FTF 2016
TECHNOLOGY FORUM

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

## FTF-HMB-N1984

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MAY 16, 2016

# 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

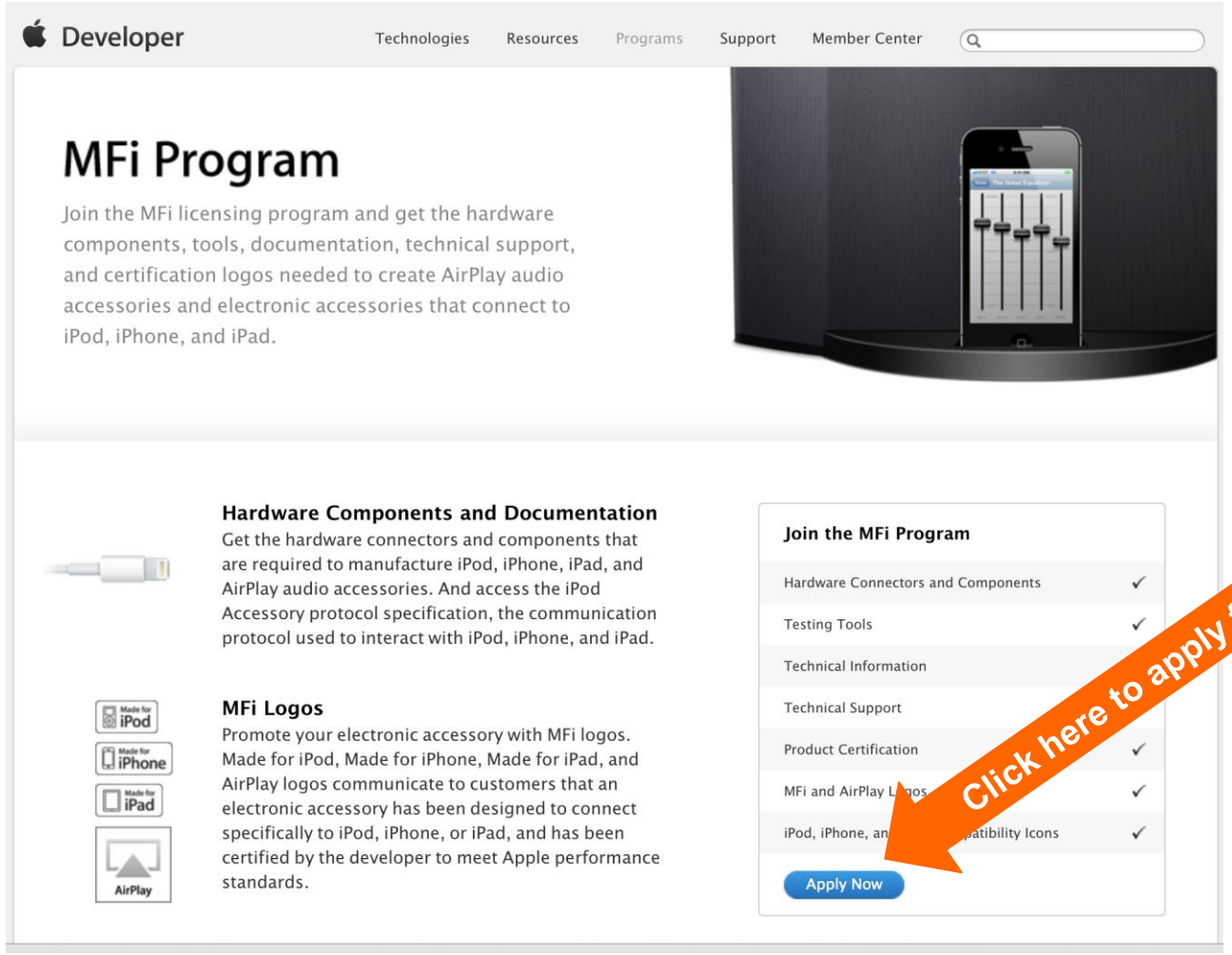
# INTRODUCTION TO HOMEKIT AND MADE FOR IPOD (MFI)

# 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




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

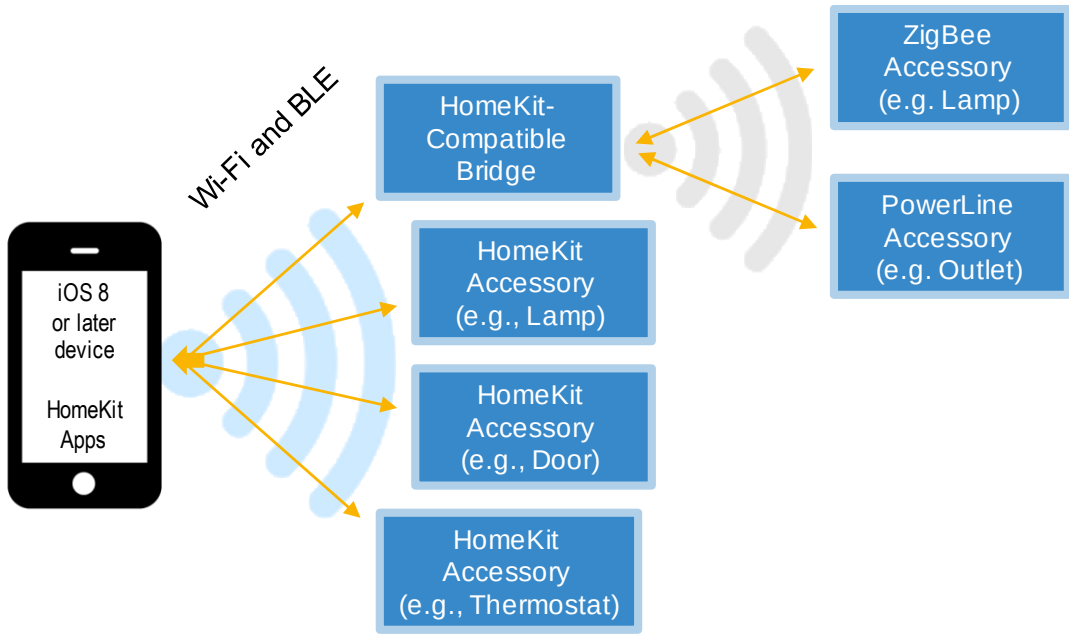
# HomeKit - Overview

## 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

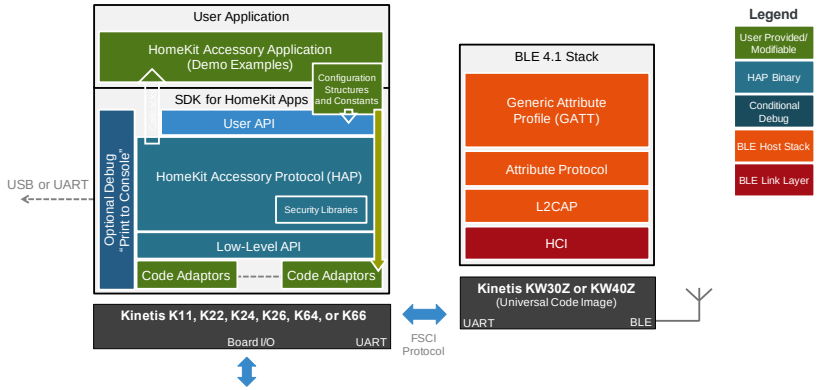


# MFi Accessory Connection Options

| Connection | Wired | | Wireless | | | |
|---|---|---|---|---|---|---|
| | Lightning | 30-pin | BLE | BT | BT (MFi) | WiFi |
| |  |  | Bluetooth 4.0 | Bluetooth | Bluetooth | |
| 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**<br>ARM® Cortex®-M4 MCUs<br>(min. 64 KB SRAM, 512 KB Flash)<br>K22, K24, K26, K64, K66 | No OS,<br>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

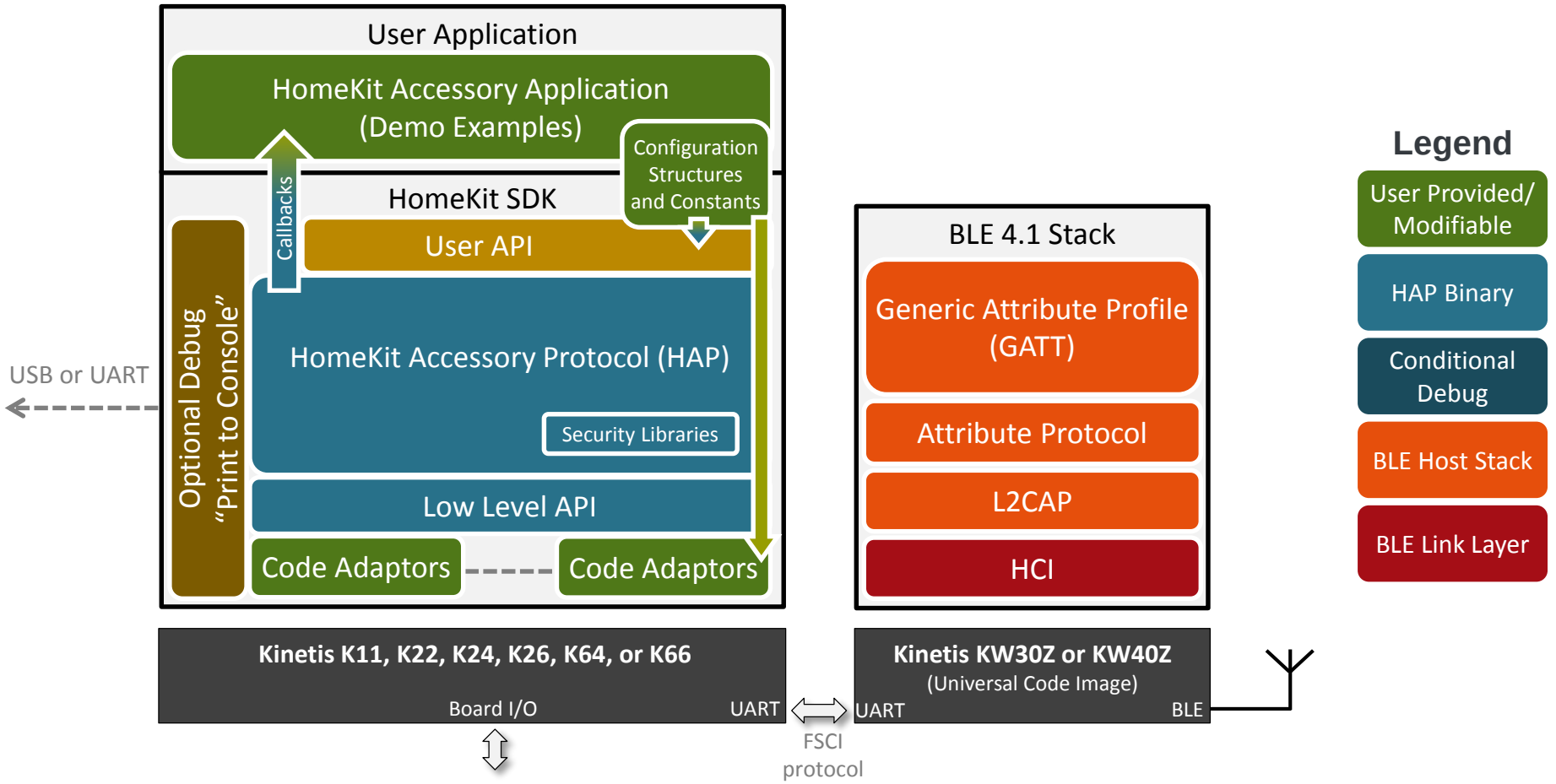
- Availability: HomeKit BLE for Kinetis MCUs: Now

# 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

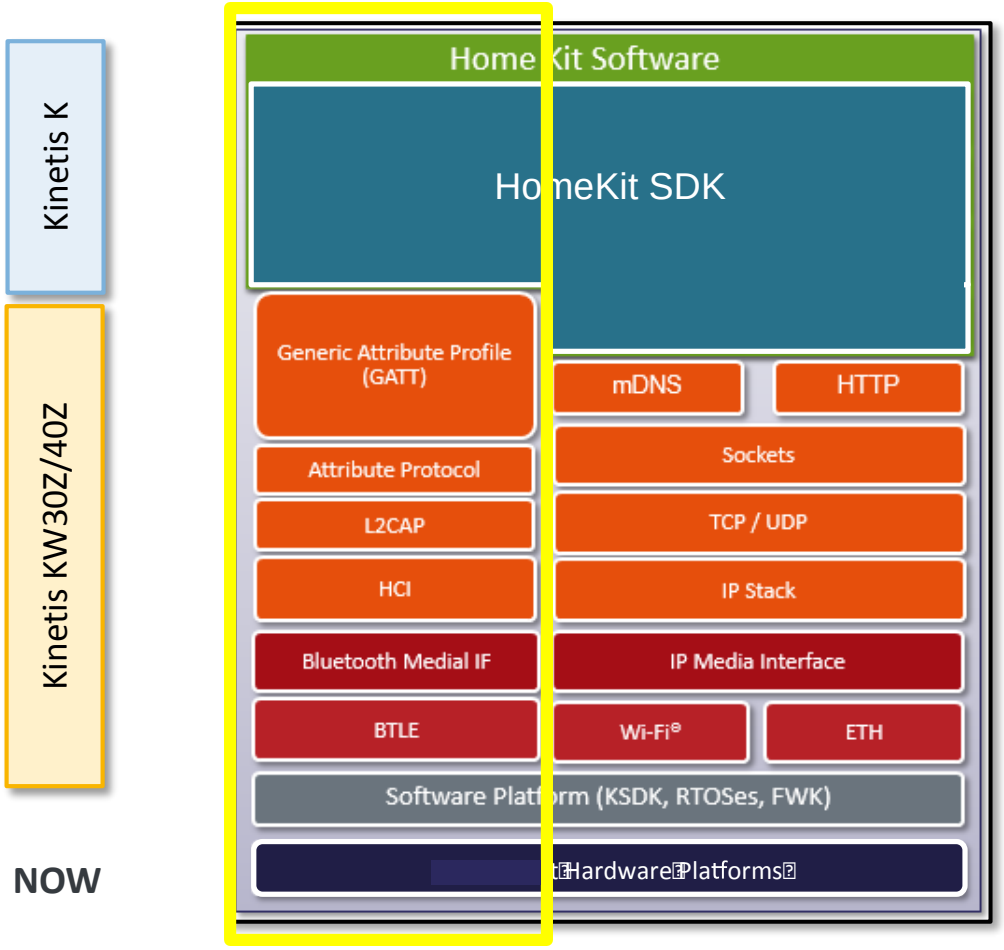
The HomeKit Software Development Kit (SDK) from NXP for Kinetis MCUs offers support for home automation applications using HomeKit technology.

