

Smart Door Lock With SimpleLink™ Platform

Ben Gilboa

ABSTRACT

Smart door locks have gained incredible momentum in the last few years. This is mainly because security, privacy and reliable connectivity have become ubiquitous bringing clear benefits with an easy use case model. Similar to smart thermostats, security cameras, and garage door openers, smart door locks bring added value to the users providing the ability to monitor the status of entry ways, as well as, selectively grant access to service providers. This application report covers some of the more common use cases for smart door locks and discusses tradeoffs between the approaches.

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1 Introduction

From a connectivity standpoint, the smart locks are classified into four categories:

- **Bluetooth low energy SIG, Inc Smart Lock** – Control is done using the phone and *Bluetooth*® low energy. You must be in close proximity to the door. No cloud connectivity for remote monitoring or setup.
- **Wi-Fi Smart Lock** – This smart lock is connected to the internet over the Wi-Fi® network that is available in every house. Cloud connectivity brings remote monitoring capabilities and remote setting. You can grant access to someone while sitting in your office. Wi-Fi Smart Locks generally also have Bluetooth low energy as the main interface for accessing the door.
- **Zigbee Smart Lock** – The Smart lock device that uses Zigbee connectivity is usually connected to a smart home hub. The lock becomes part of the Zigbee mesh network much like light bulbs and other smart devices in the home. Zigbee-based smart locks support cloud connectivity through the hub and they are very low power enabling long battery life. In many cases, this type of lock also supports Bluetooth low energy for direct access from smart phone device. (Other low power networks can be used to design similar type of smart lock like Thread or Bluetooth 5).
- **Sub-1 GHz Smart Lock** – This target mainly targets commercial deployments (hotels). Sub-1 GHz technology provides long range. All the doors at the hotels can be connected to the same Sub-1 GHz hub for back office control. At the same time, each door can be accessed by smart phone over Bluetooth low energy. The system administrator can configure credentials directly to the locks from a remote location or open all of the doors in case of emergency.

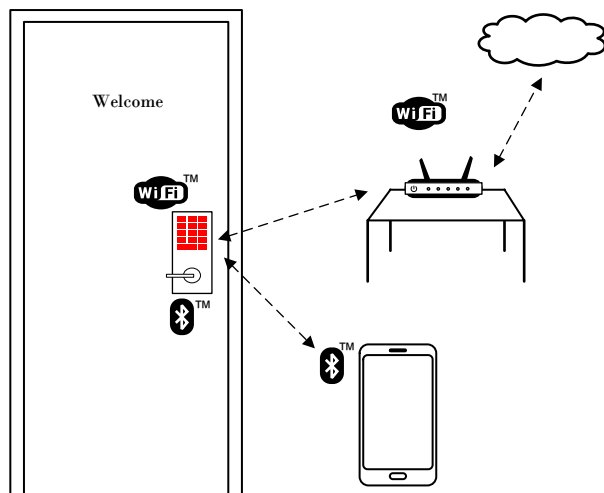


Figure 1. BLE and Wi-Fi Smart Lock - This smart lock is connected to the internet over the WI-Fi network that is available in every house. Cloud connectivity brings remote monitor and control.

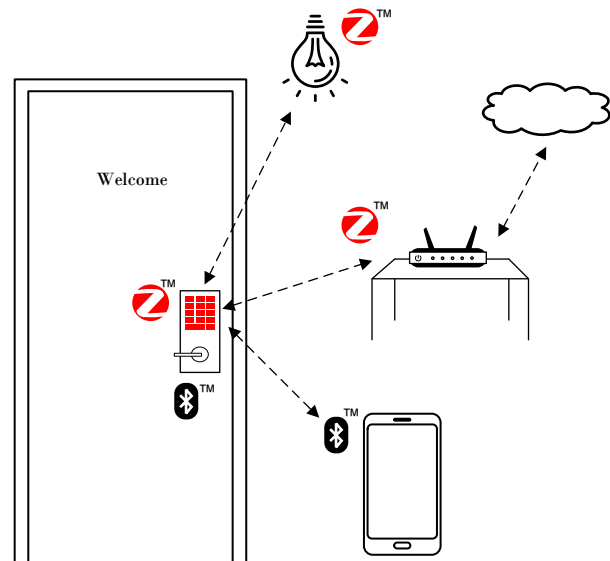


Figure 2. BLE and Zigbee Smart Lock - Zigbee enabled smart lock adds mesh network capabilities. Connect to Zigbee hub for internet access or directly to the other Zigbee enabled devices like light bulbs.

