



FTF 2016
TECHNOLOGY FORUM

HOMEKIT SDK CONFIGURATION AND INTEGRATION INTO ACCESSORY APPLICATIONS

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SESSION #FTF-HMB-N2012
15, APRIL, 2016

PUBLIC USE



AGENDA

- HomeKit SDK Introduction and Architecture
- HomeKit SDK Built in Demo Accessory, with Demo
- HomeKit SDK Supported Profiles and APIs
- HomeKit SDK Optional Debug Interface, with Demo
- HomeKit SDK Resource Requirements and Performance
- HomeKit SDK Hardware Development Options
- Arcturus IoT Development Platform and Module, with Demo
- HomeKit SDK Documentation, Support, and Availability
- NXP Products Suitable for HomeKit Accessories
- Q & A

HOMEKIT SDK INTRODUCTION AND ARCHITECTURE



Introduction



- The development of most Accessories for iPod[®], iPhone[®] or iPad[®] devices requires an **MFi (Made For iPod) license** from Apple
- MFi licenses covers:
 - Lightning dock connector accessories
 - 30-pin dock connector accessories
 - Advanced functionality for Bluetooth (classic) accessories
 - Apple AirPlay
 - **Apple HomeKit**
 - Apple CarPlay
 - iBeacon technology is now included in the Apple Developer Program

HomeKit - Overview

[WWDC 2014 HomeKit relevant sessions:](#)

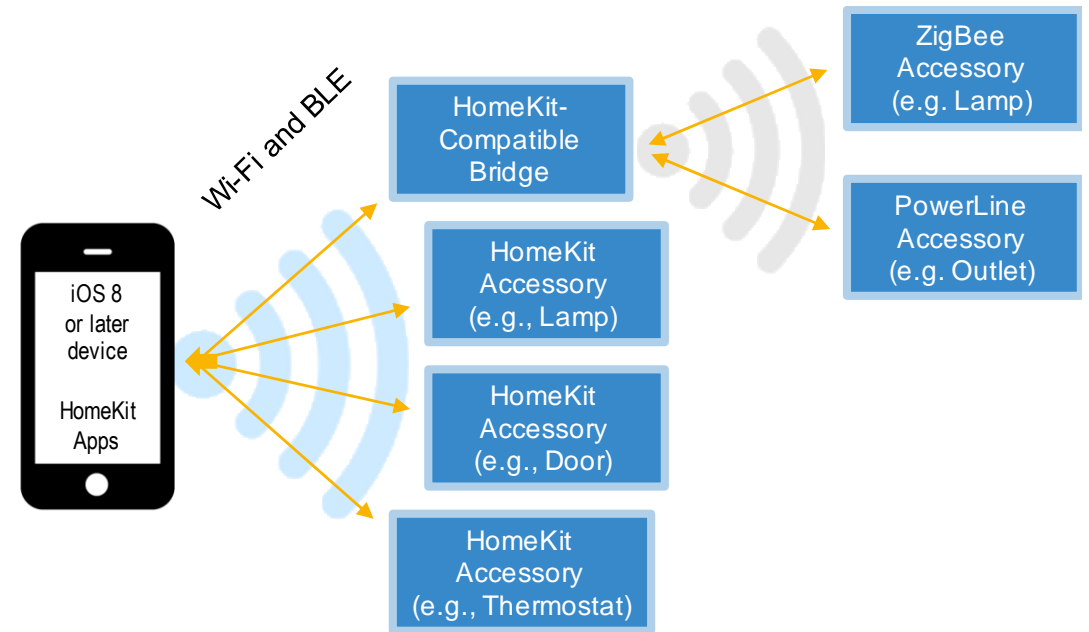
- [Introducing_homekit](#)
- [Designing_accessories_for_ios_and_os_x](#)

[WWDC 2015 HomeKit relevant sessions:](#)

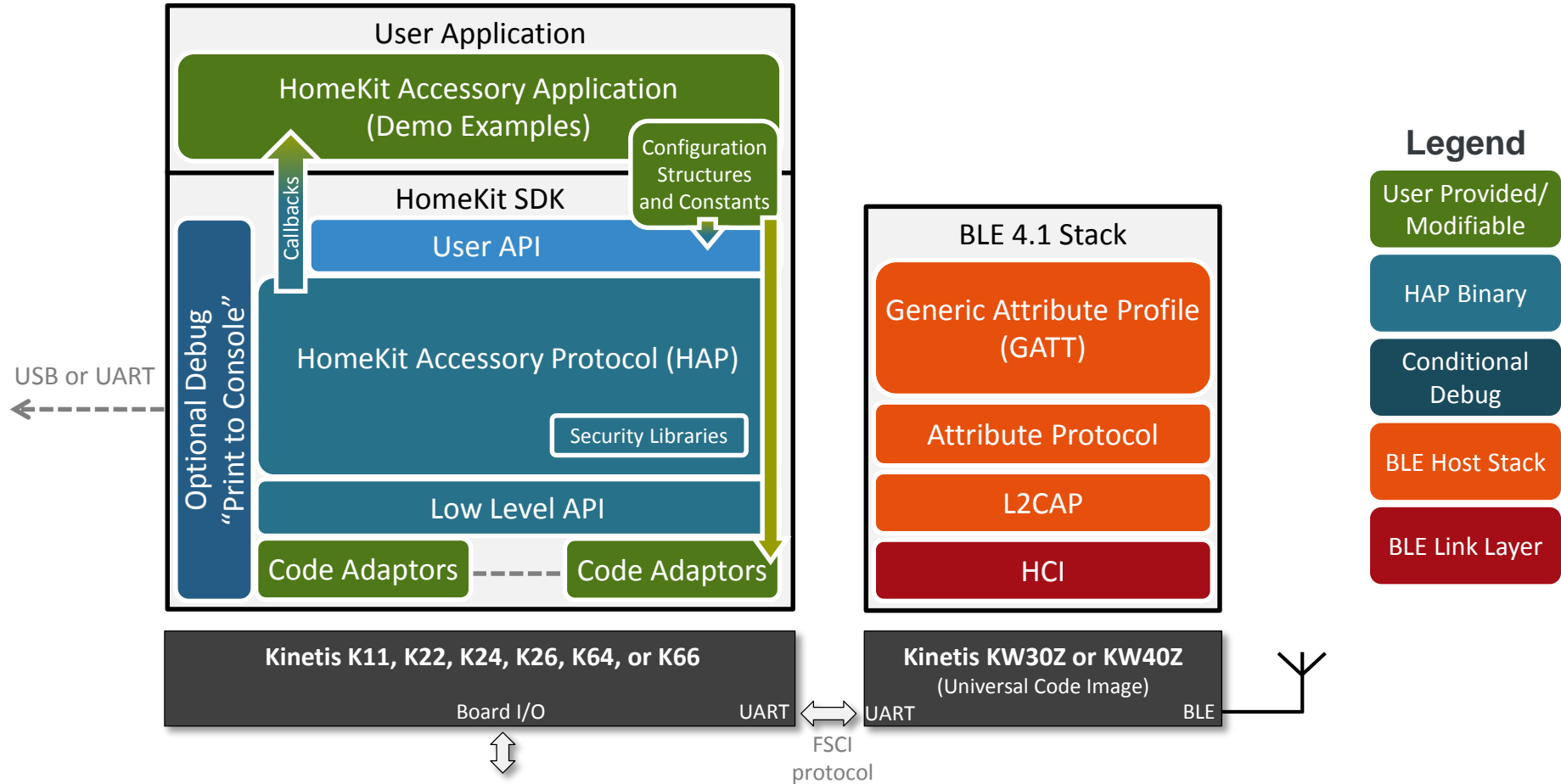
- [What's New in HomeKit](#)

Announced at WWDC (June 2014) to support home automation:

- Defines standard interface between iOS and Home Automation accessories
- Directly supports Internet Protocol (IP) (Wi-Fi® and Ethernet) and BLE (4.0+) transports
- Supports multiple legacy transports such as ZigBee, Z-Wave and PowerLine via accessory Bridges
- Multiple vendor accessories may be controlled by one or more iOS Apps
- Multiple iOS Apps may control each accessory
- Siri may be used to control HomeKit defined accessories
- HomeKit support available from iOS 8
- iOS 9 adds several accessory definitions

