Technical Article

How to Manage Wireless Sensor Networks with Dual-band Connectivity

One recent trend for Internet of Things (IoT) applications (especially in building automation) is that while “smartness” is being added to things, more objects are connected and the complexity of provisioning and maintaining such a system increases becoming a challenge for the adopters.

As such, simplifying and reducing the cost of deployment and maintenance of the sensor network is one of the key requirements for the players in the Industrial market. When using the Sub-1 GHz as a connectivity link, the performance of the system greatly benefits from the underlying technology, due to a less crowded spectrum than 2.4 GHz, longer outdoor range and better indoor performance. Today, there are system-level solutions to easily build Sub-1 GHz to IP wireless sensor networks that can address building, factory and retail automation needs, where coverage of the whole area is realized with a star-network topology,.

However, large network deployment and maintenance also requires that each and every single node of the network is accessible and can be operated independently. One of the biggest challenges to perform these tasks is that in most cases sensors don't have a display to interact with or relay this information locally to the technician sent on site to commission or repair a device in the network. Take the example of a lighting technician, sent regularly to several buildings to check on the Sub-1 GHz fixtures and ballasts which are hard to reach to manually set into ‘maintenance’ mode with a special button press.

What if he could use a direct *Bluetooth*® low energy link with a tablet or a smartphone as the backup display, to capture the information that the ballast sent 'intelligently' (e.g. only when in the proximity of the device), or when he wants to trigger a diagnostic operation on that node?

Or, what if a professional home security installer could use the direct Bluetooth low energy link with a tablet to add a set of Sub-1 GHz door and window sensors to an existing security network? He could avoid Sub-1 GHz in-band commissioning procedures (which require the gateway to be involved while at the same time operating in the network). Network parameters and security materials (like keys and certificates) could be exchanged on the 2.4 GHz band as well, in a safer and more reliable way than using the native Sub-1 GHz band.

The alternate Bluetooth low energy link could also be employed as a higher throughput backup channel. Firmware upgrades can be pushed faster, saving overall power and without disrupting the rest of the network while the firmware is upgraded on the node.

By adding the ability to smoothly interact with a smartphone, DYI users, technicians and professional installers can more securely and easily create, install and maintain a network of Sub-1 GHz wireless connected devices (e.g. like an alarm or security system in a home, a pressure/flow sensor network in a factory, or the elevator cars in a building).

With products able to support dual-band Sub-1 GHz and 2.4 GHz Bluetooth low energy connectivity, benefits of the respective technologies can be leveraged within their class of merit: long range and robustness to interference when using the Sub-1 GHz link, and easy smart devices ecosystem integration when using Bluetooth low energy.

For more information, watch the Why Sub-1 GHz + BLE? video on Youtube.

This opens the door also to a variety of additional industrial applications in other spaces, for example automated parking meters and lot management. Picture each parking stall equipped with a sensor reporting via the long-range Sub-1 GHz haul to a central server when the spot is taken, and the server in turn using the same link to change the role of the sensor to operate in Bluetooth low energy. It then can push information like the parking spot number to the smartphone as shown in Figure 1 (so you won’t lose your car at the airport after a long trip), and payment could be easily automated and linked to the users account registered on the smartphone.

Figure 1. Use a Sub-1 GHz network to locate your car and receive the location on your smartphone

Another use case could be using the Sub-1 GHz link in a retail automation network to push an image or price update to a set of electronic shelf label (ESL) tags (like an aisle) in a store. The administrator of that network can also use the Sub-1 GHz link to efficiently send customized advertisement messages to the consumers, or manage shopping 'happy hours' with sale notifications sent directly to their phones via Bluetooth low energy.

With new SimpleLink™ dual-band CC1350 wireless microcontroller (MCU), TI delivers the first dual-band and multi-protocol system-wide solution to the market on a single device. The CC1350 device features operations both in the Sub-1 GHz and 2.4 GHz bands, and thanks to the flexible ARM® Cortex-M0 based modem, a wide range of Sub-1 GHz modulation schemes and Bluetooth low energy connectivity are available on the same chip. In combination with the a low-cost LaunchPad™ development kit, TI provides a full hardware reference design to help developers solve the challenge of building a dual-band RF system.

The CC1350 wireless MCU offers ultra-low power performance like all devices of the SimpleLink family in a highly integrated package that can fit on your fingertip.

The software framework and drivers, part of the CC1350 whole solution, have also been designed to make the best use of the flexible hardware platform capabilities and working harmoniously with it. Arbitration between the Sub-1 GHz and Bluetooth low energy radio modem and advertisement links are managed by the TI dual-band RF driver. Examples of firmware upgrade and Bluetooth low energy advertisement are delivered in the package in TI-RTOS to accelerate the development and propel the differentiation on your applications!

We now challenge you to find new and compelling dual-band applications that we ourselves haven't even thought of. Innovation has no limits when at its heart there's a powerful and flexible hardware and software platform like the CC1350 wireless MCU.

Additional Resources:

- Read this white paper on 'Diversifying the IoT with Sub-1 GHz technology'
- Learn why you should choose Sub-1 GHz + Bluetooth low energy for your IoT applications:
  - Why Sub-1 GHz video
  - Sub-1 GHz + Bluetooth® low energy and low-power MCUs help make meter reading automatic
  - Trends in building automation: connected sensors for user comfort
- Download tested TI reference designs focused on Sub-1 GHz. Jump-start your designs.

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