

Bluetooth Mesh simplifies equipment location

Russ Sharer, Vice-President of Global Marketing for Fulham, a 'manufacturer of innovative and energy-efficient lighting sub-systems for lighting manufacturers and distributors worldwide', explores the capabilities of Bluetooth Mesh in faster tracking and location of key equipment in hospitals, and explains how the technology can easily be embedded into its LED drivers.

If your life depended upon a hospital's ability to locate a given piece of medical equipment and get it to your side immediately, are you comfortable that staff could do so? If you were in cardiac arrest, could they locate a defibrillator and shock your heart back into rhythm, or, if you weren't sure of your cardiac condition, could they locate a cardiac monitor? If every breath was laboured, could they find a nebuliser, oxygen pump, and monitor? Or, more importantly, are the hospital staff confident that they could locate and deliver the required equipment to your bedside in time to save your life, or that of someone else?

It is common knowledge that most hospitals and medical centres only have confidence in their ability to provide for such situations by purchasing more equipment than they need, and then placing it in strategic locations around the facility. The assumption is that an abundance of equipment will support peak use times, although in most facilities there is no way to measure utilisation of individual hospital equipment, or the

entire inventory of such equipment. Even with a surplus of equipment, however, too often it could be in use or simply misplaced when critically needed.

Starting now, however, new functionality is being added to a well-known wireless standard that can make location and retrieval of hospital equipment easy and, more importantly, fast. It can also assist in measuring the utilisation of individual pieces or groups of equipment.

Bluetooth tagging

Bluetooth is a well-established, open standard that adds wireless communications to a wide variety of devices. Bluetooth Mesh adds a mesh networking layer on top of Bluetooth, and is touted for its ability to allow all devices to share information without a single point of failure. Effective and rapid tracking of key equipment depends, however, on how well the facility can receive Bluetooth beacons, usually implemented in a Bluetooth tag – a low-energy, self-powered or long-term battery-powered

device that is placed on each piece of equipment to be tracked. The tag is similar to a serial number barcode, and can be programmed to keep all relevant information on that piece of equipment. For example, the tag could include the type of equipment, its manufacturer, date put into service, and potentially even hours of operation since last calibration.

Optimised tag design

The more sophisticated the tag, the more power it will need to operate. Manufacturers, or the provider of the Bluetooth tracking system, can optimise the design based on the needs of the facility. For some facilities, the operators may want extensive information about the equipment, but they could limit the availability of that data to only when the equipment is powered on or plugged into an electrical socket. Therefore, a cart of equipment awaiting deployment in a cupboard could only communicate the bare minimum data, which is usually the type of equipment, its location, and remaining battery life.

The equipment with its tag can sit idle for weeks or months, yet occasionally continue to broadcast its identity and location. This broadcast data, known as beacons, is collected via a Bluetooth network in the facility and transmitted to an application running either in the 'cloud', or in the facility's computer centre, which maps the equipment location to a physical layout of the hospital.

When an emergency or other situation arises that requires the equipment, a single call to a nurse's station or the simple process of checking an 'app' on a handheld device can locate the nearest pieces of equipment that are not in use, and the caregiver can immediately retrieve that equipment.

Mapping equipment locations with handheld devices

The tags communicate to the equipment and the Bluetooth network via beacons. The most common of those is the iBeacon, a protocol developed by Apple and



Fulham says Bluetooth beacons integrated into lighting fixtures can be used for effective asset tracking and faster equipment location in healthcare facilities.

introduced at the Apple Worldwide Developers Conference in 2013. Various vendors have since made iBeacon-compatible hardware transmitters – typically called beacons – a class of Bluetooth low-energy devices that broadcast their identifier to nearby portable electronic devices. The technology enables smartphones, tablets, and other devices, to perform actions when in close proximity to an iBeacon.

iBeacon is based on Bluetooth low-energy proximity sensing by transmitting a unique universal identifier (UUID) picked up by a compatible app or operating system. iBeacon can also be used with an application such as an indoor positioning system, which helps smartphones determine their approximate location or context. With the help of an iBeacon, a smartphone's software can approximately find its relative location to an iBeacon in a facility. The initial iBeacon application has been in retail stores, which use the beacons to offer customers special deals through mobile marketing, and can enable mobile payments through point-of-sale systems.