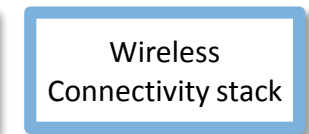
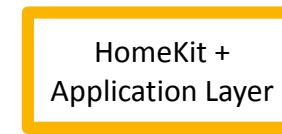
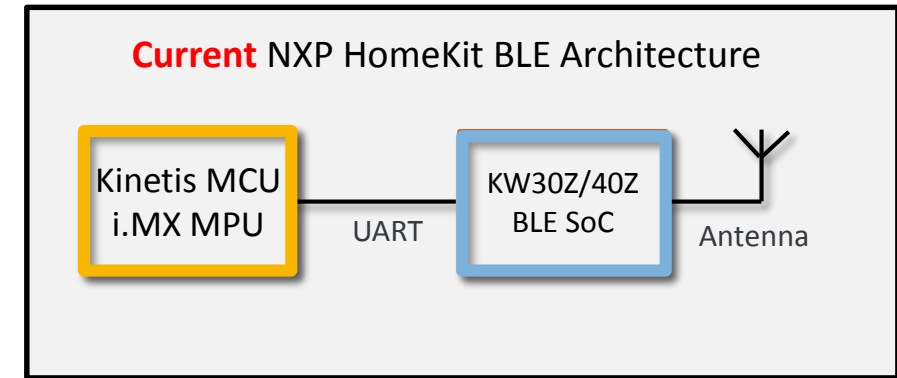
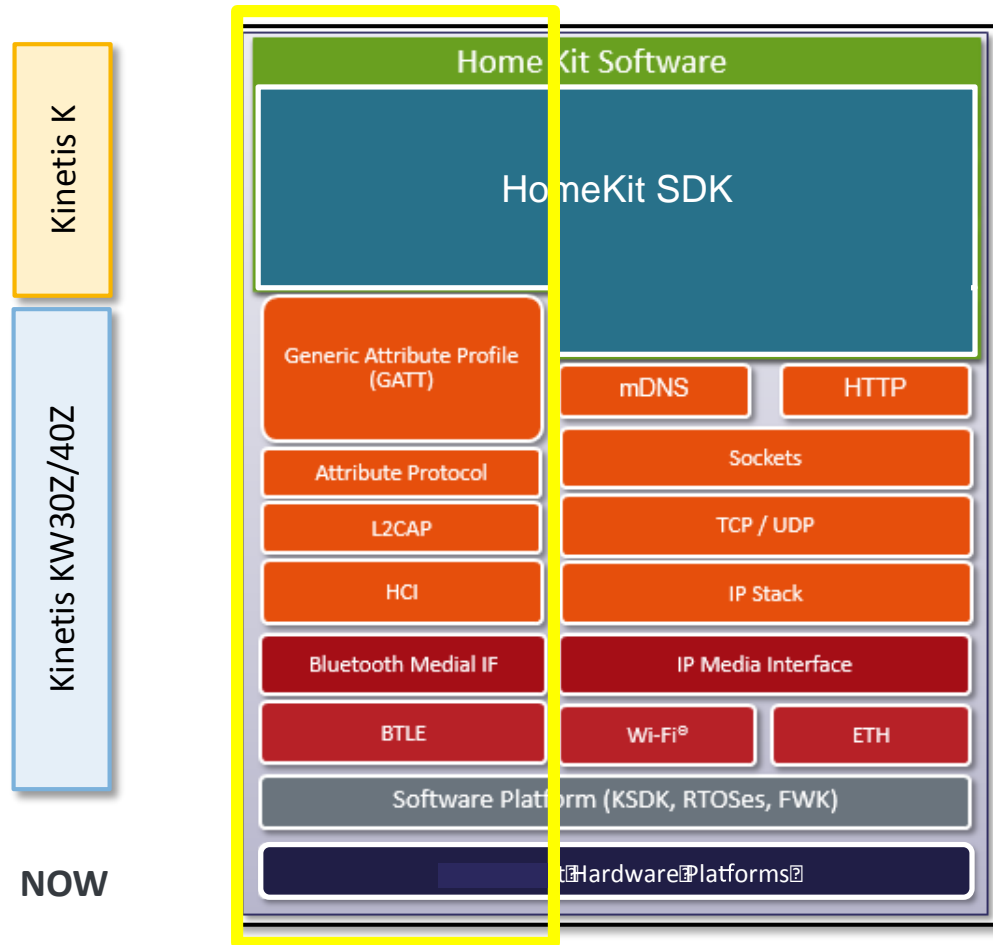


HomeKit SDK from NXP Solution (1/2)

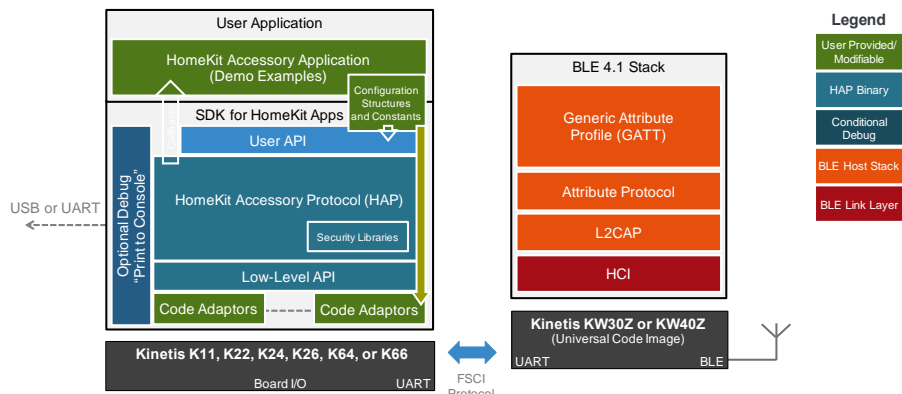


HomeKit SDK from NXP Solution (2/2)

Bluetooth Low Energy 4.x (BLE) Transport



HomeKit SDK from NXP for Home Automation Applications



HomeKit Accessory Protocol (HAP) software SDK includes communication protocol stacks



Targeted Applications

- HomeKit accessories (end-points):
 - Lighting, power outlets, thermostats, security, door locks, sensors, smoke detectors, garage doors, and more,

Supported Processor Products

Host MCU/MPU (* with Ethernet)	OS	Wireless Connectivity	
Kinetis K ARM® Cortex®-M4 MCUs (min. 64 KB SRAM, 512 KB Flash) K22, K24, K26, K64, K66	No OS, FreeRTOS	+	BLE Kinetis KW30z/40z

Key Features

- Full HomeKit Accessory Protocol (HAP)
- Easy configuration setup
- User API independent of communications transport
- Easy porting and adaptation to target platform
- Support for all defined Profiles and Characteristics
- Easy addition of custom Characteristics and Services
- Built-in firmware update support
- Support for Bluetooth Smart 4.1 (BLE)
- \$499 download includes:
 - Unlimited production license
 - Two hours of email Professional Support
- Additional Professional Support, and Professional Services are available

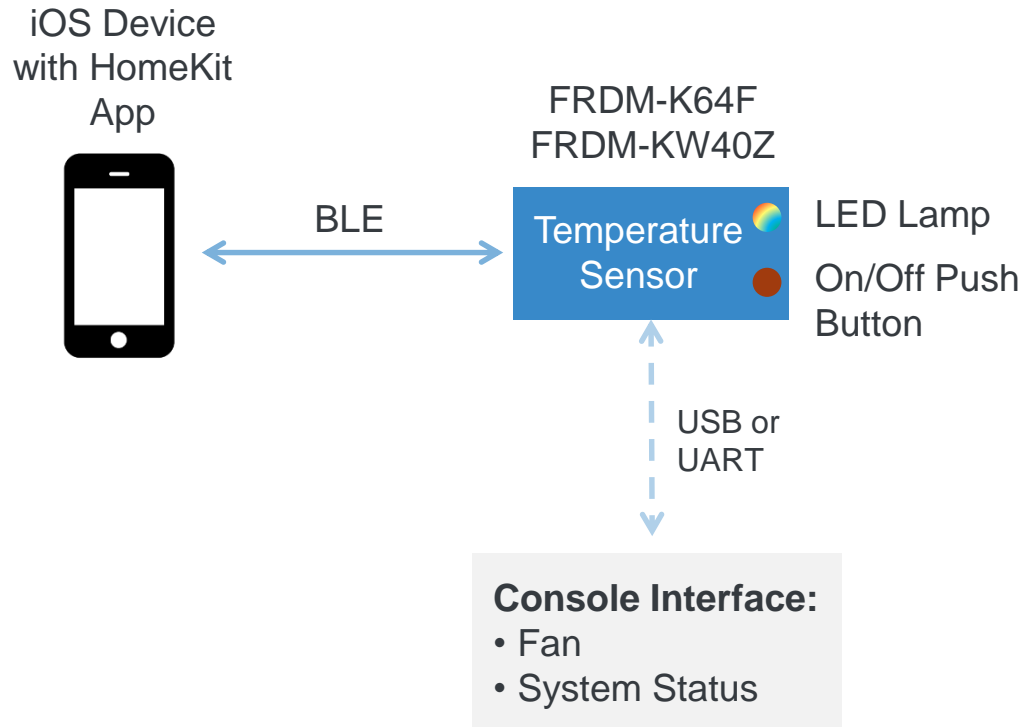
Availability: HomeKit BLE for Kinetis MCUs: Now



HOMEKIT SDK BUILT IN DEMO ACCESSORY, WITH DEMO



HomeKit SDK from NXP - Example Accessory Demo



Demo (part of SDK) includes:

- Example HomeKit iOS app
- LED bulb including brightness and hue control of RGB LED on FRDM-K64F
- Local On/Off push button control on FRDM-K64F
- Simulated fan control shown on a Mac/PC console interface, connected via USB
- Temperature sensor showing temperature of onboard K64F sensor

HomeKit SDK Demo 1

- HomeKit iOS Apps
- Home setup
- Accessory Pairing
- RGB LED control
- Control with Siri



HOMEKIT SDK SUPPORTED PROFILES AND APIs



HomeKit SDK from NXP – Accessories Support

- The HomeKit SDK includes support for all currently defines accessories
 - Defined accessories may be controlled with Siri
- The HomeKit SDK supports the addition of custom accessory definitions

