



FTF 2016
TECHNOLOGY FORUM

DEVELOPING HOMEKIT AND MADE FOR IPOD (MFI) ACCESSORIES WITH NXP PROCESSORS AND SOFTWARE

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PUBLIC USE



AGENDA

- Introduction to HomeKit and Made For iPod (MFi)
- HomeKit Software Development Kit (SDK) from NXP
- MFi Software Development Kit (SDK) from NXP
- CarPlay Solution from NXP Professional Services
- AirPlay and Audio Streaming Solution
- NXP Products Suitable for HomeKit and MFi Accessories
- NXP Hardware Development Systems for HomeKit and MFi
- Q & A

INTRODUCTION TO HOMEKIT AND MADE FOR IPOD (MFI)

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

Apple Developer Program

MFi Program

Join the MFi licensing program and get the hardware components, tools, documentation, technical support, and certification logos needed to create AirPlay audio accessories and electronic accessories that connect to iPod, iPhone, and iPad.

Hardware Components and Documentation

Get the hardware connectors and components that are required to manufacture iPod, iPhone, iPad, and AirPlay audio accessories. And access the iPod Accessory protocol specification, the communication protocol used to interact with iPod, iPhone, and iPad.

MFi Logos

Promote your electronic accessory with MFi logos. Made for iPod, Made for iPhone, Made for iPad, and AirPlay logos communicate to customers that an electronic accessory has been designed to connect specifically to iPod, iPhone, or iPad, and has been certified by the developer to meet Apple performance standards.

Join the MFi Program

Hardware Connectors and Components	✓
Testing Tools	✓
Technical Information	
Technical Support	
Product Certification	✓
MFi and AirPlay Logos	✓
iPod, iPhone, and iPad Compatibility Icons	✓

[Apply Now](#)

Click here to apply for an MFi license

<https://developer.apple.com/programs/mfi/>

HomeKit - Overview

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

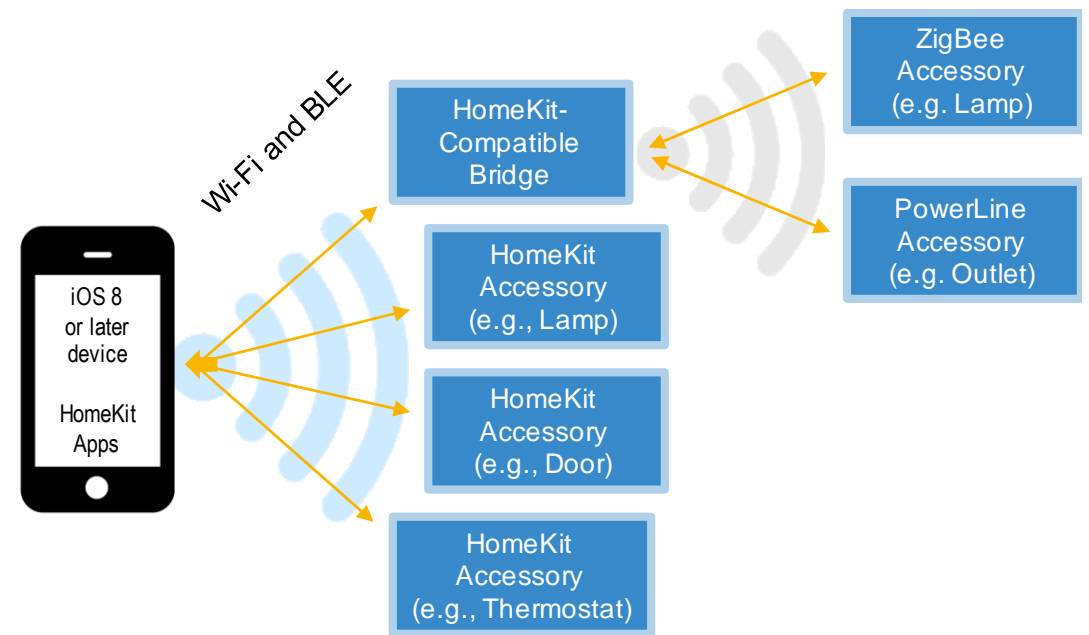
- Defines standard interface between iOS and Home Automation accessories
- Directly supports Internet Protocol (IP) (Wi-Fi® and Ethernet) and BLE (4.0+) transports
- Supports multiple legacy transports such as ZigBee, Z-Wave and PowerLine via accessory Bridges
- Multiple vendor accessories may be controlled 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

[WWDC 2014 HomeKit relevant sessions:](#)







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

[WWDC 2015 HomeKit relevant sessions:](#)

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



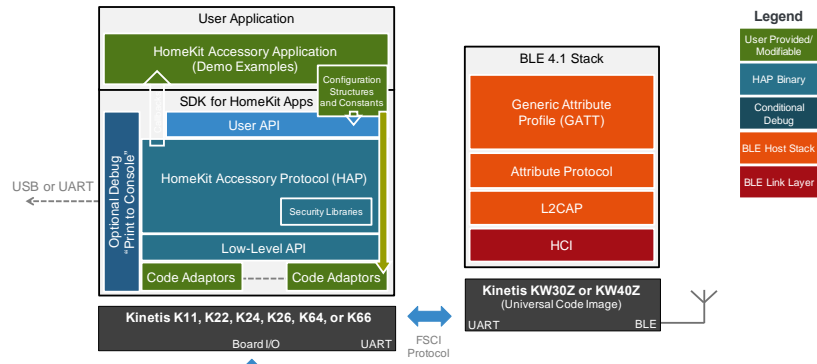
MFi Accessory Connection Options

Connection	Wired		Wireless			
	Lightning	30-pin	BLE	BT	BT (MFi)	WiFi
						
License Required	MFi	MFi	MFi for HomeKit, iBeacon for beacons	No	MFi	MFi
Audio	Digital	Analog and Digital	No (except hearing aids)	Yes	Yes	Yes, with AirPlay and CarPlay
Notes/ Comments	Supports all MFi functions	Some MFi functions not supported	Wearables, Apple HomeKit, iBeacon	A2DP audio, Handsfree only	MFi BT Connection, Gaming controllers	Apple AirPlay, Apple CarPlay, Apple HomeKit

HOMEKIT SOFTWARE DEVELOPMENT KIT (SDK) FROM NXP



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

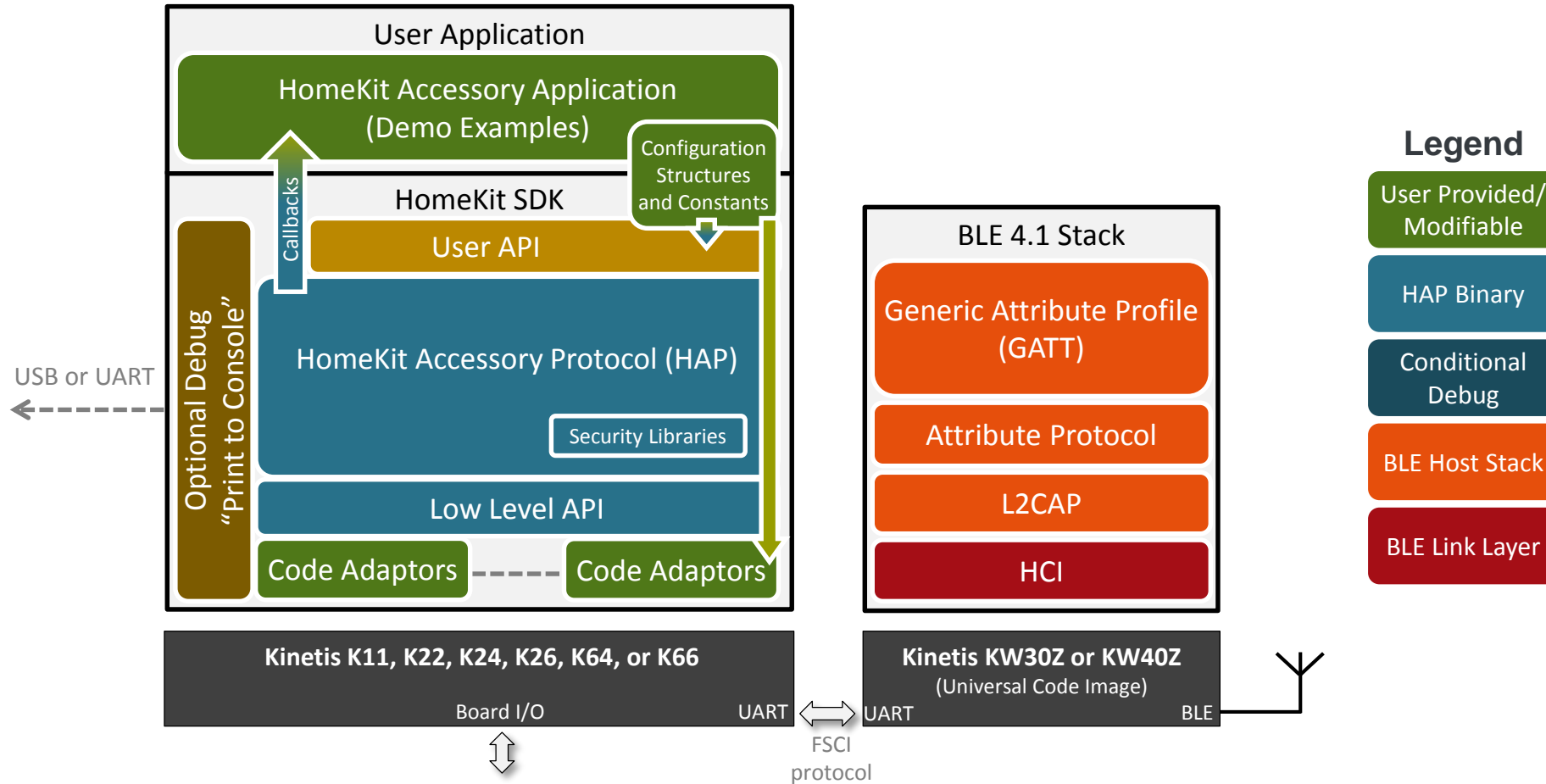


HomeKit SDK Target Home Automation Applications

- 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

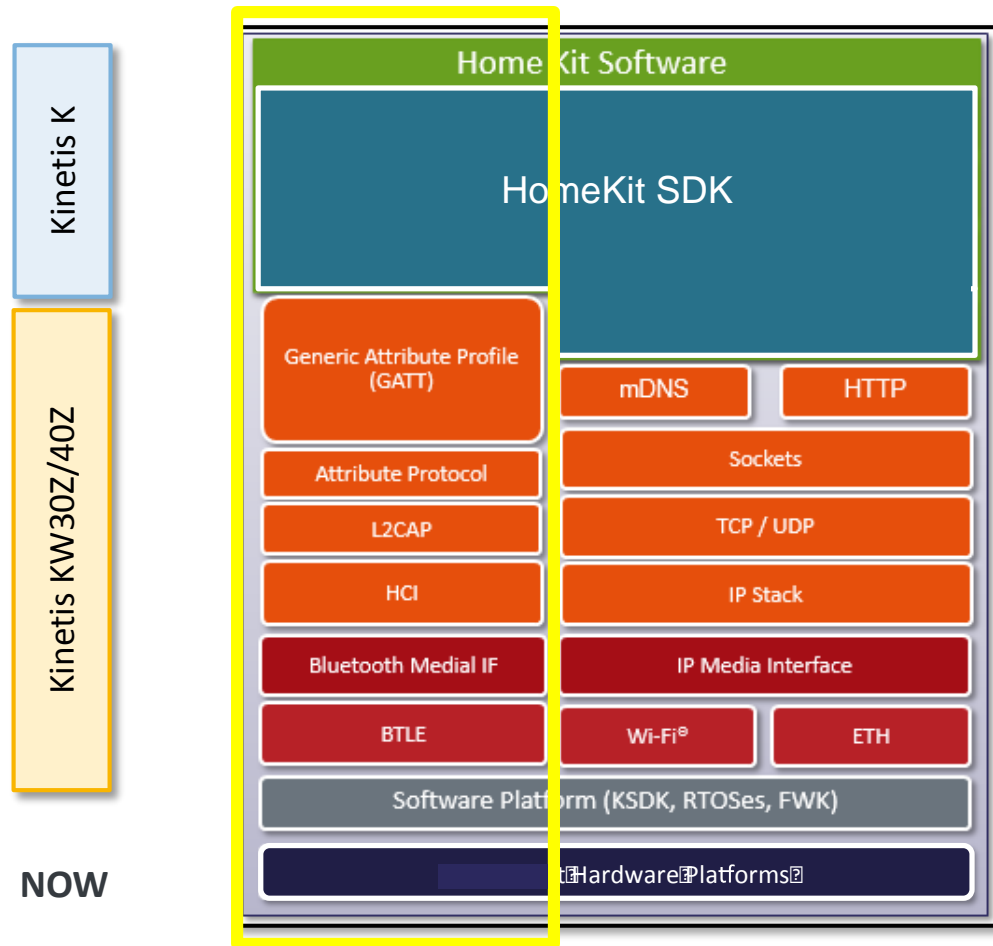
The HomeKit Software Development Kit (SDK) from NXP for Kinetis MCUs offers support for home automation applications using HomeKit technology.

HomeKit SDK from NXP Solution (1/2)

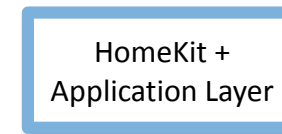
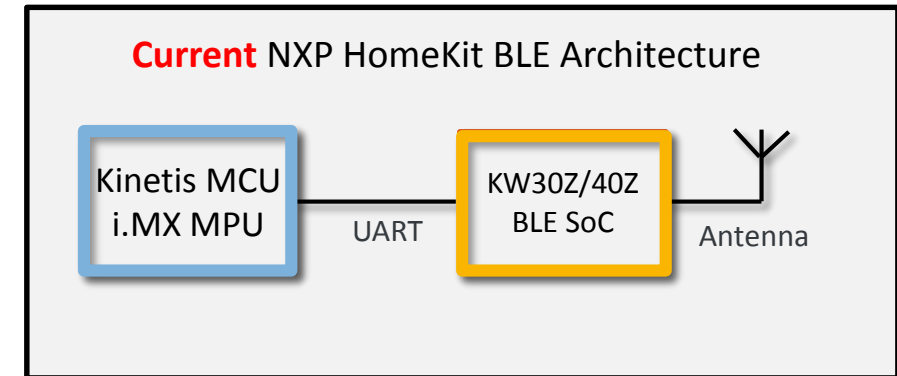


HomeKit SDK from NXP Solution (2/2)

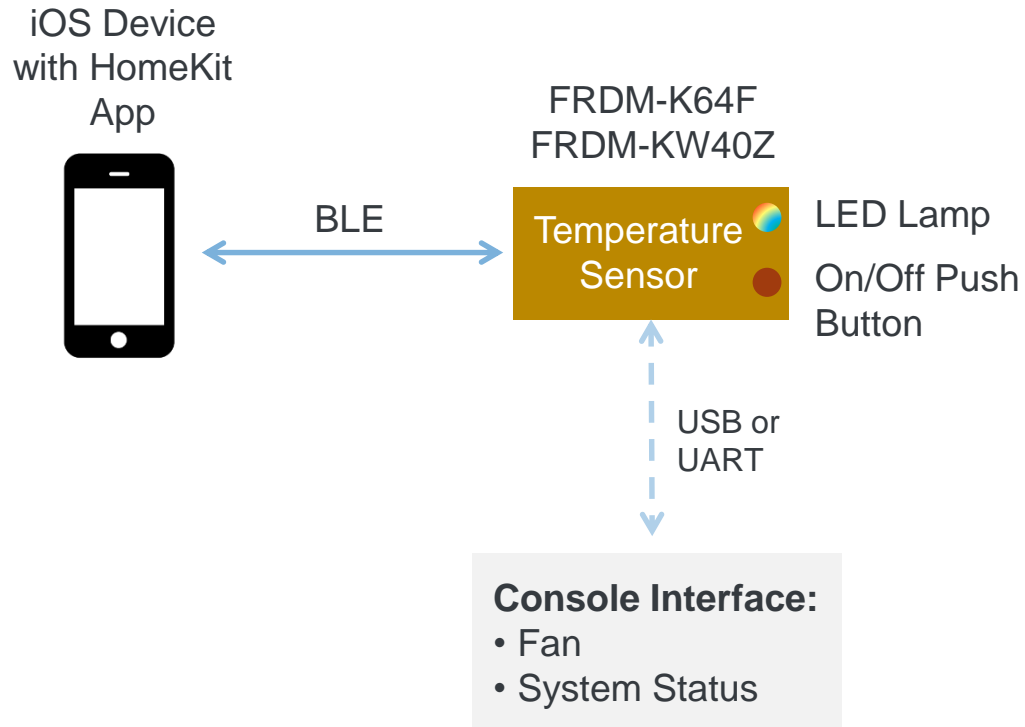
Bluetooth Low Energy 4.x (BLE) Transport