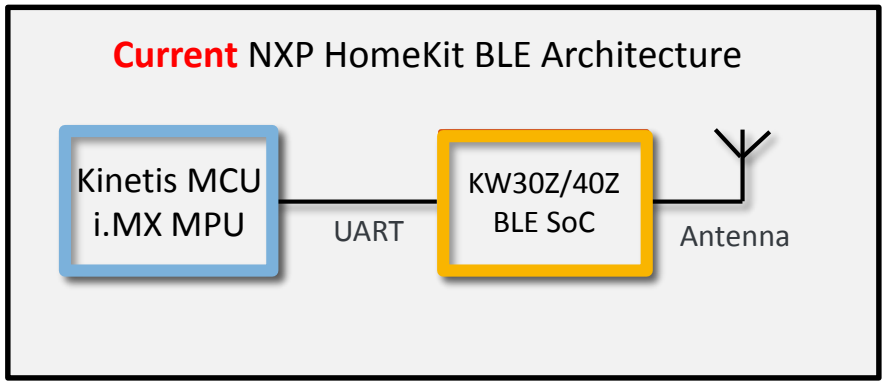
# HomeKit SDK from NXP Solution (1/2)

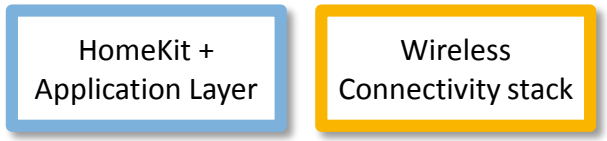


# HomeKit SDK from NXP Solution (2/2)

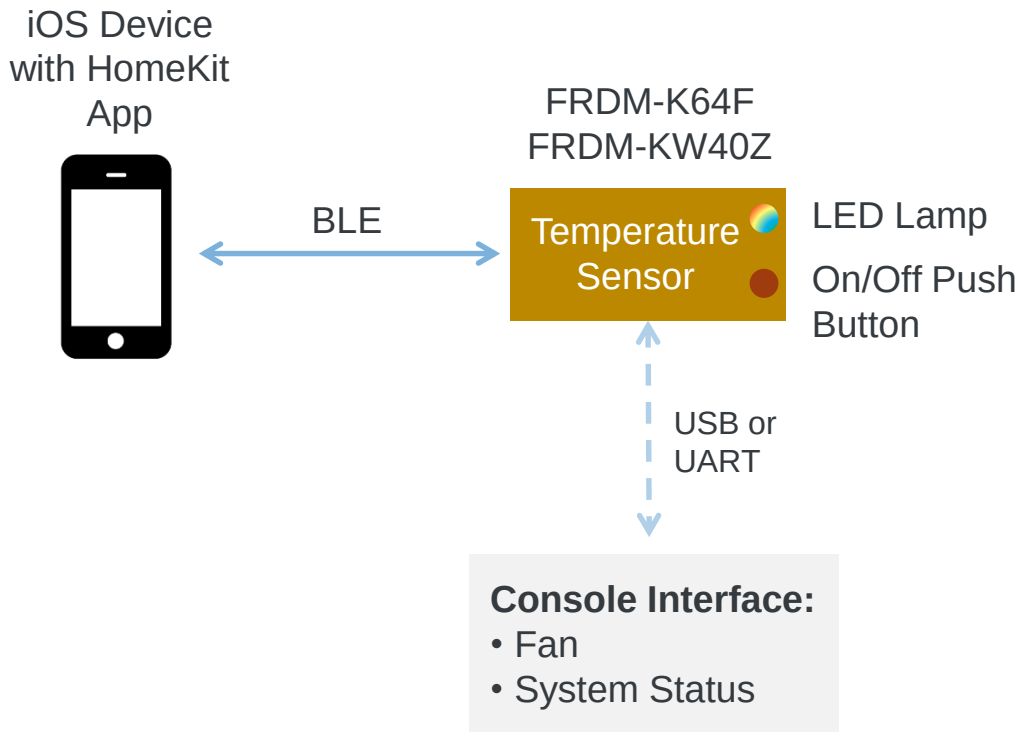
**Bluetooth Low Energy 4.x (BLE) Transport**



# HomeKit SDK from NXP – Example Accessory Demo

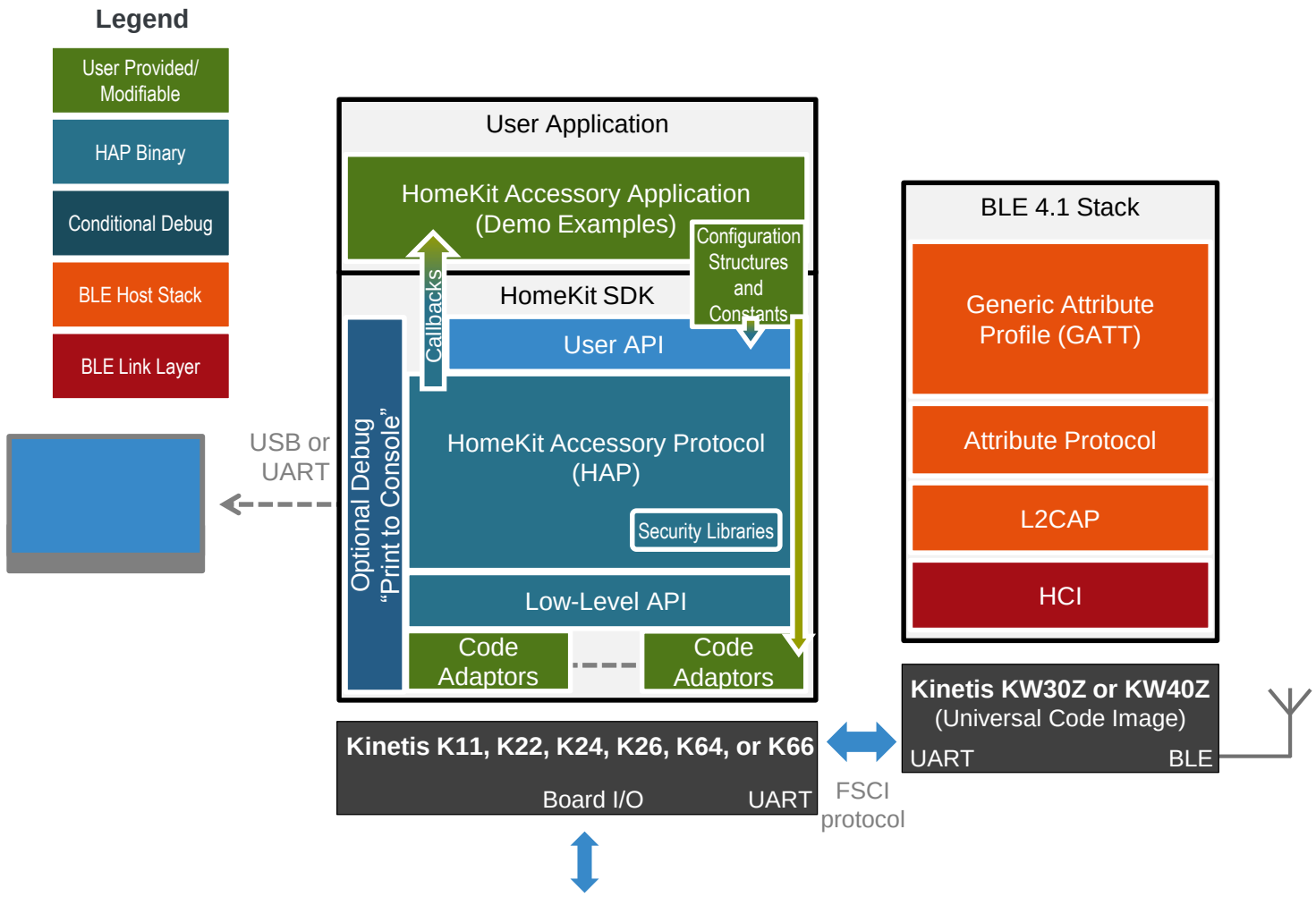



## Demo (part of SDK) includes:

- 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



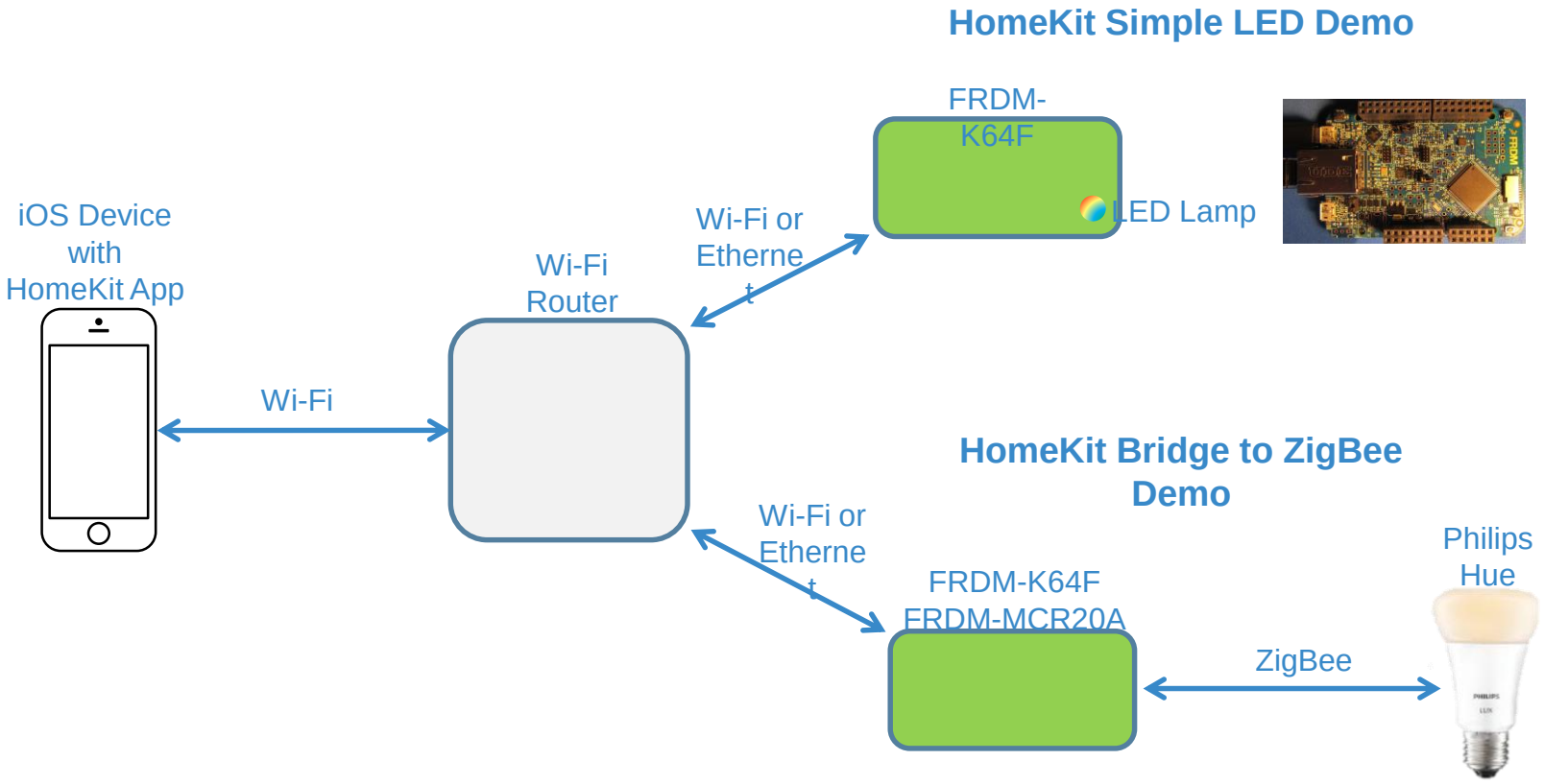
# HomeKit SDK from NXP – Wi-Fi/Ethernet Transport Demos