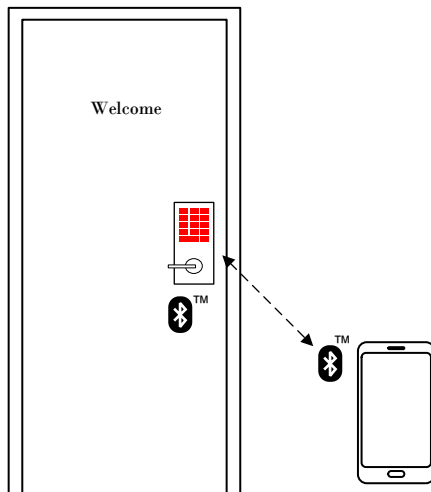


Figure 3. Bluetooth low energy Smart Lock - Control is done using the phone and Bluetooth low energy. You must be in close proximity to the door. No cloud connectivity for remote monitoring or setup.

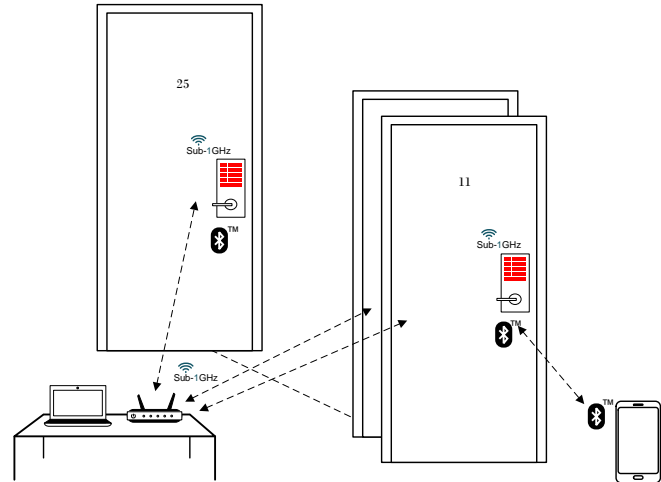


Figure 4. BLE and Sub-1 GHz Smart Lock - takes advantage of the long range capabilities of Sub-1 GHz technology for commercial deployments like hotel or multi-family. Monitor and control large number of doors at once.

2 Smart Lock Connectivity Tradeoffs

The main advantage of the Bluetooth low energy only smart door lock is its simplicity and low cost. Bluetooth low energy technology is easy, robust and very common today. It is the easiest technology to connect to a headless device from a smart phone. The main disadvantage is the lack of internet connectivity for remote control and monitoring.

Adding Wi-Fi technology to the smart lock brings the native internet connectivity. There is no need to have a special hub or other devices in the system, simply connect the smart door lock to the home access point and enjoy all of the benefits that internet brings. Another major benefit of Wi-Fi is the throughput. If the smart door lock requires audio or video capabilities, then Wi-Fi is an excellent fit thanks to its support in higher throughputs.

Zigbee or Thread smart locks enjoy internet connectivity through a dedicated IoT hub. The smart home trend is gaining momentum; many such hubs like Amazon Echo Plus, Samsung SmartThings, Wink and more are being deployed in residential houses at growing pace. Mesh networks (like Zigbee or Thread) benefit as more and more devices join the network. House coverage is increased as more nodes are added and many use-cases can be implemented at the network layer. For example, turn on the light when door is being unlocked. Therefore, choosing Zigbee or Thread based smart door lock makes a lot of sense when having many other home automation devices.

Sub-1 GHz is recommended when range is a key factor. The main benefit of Sub-1 GHz technology is its long range and low power. It fits well for hotels or multi-family with many doors that can be connected to one aggregator.

Although there are many options to choose from and each option has its unique capabilities and advantages, there are some common requirements that all smart locks share regardless of the selected connectivity technology:

- **Low power** – Long battery life is key requirement because most smart locks are battery operated. Changing the batteries (or recharging them) is a hassle. In some cases it might be a real limitation to system performance. Consider Airbnb rental owners whose customers are locked outside the door and cannot access the room because the smart lock ran out of battery.
- **Security** – Any IoT device has to be secured in order to keep the sensitive information that runs through your network private. For Smart lock, this requirement is even more important since the main functionality of the IoT device is to guard the entry point.
- **Low latency** – It has to react quickly to the open command, especially when you are at your door and want to unlock it to get inside.