NOW



HomeKit SDK from NXP – Example Accessory Demo

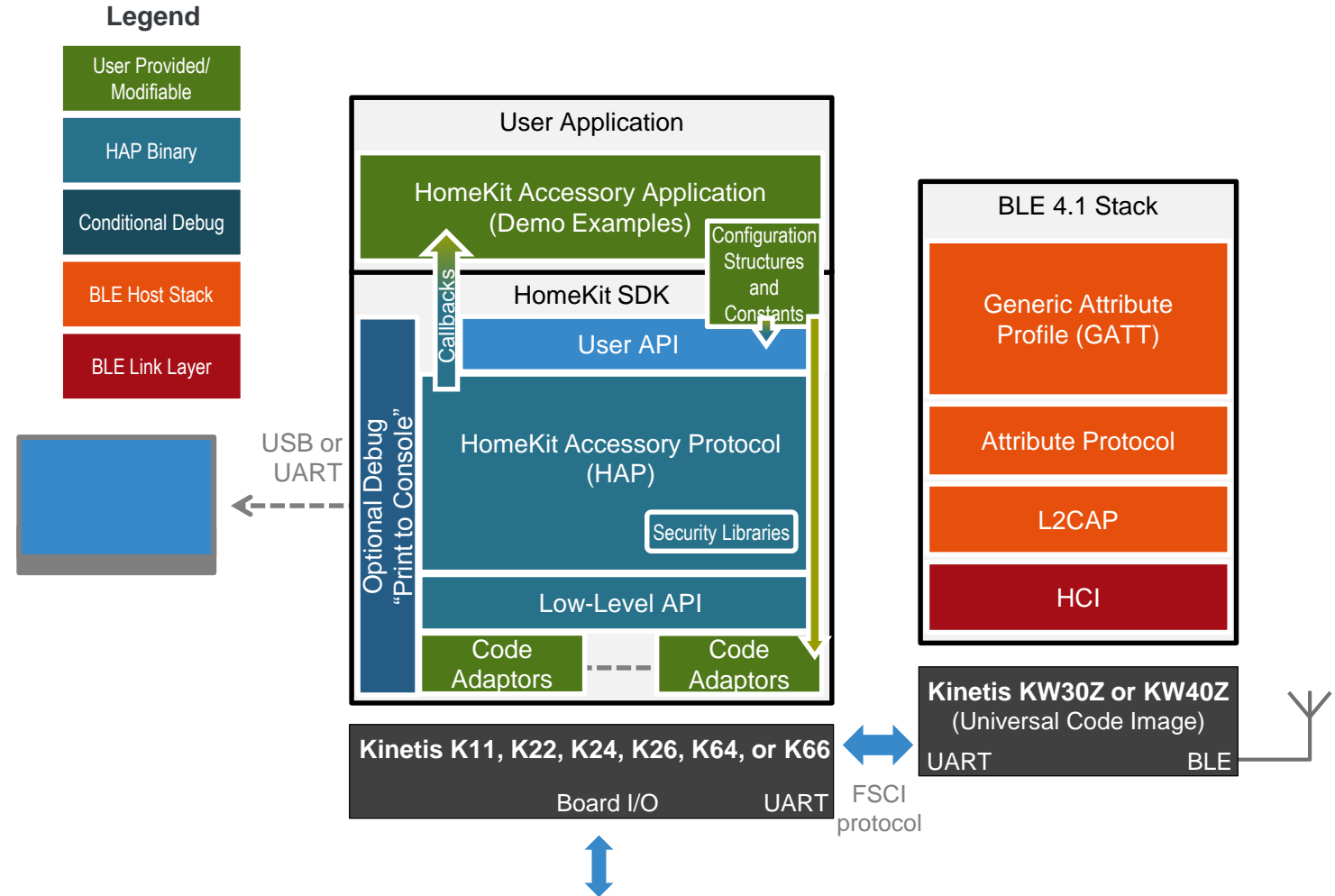


Demo (part of SDK) includes:

- 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 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

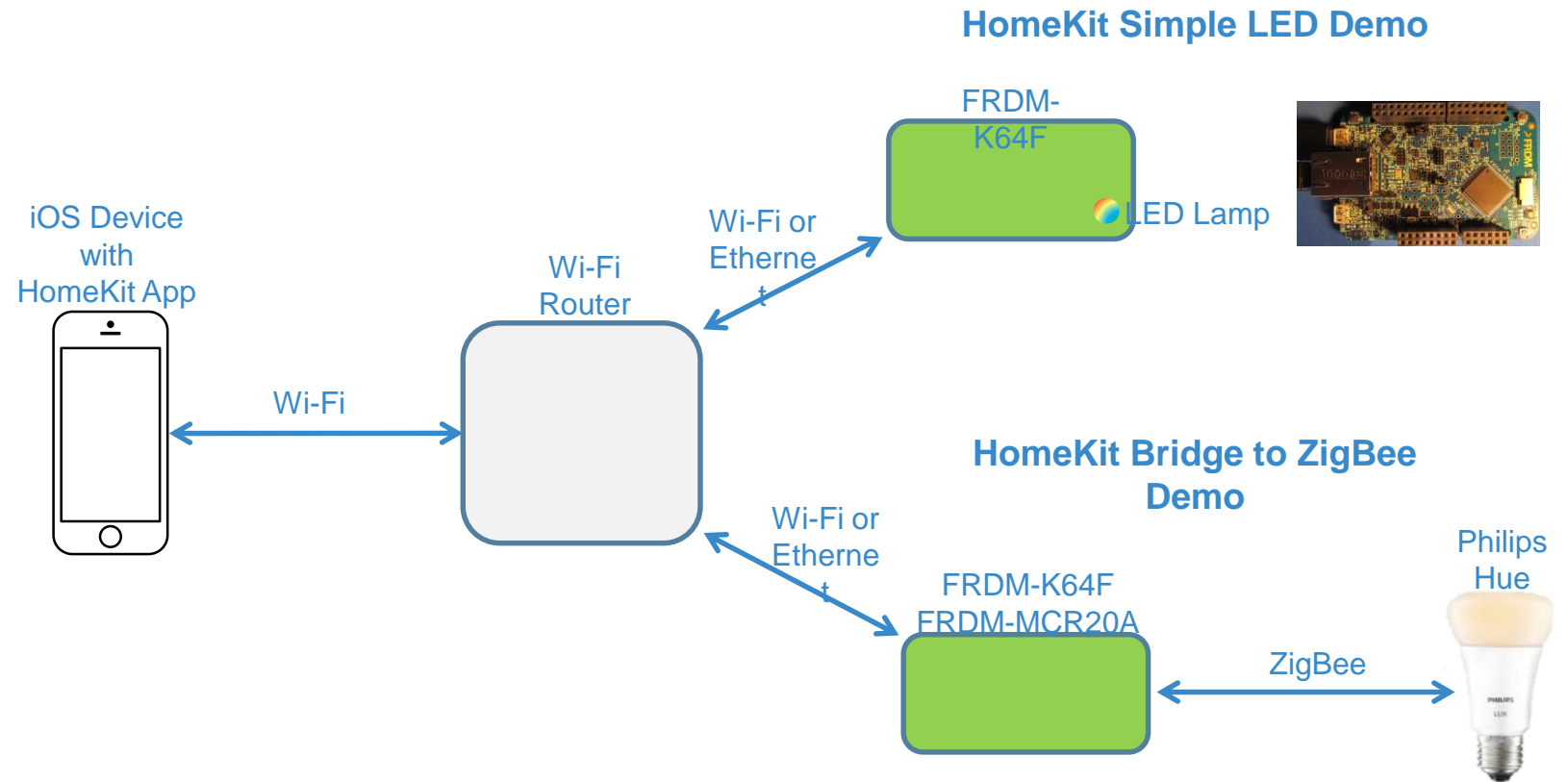
- Based on Kinetis K11

- Video available

In development:

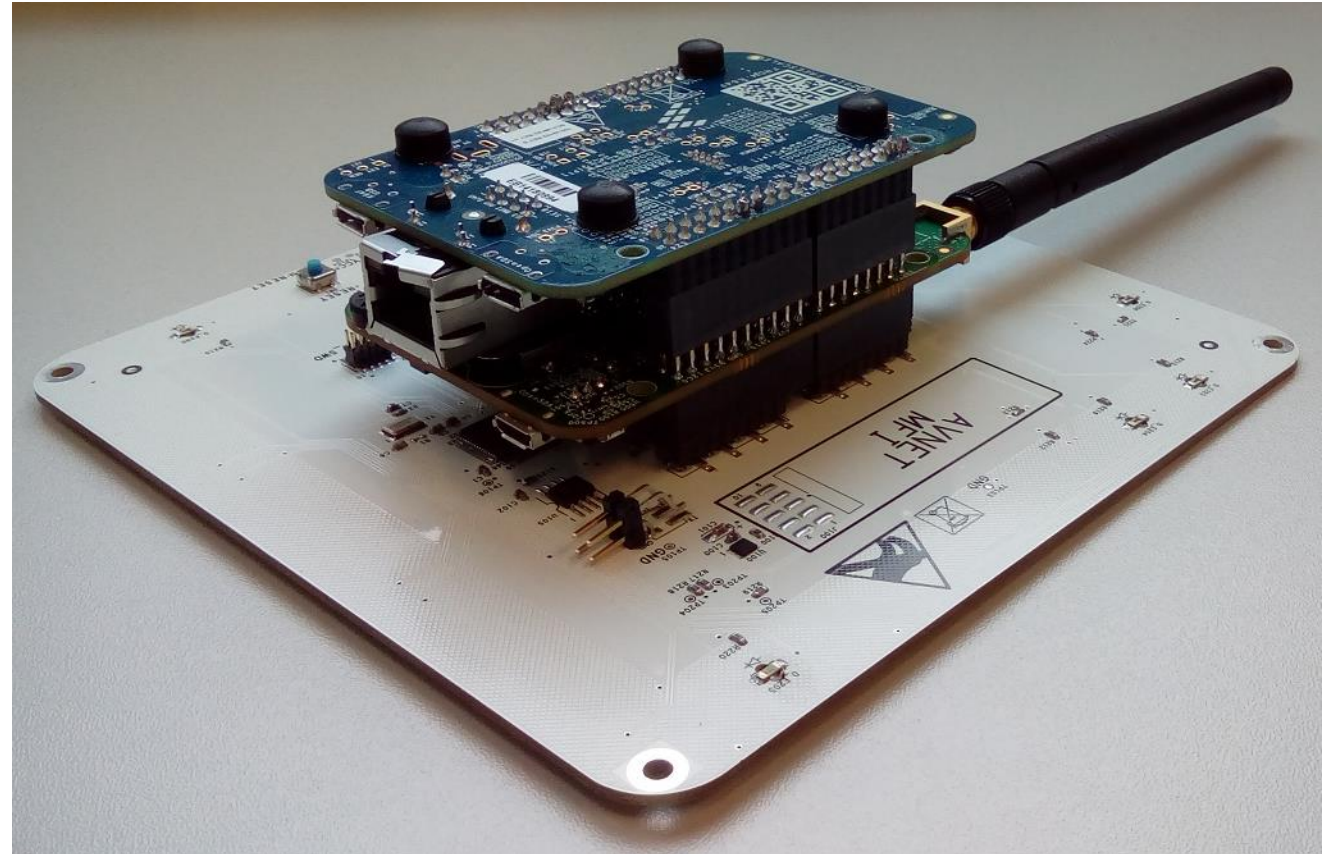
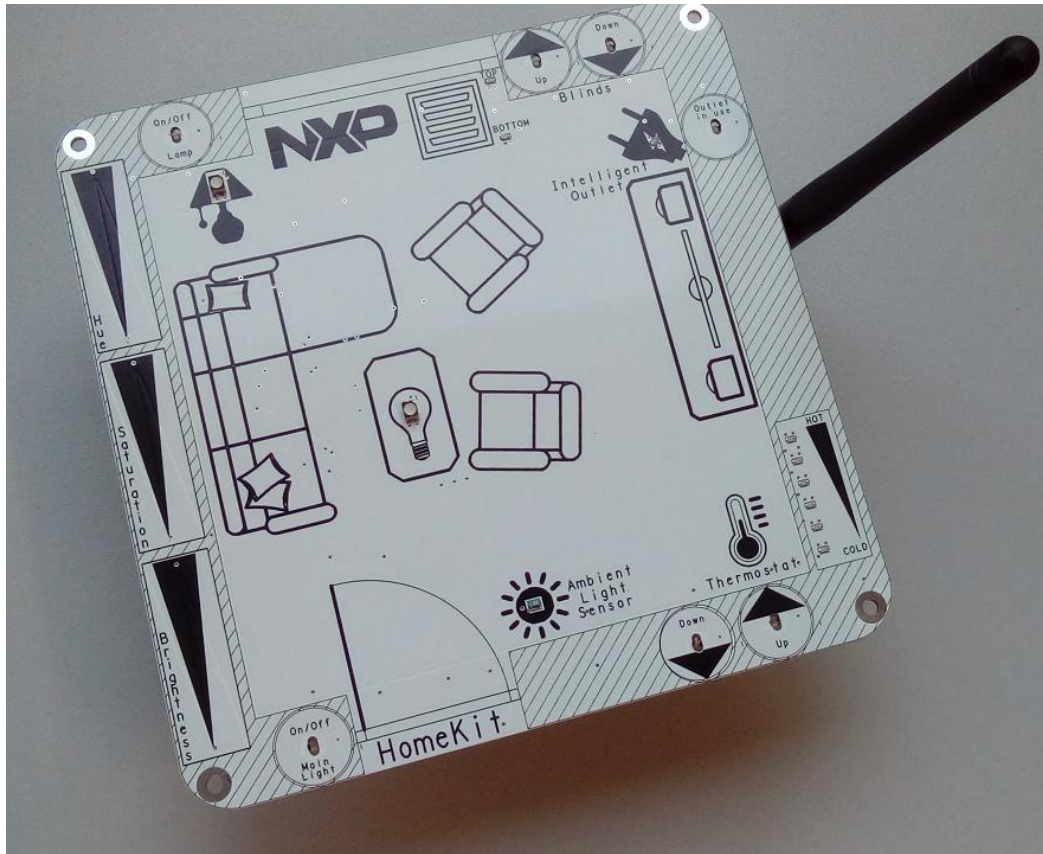
- Simple Lamp (LED)

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



HomeKit 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 - 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