Adjustable frequency

The frequency of the iBeacon transmission depends on the configuration of the iBeacon, and can be altered using device-specific methods. Both the rate and the transmit power have an effect on the iBeacon battery life. iBeacons come with predefined settings, and several of them can be changed by the developer. Among the adjustable parameters the rate and the transmit power can be changed, as well as the 'Major and Minor' values. The Major and Minor values are settings that can be used to connect to specific iBeacons, or to work with more than one iBeacon at the same time. Typically, multiple iBeacon deployment at a venue will share the same UUID and use the Major and Minor pairs to segment and distinguish sub-spaces within the venue. For example, the Major values of all the iBeacons in a specific store can be set to the same value, and the Minor value can be used to identify a specific iBeacon within the store.

Unlike iOS, Android does not have native iBeacon support. To use iBeacon on Android a developer either has to use an existing library, or create code that parses BLE (Bluetooth low energy) packets to find iBeacon advertisements. BLE support was introduced in Android Jelly Bean, with major bug fixes in Android KitKat. Stability improvement and additional BLE features have been progressively added thereafter, with a major stability improvement in version 6.01 of Android Marshmallow that prevents inter-app connection leaking.

Another application is distributing messages at a specific point of interest, such as a store, a bus stop, a room, or a more specific location like a piece of



'Using Bluetooth Mesh for equipment location monitoring is improving hospital efficiency', says Fulham.

furniture or a vending machine. This is similar to geopush technology based on GPS, but with a much-reduced impact on battery life, and better precision.

User privacy

iBeacon differs from some other location-based technologies because the broadcasting device (beacon) is only a one-way transmitter to the receiving smartphone or receiving device, which necessitates a specific app being installed on the device to interact with the beacons. This ensures that only the app (not the iBeacon transmitter) can track users, potentially against their will, as they passively walk around the transmitters.

A second managerial app could be used to monitor overall utilisation of the equipment by specific hospital floors or areas and determine if the staging areas for equipment are optimised, or if additional or less equipment is needed to maintain required care levels.

Light fixtures 'ideal' for Bluetooth Mesh

For many hospitals and other healthcare facilities, the easiest way to integrate a Bluetooth beacon tracking system is to embed the receiving Bluetooth network in the lighting. Lighting has two important attributes to leverage as the tracking grid – power and location. All lighting fixtures are powered by building power, which in a hospital includes emergency back-up. This enables the beacons originating from the equipment to be read and passed along continuously, so that a facility-wide database can be kept in whatever time increment (every minute, every half hour, every hour) is desired.

Lighting systems are also attached at fixed positions, so once the facility grid is set, there is rarely a need to make changes. A piece of equipment near a light fixture on the first floor, in, say, room 101, is easy to locate. The light can't be misinterpreted as being on the third floor. Fulham is an example of a lighting systems provider that embeds Bluetooth Mesh in its LED drivers to provide this kind of

service, and then sells the drivers to hundreds of lighting manufacturers worldwide. The functionality can be installed via new light fixtures, or through the retrofitting of existing fixtures. The same technology can also empower other lighting functions, including sensors for movement or smoke, or even changes in the colour of light to promote better healing.

Web-enabled capability

With power and a fixed grid, any web-enabled device (a tablet or computer at the nurse's station) can be used to search for a specific piece of equipment (like a Google search), and will then come up with the location of the four or five closest pieces of equipment. A quick visual scan by the nurse can determine if the equipment is in a patient's room or emergency triage bay (and therefore likely in use), and, conversely, which items are in hallways or storage facilities.

The result is better patient care, since emergency issues (or even non-emergency issues when it comes to locating equipment like infusion pumps), can be dealt with more quickly. In addition, whatever reduces the hospital's costs, ultimately cuts costs for the patient as well.

Using Bluetooth Mesh for equipment location monitoring is improving hospital's efficiency, resulting in more happy, healthy patients being returned to their families sooner.

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