The following demoes 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

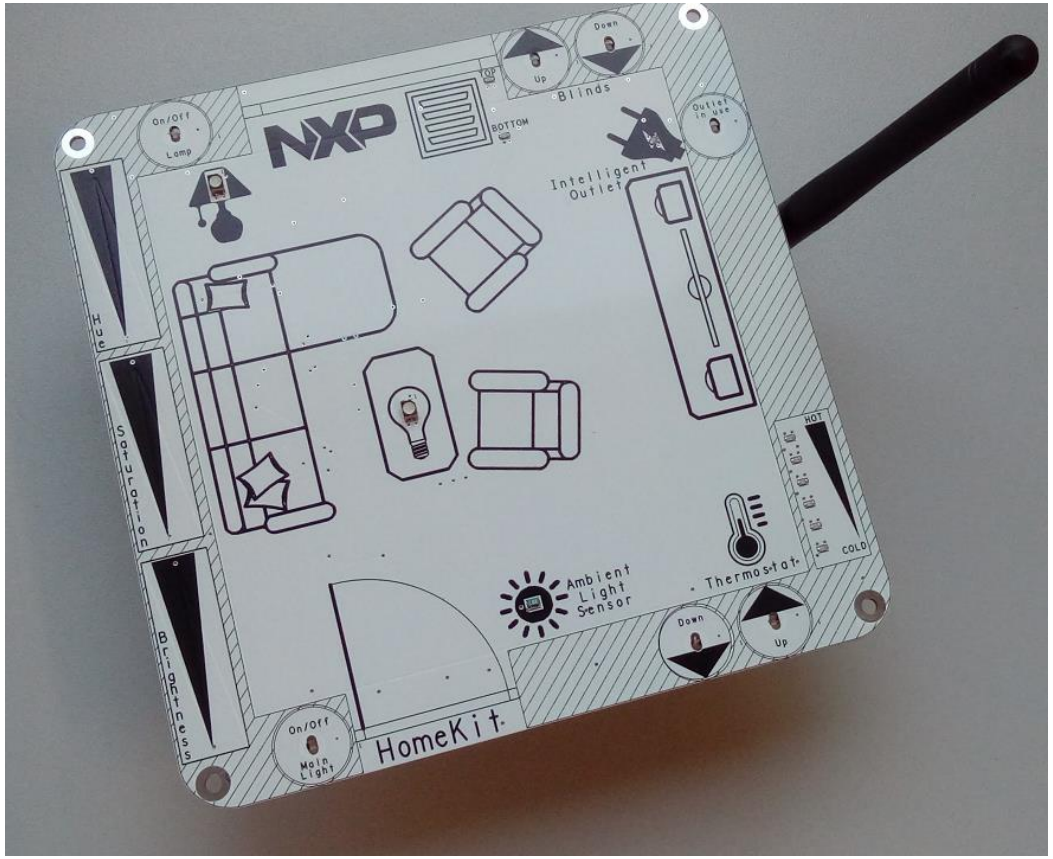
In development:

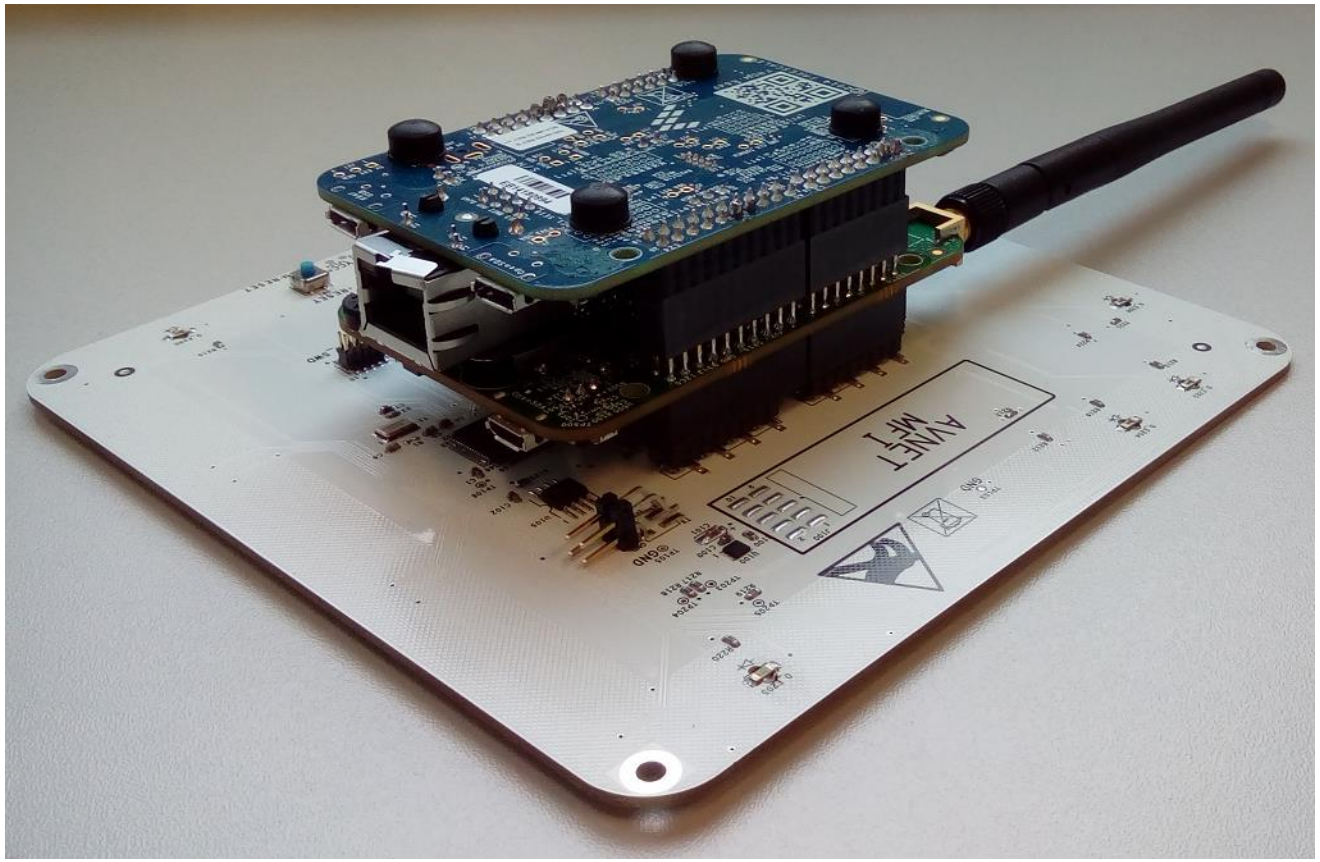
- Simple Lamp (LED)
  - Based on TWR-K21, TWR-DOCK2, TWR-PROTO with BLE module, using BLE transport (authenticated)



# 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

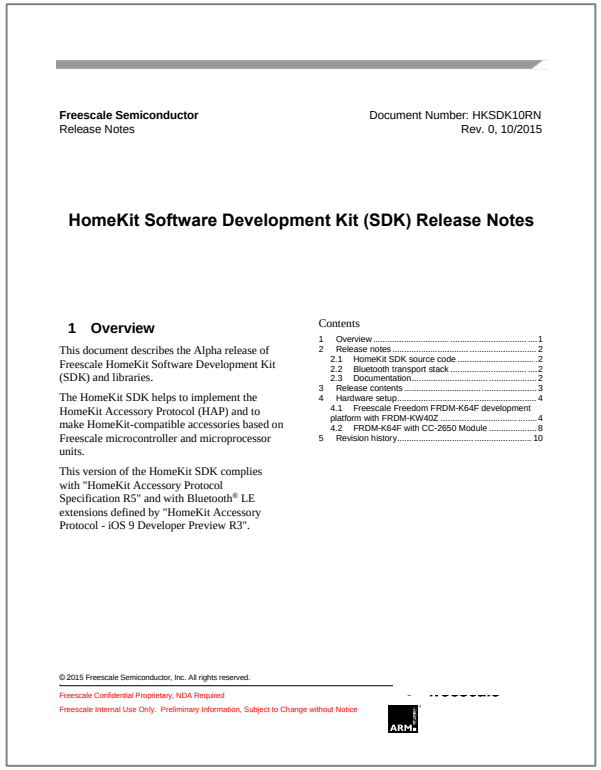
Memory system requirements:

| | 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



Freescale Semiconductor
Release Notes

Document Number: HKSDK10RN
Rev. 0, 10/2015

**HomeKit Software Development Kit (SDK) Release Notes**

**1 Overview**

This document describes the Alpha release of Freescale HomeKit Software Development Kit (SDK) and libraries.

The HomeKit SDK helps to implement the HomeKit Accessory Protocol (HAP) and to make HomeKit-compatible accessories based on Freescale microcontroller and microprocessor units.

This version of the HomeKit SDK complies with "HomeKit Accessory Protocol Specification R5" and with Bluetooth® LE extensions defined by "HomeKit Accessory Protocol - iOS 9 Developer Preview R3".

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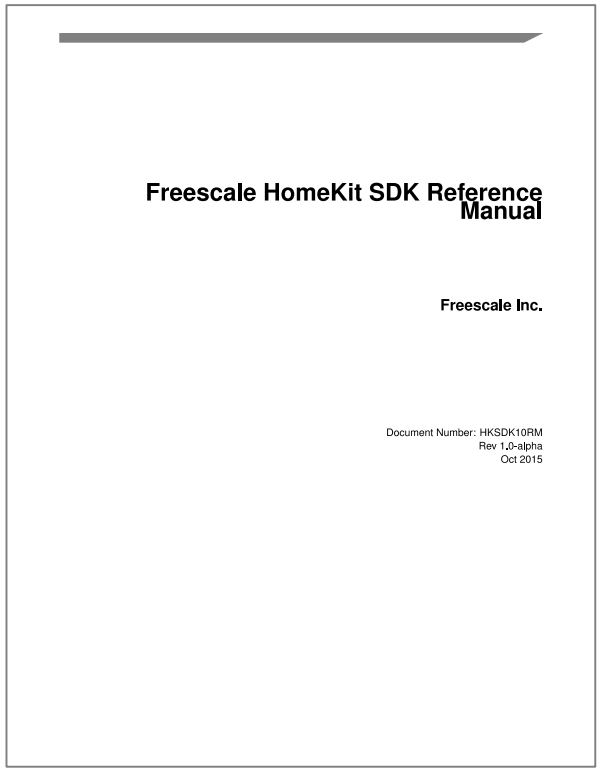


**Freescale HomeKit SDK Reference Manual**

**Freescale Inc.**

Document Number: HKSDK10RM
Rev 1.0-alpha
Oct 2015

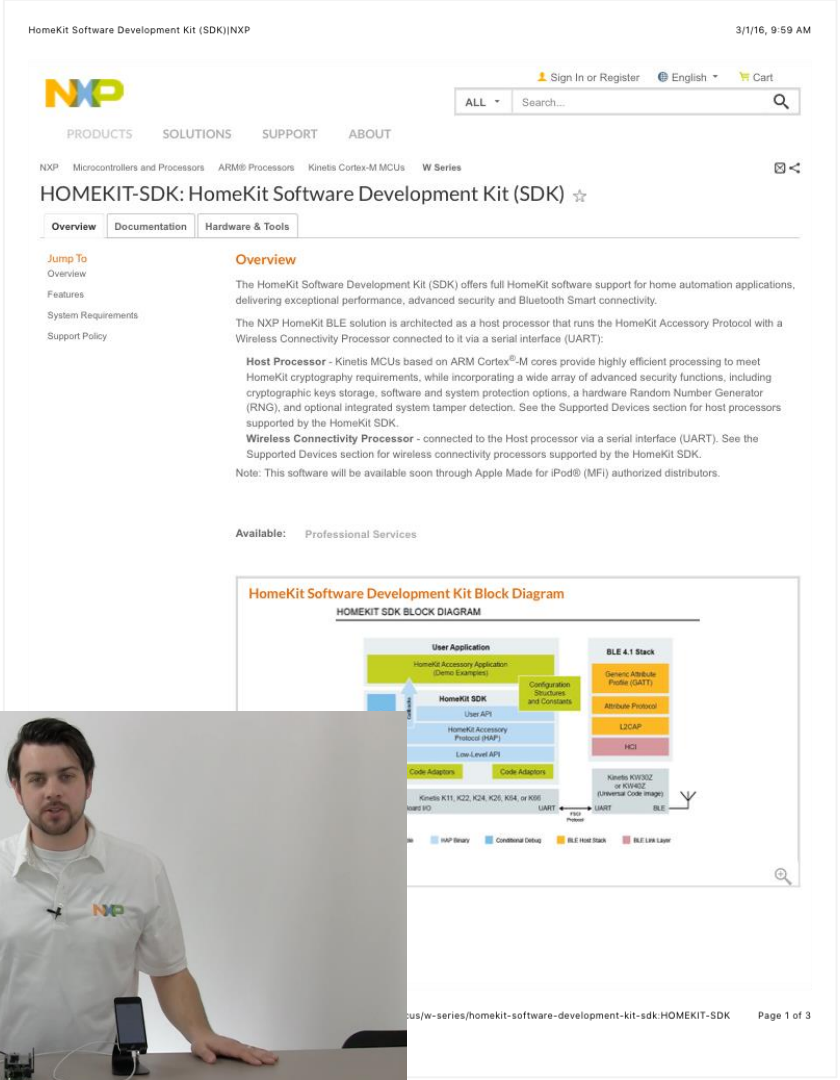
# HomeKit SDK from NXP – Webpage and Videos