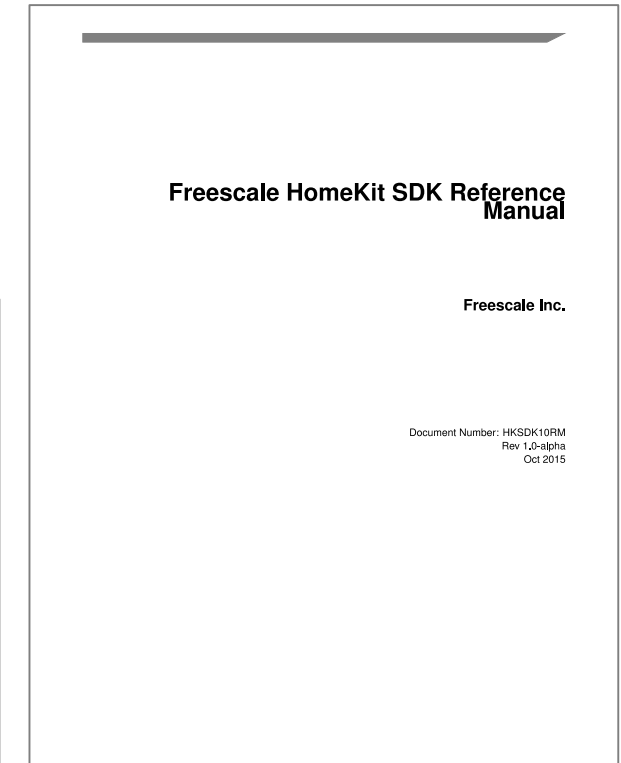
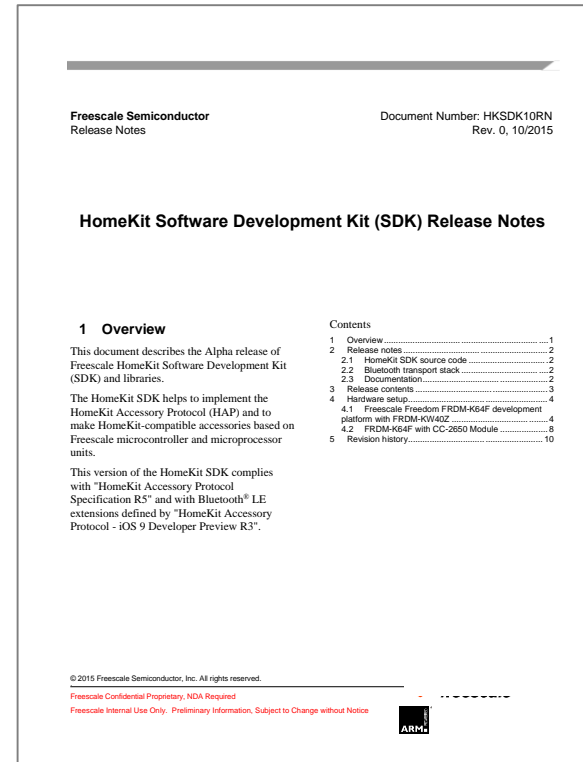
Memory system requirements:

	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 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

The screenshot shows the NXP HomeKit SDK webpage. The page title is "HOMEKIT-SDK: HomeKit Software Development Kit (SDK)". The navigation menu includes "PRODUCTS", "SOLUTIONS", "SUPPORT", and "ABOUT". The main content area is titled "Overview" and contains the following text:

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

Below the text is a "HomeKit Software Development Kit Block Diagram" showing the architecture. The diagram is divided into two main sections: "User Application" and "BLE 4.1 Stack".

The "User Application" section includes:

- HomeKit Accessory Application (Generic Accessories)
- HomeKit SDK (Configurable Structures and Constants)
- User API
- HomeKit Accessory Protocol (HAP)
- Low Level API
- Code Adapters

The "BLE 4.1 Stack" section includes:

- Generic Attribute Profile (GATT)
- Attribute Protocol
- L2CAP
- HCI

At the bottom, the diagram shows the hardware components: "Kinetis K11, K22, K24, K26, K34, or K36" and "Kinetis K1032Z or K1032Z (External Code Image)". The Kinetis MCUs are connected to the BLE 4.1 Stack via UART. The Kinetis K1032Z is connected to the BLE 4.1 Stack via UART. The Kinetis MCUs are also connected to the HAP Library via UART. The Kinetis MCUs are connected to the BLE 4.1 Stack via UART. The Kinetis MCUs are connected to the BLE 4.1 Stack via UART.

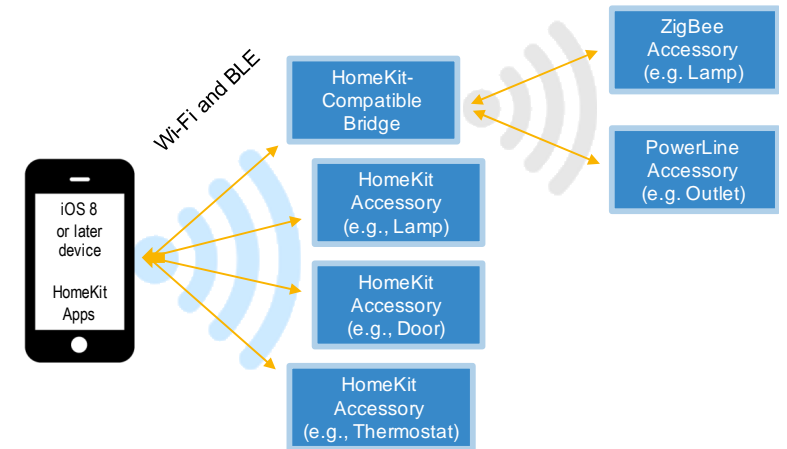
Videos



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



HomeKit SDK Videos

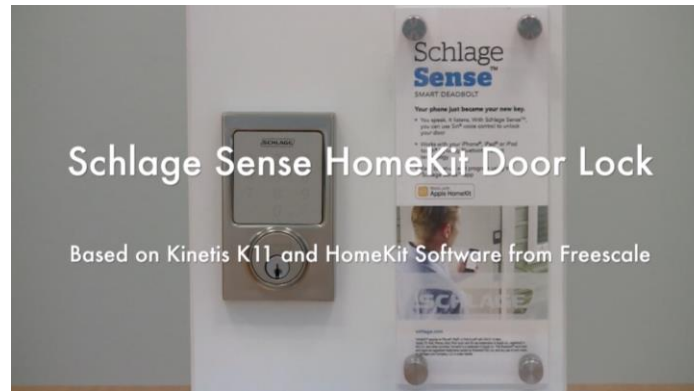
The following demo videos are available on the HomeKit SDK web page:



HomeKit SDK Introduction and Demo

Based on Kinetis K64 and KW30

HomeKit with Siri control



Schlage Sense HomeKit Door Lock

Based on Kinetis K11 and HomeKit Software from Freescale

HomeKit with Siri control



HomeKit Bridge to Philips Hue Bulb

Based on Kinetis K64 and MCR20

HomeKit with Siri control

MFI SOFTWARE DEVELOPMENT KIT (SDK) FROM NXP



NXP Made For iPod (MFi) Software Development Kit (SDK)



MFi Interface Software for Audio and non-audio Accessories

Targeted Applications

- Accessories for iPhone/iPad/iPod
 - Consumer and Professional Audio
 - Battery and Memory Cases
 - Medical and Fitness
 - Commercial systems
 - Test and Diagnostic interfaces



Key Features

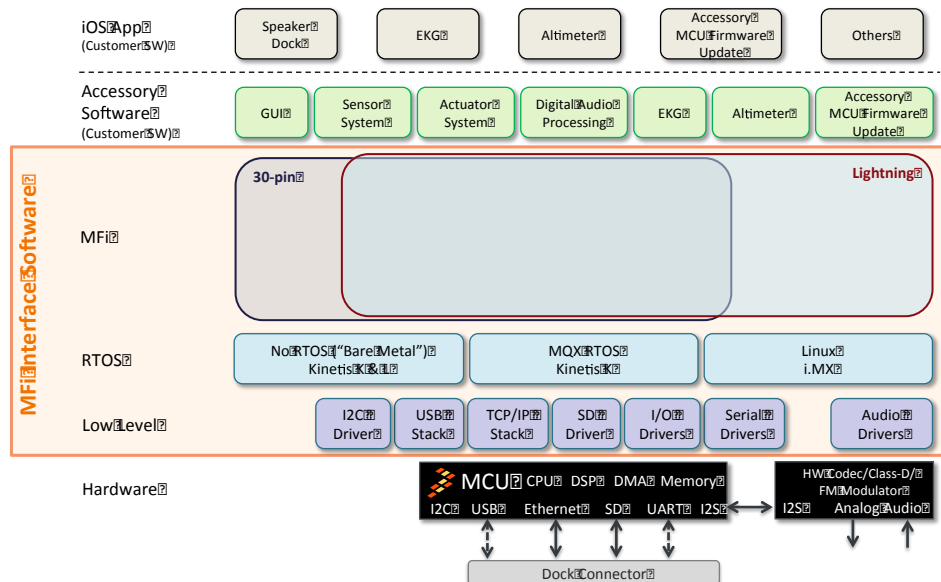
- Supporting Lightning and 30-pin dock connector devices
- Digital audio streaming input and output
- \$499 download includes:
 - Unlimited production license
 - Two hours of Professional Support
- Available Professional Support and Professional Services

Target Availability

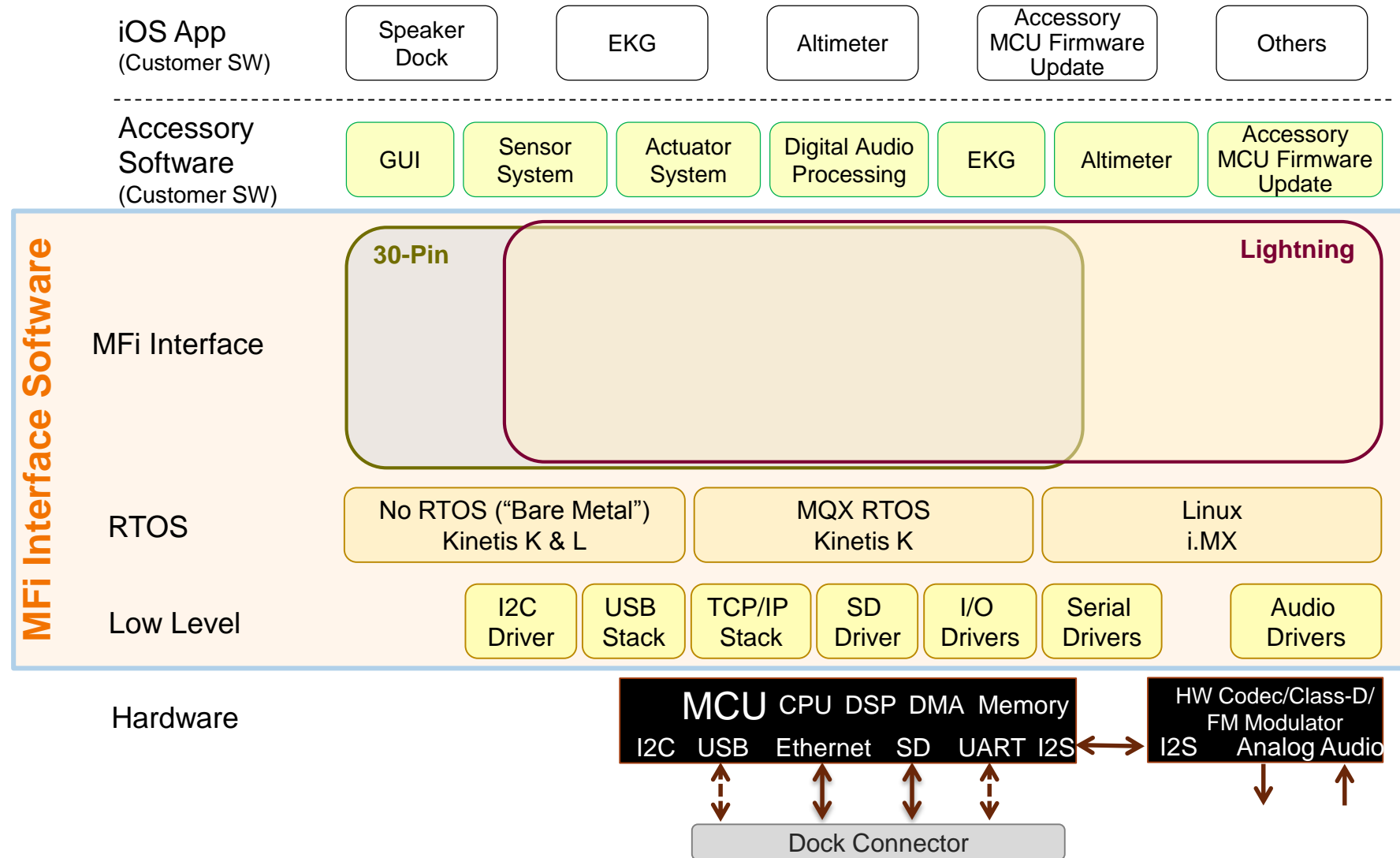
- Kinetis no-RTOS for iOS 7 and iOS 8: Now
- Kinetis KSDK 1.3 (KDS 3.0) for iOS 9: 3Q2016
- i.MX Linux for iOS 9: 4Q2016

Supported Products

- Kinetis K and L no RTOS now
- Kinetis K MQX, FreeRTOS, KSDK planned for iOS 9
- i.MX Linux planned for iOS 9



NXP MFi Software



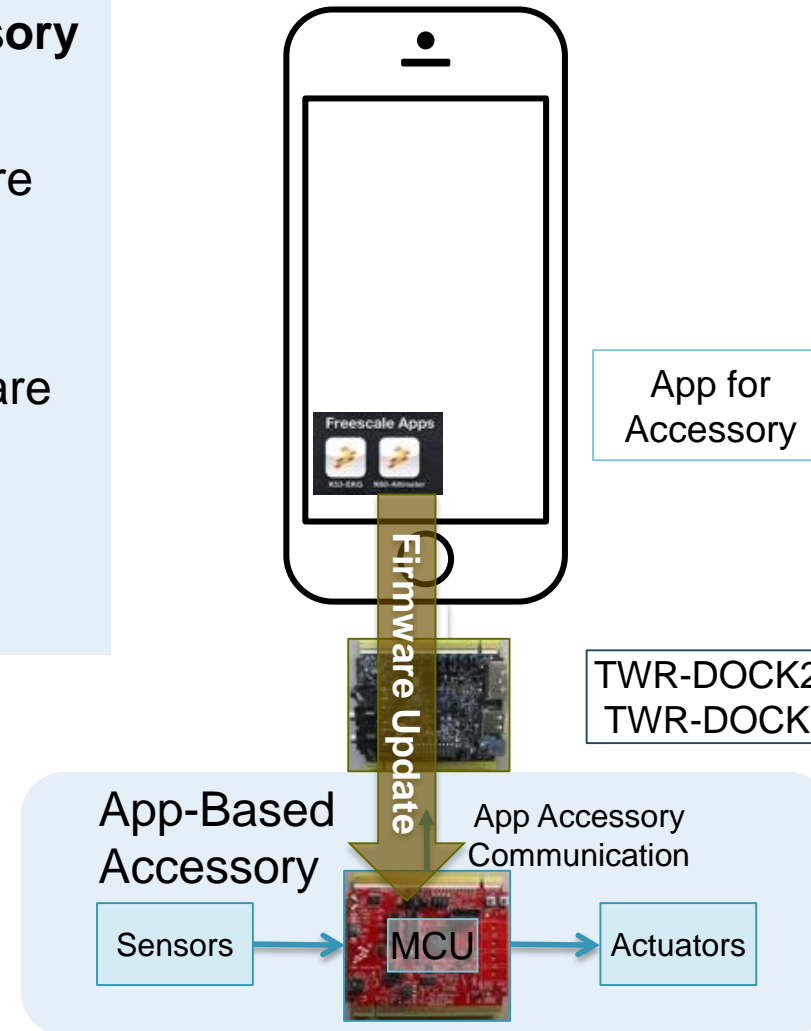
NXP MFi Software Memory Requirements

Use Case (Kinetis MCU, no RTOS)	Approximate Memory Requirement	
	Flash (KB)	RAM (KB)
All MFi Functions and Features	100	17
Digital Audio Playback for Lightning and 30-pin devices	80	16
Digital Audio Playback for Lightning iOS devices	45	14
Non-Audio Accessory using the standard USB to Lightning or 30-pin connector cables	70	11
Non-Audio Accessory using standard USB to Lightning connector cable for iOS devices	40	9
Non-Audio Accessory using built in Lightning and 30-pin dock connectors	45	8
Non-Audio Accessory using built in Lightning dock connector for iOS devices	25	7
Note: The above are approximate typical memory requirements, actual memory needs will vary depending on the actual MFi features and functions selected, compiler and optimization level used, and the size of user configurable buffers		