HomeKit SDK Target Home Automation Applications

- Lighting; bulbs and fixtures
- Power outlets and switches
- Ceiling (and other) fans
- Relocatable and portable switches
- Security systems; cameras, sensors, control panels
- Locks, garage doors (including chicken coop doors), and gates
- Thermostats and HVAC control
- Windows and Doors
- Window coverings; blinds and drapes
- Pool and Spa control
- Weather stations
- Irrigation systems
- Water leak monitoring
- Appliances; Dish washers, Washing machines, Driers, Fridges, Freezers, Coffee machines
- Sensors; Moisture, Air Quality, Fire, Smoke, CO2 detectors
- Robot vacuum cleaners
- Pet feeders
- Multi media equipment; e.g. home theater screen, projector, lens control

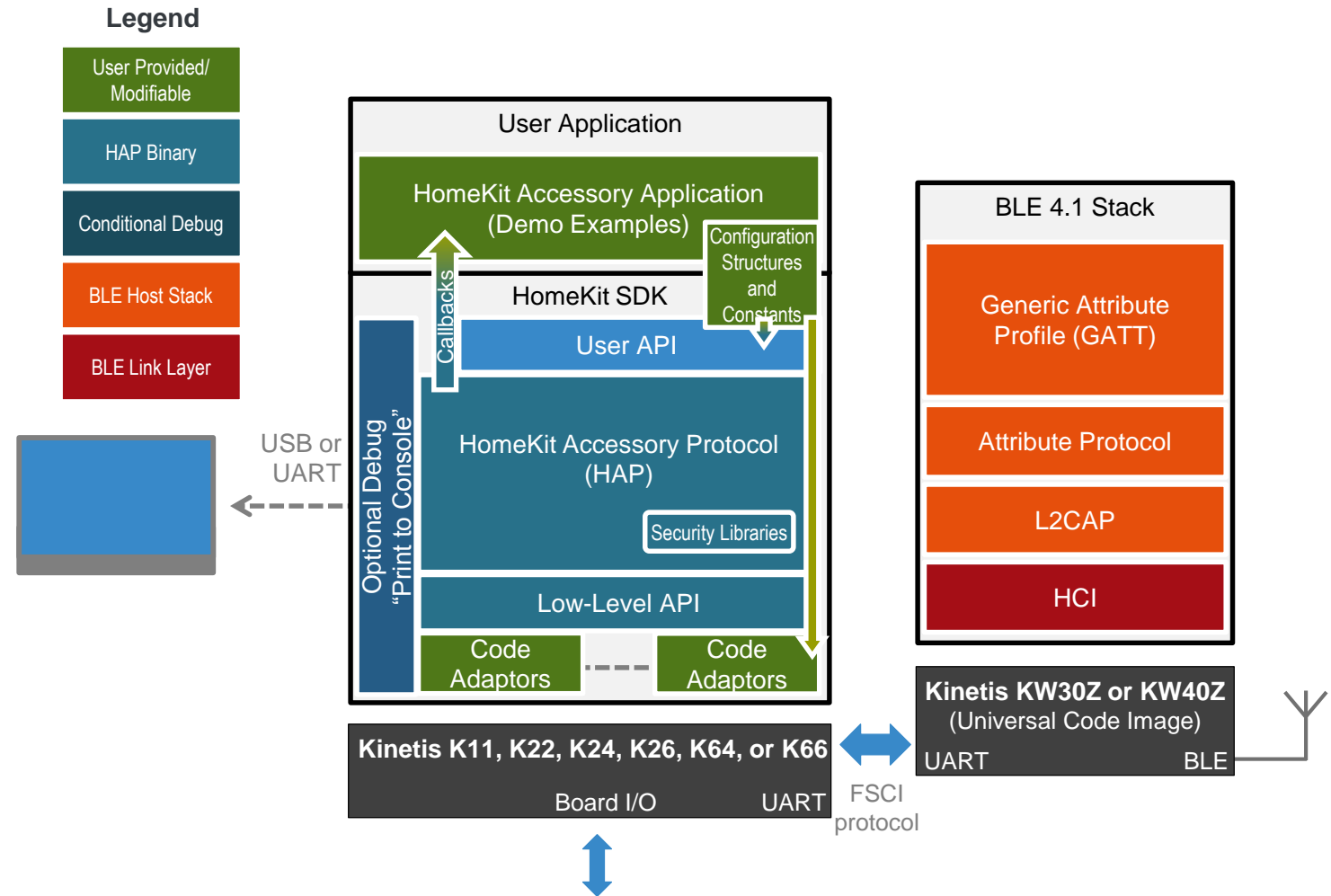
The HomeKit Software Development Kit (SDK) from NXP for Kinetis MCUs offers support for home automation applications using HomeKit technology.

HOMEKIT SDK OPTIONAL DEBUG INTERFACE, WITH DEMO



HomeKit SDK from NXP - Development and Debug Support

- The SDK includes an **example accessory** with functions for a light bulb, fan and temperature sensor
- The example accessory is intended and suitable for use as a **starting point** for accessory development
- This SDK includes **two high-level configuration options**:
 1. “Debug”: in this configuration, selected HAP status parameters are “printed” to console on a Mac or PC via Serial or USB interface for **debug and testing**
 2. “Release”: this configuration **removes the print-to-console functionality** and is suitable for the accessory production release



HomeKit SDK from NXP - Wi-Fi/Ethernet Transport Demos

The following demos and videos are available:

- Simple Lamp (LED)

- Based on FRDM-K64 using IP Ethernet transport (not authenticated)

- Video available

- Based on TWR-K64, TWR-DOCK2, TWR-SHIELD, GT202 using IP Wi-Fi transport (authenticated)

- Hue Lamp

- Based on FRDM-K64 and FRDM-MCR20A using IP Ethernet transport (not authenticated) connecting to ZigBee

- Video available

- Schlage Sense HomeKit door lock

- Based on Kinetis K11

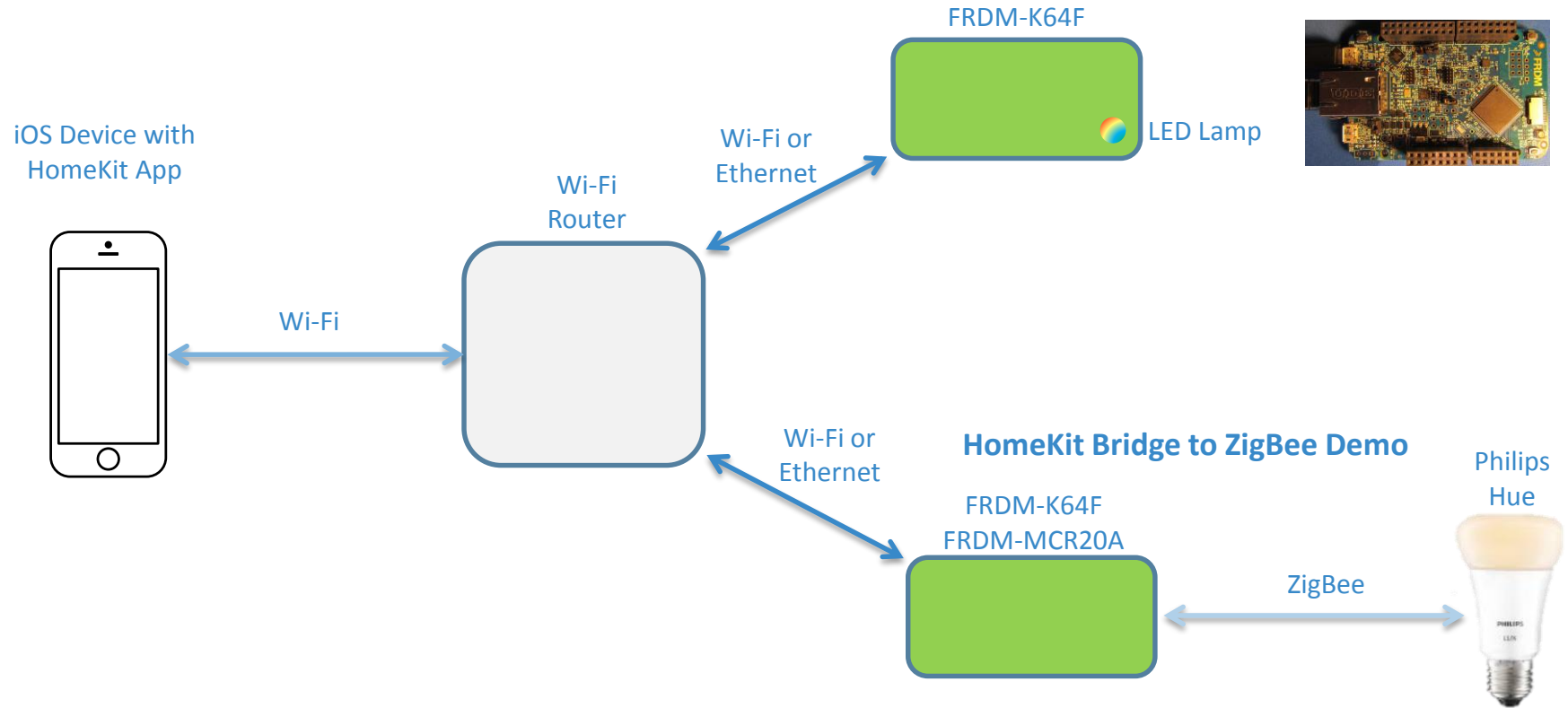
- Video available

In development:

- Simple Lamp (LED)

- Based on TWR-K21, TWR-DOCK2, TWR-PROTO with BLE module, using BLE transport (authenticated)