- 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

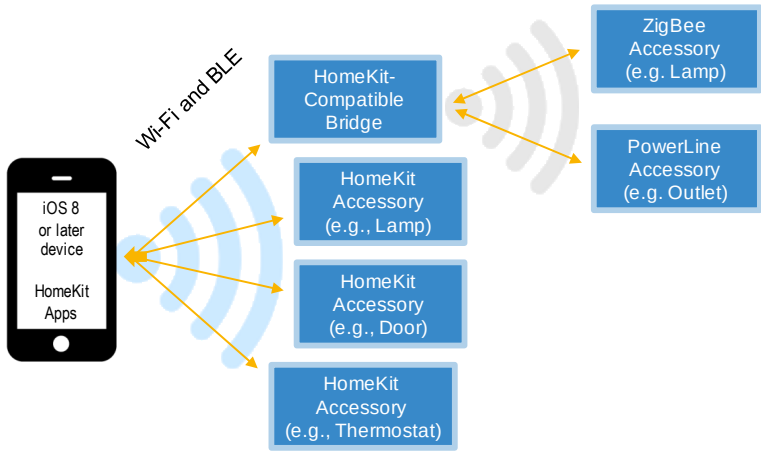



Videos

# 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 with Siri control


HomeKit with Siri control


HomeKit with Siri control

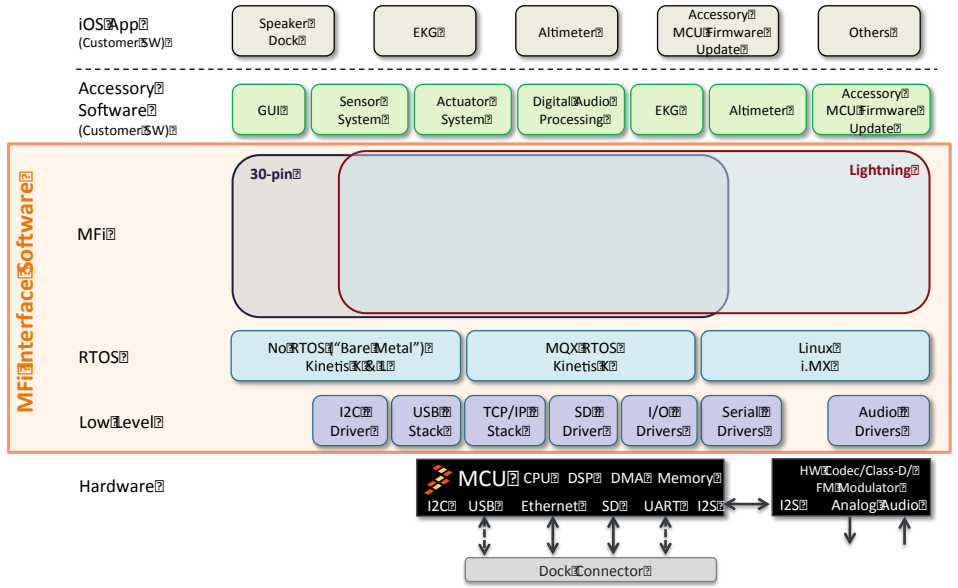
# MFI SOFTWARE DEVELOPMENT KIT (SDK) FROM NXP

# 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

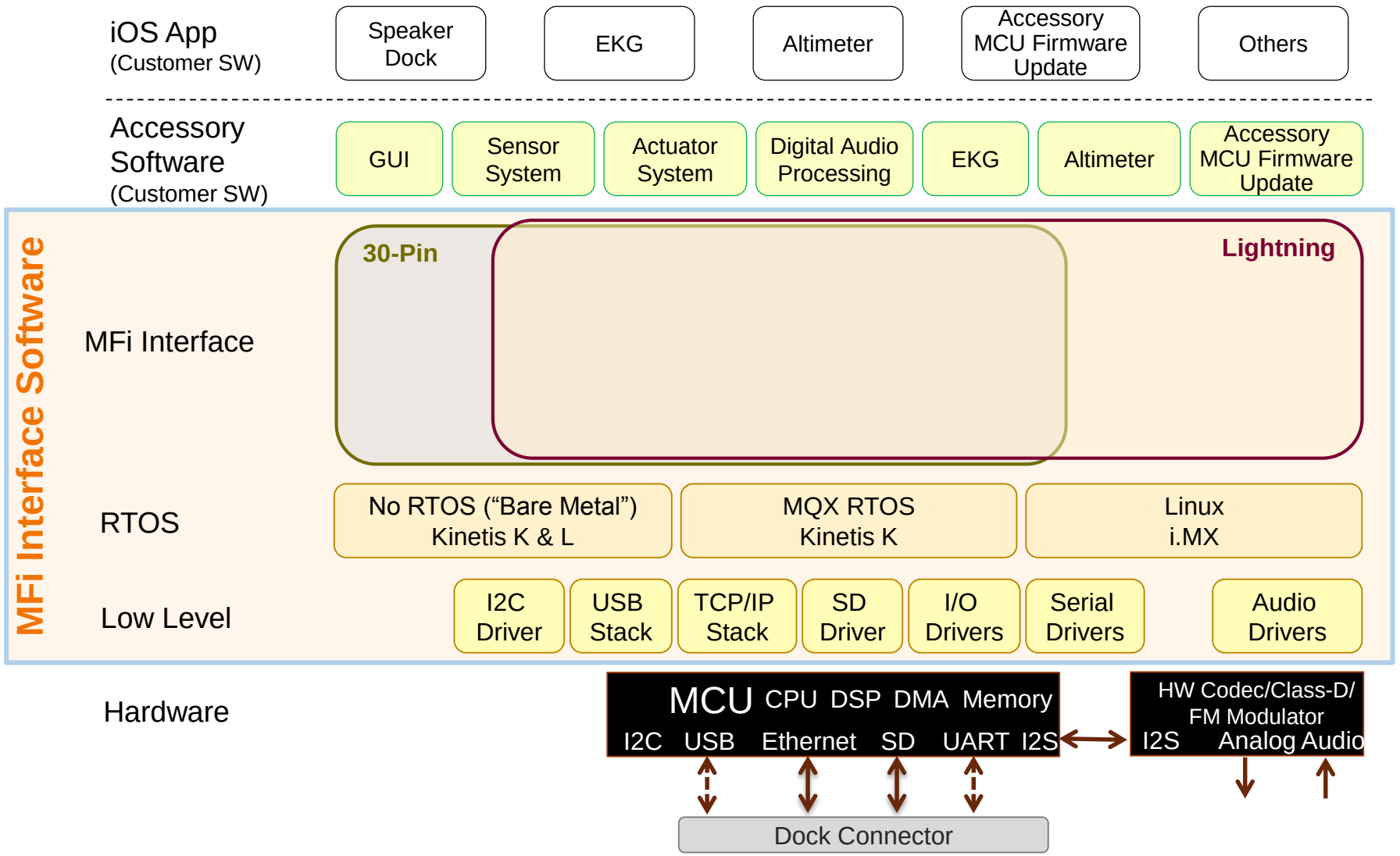
## Target Availability

- 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



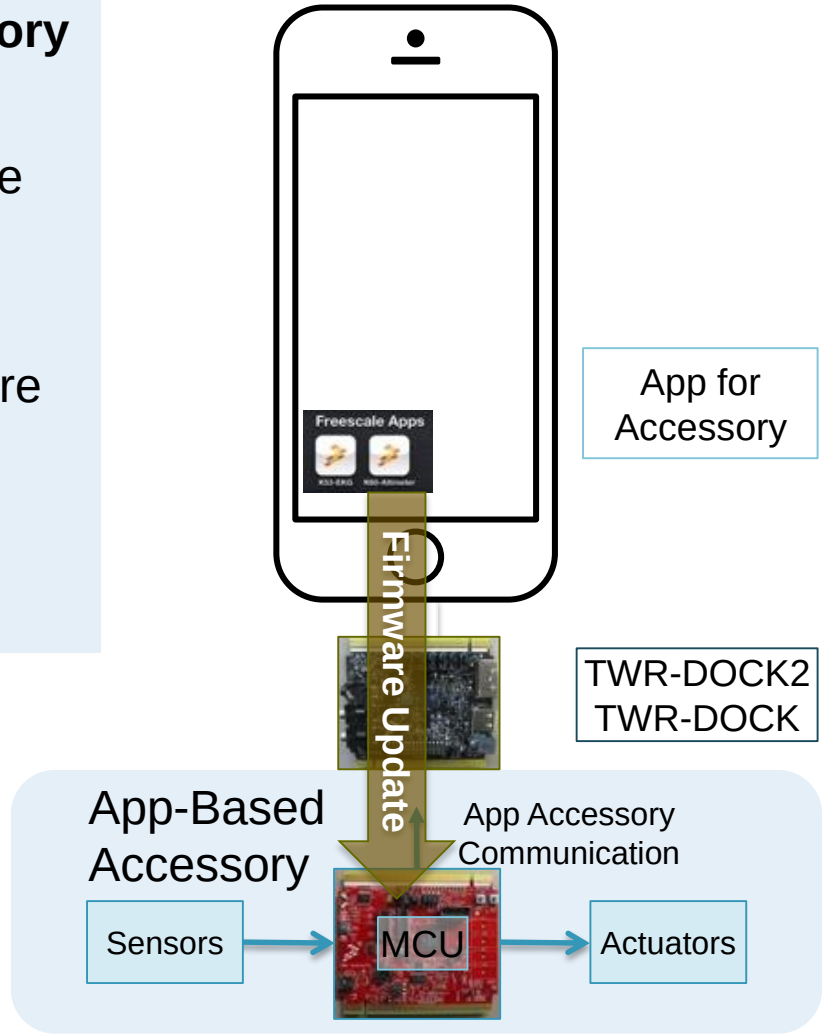
# NXP MFi Software Memory Requirements

| **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 | | |

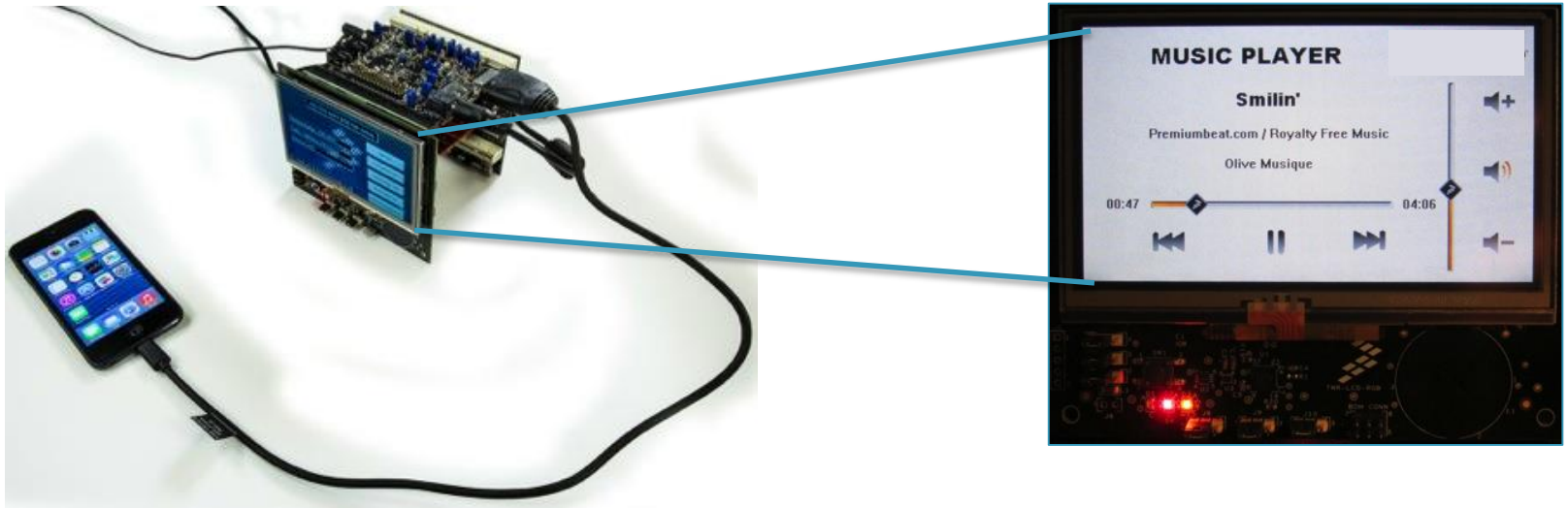
# Accessory Firmware Update

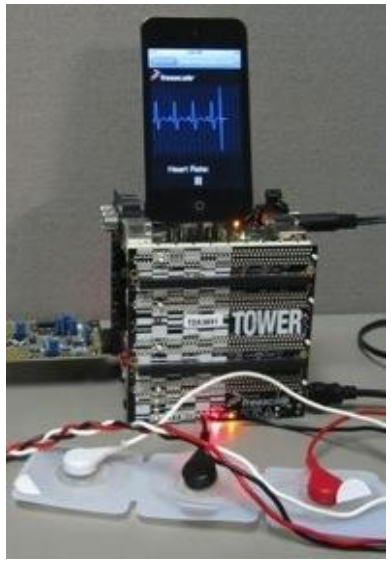
**MFi Software may include a function to update Accessory MCU firmware via an iOS App:**