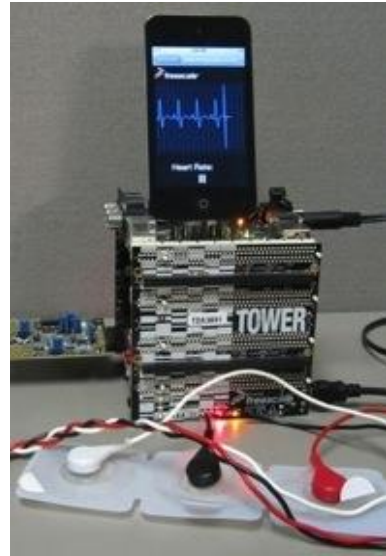
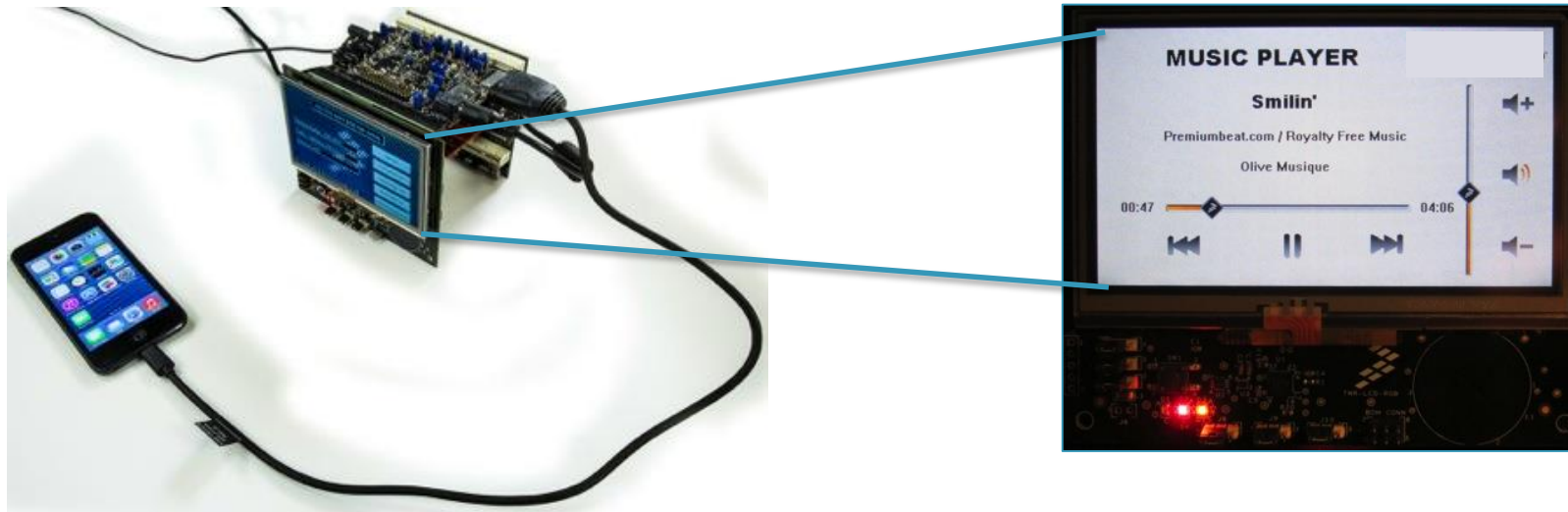
Accessory Firmware Update

MFi Software may include a function to update Accessory MCU firmware via an iOS App:

- An App update may include the Accessory MCU firmware update, which will be completed when the iOS device is connected to the Accessory with the App active
- This supports secure method of Accessory MCU firmware updates without the need for the Accessory to include a network connection



NXP's MFi Demo Software



Demos:

- Simple iPod control with digital audio– *Now*
- iPod control functions with GUI and digital audio – *Now*
- Digital audio streaming with optional post processing, and iOS App control – *Planned*
- iOS App based EKG– *Available with Lightning connector*
- iOS App based Altimeter – *Available with Lightning connector*

What other demos would you like?

Devices:

- Tested with all iPhone, iPad, and iPod devices introduced since 2009

Freescale Focus MFi Applications: External Memory

- External Memory Expansion Accessories:
- Memory only (no battery)
 - Must be able to enumerate at less than 30mA, maximum run consumption at less than 100mA
 - Maximum current limits maximum memory to 64GB with today's SDXC memory cards
- Memory with battery
 - Battery can provide additional current during enumeration and peak demand
- All memory accessories
 - No removable memory is allowed, SD/SDXC memory cards must be fully internal and non-removable
 - SDXC standard requires exFAT file system, but since card is not removable it's okay to use FAT32
 - MQX supports FAT32, but not exFAT
 - Most memory accessories require one connection to iOS device and one to PC/Mac
 - Freescale recommends using Kinetis K66 with FS USB connected to Lightning connector for iOS device, and HS USB for PC/Mac connection
 - Memory accessory will require an interface iOS App, from iOS 8 this App may share data with other Apps subject to user permission

TWR-DOCK2 NXP Web Page

Overview

Designing electronic accessories for ever-popular devices like the iPhone®, iPad® and iPod® has never been easier. Simply add the TWR-DOCK2 module to your Tower System and begin prototyping. The TWR-DOCK2 module supports both Apple Lightning® and 30-pin accessory dock connectors for iPod, iPhone and iPad devices, and includes a USB A receptacle for the standard USB to dock connector cable that comes with each device. The TWR-DOCK2 module enables digital audio streaming and includes the SGT15000 audio codec to provide direct analog audio input and output support. Leverage the interface software with IAR Systems, Keil, and CodeWarrior development tools and your next accessory product is at your fingertips.

This peripheral module is designed to be combined and used with other modules in the Tower System such as the TWR-K70F120M ARM® Cortex™-M4 based Kinetis MCU module, the TWR-KL46Z48M ARM Cortex-M3+ based Kinetis L MCU module, the TWR-LCD-RGB graphical LCD module, and a wide range of other Tower System peripheral, sensor interface, and MCU/MPU modules.

The TWR-DOCK2 is sold standalone and as part of complete Tower System development kits, all available only through the MFI Program.

Note: If your accessory development does not require a built-in Lightning connector, check out the TWR-DOCK2 module, which supports the standard white USB to Lightning or 30-pin dock connector cables, and direct 30-pin dock connection.

Features

- USB A receptacle for connecting to iPhone, iPad, or iPod via standard USB to Lightning or 30-pin cable
- Optional Lightning and 30-pin dock connector cables supporting all digital accessory dock connections to iPhone, iPad, and iPod devices
- Hardware audio codec SGT15000 with analog stereo audio line out, line in, and headset 3.5 mm connections
- Digital audio input and output is transferred via the USB connection
- Includes global power supply
- Useable with various Tower System processor and peripheral modules

Supported Devices

- iPod
- iPhone
- iPad

Kit Contains

- **TWR-DOCK2** contains:
 - TWR-DOCK2 module with global power supply
 - Quick Start Guide
- **TWR-DOCK2-CBL** contains:
 - Custom Lightning and 30-pin dock connector cables
- **TWR-DOCK2-K70LCD** kit contains:
 - TWR-DOCK2 module with power supply
 - TWR-K70F120M Kinetis K70 MCU module includes on-board 3-axis accelerometer MMAB451Q
 - TWR-LCD-RGB graphical LCD module
 - TWR-ELEV elevator modules
 - Quick Start Guide
- **TWR-DOCK2-KL46** kit contains:
 - TWR-DOCK2 module with 5A global power supply
 - TWR-KL46Z48M Kinetis KL3x, KL4x MCU module
 - TWRP-MPL115A barometer plug-in
 - TWRP-KEYPAD 12-key capacitive touch keypad plug-in
 - TWRP-ROTARY capacitive touch rotary plug-in
 - TWR-ELEV elevator modules
 - Quick Start Guide

Link to Apple MFi developer web page

TWR-DOCK Fact Sheet, visit:

All Featured Videos

- App-based accessory demo: EKG with TWR-DOCK module (04:59 min)**
App-based accessory demo for an EKG (Electrocardiogram) using the Tower System with TWR-DOCK module.
- App-based accessory demo: Altimeter with TWR-DOCK module (06:33 min)**
App-based accessory demo for an altimeter using the Tower System with TWR-DOCK module. Combines a sensor and a microcontroller to calculate pressure-based elevation and air temperature, and passes the data to an iOS device, where an app displays the data.
- App-based accessory demo: Audio remotes with TWR-DOCK module (05:42 min)**
App-based accessory demo for an iPod remote control using the Tower System with TWR-DOCK module. Demonstrates an example of how you can build audio accessories such as speaker docks, soundbars and car audio systems.

Check out the videos!
(On the TWR-DOCK Web Page)



NXP MFi Applications

iPhone, iPad, and iPod devices provide a great interface for many applications, and increasingly consumers already have them and know how to use them!

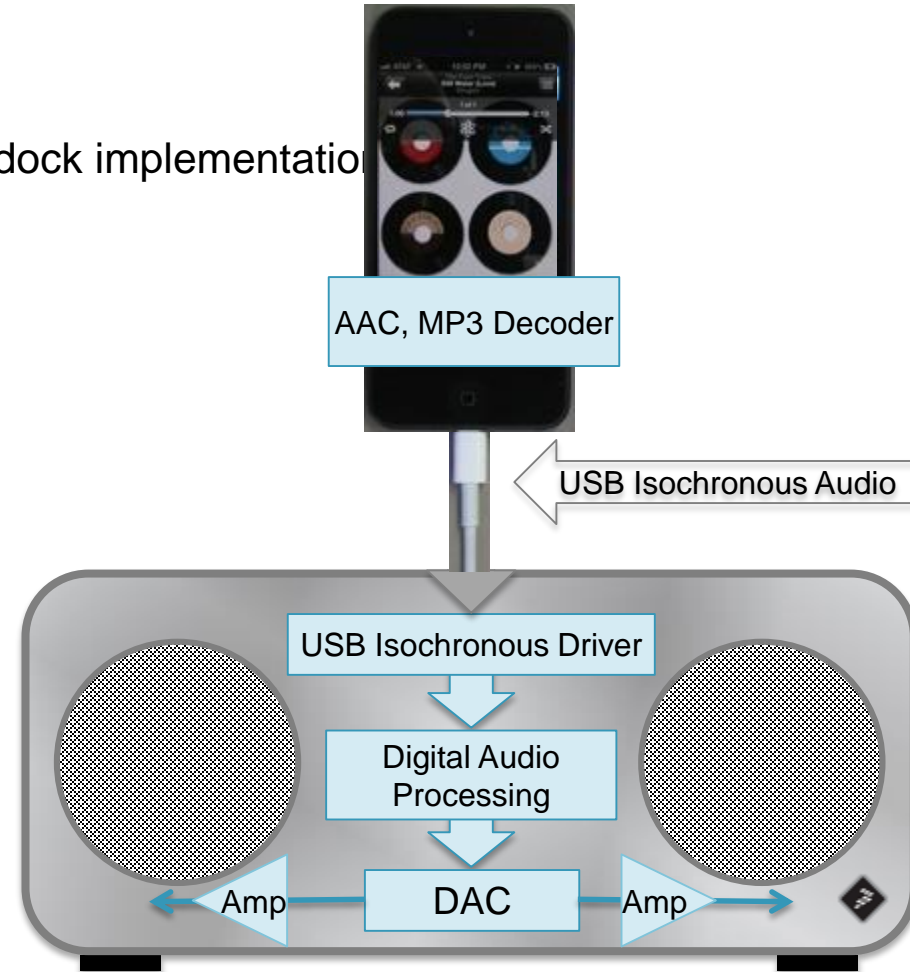
Target application areas:

- Audio
- Toys
- Home health
- Portable medical
- Professional medical
- Automotive
- Home automation
- Exercise
- Outdoor sports
- Smart metering
- Professional
- Point of transaction
- Input devices
- *And many more, let your imagination run wild*



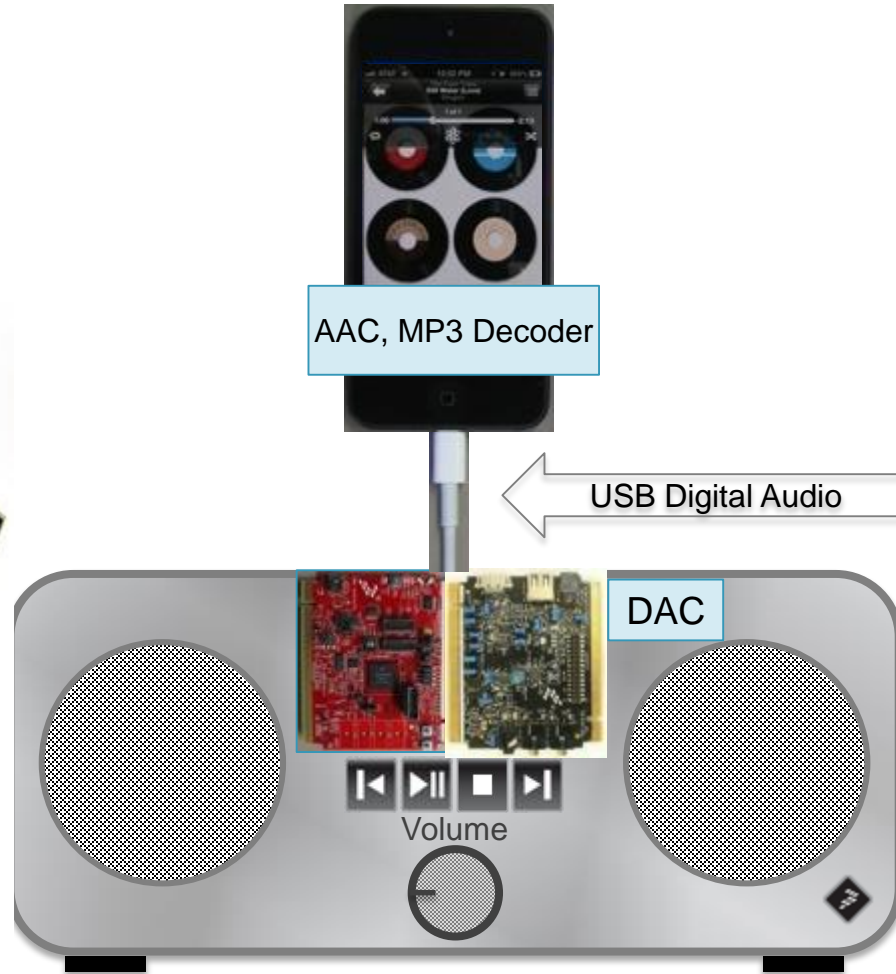
Fully Digital Speaker Dock

- Required with all devices with Lightning connector
- Best potential audio quality
 - Depends only on quality of source material and speaker dock implementation
- Easy to add digital audio processing



Demo Example: Simple Speaker Dock

- Simple playback control
- USB digital audio streaming, or
 - Optional analog audio line output
- Optional digital audio processing



Demo Example: GUI Speaker Dock

- Playback and audio control via touchscreen LCD
- USB digital audio streaming, or
 - Optional analog audio line output
- Optional digital audio processing