HomeKit Simple LED Demo



HomeKit Bridge to Hue Lamp Demo

Based on FRDM-K64 and FRDM-MCR20A using IP Ethernet transport Bridging to ZigBee



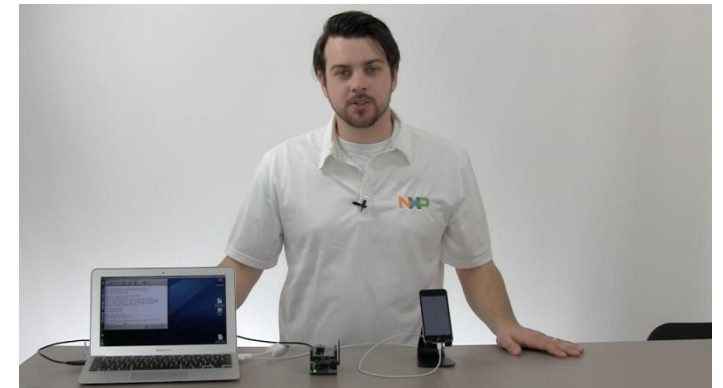
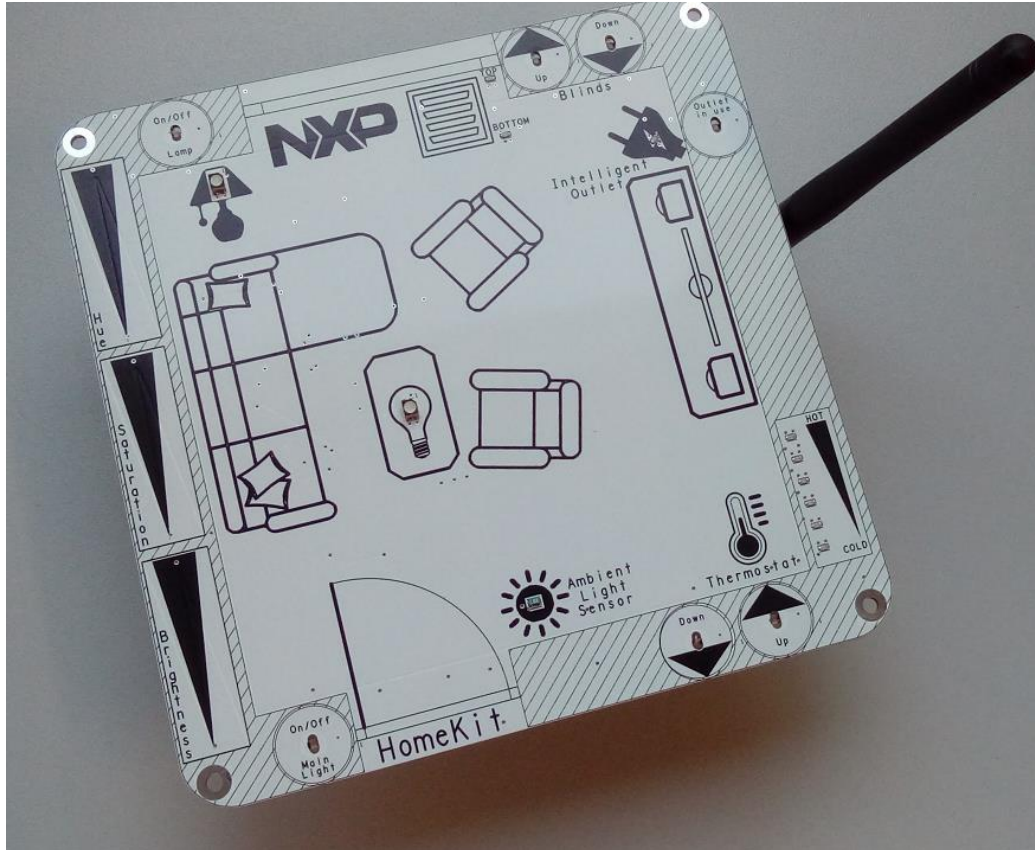
HomeKit SDK Demo 2

- Print to Console interface
- Display of Pairing status
- Display of API changes
- Virtual Fan control
- Display of status change following local switch control



HomeKit SDK Demo 3

- “Living Room” accessories hardware simulator on FRDM system



HOMEKIT SDK RESOURCE REQUIREMENTS AND PERFORMANCE



HomeKit SDK from NXP - Host System Recommendations

Minimum Host CPU requirements:

- ARM Cortex-M4 at 50 MHz system clock
- ARM Cortex-M0+ at 72 MHz system clock

Minimum security hardware requirement:

- Hardware Random Number Generator (RNG)
- Secure key storage
 - On Kinetis set Security Bit as a minimum to protect internal Flash data
 - On i.MX either use Secure System configuration or an external secure storage component

Memory system requirements:

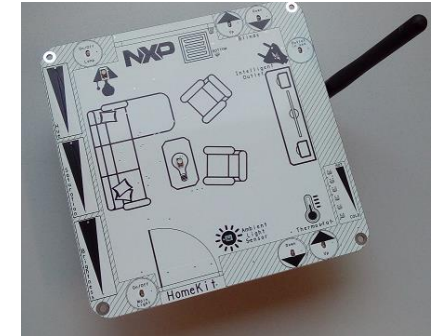
	Platform	Flash ¹⁾	SRAM	Comments
Estimated HomeKit SDK only	HomeKit over Wi-Fi	256 KB	64 KB + TCP/IP stack	TCP/IP and HTTP server requirements will typically be 32-48k (preliminary estimation)
	HomeKit over BLE	160 KB	48 KB	If full BT (with controller) stack: 230/48 KB

HOMEKIT SDK HARDWARE DEVELOPMENT OPTIONS



HomeKit SDK Hardware Support

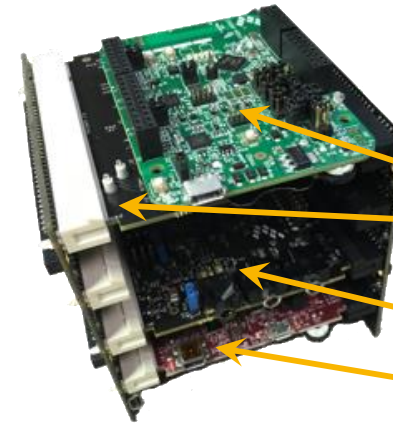
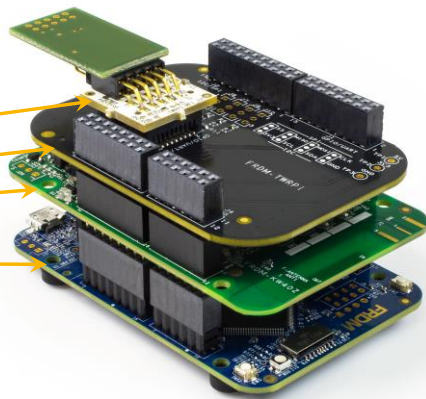
- FRDM system (Arduino compatible) is available now, supporting a range of Kinetis application MCUs
- Next HomeKit SDK release will add support for TWR system and TWR-DOCK2
 - Adding support for QN9020 BLE MCU
 - FRDM and TWR systems include hardware support for BLE, Ethernet and Wi-Fi transports
- Developing a one board replacement for FRDM-TWRPI and TWRPI-I2C combination
- "Living Room" demo FRDM-HK-LVGR board
 - To enable easy testing of more accessory functions
 - To enable demos of a wider range of accessory functions



FRDM-HK-LVGR

FRDM System consisting of:

- TWRPI-I2C adaptor
- FRDM-TWRPI adaptor
- FRDM-KW40Z
- FRDM-K64F

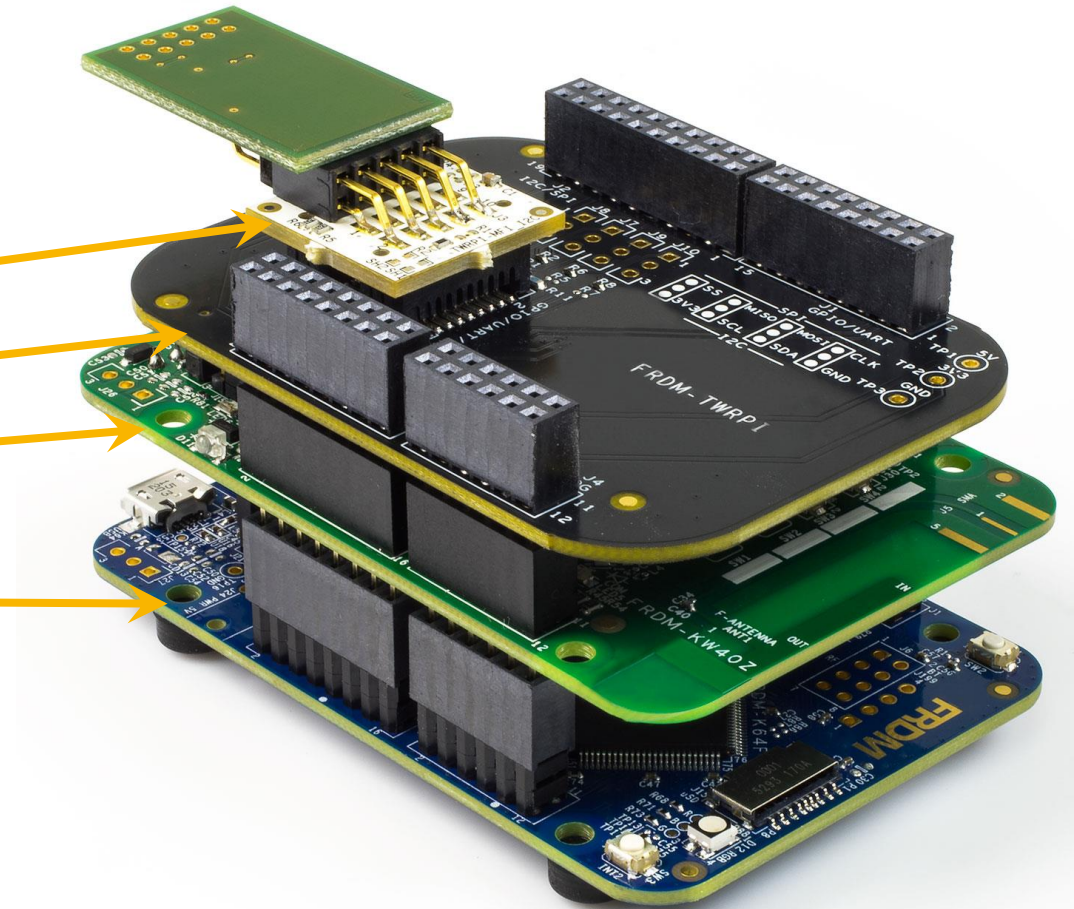


- [FRDM-KW40Z](#): BLE Connectivity
- [TWR-SHIELD](#)
- [TWR-ELEV](#)
- [TWR-DOCK2](#) or [TWR-DOCK](#): Board w/ Wi-Fi module
- [TWR-K64F120M](#): Host processor

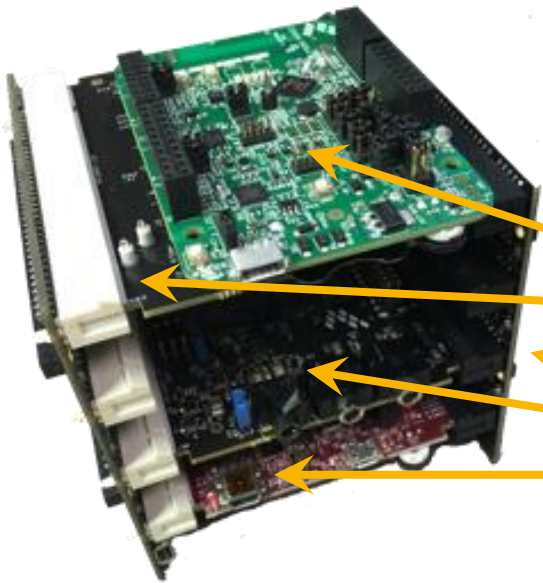
HomeKit Software Development with NXP Freedom Boards

FRDM System consisting of:

- TWRPI-I2C adaptor
- FRDM-TWRPI adaptor
- FRDM-KW40Z
- FRDM-K64F

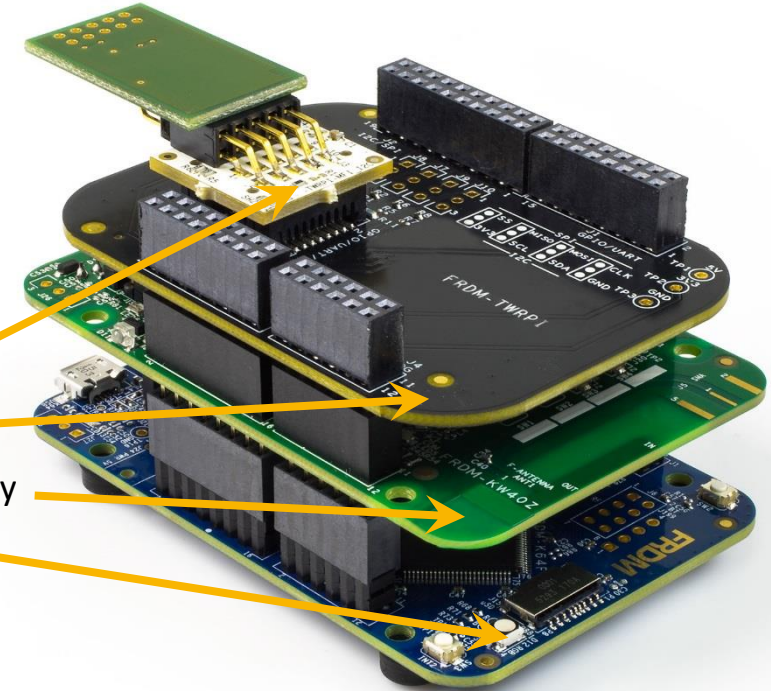


Kinetis Development Platforms for HomeKit



- [FRDM-KW40Z](#): BLE Connectivity
- [TWR-SHIELD](#)
- [TWR-ELEV](#)
- [TWR-DOCK2](#)
- [TWR-K64F120M](#): Host processor

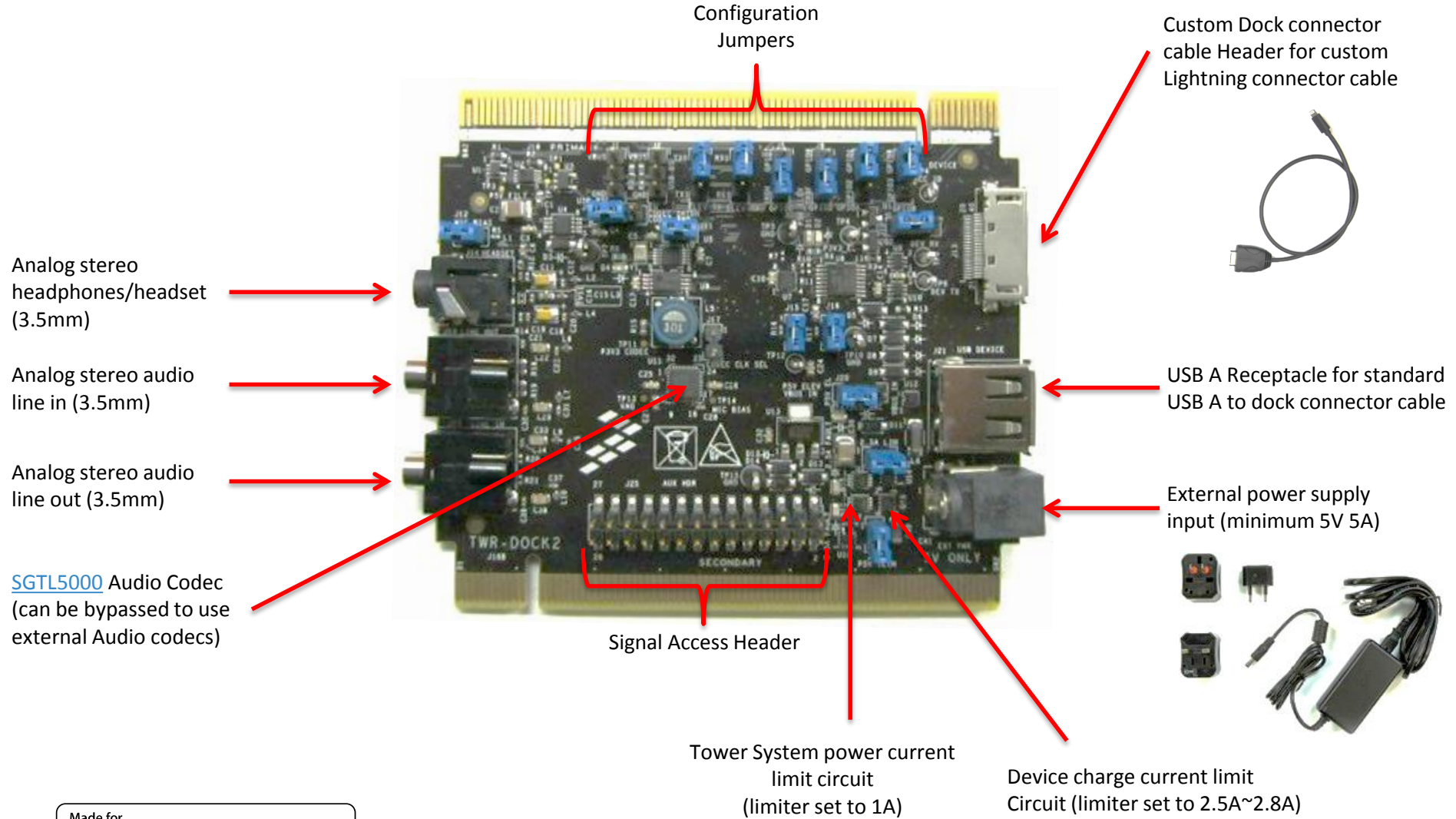
Tower System
Richer feature sets



- TWRPI-I2C* adaptor board
- [FRDM-TWRPI](#) adaptor
- [FRDM-KW40Z](#): BLE Connectivity
- [FRDM-K64F](#): Host Processor