- 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?***

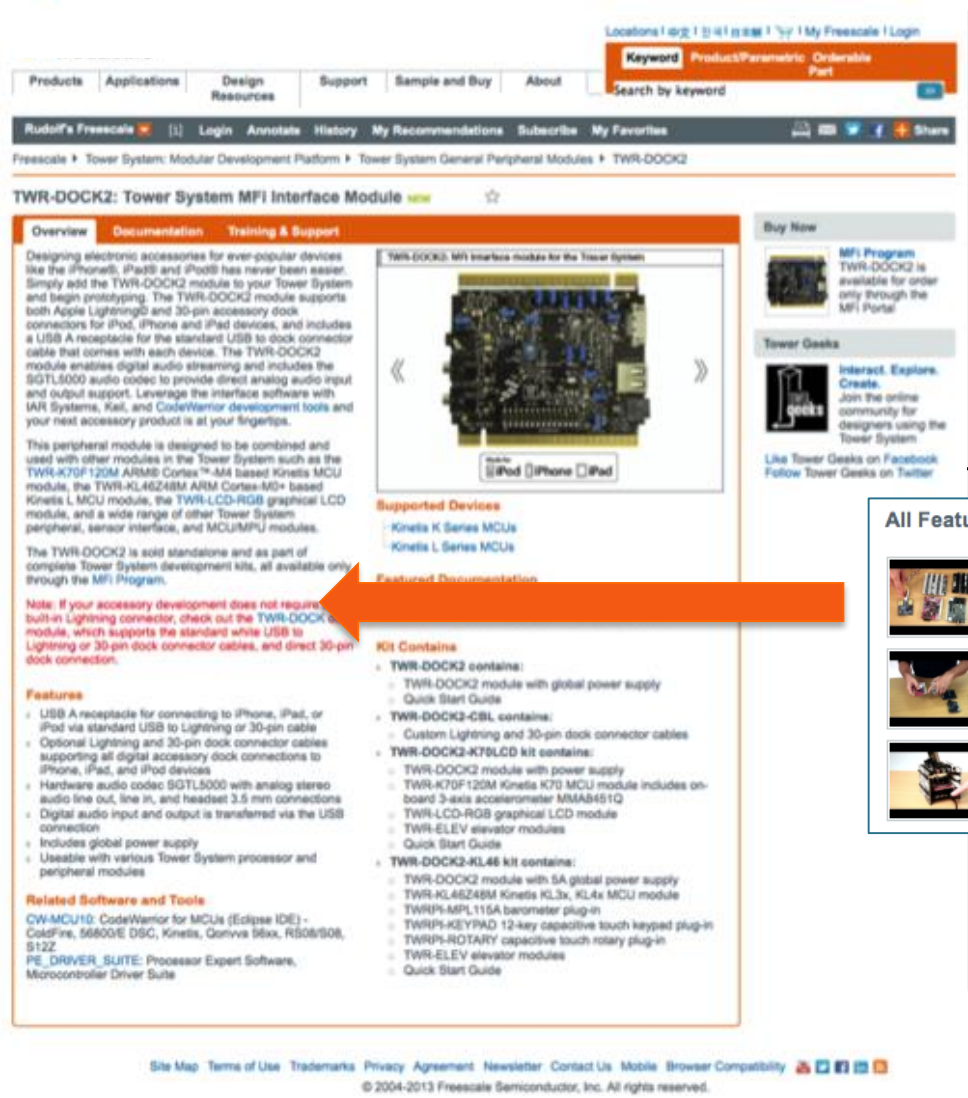
**Devices:**

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

# Freescale Focus MFi Applications: External Memory

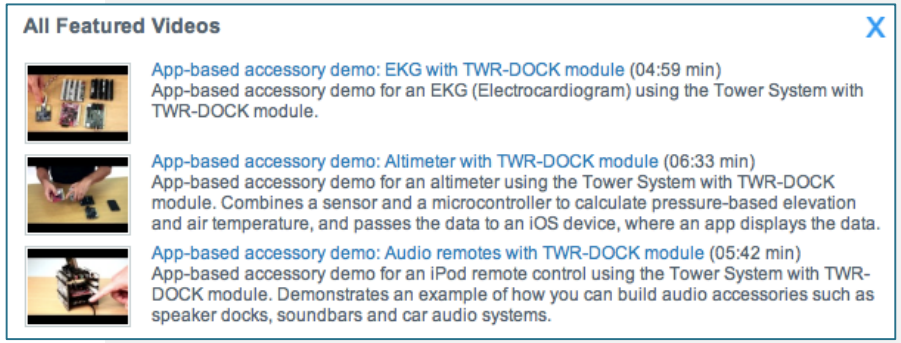
- External Memory Expansion Accessories:
- Memory only (no battery)
  - Must be able to enumerate at less than 30mA, maximum run consumption at less than 100mA
  - Maximum current limits maximum memory to 64GB with today's SDXC memory cards
- Memory with battery
  - Battery can provide additional current 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




Link to Apple MFi developer web page

·DOCK Fact Sheet, visit:




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

# NXP MFi Applications

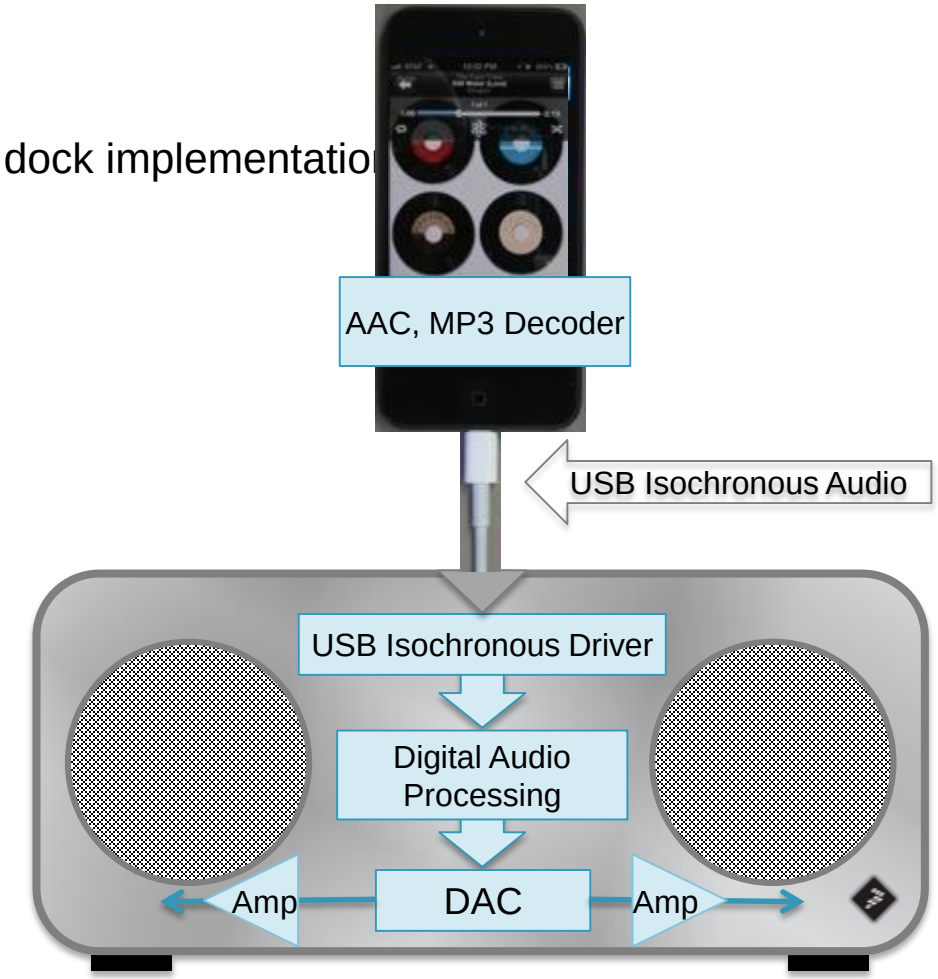
**iPhone, iPad, and iPod devices provide a great interface for many applications, and increasingly consumers already have them and know how to use them!**