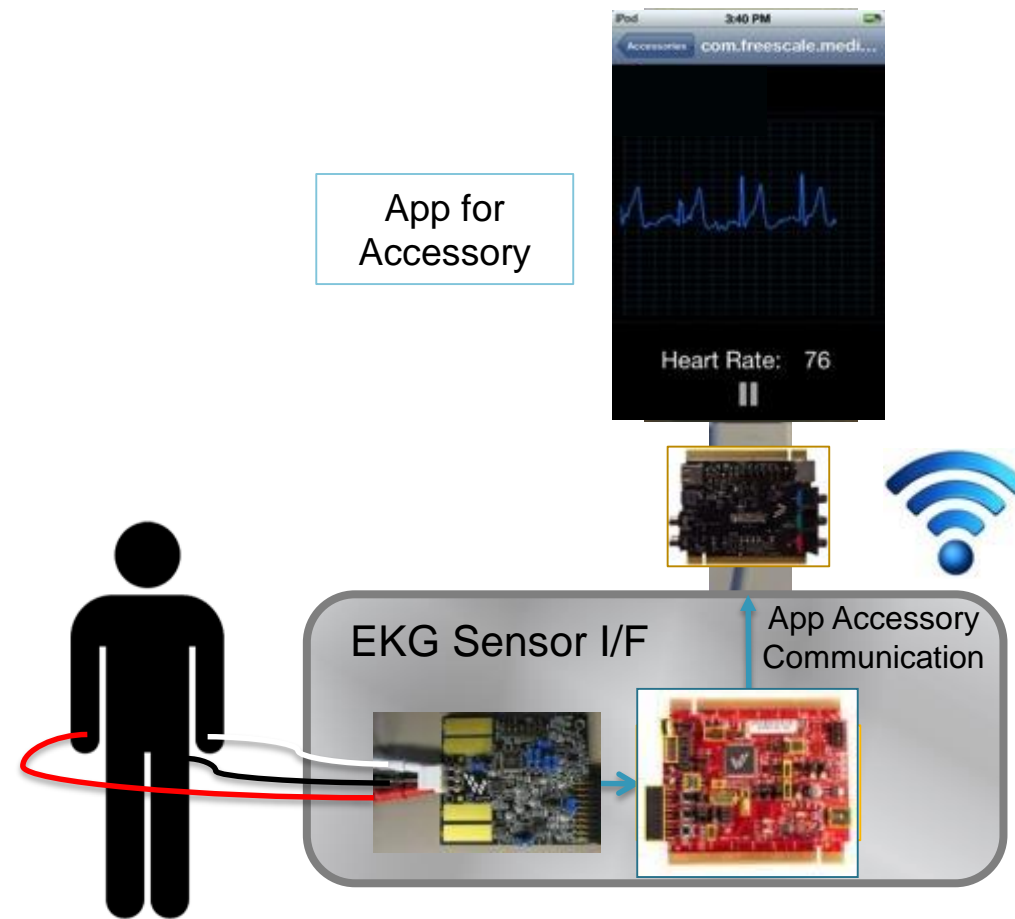
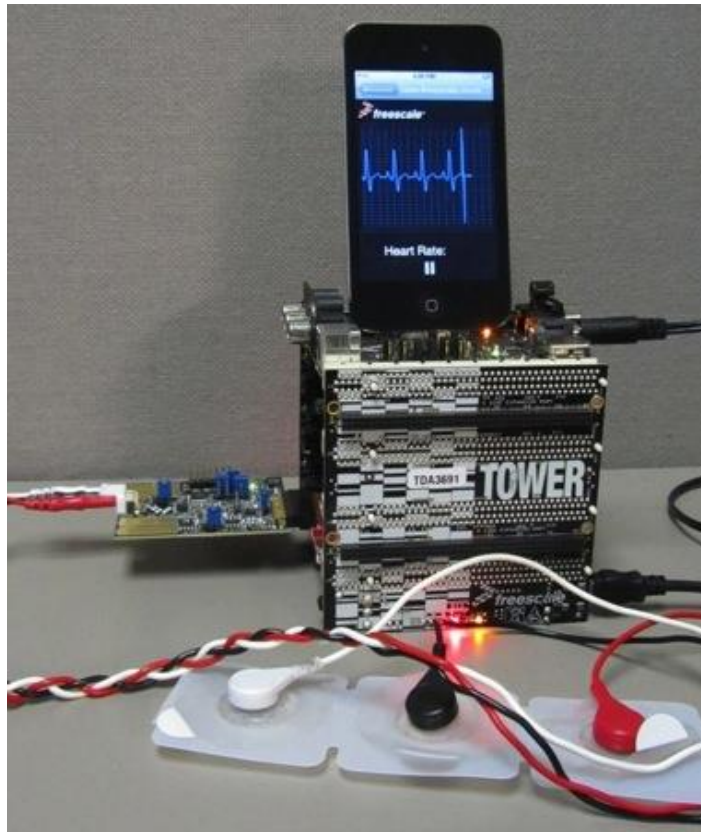
App-Based Speaker Dock

- Uses smartphone based App to control the speaker dock
 - Saves on separate GUI on speaker dock
 - Limited to smartphone or devices that support App-Based Accessories (such as iOS devices)
 - Possible with multiple connection options



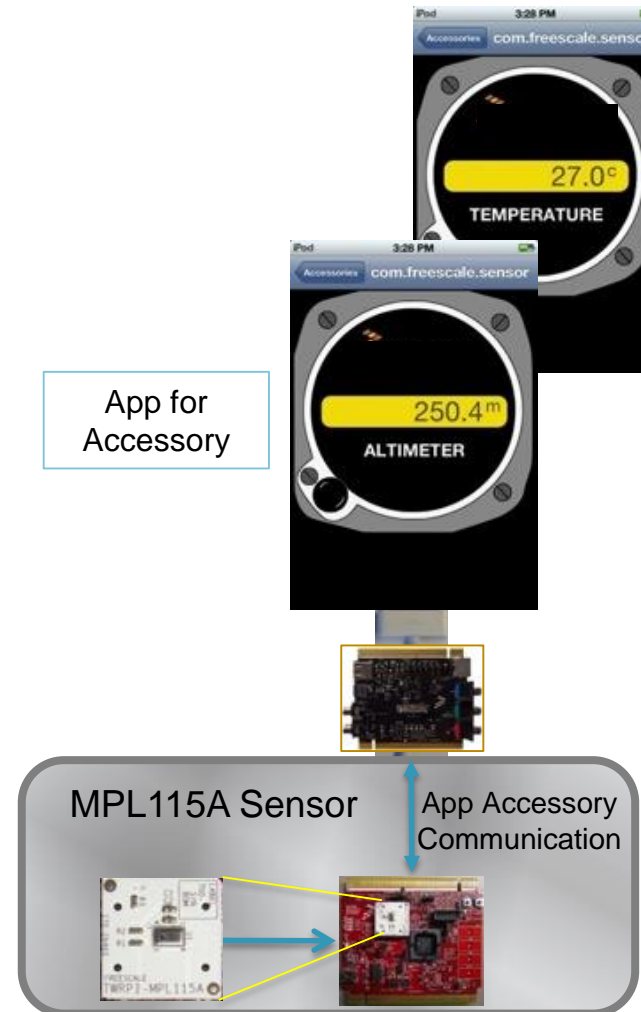
Demo Example: EKG - Electrocardiogram

- Kinetis K53 with EKG sensor module
- iOS App to display EKG graph and heart rate



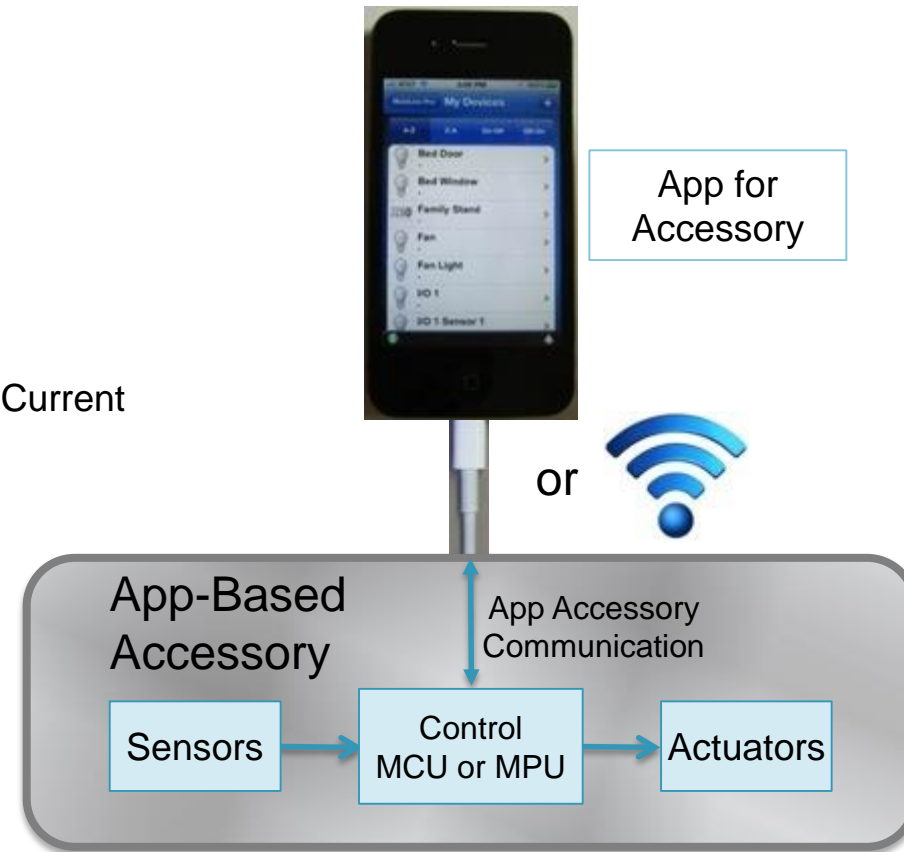
Demo Example: Altimeter

- Air pressure based altimeter
 - High sensitivity: ~ 30 cm (12")
- Ambient air temperature

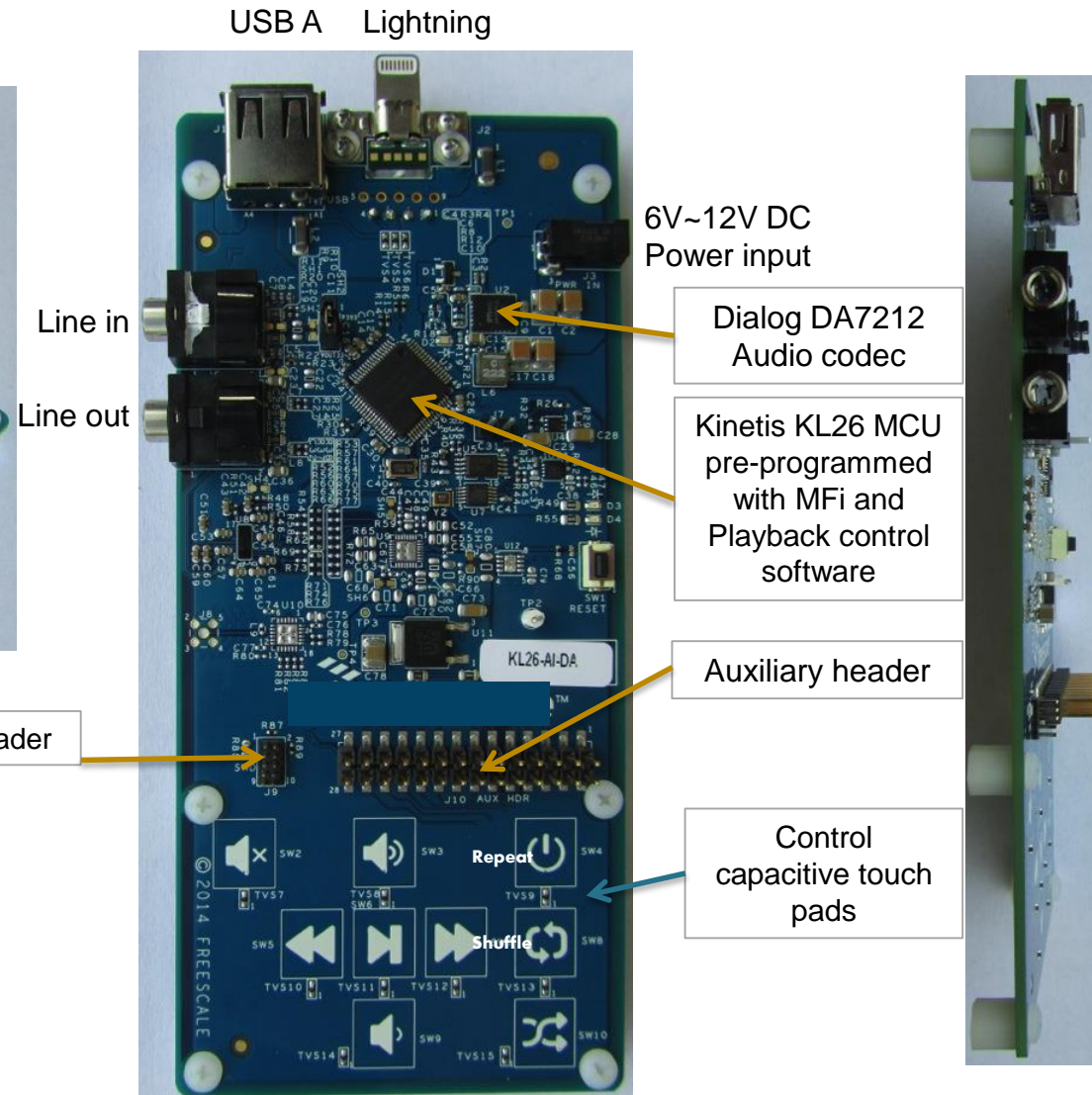
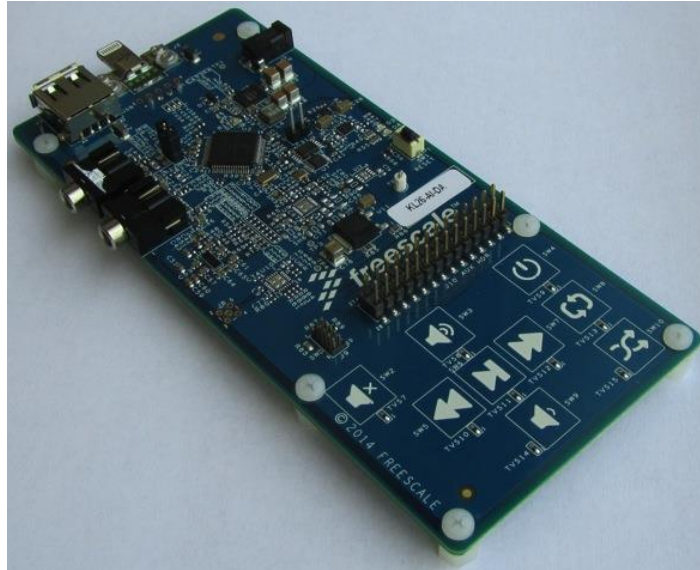


Anatomy of an App-Based Accessory

- App provides:
 - User interface
 - Network or Remote access
 - Optional additional processing
- Accessory provides:
 - Additional sensors
 - E.g. Pressure, Chemical (e.g. Glucose), Level, Light, Voltage, Current
 - Actuators as needed
 - E.g. Motors, Switches, Valves, Lights
 - Local control and processing
 - May be very low power & independent of device
 - Optionally, power for device



