

Dynamic Multi-protocol Manager (DMM)



Connectivity solutions continue to be widely adopted for sensing and monitoring in applications like Building Security and HVAC systems. A growing trend in these industries is to leverage multiple wireless technologies to enhance and expand applications by capitalizing on the unique benefits of different wireless standards (that is, BLE for smartphone connectivity, Zigbee® for mesh, Sub-1 GHz for long range and low power). The Texas Instruments™ SimpleLink™ platform has the hardware to support these applications along with a software module called the Dynamic Multi-protocol Manager (DMM).

Without DMM, supporting two wireless protocols requires a two-chip design, which can increase board size and expenses for designers. Alternatively, a single-chip cannot operate two protocols at the same time, and must bootload a new firmware image every time it switches between them.

Texas Instruments™ single-chip, multi-standard solution supported by the DMM is not only cost-effective, but also simplifies multi-protocol design. With the SimpleLink™ CC1352R and CC2652R MCU, users can leverage a single wireless MCU and support multiple different wireless standards. For example, a multi-band device like the SimpleLink™ CC1352R MCU can support concurrent operation of BLE and Sub-1 GHz by leveraging the DMM.

1 What is DMM?

The DMM is a software module that enables a single radio to operate multiple wireless protocols concurrently by switching between them in real time. This is also known as “Time Multiplexing”, in which the radio switches between the two protocol stacks by changing the settings, channels, and other parameters. The DMM will potentially modify the order in which RF commands are scheduled based on the constraints of the protocol stacks and the user application.

[Figure 1](#) is a visual of the overall architecture of the DMM.

The DMM consists of two primary components: the policy table and the scheduler. The policy table is a set of policies that represent a comprehensive system state with parameters for stack priorities and timing constraints of RF commands. Furthermore, it calculates which stack has priority in certain application states, and whether RF commands can be deferred or not.

The DMM scheduler is a customizable software module that keeps track of RF commands that are submitted by each protocol stack. The scheduler subsequently uses the policy table to perform scheduling of the associated stacks. The scheduler determines the priorities listed in the policy table, and allots radio time to each protocol based on the trigger type, timings, and priority of the command; it can schedule the command as is, or cancel the command based on the current policy. If a stack submits a command and there are commands ahead of it in the queue, the scheduler will attempt to fit the command in a free slot.

For example, the policy table can give higher priority to the Sub-1 GHz stack, causing the scheduler to preempt the BLE task when there is an immediate need for the Sub-1 GHz state. [Table 1](#) is an example of a simplified policy table for that instance, in which the Sub-1 GHz sensor uses the TI 15.4 SimpleLink™ Sub-1 GHz stack solution.

Figure 1. DMM Architecture

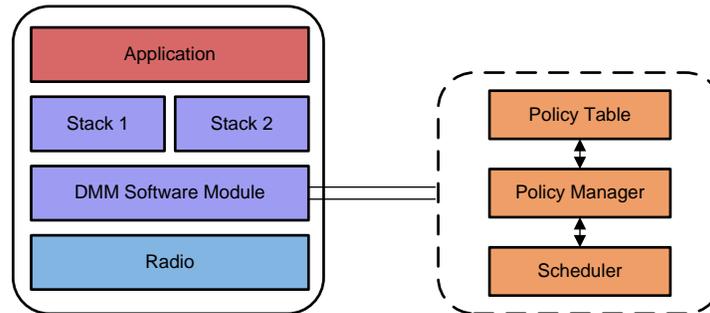
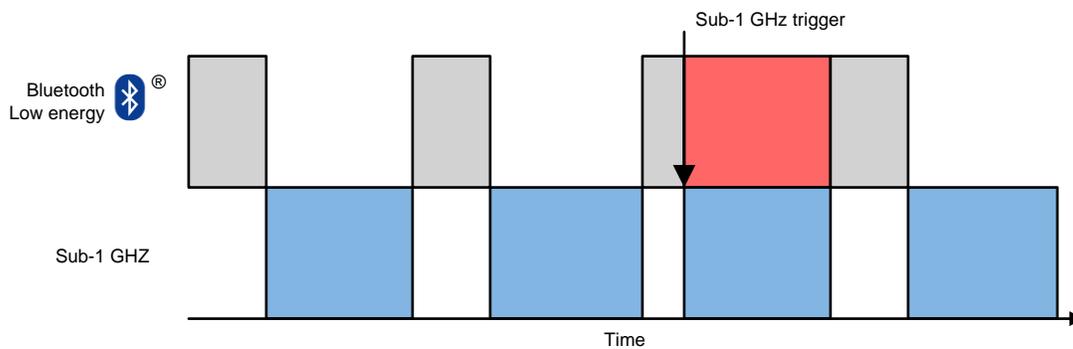