Table 1 provides a quick comparison between the connectivity technologies that have been presented for electronic locks and key parameters.

Table 1. Door Lock Companion Table

	Cloud Connectivity HUB	Range	Battery Lifetime	Throughput
BLE	NA	Short (Personal Area Network)	> 5 years	Low <2 mbps
Wi-Fi	Wi-Fi access point	Medium (Local Area network)	0.5 - 2 years * Varies depending on device and use-case	High > 754 mbps (802.11g)
Zigbee	Smart HUB	Medium (Mesh network)	> 5 years	Low 250 kbps
Sub-1 GHz	Proprietary gateway	Long (Wide Area Network)	> 5 years	Low Varies, typically <1 mbps

3 Smart Lock With SimpleLink Platform

SimpleLink devices are designed to meet any smart lock requirements regardless of the chosen technology.

The SimpleLink platform provides 100% code portability. Once you have developed one of your smart door locks (for example, the Bluetooth low energy smart lock using CC2640R2F), you can easily port your code to another SimpleLink device (for example CC3220S). This way TI customers minimize effort and time to market while building a portfolio of smart lock products.

- Bluetooth low energy Smart Lock: CC2640R2F or CC2642R are the primary recommended devices for a standalone Bluetooth low energy smart lock. They can achieve 5 years of battery lifetime for door lock use-case. A unique sensor controller (available in many of the SimpleLink devices) is a low-power processor unit that can monitor sensors while the rest of the system is asleep. In addition, the sensor controller can be connected directly to capacitive touch UI.
- Wi-Fi Smart Lock: CC3220S or C3220SF are the primary recommended devices for Wi-Fi door lock. SimpleLink Wi-Fi is designed with special low-power modes that can achieve 1.5 years while maintaining continuous connection with the cloud. In addition, it has an extensive set of security features such as unique device ID, integrated SSL/TLS protocol stacks, secured key storage, separated execution environment, secured boot, secured over the air (OTA) software upgrade and more. For Wi-Fi and Bluetooth low energy smart lock, integrate a CC2640R2F alongside the CC3220 Wi-Fi device.
- Zigbee Smart Lock: CC2652 is the primary recommended device for Zigbee and Bluetooth low energy smart lock. This multi-protocol device can support both Bluetooth low energy for easy UI and Zigbee for network and cloud connectivity. It supports the latest Zigbee 3.0 standard and Bluetooth 5, an exceptional combination of RF performance and low power.
- Commercial Smart Lock: CC1352 or CC1352P are the primary recommended devices for commercial smart lock design (hotels for example). The dual band capabilities of Sub-1 GHz technology and Bluetooth low energy concurrently supported (time multiplexing) are perfect for this type of deployment. To easily build a network in the Sub-1 GHz ISM bands, TI provides a network called "TI 15.4 Stack". This robust network has a synchronous mode design primarily used to reduce latency in smart lock use-cases. It is a fully featured two way communication network with security and over the air upgrade capability.

4 Summary

Smart Electronic Lock add significant value to home owners, property managers and other institutional facility managers. Different connectivity technology serve different needs in the market. The SimpleLink platform helps Elock manufactures build portfolio of products while leveraging platform investment. Many Elock products require more than one connectivity technology (usually it is BLE along with other technology that allows cloud connectivity Like Wi-Fi, Zigbee, Thread or Sub-1 Ghz). Multi-protocol devices like SimpleLink CC2652 and CC1352 help building more integrated and cost effective products by supporting several connectivity protocols concurrently.

5 References

- [*Battery-Powered, Smart-Lock Reference Design With Cloud Connectivity Using SimpleLink™ Wi-Fi®*](#)
- [*Access Control Panel With Bluetooth® low energy, Capacitive Touch, and Software Integration Reference Design*](#)
- [*Smart Lock Reference Design Enabling More Than Five Years of Life on Four AA Batteries*](#)
- [*SimpleLink™ Wi-Fi® Enabled Electronic Smart Lock*](#)
- [*IP smart door locks: Power optimized and added security features for cloud connectivity with SimpleLink™ Wi-Fi®*](#)

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