MFI-KL26-AI Module



iOS Apps

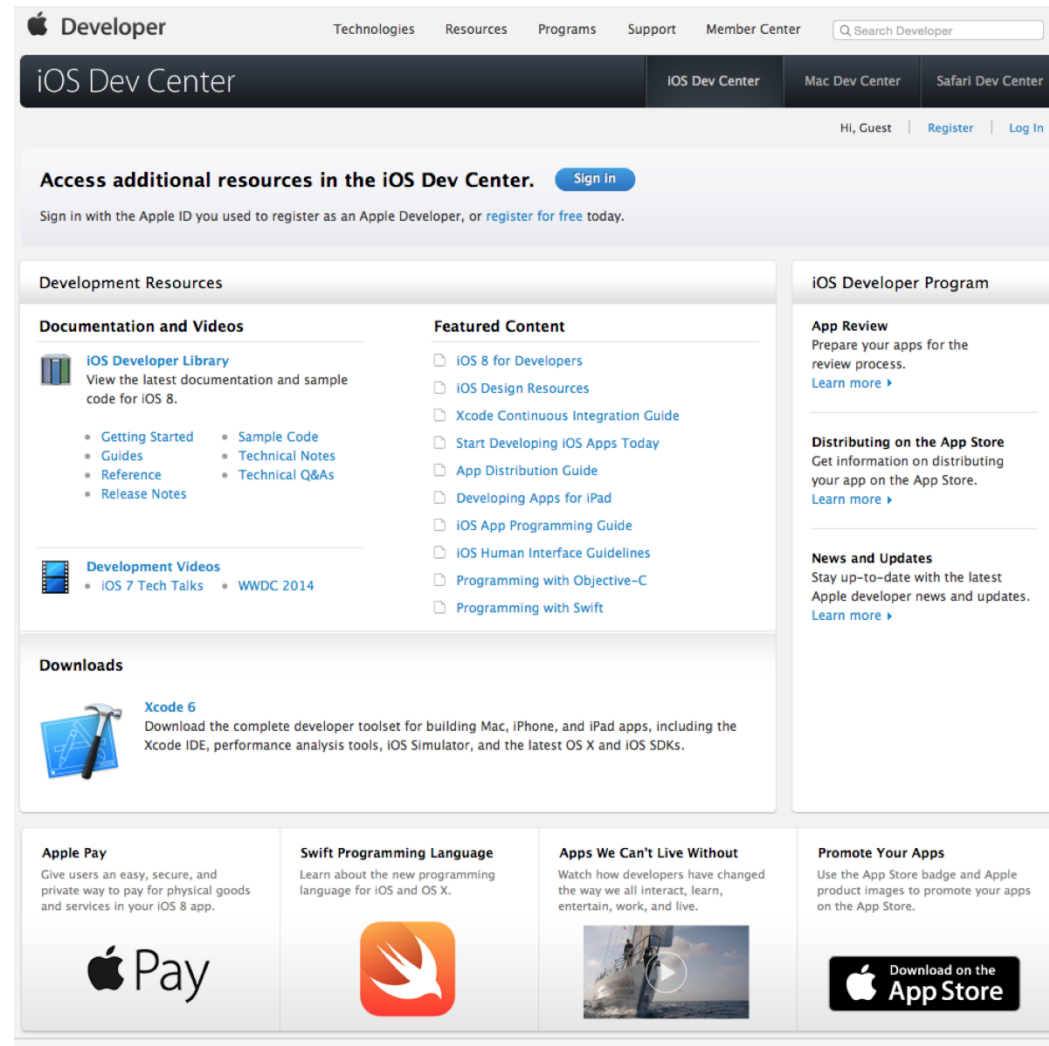
The iOS App Developer Program supports the development of iOS Apps

- Several levels of membership are available

Apple provides significant technical resources (for Macs only):

- Xcode development and debug tools
- iPhone, iPad, and iPod simulators
- Installation and testing of Apps on iPhone, iPad, and iPod devices
- Releases of future iOS versions developer previews

<https://developer.apple.com/devcenter/ios/index.action>



The screenshot shows the Apple Developer website's iOS Dev Center. The page is titled "iOS Dev Center" and includes navigation links for "Technologies", "Resources", "Programs", "Support", and "Member Center". A search bar is located in the top right corner. Below the navigation, there are tabs for "iOS Dev Center", "Mac Dev Center", and "Safari Dev Center". The main content area is divided into several sections:

- Access additional resources in the iOS Dev Center.** A "Sign In" button is present, with a note: "Sign in with the Apple ID you used to register as an Apple Developer, or register for free today."
- Development Resources**
 - Documentation and Videos**
 - iOS Developer Library**: View the latest documentation and sample code for iOS 8. Includes links for Getting Started, Guides, Reference, Release Notes, Sample Code, Technical Notes, and Technical Q&As.
 - Development Videos**: Includes links for iOS 7 Tech Talks and WWDC 2014.
 - Featured Content**: A list of articles including "iOS 8 for Developers", "iOS Design Resources", "Xcode Continuous Integration Guide", "Start Developing iOS Apps Today", "App Distribution Guide", "Developing Apps for iPad", "iOS App Programming Guide", "iOS Human Interface Guidelines", "Programming with Objective-C", and "Programming with Swift".
 - Downloads**: Features "Xcode 6" with a description: "Download the complete developer toolset for building Mac, iPhone, and iPad apps, including the Xcode IDE, performance analysis tools, iOS Simulator, and the latest OS X and iOS SDKs."
- iOS Developer Program**
 - App Review**: Prepare your apps for the review process. Includes a "Learn more" link.
 - Distributing on the App Store**: Get information on distributing your app on the App Store. Includes a "Learn more" link.
 - News and Updates**: Stay up-to-date with the latest Apple developer news and updates. Includes a "Learn more" link.
- Apple Pay**: Give users an easy, secure, and private way to pay for physical goods and services in your iOS 8 app.
- Swift Programming Language**: Learn about the new programming language for iOS and OS X.
- Apps We Can't Live Without**: Watch how developers have changed the way we all interact, learn, entertain, work, and live.
- Promote Your Apps**: Use the App Store badge and Apple product images to promote your apps on the App Store. Includes a "Download on the App Store" button.

NXP MFi Development Hardware

Combination of processor and specific boards supported:

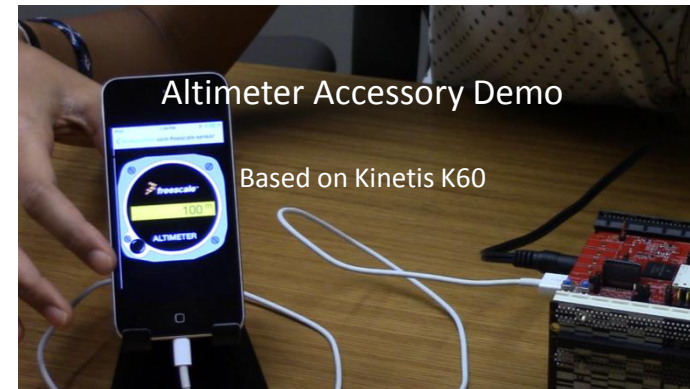
1 Processor		2 MFi and other boards	3 Application specific boards (optional)
Processor	Dev. Platform		
Kinetis MCUs	<u>Kinetis FREEDOM</u> Low-cost Kinetis development Platform	<ul style="list-style-type: none"> - <u>TWR-DOCK2</u>: MFi interface and Freescale <u>SGTL5000</u> audio codec - <u>FRDM-TWRPI</u>: Freedom to Tower adaptor - <u>TWR-ELEV</u>: Tower elevator 	<ul style="list-style-type: none"> - <u>MED-EKG</u>: iOS app based ECG - <u>TWR-LCD-RGB</u>: MFi GUI Digital Speaker Dock - <u>TWRPI-MPL115A</u>: iOS App Based Altimeter
	<u>Kinetis TOWER</u> Kinetis modular development Platform	<ul style="list-style-type: none"> - <u>TWR-DOCK2</u>: MFi interface and Freescale <u>SGTL5000</u> audio codec - <u>TWR-ELEV</u>: Tower elevator 	
i.MX 6 Application Processors	<u>i.MX 6 SABRE</u> Automotive development Platform (include Cirrus <u>CS42888</u> audio codec)	MFi module	

MFi SDK Videos

The following demo videos are available on the MFi SDK web page:



Made For iPod (MFi)

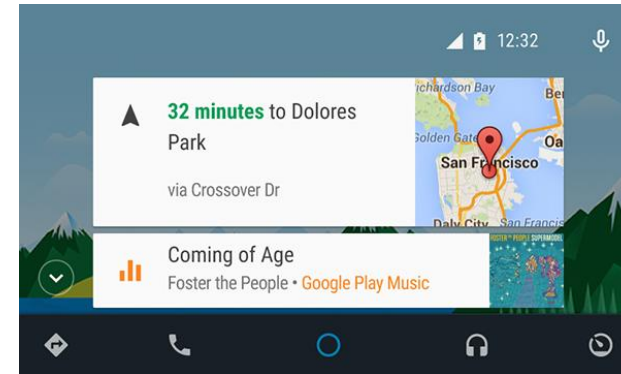
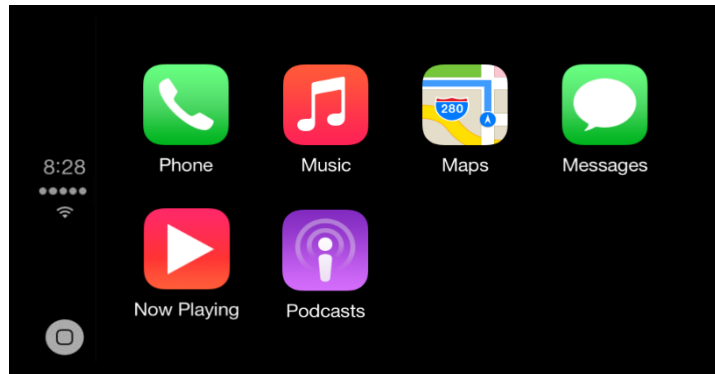


Made For iPod (MFi)

CARPLAY SOLUTION FROM NXP PROFESSIONAL SERVICES



Introduction to Apple CarPlay and Android Auto



Apple CarPlay and Android Auto provide a user interface optimized for the driver and “projected” onto the automotive infotainment system

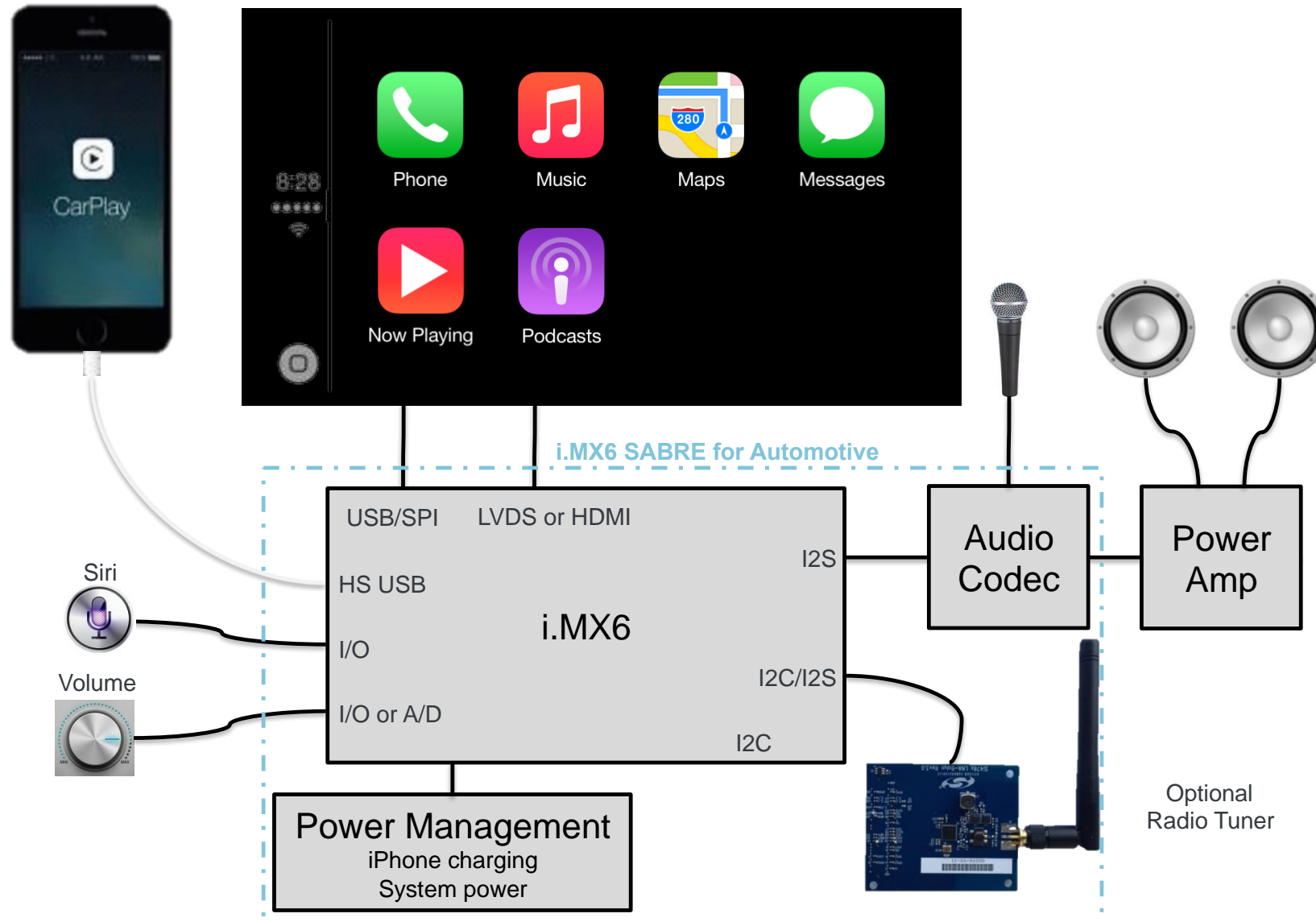
- The functionality and user experience is almost entirely controlled by the smartphone
- The functionality is limited to that appropriate for the driver
 - No video playback, no emails, no FaceBook, no web browsing, no typing
- Many functions are voice activated (Siri or Google Now)
- User interface icons are large and Apps are simplified
- Key functionality is;
 - Navigation, hands-free phone, audio playback, hands-free messaging
- The display is generated by the smartphone
 - Freescale target processors are i.MX 6Solo, i.MX 6DualLite, i.MX 6Dual, and i.MX 6Quad

Head Unit Functions

- Display GUI
- Capture user input from touch screen or hardware buttons and provide to iPhone
- Manage audio streams, instructions and calls from iPhone, audio entertainment from iPhone, Radio tuner or other source
- Voice input for Siri and phone calls
- Backup camera display
- Audio controls, volume and others as required
- Head unit setup
- Radio tuner and other head unit functionality as required
- Manage USB connection

Note: Wireless connection option is expected in the future

CarPlay System



NXP Apple CarPlay Development System (Demo)

Components:

- i.MX 6 SABRE for Automotive Infotainment base board – MCIMXABASEV1
- i.MX 6Solo, i.MX 6Dual or i.MX 6Quad core CPU board – MCIMX6QAICPU1
- 10" LVDS touch LCD panel – MCIMX-LVDS1, or HDMI output up to 1080P 60 fps
- MFi module
- Powered speakers with RCA audio cable
- Microphone
- Apple USB to Lightning dock connector cable to iPhone
- SD memory card with firmware
- Optional: Powered USB hub for connecting multiple USB devices concurrently (Note: iPhone cannot be connected via a USB hub)
- Optional: BT module



Apple CarPlay 3rd Party Implementations

- The majority of implementations are based on i.MX 6 series processors
- Multiple third party infotainment software providers offer Apple CarPlay solutions for i.MX 6 systems:
 - AllGo
 - Symbio (<https://www.youtube.com/watch?v=CM-8qA2NZe8>)
 - QNX
 - WindRiver
 - Jungo
 - Cinemo
- Multiple OSes are currently supported; Linux, Android, QNX

The following site lists all countries where Apple CarPlay is available;
<http://www.apple.com/ios/feature-availability/#applecarplay-applecarplay>