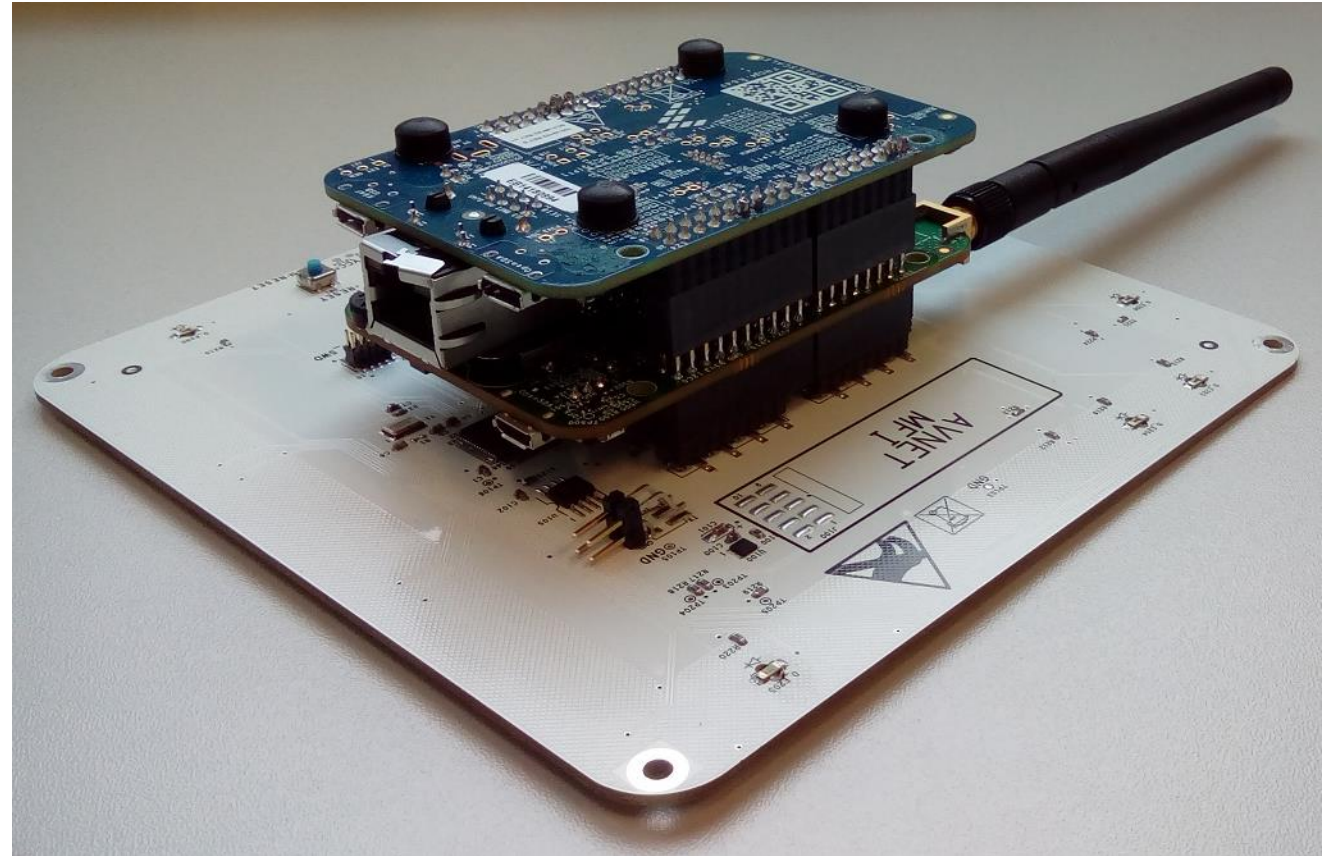
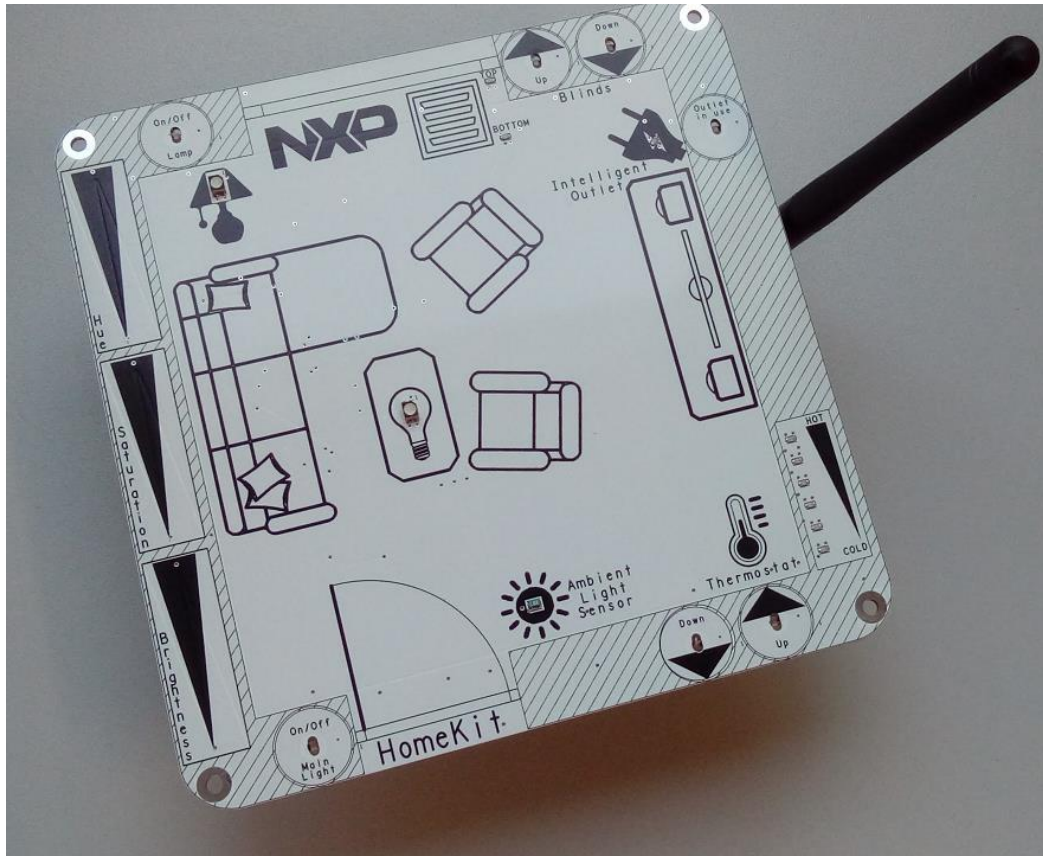
Freedom System
Lower cost

TWR-DOCK2: Tower Module for HomeKit and MFi Development



HomeKit Accessory Shield Card – Living room (FRDM-HK-LVGR)

- Two RGB lightbulbs(Main light and lamp), Ambient light sensor, Thermostat, Intelligent outlet, Window covering



HomeKit SDK from NXP - Development Solutions

1) Host Processor						2) Wireless Connectivity MCU					3) Add-on development boards					
Recommended Part #	Development board	Homekit SDK	Kinetis SDK	IDE	RTOS	Part #	SDK	IDE	RTOS	Dev. board	TWR-DOCK2 or TWR-DOCK	FRDM-TWRPI	TWRPI-I2C	MFI module	TWR-SHIELD Adaptor for FRDM-KW40Z	TWR-ELEV
K11DN512	TWR-K21D50M	SDK 1.0	Kinetis SDK	IDE	FreeRTOS	KW40Z or KW30Z	SDK 1.3 Mainline	IAR only	Bare Metal or FreeRTOS	FRDM-KW40Z	X				X	X
K22FN512	FRDM-K22F										X	X	X			
	TWR-K22F120M										X			X	X	
K22FN1M	TWR-K21F120MA										X			X	X	
K24FN1M	FRDM-K64F											X	X	X		
	TWR-K64F120M										X			X	X	
K26FN2M	TWR-K65F180M										X			X	X	
	FRDM-K66F											X	X	X		
K64FN1M	FRDM-K64F										X			X	X	
	TWR-K64F120M										X			X	X	
K66FN2M	TWR-K65F180M										X			X	X	
	FRDM-K66F											X	X	X		
K80FN256 K81FN256 K82FN256	TWR-K80F150M										X			X	X	

Recommended setup for initial evaluation

- Development HW required: Host processors (1) + Wireless Connectivity (2) + add-on boards (3)
- HomeKit SDK SW, TWR-DOCK2, MFi Module can only be purchased through **Arrow** (<https://mfi.arrow.com/mfi>) or **Avnet MFi portal** (<https://mfi.avnet.com>). Other boards can also be purchased from www.nxp.com and any other official distributors
- TWRPI-I2C board must be supplied by NXP