**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*

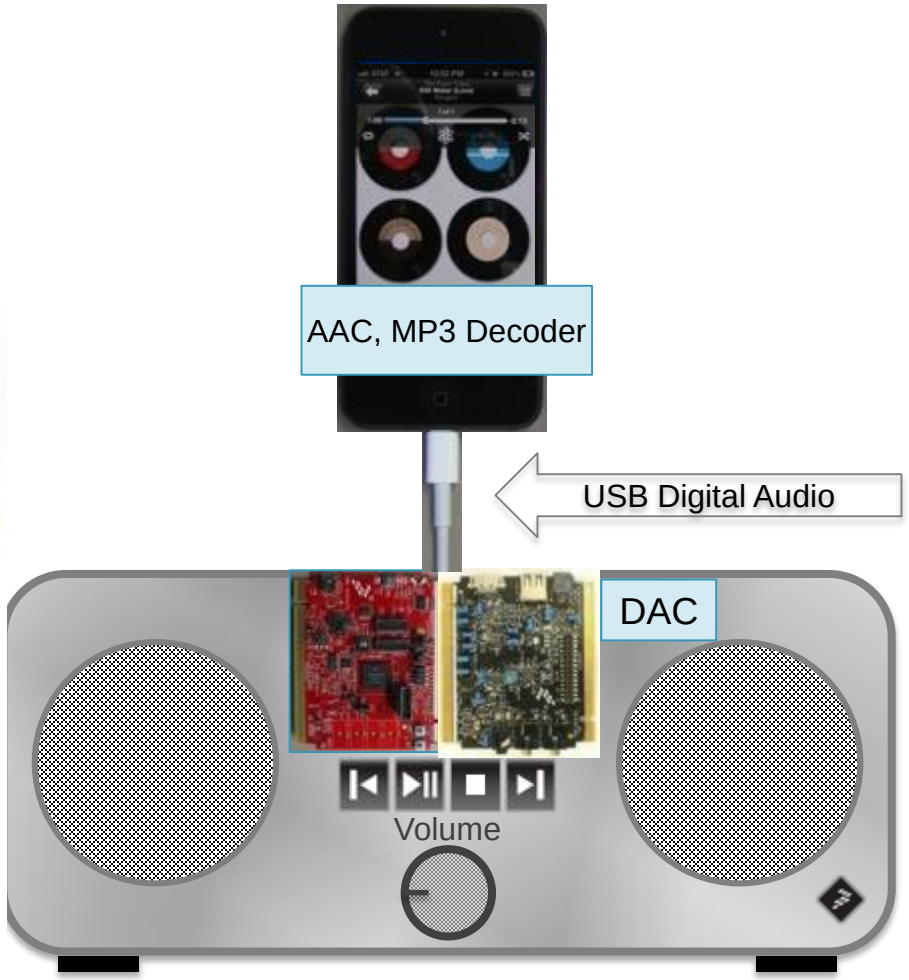
# Fully Digital Speaker Dock

- 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



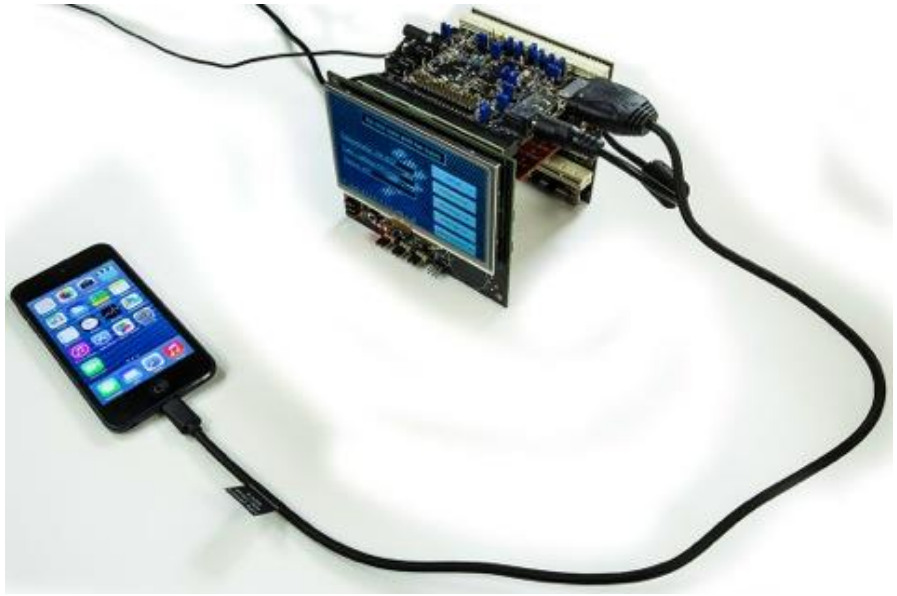
# Demo Example: Simple Speaker Dock

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



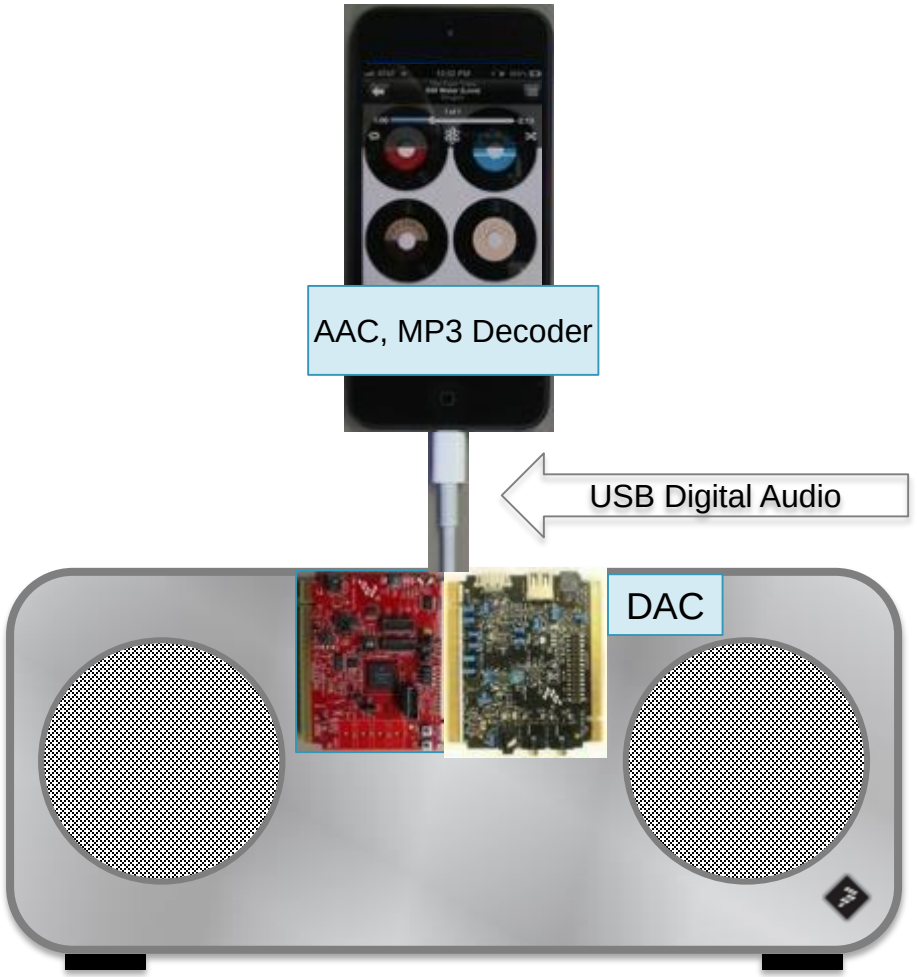
# Demo Example: GUI Speaker Dock

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



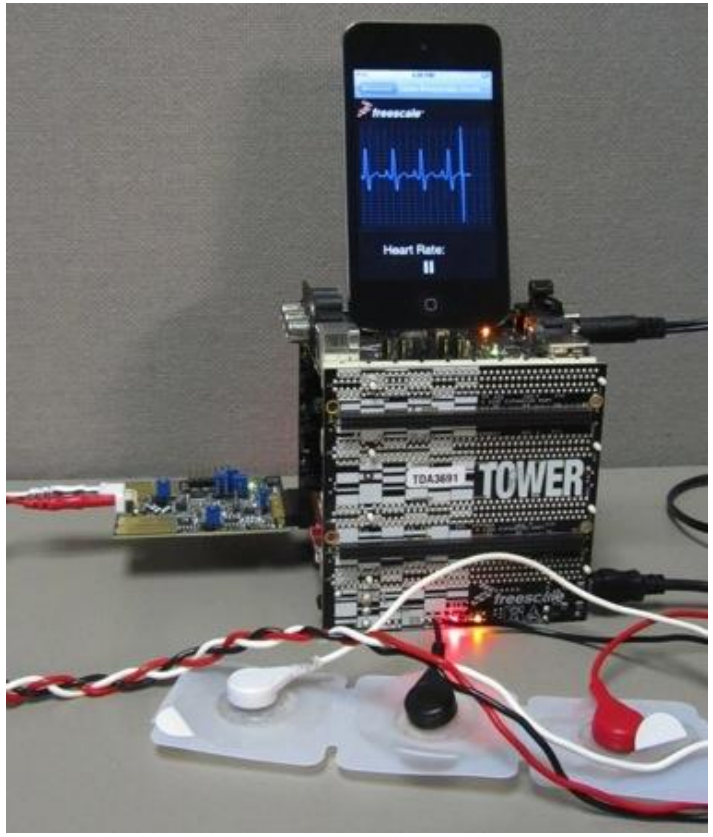
# App-Based Speaker Dock

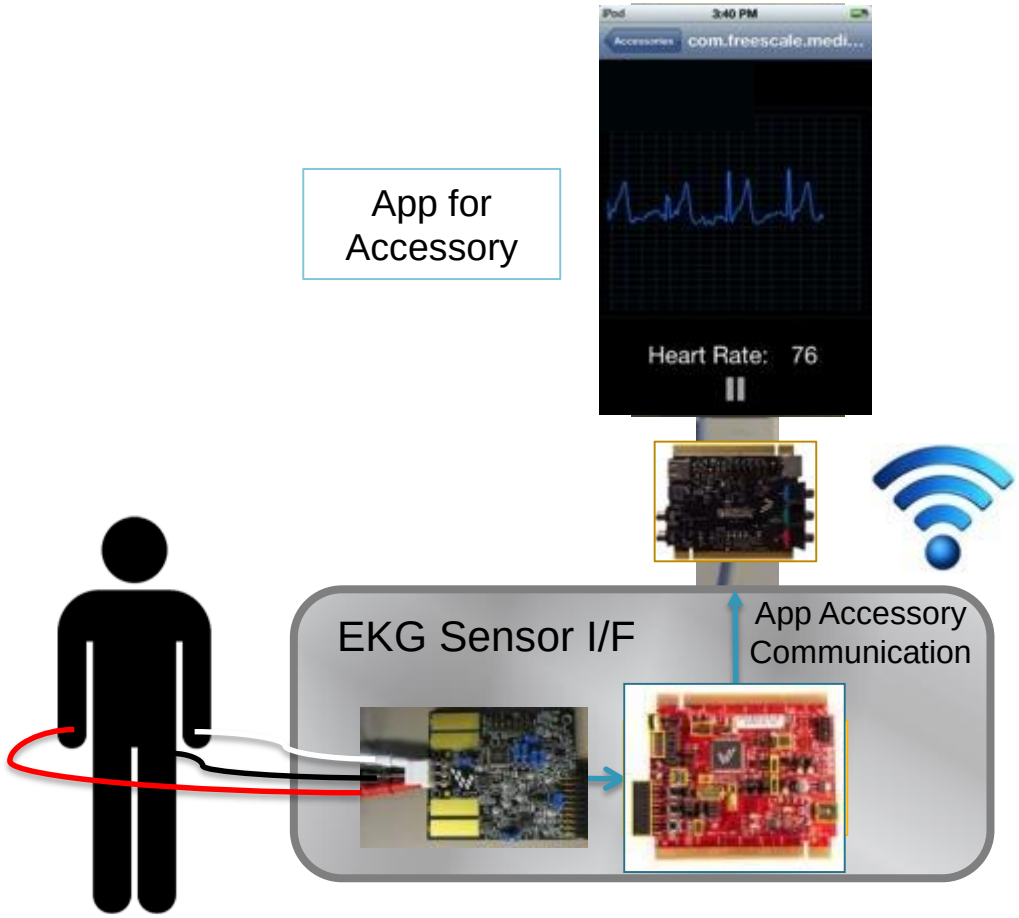
- Uses smartphone based App to control the speaker dock
  - Saves on separate GUI on speaker dock
  - Limited to smartphone or devices that support App-Based Accessories (such as iOS devices)
  - Possible with multiple connection options



# Demo Example: EKG - Electrocardiogram

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



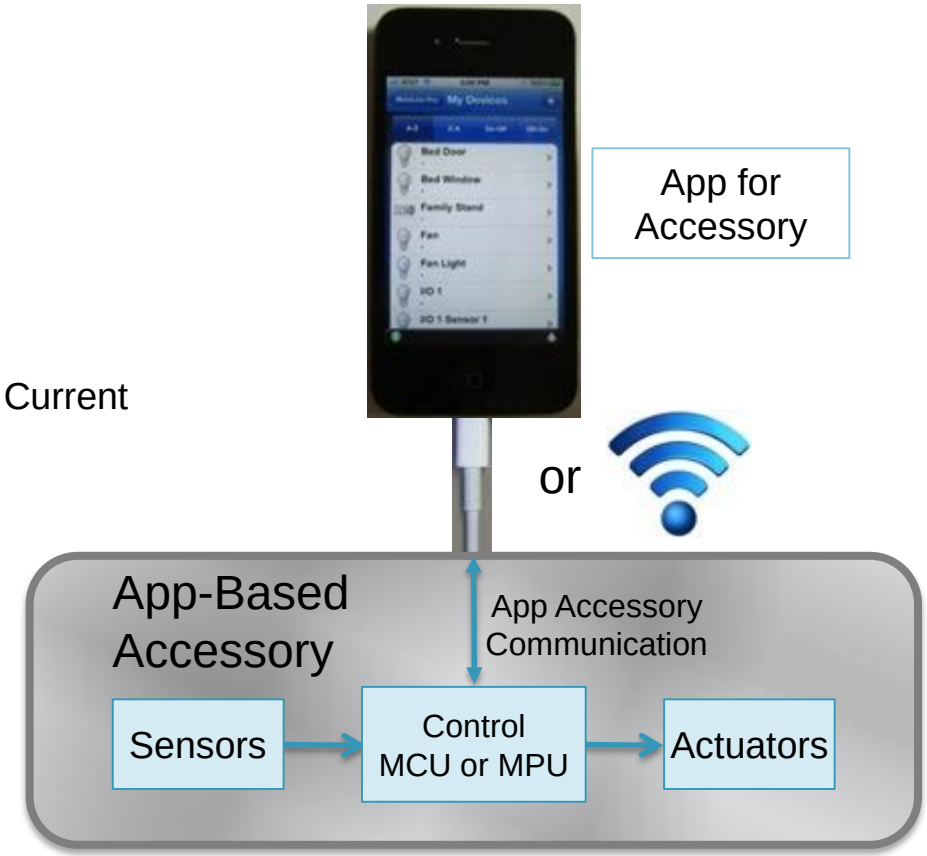



# Demo Example: Altimeter

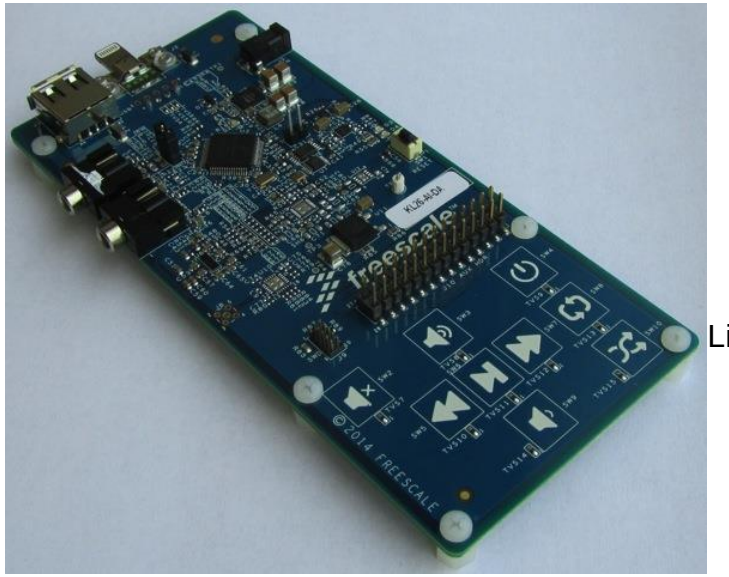
- Air pressure based altimeter
  - High sensitivity: ~ 30 cm (12”)
- Ambient air temperature