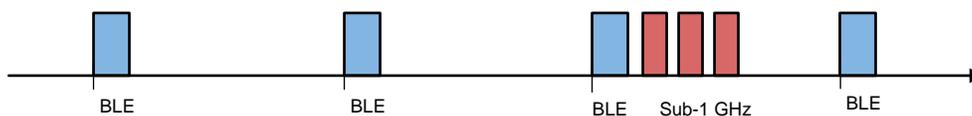
Table 1. Policy Table Example

Stack Type	BLE Peripheral	TI 15.4 Sensor
Stack state	Advertising + Connected	Connected
Policy	Low Priority, Not Time Critical, Policy Not Paused	High Priority, Not Time Critical, Policy Not Paused



2 Smart E-Lock: Sub-1 GHz + BLE

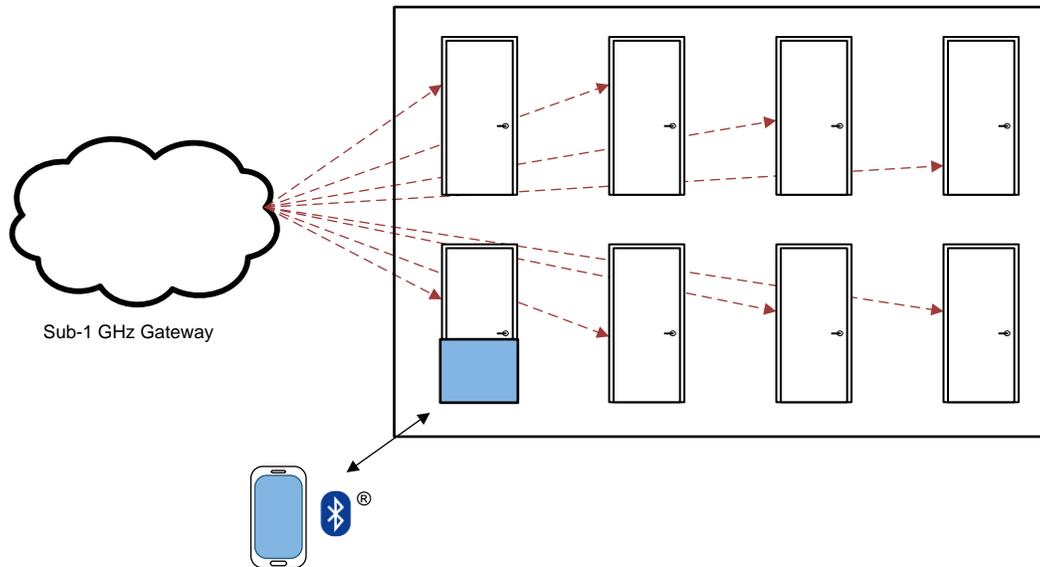
Electronic Door Locks in apartments or hotel buildings often require tedious maintenance and installation. Sub-1 GHz technology enables convenient control of a system of e-locks without the hassle or cost of wires. By integrating BLE into this system, designers can add a convenient user interface to a phone that can be used to install or control the system. The interface can potentially provide information about battery life of individual locks, status of the network, and even unlock or lock doors remotely. This can only be done concurrently on a single chip by using the DMM software module, which will allow the Sub-1 GHz stack to work simultaneously with the Bluetooth® network.



In a Bluetooth Low Energy system, there is a central (master) role and a peripheral (slave) role, in which they meet at periodic “connection events” to exchange data. Currently, TI supports a DMM solution that uses a Sub-1 GHz sensor with a BLE Peripheral. For this E-lock solution, the mobile device (as a BLE central device) can communicate with the BLE peripheral on connection events, and can send updates on the Sub-1 GHz network. The Sub-1 GHz communications are asynchronous, and they will most likely be scheduled between BLE connection events. In case of conflict, priority will typically be given to the Sub-1 GHz.

Figure 2 is a visual building automation example for electronic door locks connected to a gateway by way of the Sub-1 GHz, and an individual phone connected to a door lock through BLE.

Figure 2. Building Automation Example for Electronic Door Locks



A Zigbee® and BLE door lock system will function similarly for the Electronic Door Lock use case. A phone can connect to a Zigbee® router through BLE, and the router will connect to the rest of the Zigbee® network. The device will default to stay in the Zigbee® mode, and switch to BLE during those specific events. In case of a priority conflict, BLE is typically given priority.

3 Get Started

The DMM is part of the SimpleLink™ ecosystem, which simplifies code migration for all SimpleLink™ devices. Interactive training through the [SimpleLink™ Academy](#) provides multi-protocol demos and examples for Dynamic Multi-protocol solutions, Over-The-Air Download (OAD), and “Switching” Multi-protocol solutions.

Learn more about the [SimpleLink™ MCU platform](#) and get started on building your DMM solution with the [SimpleLink Academy DMM Fundamentals Guide](#).

4 Resources

- [SimpleLink™ Multi-Standard wireless MCUs](#)
- [DMM Wireless Sensor Network \(WSN\) Sub-1 GHz and BLE5 Remote Display Demo](#)
- [DMM 15.4 Sensor and BLE Remote Display Demo](#)
- [DMM User's Guide](#)

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