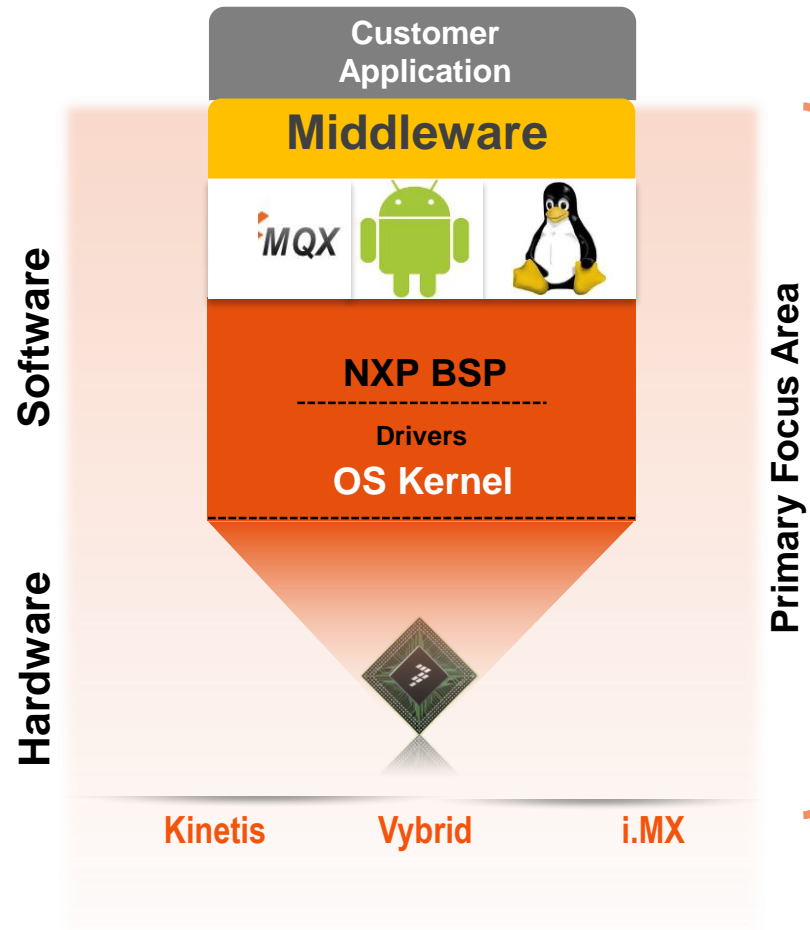
NXP Apple CarPlay Development Hardware

1 Select processor		2 Select features		3 Select below boards
Processor	Dev. Platform	Available features	Dev. Platform	
i.MX 6 Applications Processors	<u>i.MX 6 SABRE</u> Automotive development Platform (include Cirrus audio codec CS42888)	MFi	MFi module	<u>MCIMX-LVDS1</u> LVDS 10" LCD Panel <u>Dell S2240T</u> Dell Touch screen monitor Need Microphone and headphones

CarPlay is currently supported by the following devices:

- All iPhones with the Lightning dock connector
 - iPhone 5
 - iPhone 5S
 - iPhone 5C
 - iPhone 6
 - iPhone 6 plus

MCU Professional Engineering Services Technical Competency



Software Engineering Services

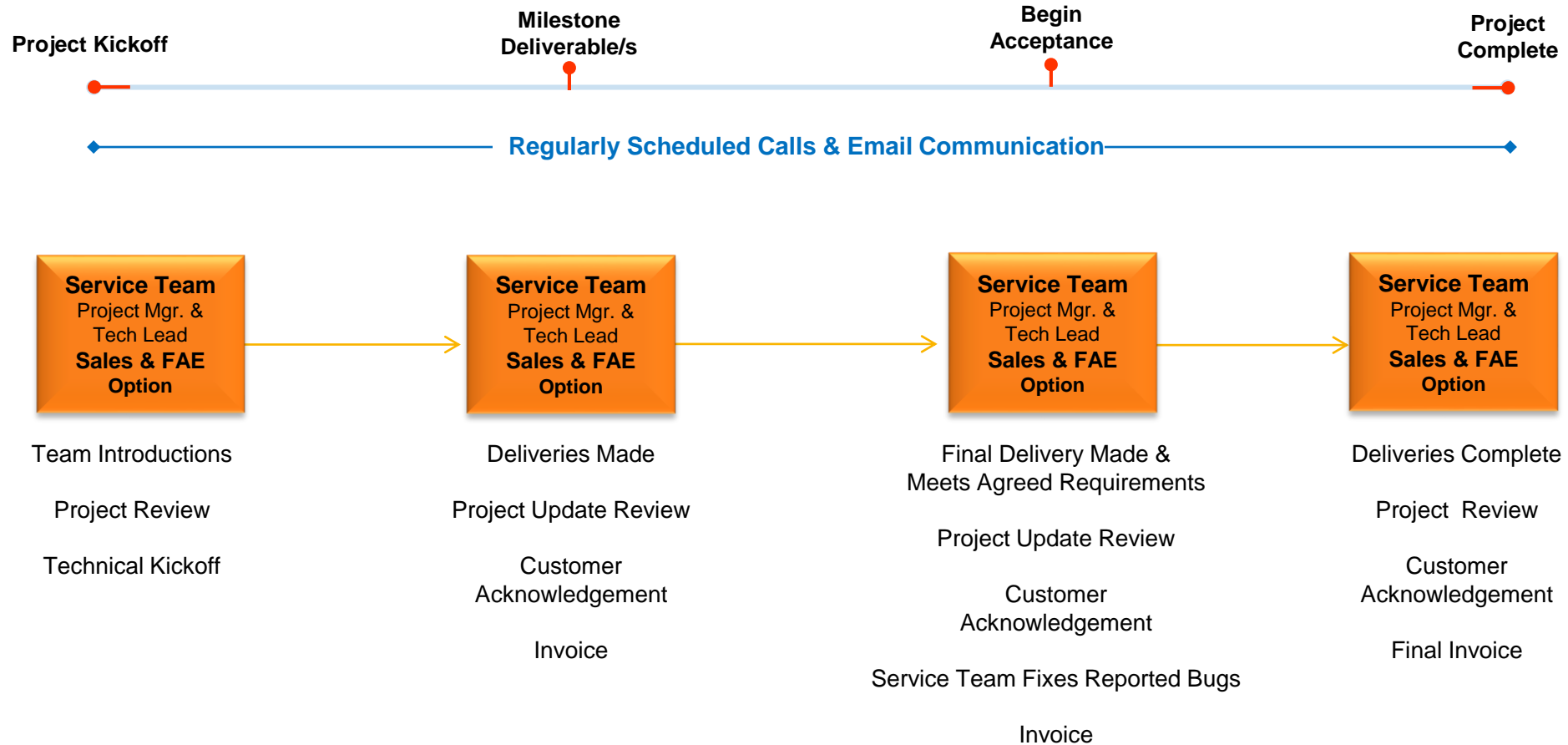
- Linux®, Android™, MQX, Stacks, Graphics, Audio/Video, Middleware, Drivers, AUTOSAR
 - Customization
 - Integration
 - Development
 - Porting
 - Testing
 - Optimization
 - Issue Analysis, Debug & Fix
- Application Migration
- Frozen Branch Support

Hardware Engineering Services

- Schematic & Layout Review
- On-site Board Bring-up

Experts in Providing Customer Specific Platforms

Project Execution: Milestones, Invoicing, Customer/Internal Communication



AIRPLAY AND AUDIO STREAMING SOLUTION



NXP PRODUCTS SUITABLE FOR HOMEKIT AND MFI ACCESSORIES



Kinetis KW40Z/30Z

BLE 4.1 & 802.15.4 Wireless MCU, Cortex-M0+, 160KB Flash, 20KB SRAM

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		

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

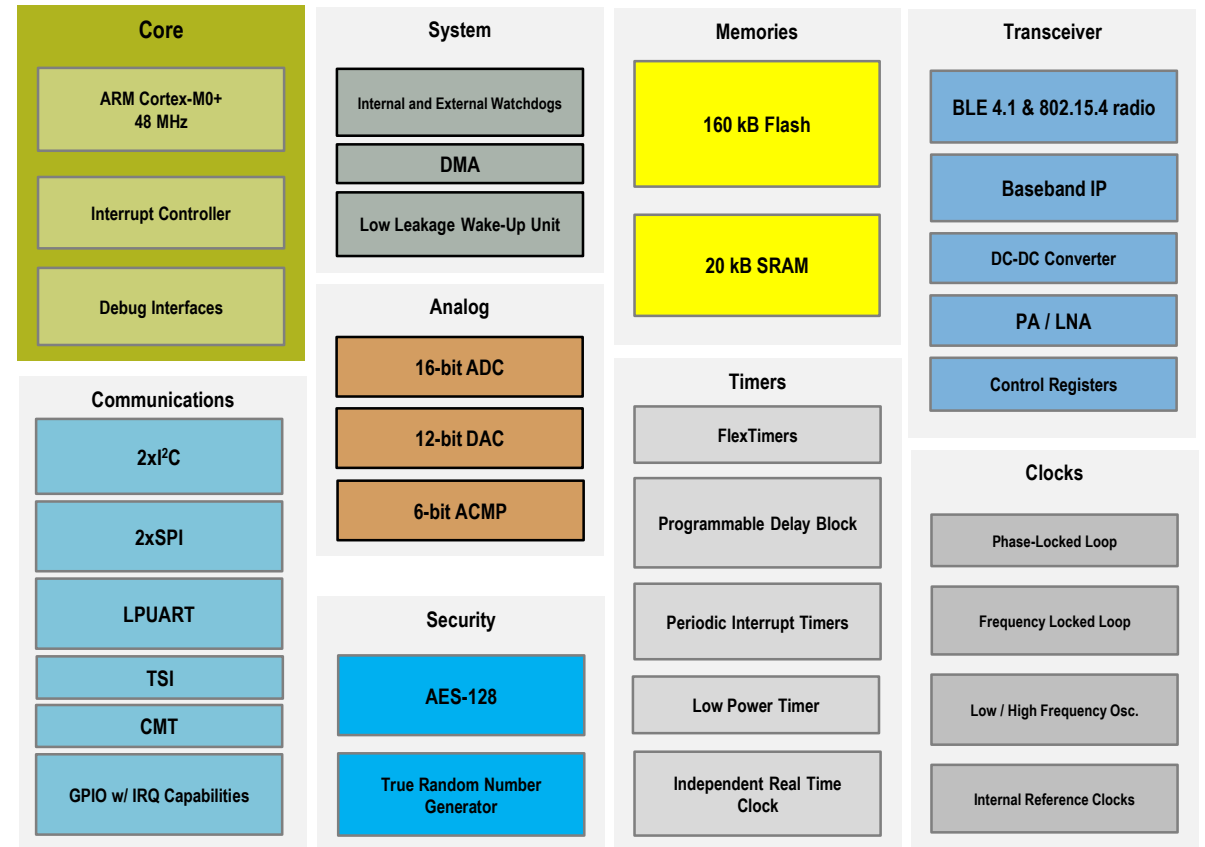
Integrated DC/DC Converter

- 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

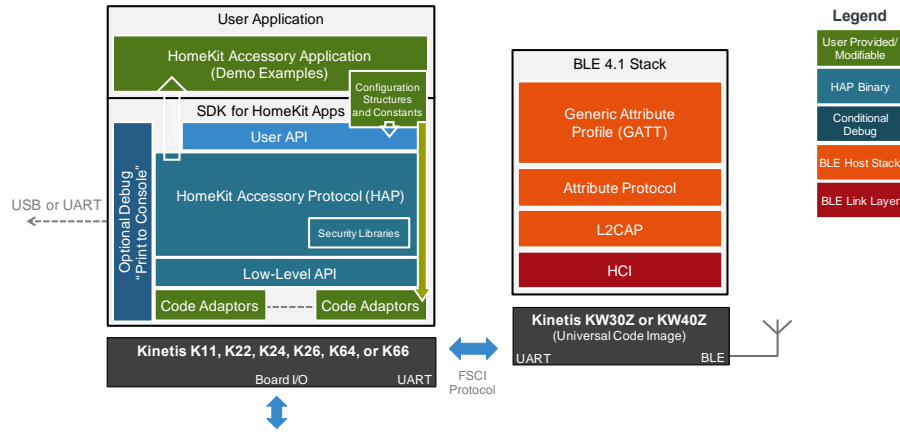


Recommended NXP Host Processors for HomeKit SDK Implementation

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, MAPGBA
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

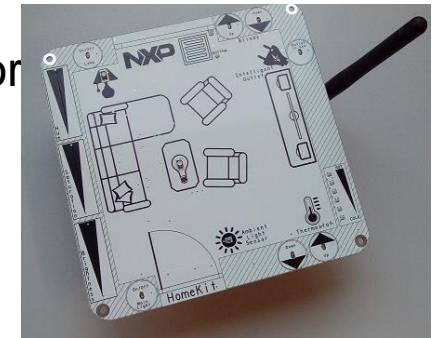


NXP HARDWARE DEVELOPMENT SYSTEMS FOR HOMEKIT AND MFI



HomeKit SDK Hardware Support

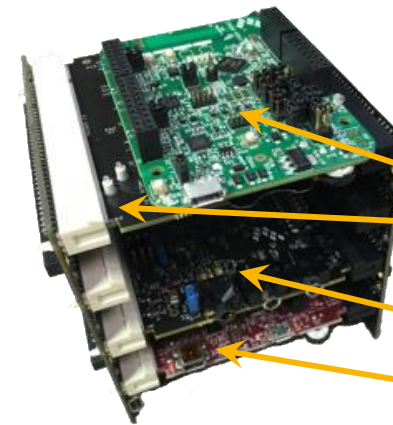
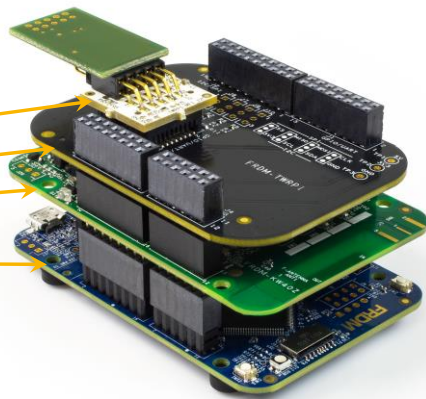
- FRDM system (Arduino compatible) is available now, supporting a range of Kinetis application MCUs
- Next HomeKit SDK release will add support for TWR system and TWR-DOCK2
 - Adding support for QN9020 BLE MCU
 - FRDM and TWR systems include hardware support for BLE, Ethernet and Wi-Fi transport
- Developing 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



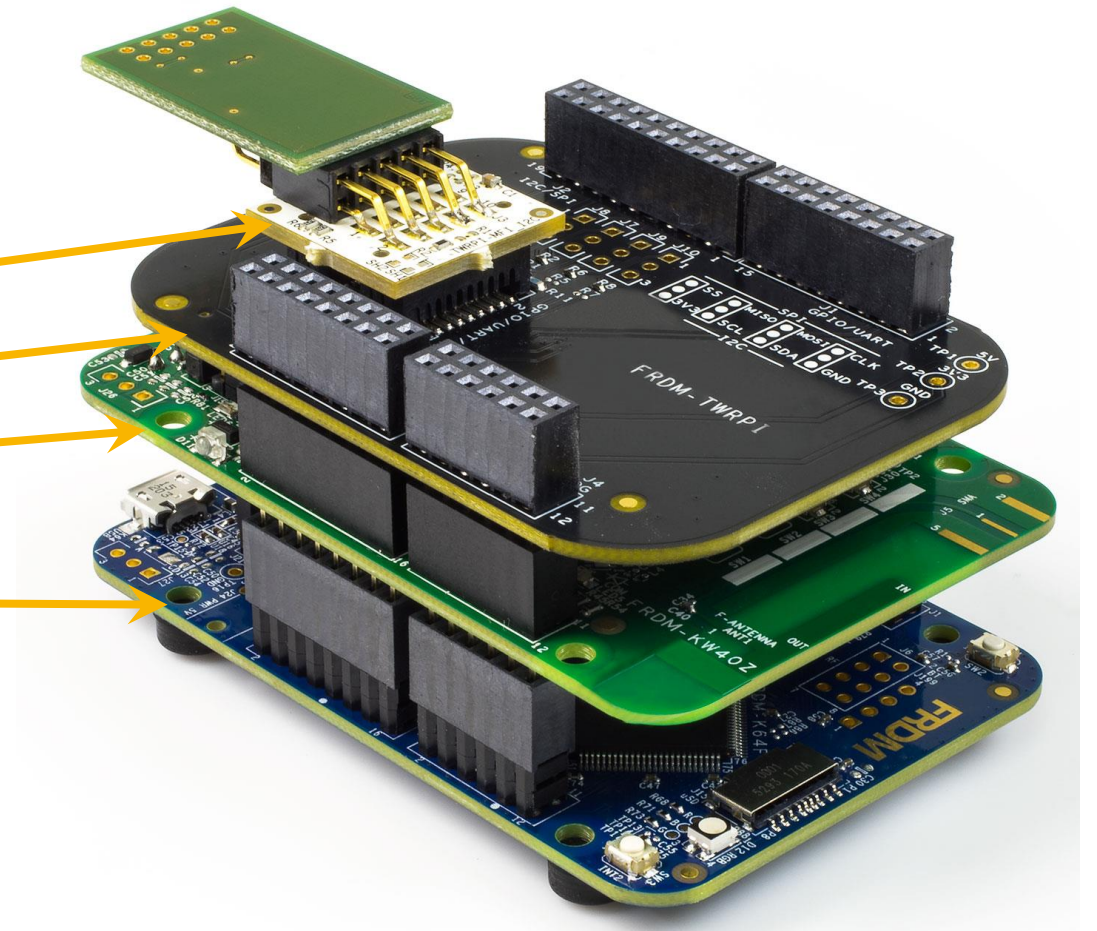
- [FRDM-KW40Z](#): BLE Connectivity
- [TWR-SHIELD](#)
- [TWR-ELEV](#)
- [TWR-DOCK2](#) or [TWR-DOCK](#): Board w/ MFi module
- [TWR-K64F120M](#): Host processor