ARCTURUS IOT DEVELOPMENT PLATFORM AND MODULE, WITH DEMO



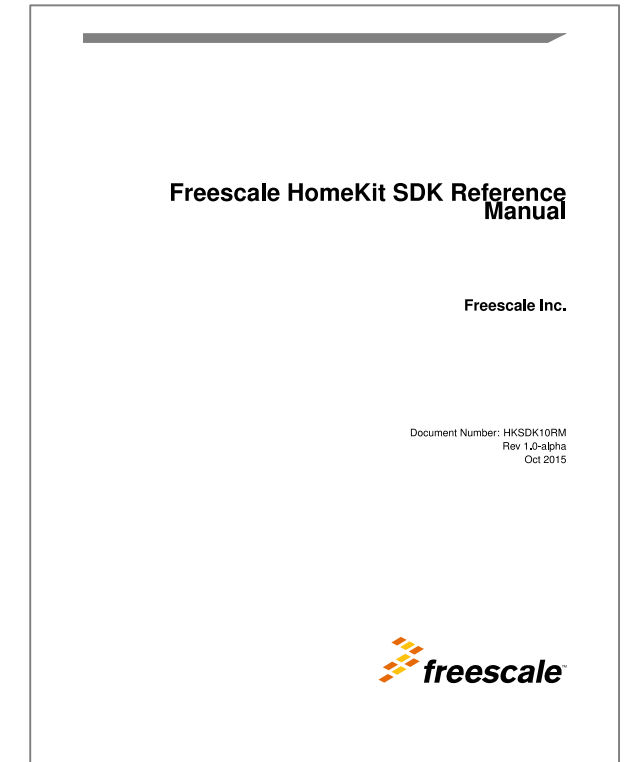
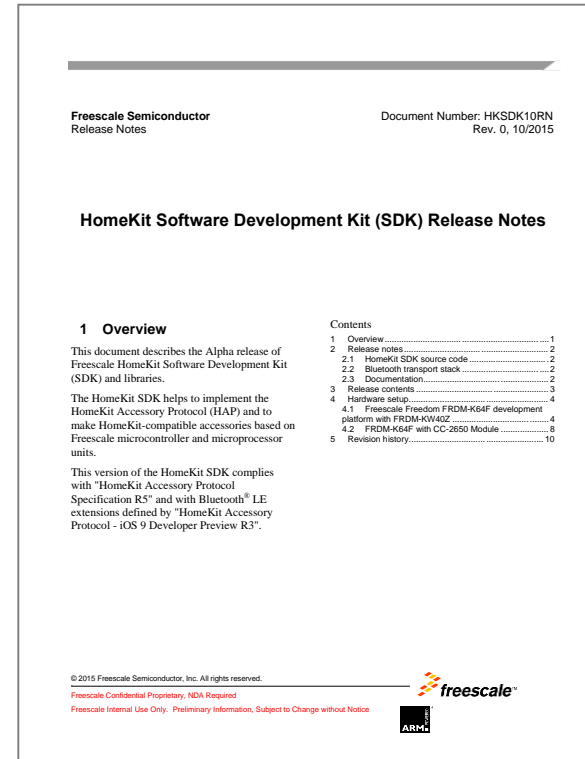
HOMEKIT SDK DOCUMENTATION, SUPPORT, AND AVAILABILITY



HomeKit SDK from NXP - Documentation

Documentation includes:

- Full API documentation
- “Code Adaptor” concept for easy support for additional processors and transports
- Configuration file(s) description and examples
- Demo examples that customers can use as project starting point
- Conditional “Print to Console” options to help with debug



HomeKit SDK from NXP - Webpage and Videos

- **Additional information** is available on the NXP SDK for HomeKit webpage:
 - <http://www.nxp.com/HomeKit>
- **Documentation including:**
 - SDK for HomeKit Reference Manual
 - SDK for HomeKit Release Notes
- **Including videos showing:**
 - Development system and example accessory demos with Siri control
 - Schlage Sense™ Deadbolt from Allegion® based on Kinetis MCU and NXP software for HomeKit-compatible applications

Webpages

HomeKit Software Development Kit (SDK) | NXP

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PRODUCTS SOLUTIONS SUPPORT ABOUT

NXP Microcontrollers and Processors ARM® Processors Kinetis Cortex-M MCUs W Series

HOMEKIT-SDK: HomeKit Software Development Kit (SDK) ☆

Overview | Documentation | Hardware & Tools

Jump To
Overview
Features
System Requirements
Support Policy

Overview

The HomeKit Software Development Kit (SDK) offers full HomeKit software support for home automation applications, delivering exceptional performance, advanced security and Bluetooth Smart connectivity.

The NXP HomeKit BLE solution is architected as a host processor that runs the HomeKit Accessory Protocol with a Wireless Connectivity Processor connected to it via a serial interface (UART).

Host Processor - Kinetis MCUs based on ARM Cortex®-M cores provide highly efficient processing to meet HomeKit cryptography requirements, while incorporating a wide array of advanced security functions, including cryptographic keys storage, software and system protection options, a hardware Random Number Generator (RNG), and optional integrated system tamper detection. See the Supported Devices section for host processors supported by the HomeKit SDK.

Wireless Connectivity Processor - connected to the Host processor via a serial interface (UART). See the Supported Devices section for wireless connectivity processors supported by the HomeKit SDK.

Note: This software will be available soon through Apple Made for iPod® (MFi) authorized distributors.

Available: Professional Services

HomeKit Software Development Kit Block Diagram

HOMEKIT SDK BLOCK DIAGRAM

The diagram illustrates the architecture of the HomeKit SDK. It shows a User Application (HomeKit Accessory Application) interacting with the HomeKit SDK. The SDK is composed of several layers: Configuration Structures and Constants, User API, HomeKit Accessory Protocol (HAP), and Low-Level API. The SDK is connected to a Kinetis MCU (K11, K22, K24, K26, K34, or K36) via UART. The MCU is also connected to a Wireless Connectivity Processor (WCP) via UART. The WCP is connected to a BLE 4.1 Stack, which includes the Generic Attribute Profile (GATT), Attribute Protocol, L2CAP, and HCI. The BLE 4.1 Stack is connected to a Kinetis K11302 or K11303 (Universal Code Image) via BLE. The diagram also shows the NXP Library, Conditional Debug, BLE Host Stack, and BLE Link Layer.

Videos

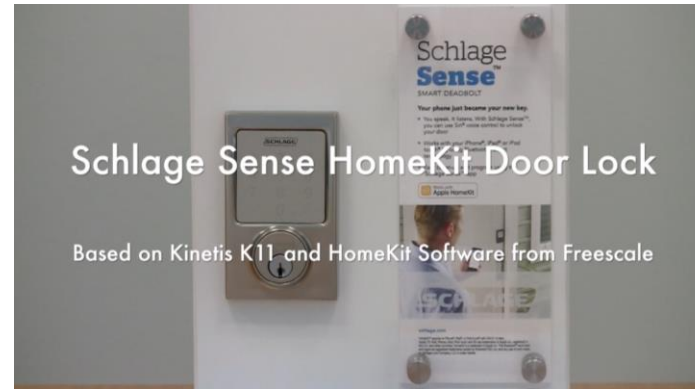


HomeKit SDK and MFi SDK Videos

The following demo videos are available on the HomeKit SDK and MFi SDK web pages:



HomeKit with Siri control



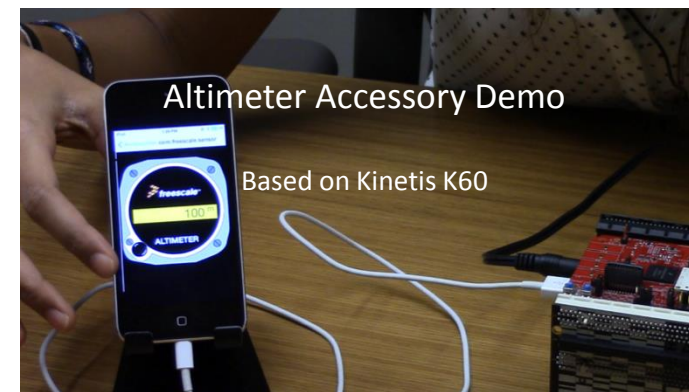
HomeKit with Siri control



HomeKit with Siri control



Made For iPod (MFi)

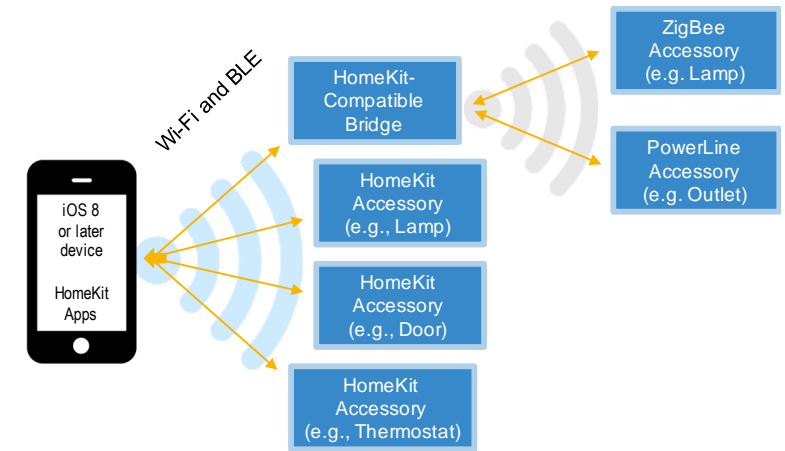


Made For iPod (MFi)

HomeKit SDK from NXP - Availability

Available Now!