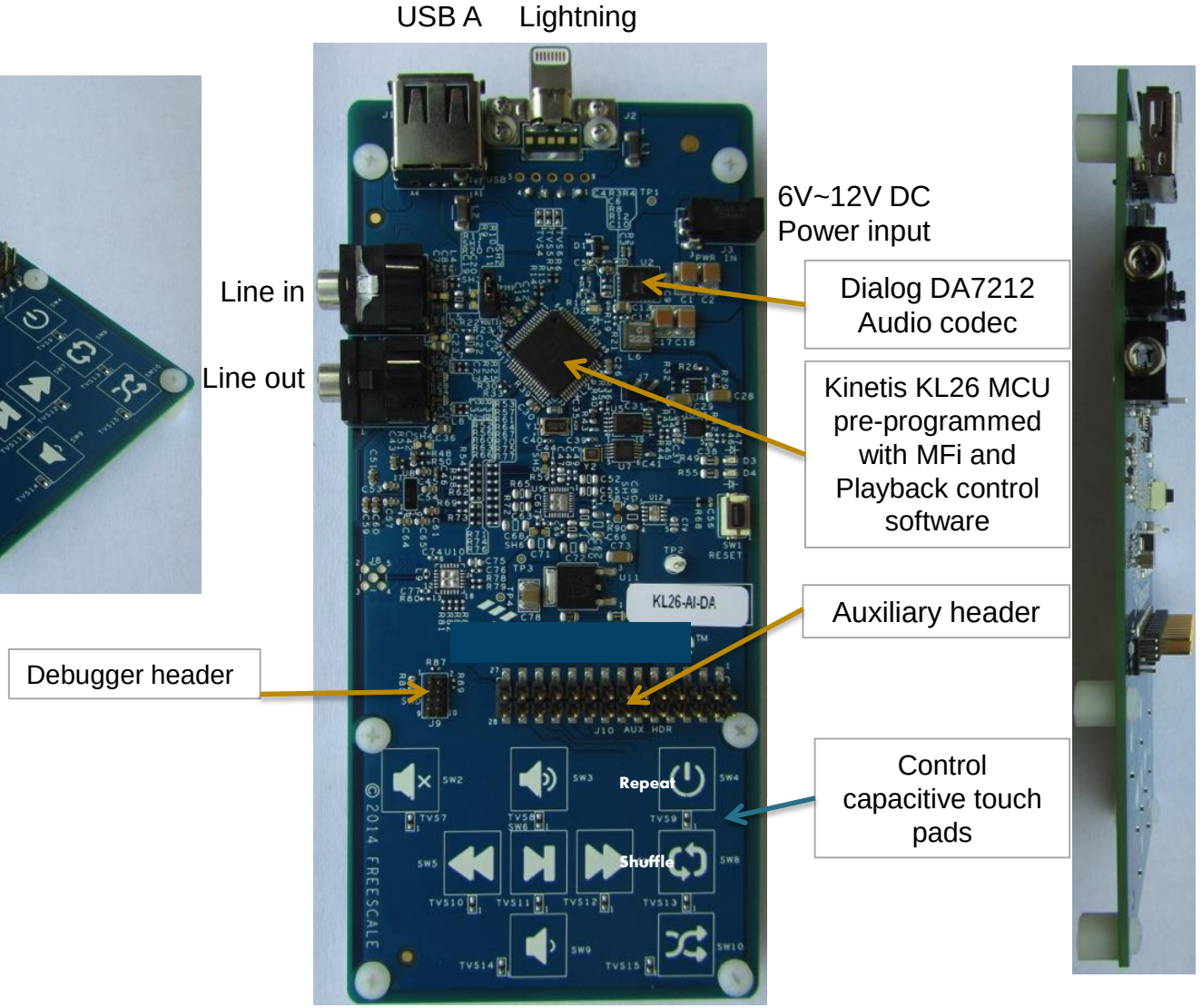
# Anatomy of an App-Based Accessory

- 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

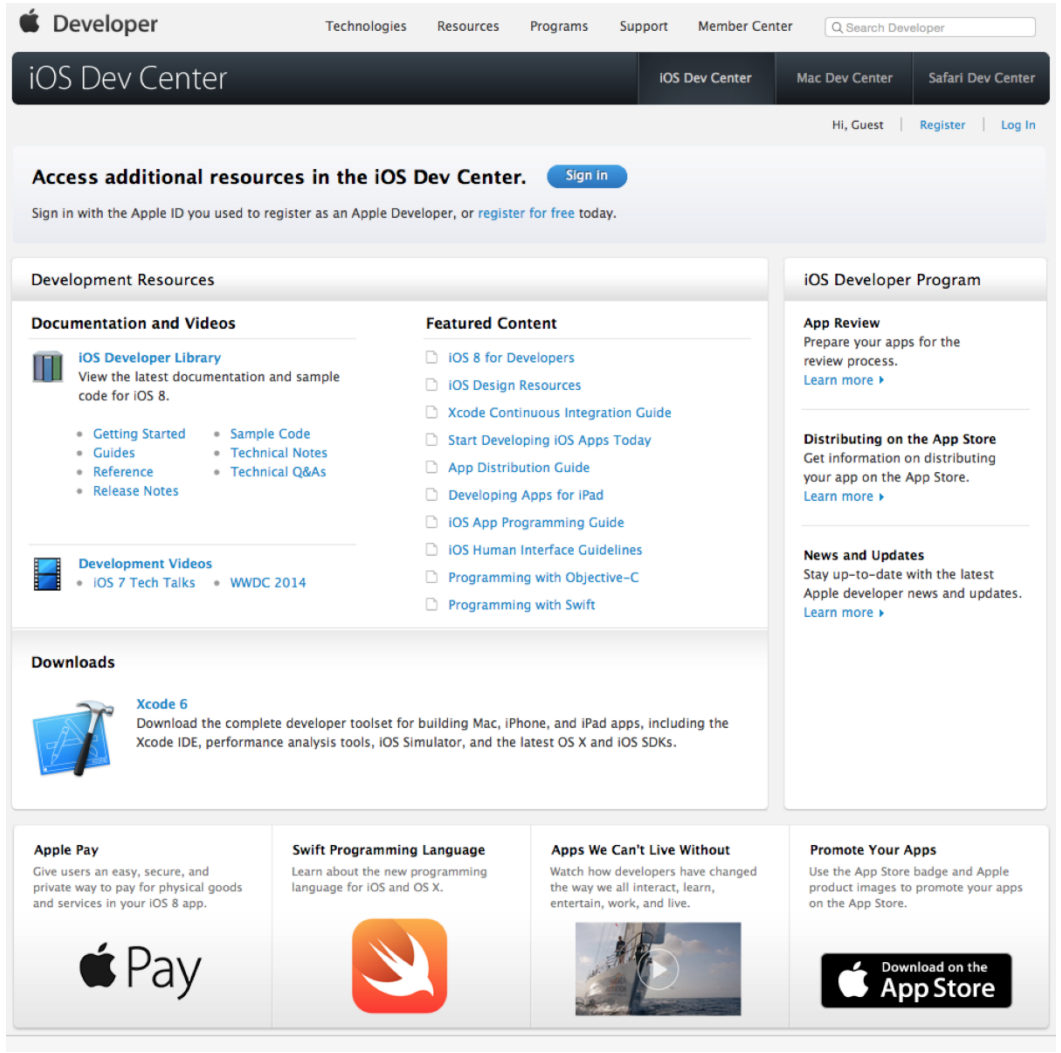
The iOS App Developer Program supports the development of iOS Apps

- 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



# 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 | **Kinetis FREEDOM**<br>Low-cost Kinetis development Platform | - **TWR-DOCK2**: MFi interface and Freescale SGTL5000 audio codec<br>- **FRDM-TWRPI** Freedom to Tower adaptor<br>- **TWR-ELEV**: Tower elevator | - **MED-EKG**: iOS app based ECG<br>- **TWR-LCD-RGB**: MFi GUI Digital Speaker Dock<br>- **TWRPI-MPL115A**: iOS App Based Altimeter |
| | **Kinetis TOWER**<br>Kinetis modular development Platform | - **TWR-DOCK2**: MFi interface and Freescale SGTL5000 audio codec<br>- **TWR-ELEV**: Tower elevator | |
| **i.MX 6** Application Processors | **i.MX 6 SABRE**<br>Automotive development Platform (include Cirrus CS42888 audio codec) | MFi module | |

# MFi SDK Videos

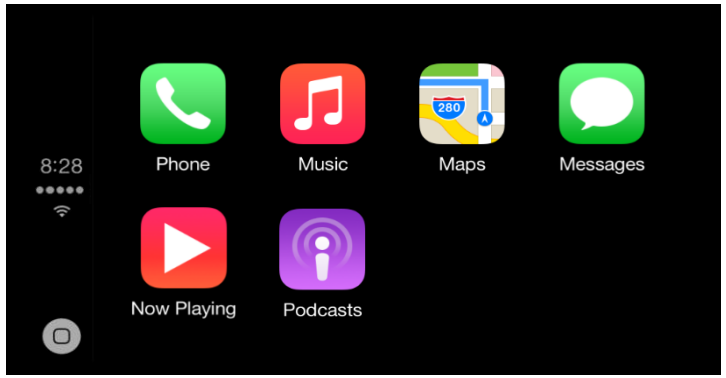
The following demo videos are available on the MFi SDK web page:

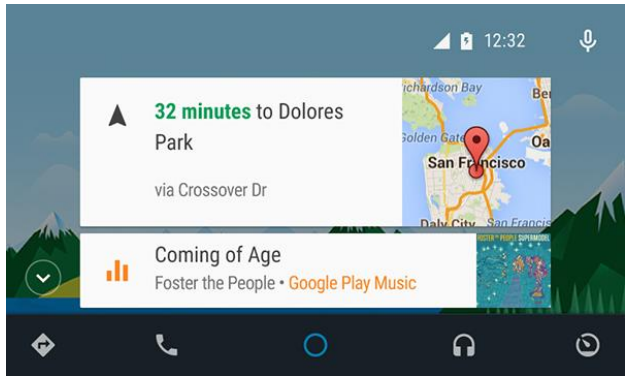

Made For iPod (MFi)


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

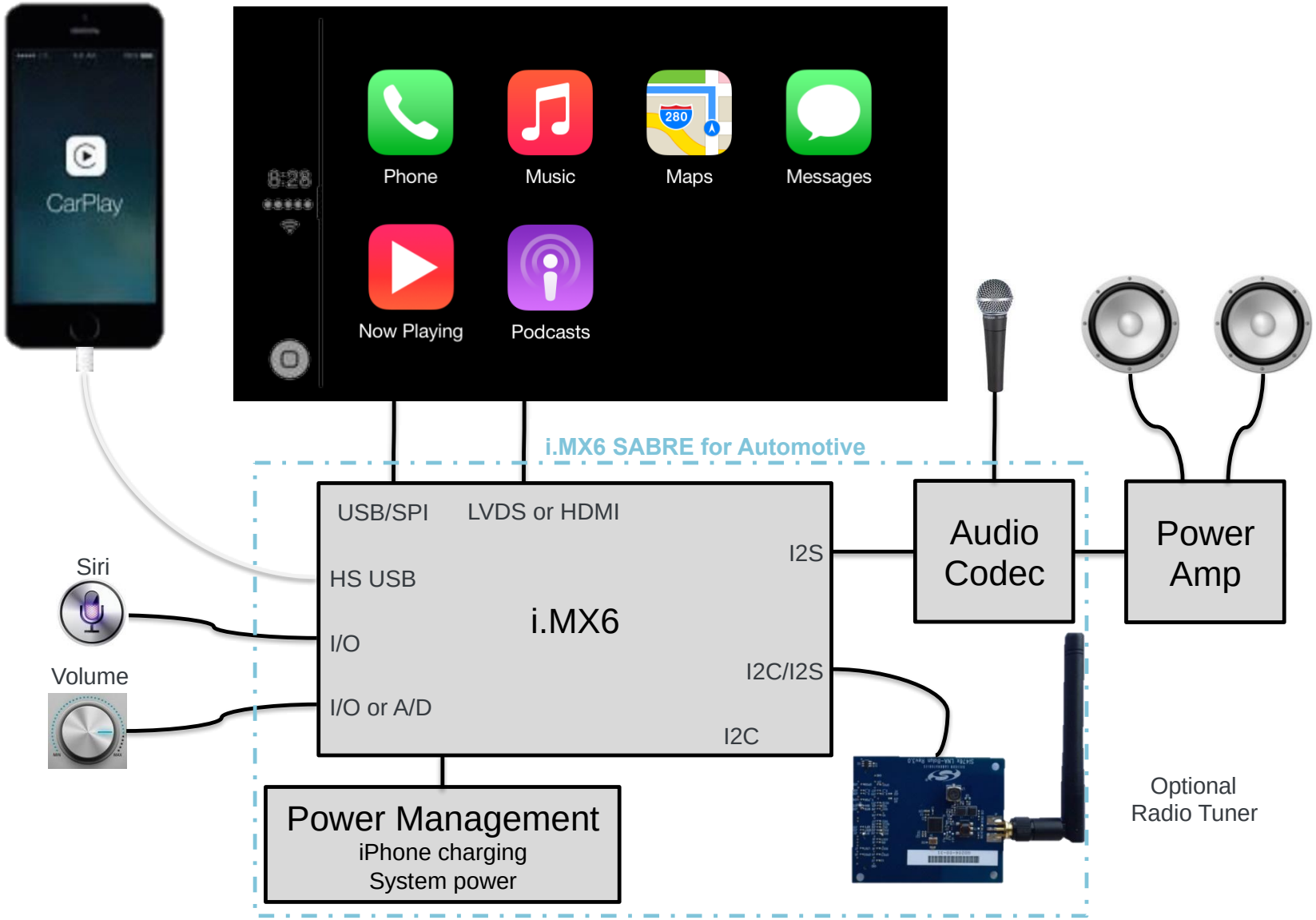
- The functionality and user experience is almost entirely controlled by the smartphone
- The functionality is limited to that appropriate for the driver
  - No video playback, no emails, no FaceBook, no web browsing, no typing
- Many functions are voice activated (Siri or Google Now)
- User interface 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