HomeKit Software Development with NXP Freedom Boards

Available Now

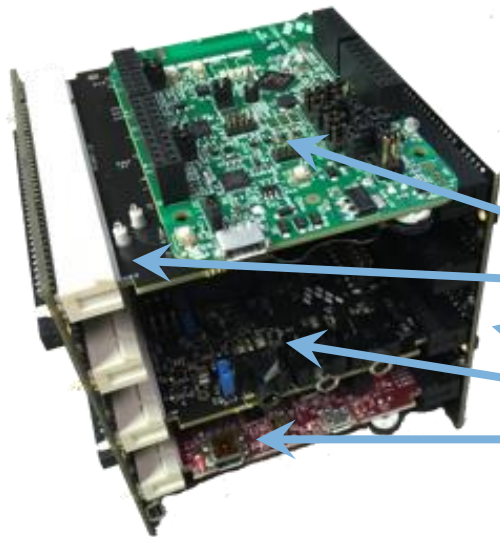
FRDM System consisting of:

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



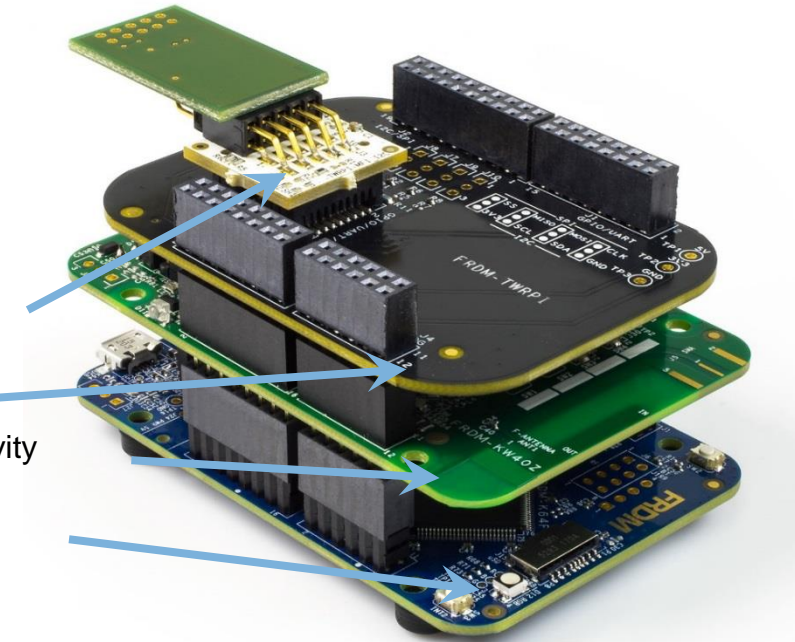
Kinetis Development Platforms for HomeKit

Available Now



- [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

Available Now

Analog stereo headphones/headset (3.5mm)

Analog stereo audio line in (3.5mm)

Analog stereo audio line out (3.5mm)

SGTL5000 Audio Codec (can be bypassed to use external Audio codecs)

Made for
iPod iPhone iPad

Configuration Jumpers

Custom Dock connector cable Header for custom Lightning connector cable

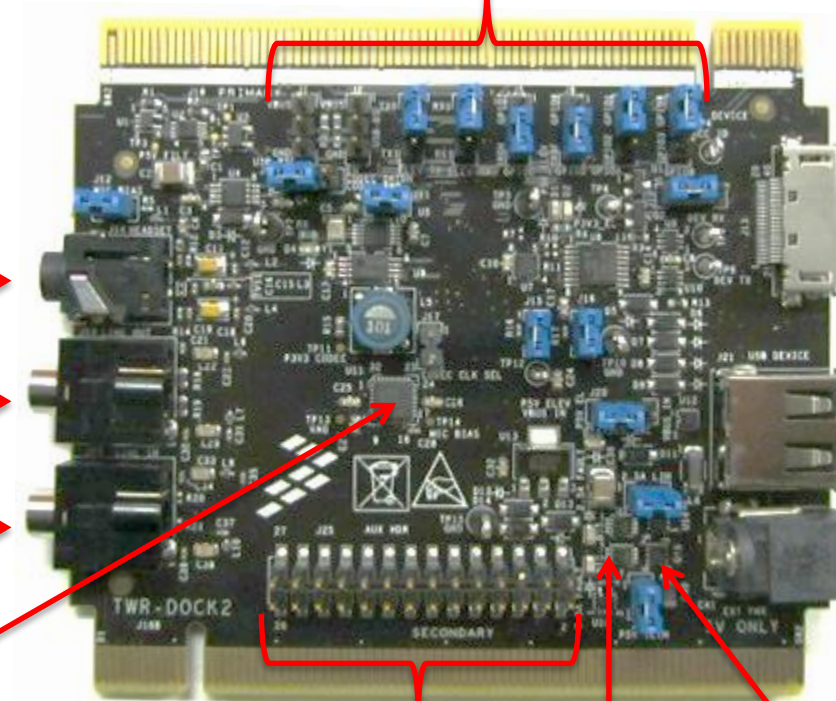
USB A Receptacle for standard USB A to dock connector cable

External power supply input (minimum 5V 5A)

Signal Access Header

Tower System power current limit circuit (limiter set to 1A)

Device charge current limit Circuit (limiter set to 2.5A~2.8A)



TWR-DOCK2 Use Examples



iPhone, iPad or iPod connected to Tower system via TWR-DOCK2 and custom Lightning or 30-pin connector cable



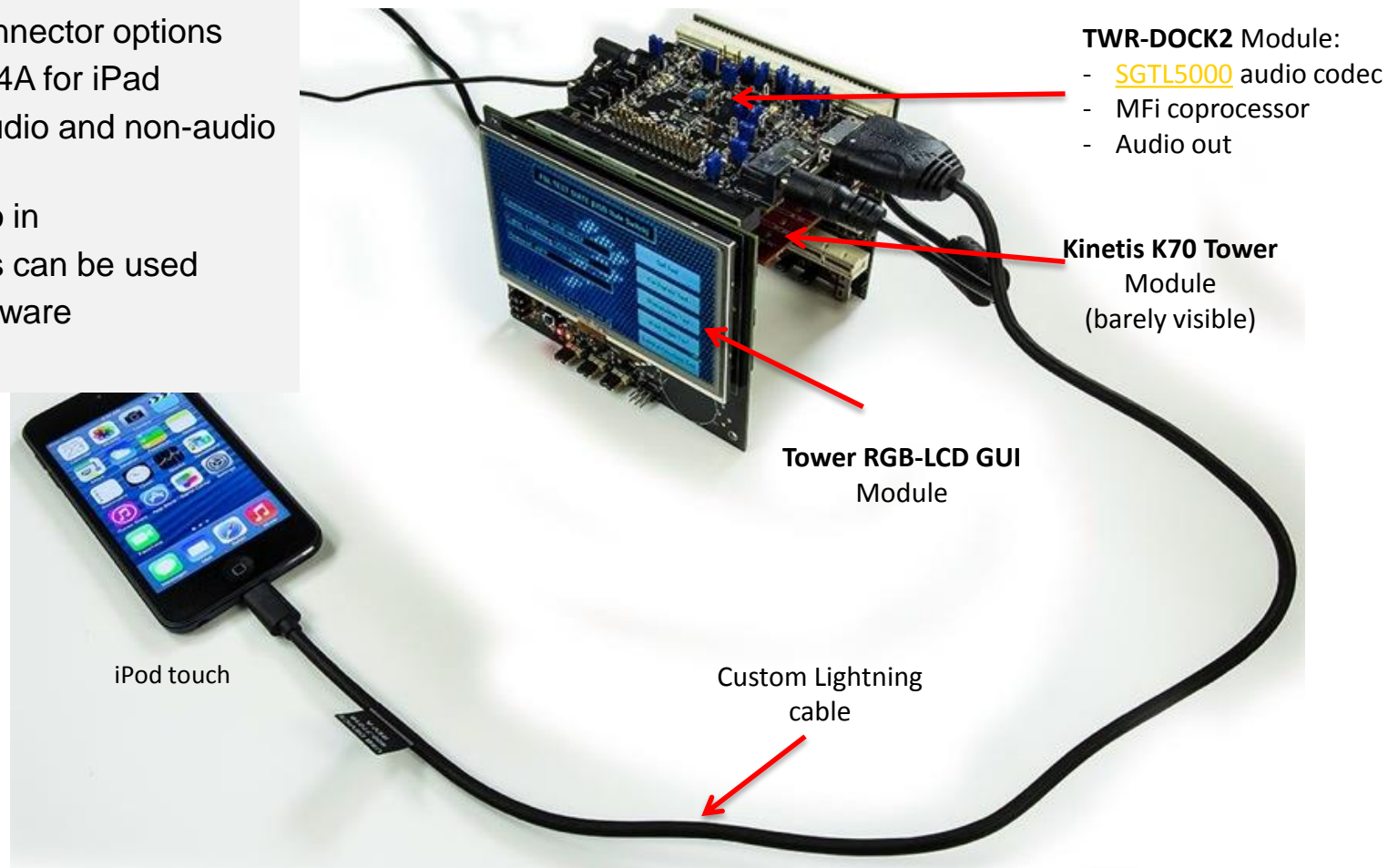
Custom 30-pin connector cable (USB and Serial connection)



Custom Lightning connector cable

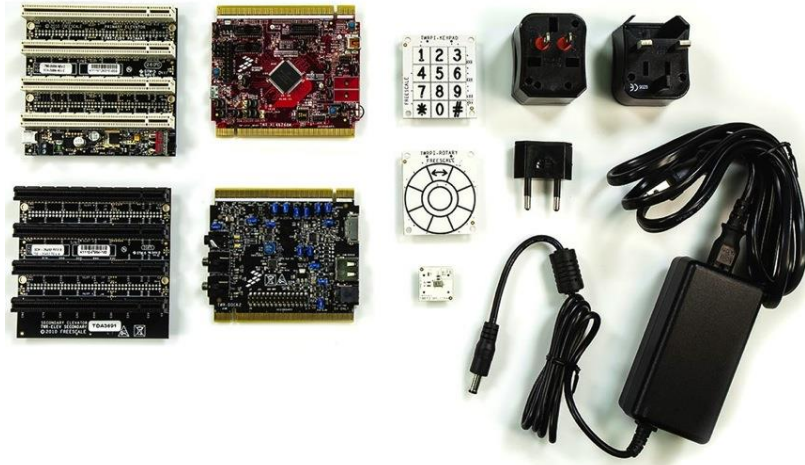
TWR-DOCK2 – Made For iPod (MFi) Development System

- Supports most Tower processor modules
- Supports most Lightning connector options
- Device charging for up to 2.4A for iPad
- Supports development of audio and non-audio accessories
- Capable of supporting audio in
- Other external audio codecs can be used
- Freescale MFi interface software
- Available since 2013



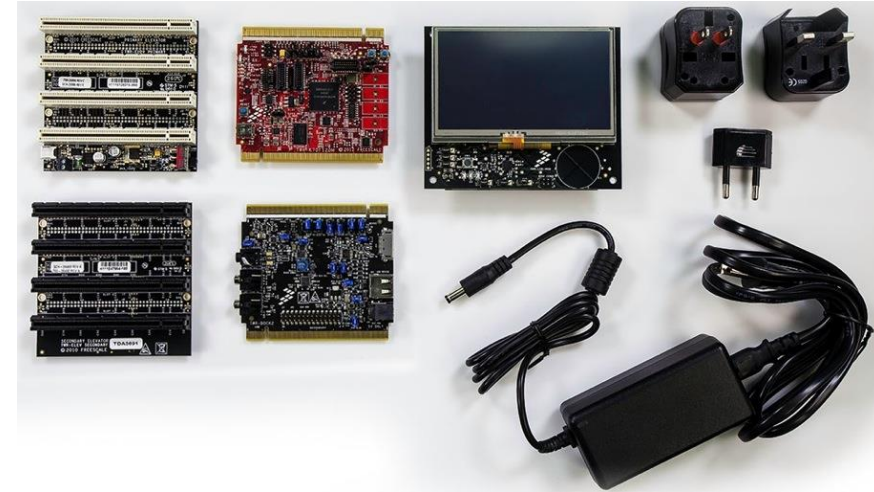
iPod touch is not included in the kit

MFi Development Kits – Available Now



TWR-DOCK2-KL46 (\$399):

- [TWR-KL46Z48M](#): Development board for KL46 ARM Cortex-M0+ MCU
- [TWR-ELEV](#): Tower elevator
- [TWR-DOCK2](#): include MFi interface and Freescale [SGTL5000](#) audio codec
- Power supply
- Custom lighting connector



TWR-DOCK2-K70LCD (\$499):

- [TWR-K70F120M](#): Development board for K70 ARM Cortex-M4F MCU
- [TWR-ELEV](#): Tower elevator
- [TWR-DOCK2](#): include MFi interface and Freescale [SGTL5000](#) audio codec
- [TWR-LCD-RGB](#): Graphical LCD Tower System Module with RGB Interface
- Power supply
- Custom lighting connector

HomeKit SDK from NXP - Development Solutions




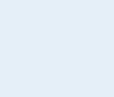















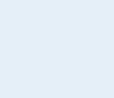




1) Host Processor						2) Wireless Connectivity MCU					3) Add-on development boards					
Recommended Part #	Development board	Homekit SDK	Kinetis SDK	IDE	RTOS	Part #	SDK	IDE	RTOS	Dev. board	TWR-DOCK2 or TWR-DOCK	FRDM-TWRPI	TWRPI-I2C	MFI module	TWR-SHIELD Adaptor for FRDM-KW40Z	TWR-ELEV
K11DN512	TWR-K21D50M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

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



Example Tower System MFi System Configurations Available Now

Demo	Application	Target MCU/ key Tower Module	iOS App Required	Interface
MFi Simple Remote	MFi Audio	 +  +  +  TWR-K40D100M TWR-DOCK2 TWR-ELEV	No	UART
MFi GUI Remote	MFi Audio	 +  +  +  TWR-K60D100M TWR-DOCK2 TWR-ELEV TWR-LCD-RGB	No	UART
MFi Altimeter	MFi Sports	 +  +  +  TWR-K60D100M TWR-DOCK2 TWR-ELEV TWRPI-MPL115A	Yes	USB
MFi EKG	MFi Medical	 +  +  +  TWR-K53N512 TWR-DOCK2 TWR-ELEV MED-EKG	Yes	UART
iPod Simple Control with Digital Audio	MFi Audio	 +  +  +  TWR-KL46Z48M TWR-DOCK2 TWR-ELEV	No	USB
iPod GUI Control with Digital Audio	MFi Audio	 +  +  +  TWR-K70F120M TWR-DOCK2 TWR-ELEV TWR-LCD-RGB	No	USB

Q & A



SECURE CONNECTIONS
FOR A SMARTER WORLD

ATTRIBUTION STATEMENT

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