery manufacturers in the world that can provide lithium thionyl batteries to a standard that meets safety requirements for use in US hospitals.

Alkaline batteries are less expensive, more reliable, and have fewer performance issues than their lithium counterparts, but they don't offer the same capacity that lithium provides. Therefore, in order to maximize the cost, reliability, and performance benefits associated with alkaline batteries, an RTLS system must be designed to minimize the drawbacks of alkaline batteries, and maximize power another way.

Ultrasound-Based RTLS

RTLS technologies typically make use of some combination of radio frequency (RF) technology, infrared, and ultrasound infrastructures. Of these, ultrasound is the most battery-efficient.

To understand why ultrasound infrastructure can eliminate the need to use lithium batteries, it is useful to review how ultrasound works. Ultrasound beams can be focused and contained within a room, saving considerable energy. Because the signal is confined to the room, ultrasound-based devices do not have to work harder to compensate for signal loss. Moreover, with ultrasound, each room has its own ultrasound signal, making it relatively inexpensive to listen for the ultrasound signature.

Another reason ultrasound is battery-efficient is that sound can be channeled in specific directions very easily. For example, in corridors, a directional beam can be emitted so that it fills the corridor and has very little lateral spread. The result is exceptionally good corridor signals with very little leakage into adjacent rooms. As a result, location "zones" can be created within the corridor or within a room, making exact directionality very easy to control. These functional benefits ultimately deliver increased range with less power.

This ultrasound-based infrastructure has performance implications, such as significantly increasing the update rate from multiple seconds to one second, reducing the latency, and increasing the system's responsiveness while extending battery life.

These advantages contrast with the shortcomings of radio frequency (RF) and infrared technologies, which have physical challenges rendering them inefficient. RF emits in all directions and passes straight through walls, wasting energy. The same can be said about infrared, which is absorbed by any color in the infrared area. These physical challenges make these technologies less efficient for use in RTLS. As a result, technologies dependent on RF for positioning are more taxing on batteries.

Doing More with Less

As cost pressures demand that hospitals deploy technologies that are economically efficient, low-maintenance, safe, and reliable, there is greater urgency for biomedical manufacturers and medical device makers to offer facilities better-engineered solutions to address these battery issues. As the use of wireless devices in healthcare inevitably continues to grow, it will be environmentally, socially, and financially beneficial to do more with less.

References

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