- NXP HomeKit Press announcement on March 17th
- Available on Avnet MFi and Arrow Mfi
 - Solutions Guide document provides detailed information on downloading the SDK, documentation, and obtaining support
 - HomeKit SDK download is \$499, includes two hours of email based Professional Support
 - Additional Professional Support packages are available for purchase
 - Documentation is available without SDK purchase
 - Reference Manual, Release Notes
- NXP Professional services are available to development projects
- Web page <http://www.nxp.com/homekit> includes three HomeKit videos
 - Includes video of HomeKit SDK with included accessory demos and Siri control
- Versions of the HomeKit SDK covering additional transports, functionality, and devices are in development



NXP PRODUCTS SUITABLE FOR HOMEKIT ACCESSORIES



Kinetis KW40Z/30Z

BLE 4.1 & 802.15.4 Wireless MCU

Cortex-M0+, 160KB Flash, 20KB SRAM

Core/Memory/System

- Cortex-M0+ running up to 48 MHz
- 160 kB Flash
- 20 kB SRAM
- Four independently programmable DMA controller channels

Radio

- Support for BLE v4.1, 802.15.4-2011
- -91 dBm in BLE mode, -102 dBm in 802.15.4 mode
- -20 to +5 dBm programmable output power
- 6.5 mA Rx & 8.4 mA Tx (0dBm) current target (DC-DC enabled)
- <2uA low power current

Communications/HMI/Timers

- 2xSPI, LP-UART, 2xI2C, GPIO with IRQ capability (KBI)
- Carrier Modulated Timer (CMT)
- Hardware Capacitive Touch Sensing Interface (TSI)
- 3xFlexTimer (TPM) with PWM & quadrature decode support
- Low Power (LPTMR), Programmable Interrupt (PIT) and RTC timers

Analog

- 16-bit ADC with integrated temperature sensor and battery monitor
- 12-bit DAC and 6-bit High-speed Comparator

Security

- AES Accelerator and True Random Number Generator

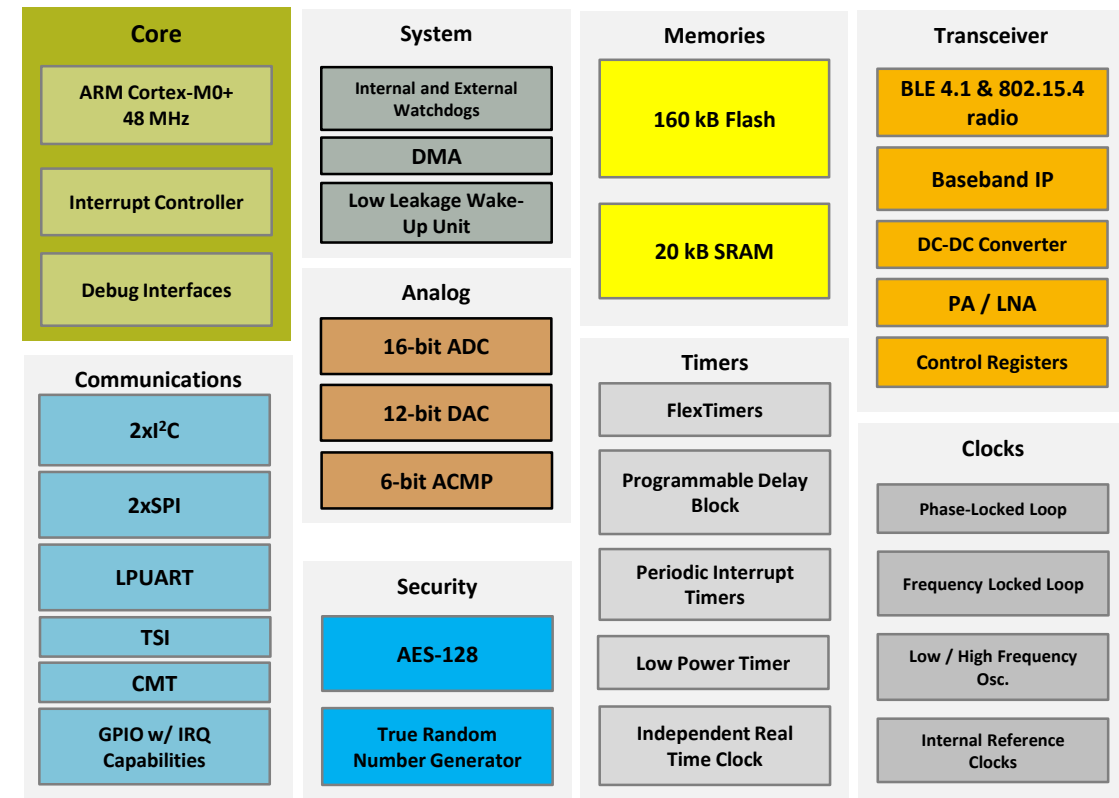
Integrated DC/DC Converter

- Normal: 1.71V to 3.6V
- Buck : 2.1V to 4.2V for coin cell operation
- Boost : 0.9V to 1.795V for single alkaline battery operation

Unique Identifiers

- 80-bit device ID programmed at factory
- 40-bit unique number can be used for Bluetooth Low Energy or IEEE 802.15.4 MAC Address

TJ: -40°C to +105°C



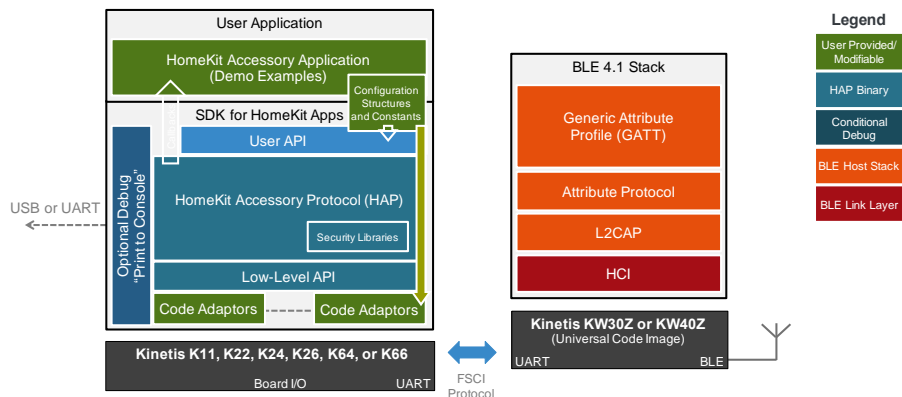
Device	Memory	Protocol	Package
MKW30Z160VHM4/R	160K Flash, 20K RAM	BLE	5x5 32-pin Laminate QFN
MKW40Z160VHT4/R	160K Flash, 20K RAM	BLE & 802.15.4	7x7 48-pin Laminate QFN
Features	Description		
Software and Protocol Stacks	Bluetooth Low Energy Host Stack & Profiles Thread Stack (supports end node only) ZigBee 3.0 IEEE 802.15.4 MAC SMAC w/ Connectivity Test and Wireless UART IAR, MQX/FreeRTOS		
Availability	NOW		

Recommended NXP Host Processors for HomeKit SDK Implementation

Recommended MCUs for Host HK Processor	CPU	Memory (kB)		Security	Interfaces	Packages
		Flash / SRAM	Dual Bank			
K11	50MHz Cortex-M4F	512 / 64	Yes	RNG, MMCAU, CRC, Tamper	-	LQFP, MAPBGA
K22	120MHz Cortex-M4F	1024 / 128 512 / 128	No	RNG, CRC	USB FS	LQFP, MAPBGA, CSP
K24	120MHz Cortex-M4F	1024 / 256	Yes	RNG, MMCAU, CRC	USB FS	LQFP, MAPBGA, CSP
K26	180MHz Cortex-M4F	2048 / 256 1024 / 256	Yes	RNG, MMCAU, CRC	USB HS & FS, SDRAM controller	LQFP, MAPBGA, CSP
K64	120MHz Cortex-M4F	1024 / 256 640 / 128	Yes	RNG, MMCAU, CRC	USB FS, Ethernet	LQFP, MAPBGA, CSP
K66	180MHz Cortex-M4F	2048 / 256 1024 / 256	Yes	RNG, MMCAU, CRC	USB HS & FS, SDRAM controller, Ethernet	LQFP, MAPBGA
K80 / K81 / K82	150MHz Cortex-M4F	256 / 256	Yes	RNG, MMCAU, CRC, Low-Power Trusted Crypto, Tamper	USB FS, QuadSPI, SDRAM Controller	LQFP, MAPBGA

Features	Benefits
Dual Bank memory	Used for Over-the-air update
RNG	Mandatory security module for Homekit
Tamper	Protect MCU against Physical attacks
QuadSPI	Memory Mapped External Flash interface
MMCAU	Enhance execution of security features for the application layer

HomeKit SDK from NXP for Home Automation Applications



HomeKit Accessory Protocol (HAP) software SDK includes communication protocol stacks



Targeted Applications

- HomeKit accessories (end-points):
 - Lighting, power outlets, thermostats, security, door locks, sensors, smoke detectors, garage doors, and more,

Supported Processor Products

Host MCU/MPU (* with Ethernet)	OS	Wireless Connectivity	
Kinetis K ARM® Cortex®-M4 MCUs (min. 64 KB SRAM, 512 KB Flash) K22, K24, K26, K64, K66	No OS, FreeRTOS	+	BLE Kinetis KW30z/40z

Key Features

- Full HomeKit Accessory Protocol (HAP)
- Easy configuration setup
- User API independent of communications transport
- Easy porting and adaptation to target platform
- Support for all defined Profiles and Characteristics
- Easy addition of custom Characteristics and Services
- Built-in firmware update support
- Support for Bluetooth Smart 4.1 (BLE)
- \$499 download includes:
 - Unlimited production license
 - Two hours of email Professional Support
- Additional Professional Support, and Professional Services are available

Availability: HomeKit BLE for Kinetis MCUs: Now



Q & A





SECURE CONNECTIONS
FOR A SMARTER WORLD