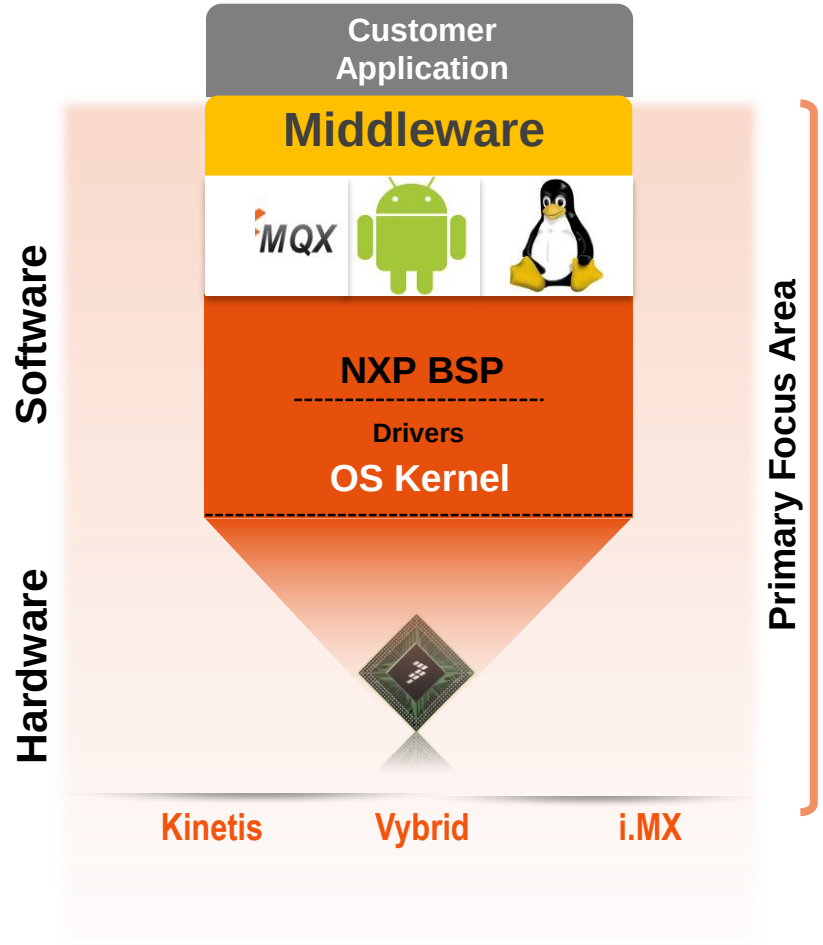
# NXP Apple CarPlay Development Hardware

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

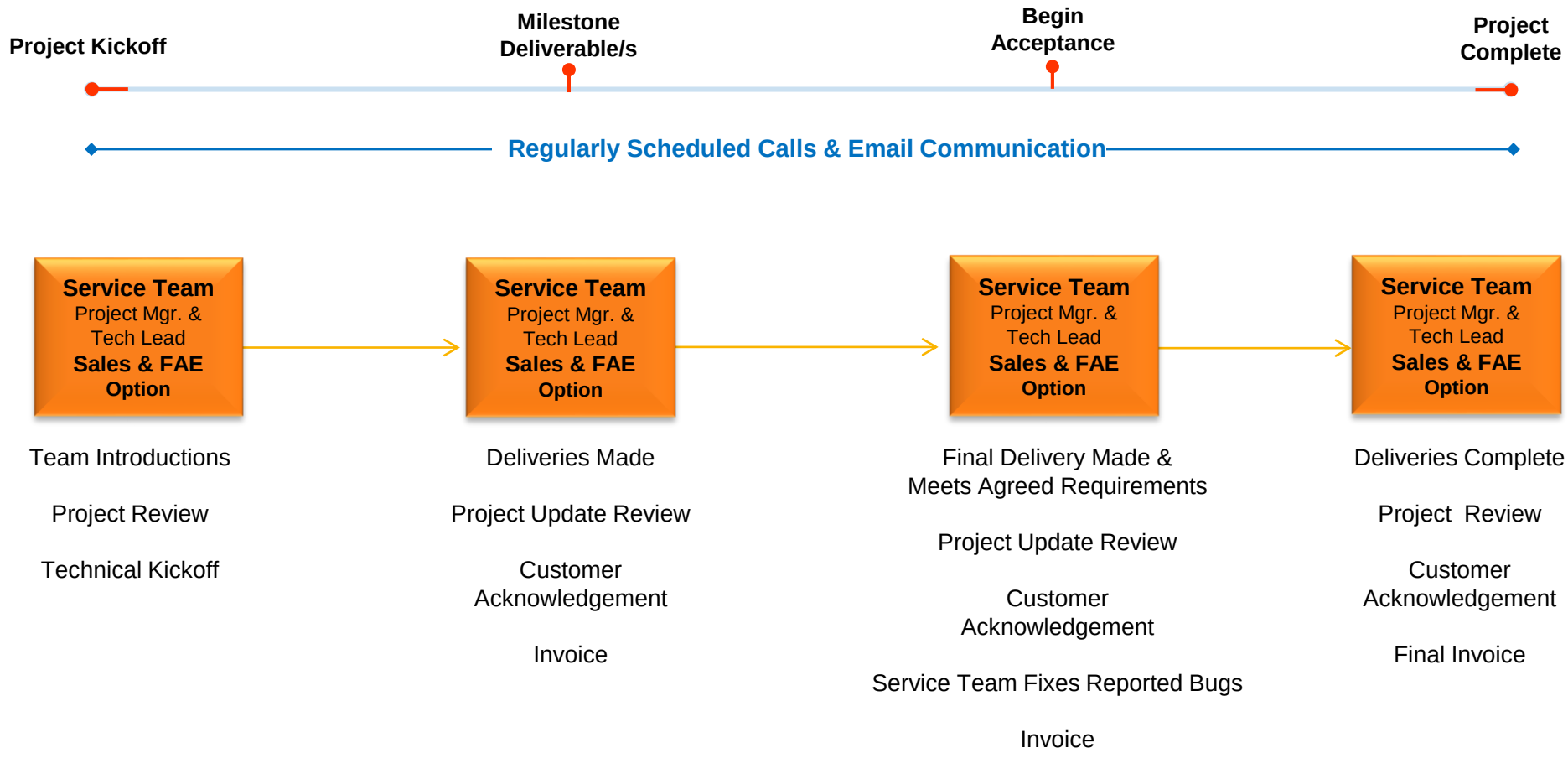
- Linux®, Android™, MQX, Stacks, Graphics, Audio/Video, Middleware, Drivers, AUTOSAR
  - Customization
  - Integration
  - Development
  - Porting
  - Testing
  - Optimization
  - Issue Analysis, Debug & Fix
- Application Migration
- Frozen Branch Support

## 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<br>Thread Stack (supports end node only)<br>ZigBee 3.0<br>IEEE 802.15.4 MAC<br>SMAC w/ Connectivity Test and Wireless UART<br>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

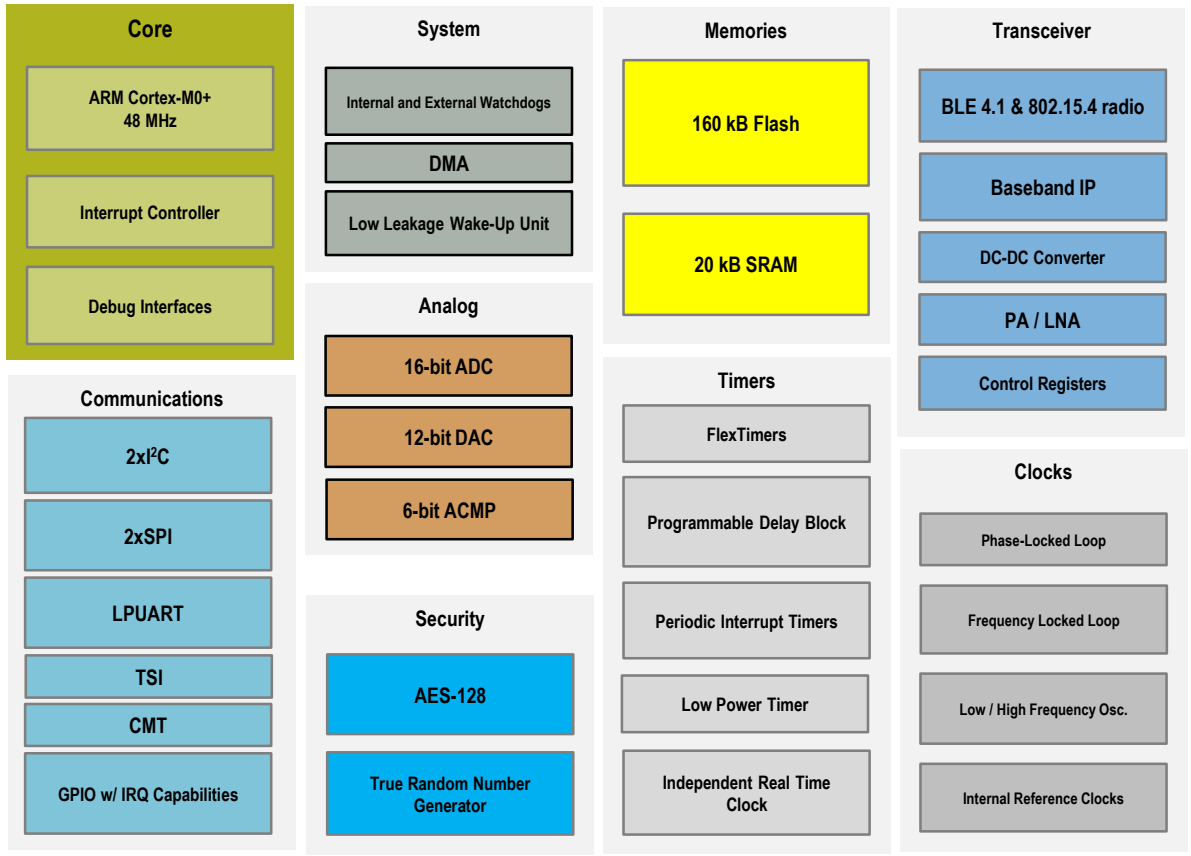
### Analog
- 16-bit ADC with integrated temperature sensor and battery monitor
- 12-bit DAC and 6-bit High-speed Comparator

### 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: -40ºC to +105ºC

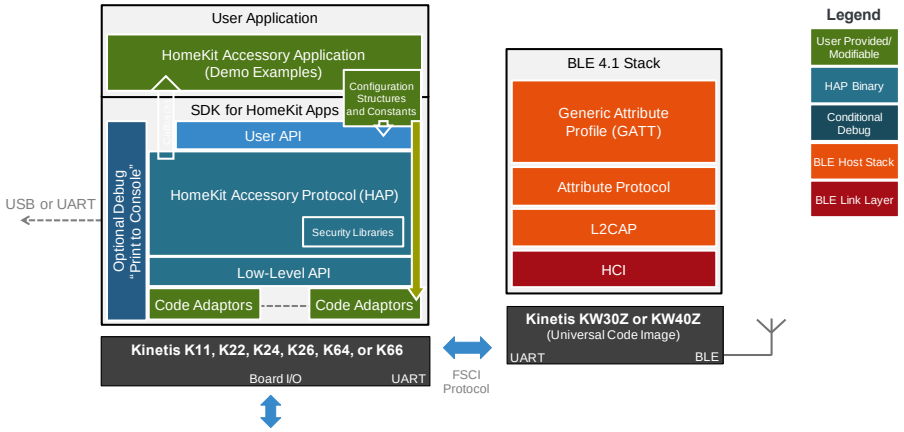


# Recommended NXP Host Processors for HomeKit SDK Implementation

| 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<br>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<br>1024 / 256 | Yes | RNG, MMCAU, CRC | USB HS & FS, SDRAM controller | LQFP, MAPBGA, CSP |
| K64 | 120MHz Cortex-M4F | 1024 / 256<br>640 / 128 | Yes | RNG, MMCAU, CRC | USB FS, Ethernet | LQFP, MAPBGA, CSP |
| K66 | 180MHz Cortex-M4F | 2048 / 256<br>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**<br>ARM® Cortex®-M4 MCUs<br>(min. 64 KB SRAM, 512 KB Flash)<br>K22, K24, K26, K64, K66 | No OS,<br>FreeRTOS | + | **BLE** | Kinetis **KW30z/40z** |

## Key Features

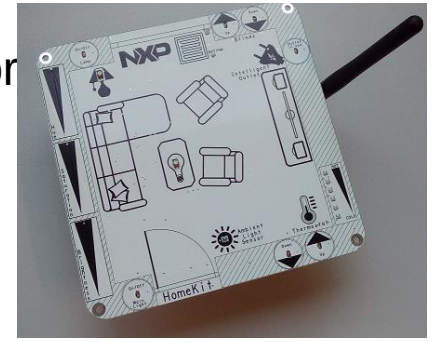
- Full HomeKit Accessory Protocol (HAP)
- Easy configuration setup
- User API independent of communications transport
- Easy porting and adaptation to target platform
- Support for all defined Profiles and Characteristics
- Easy addition of custom Characteristics and Services
- Built-in firmware update 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

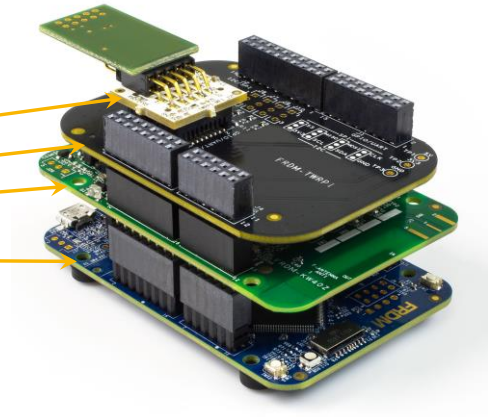
# HomeKit SDK Hardware Support

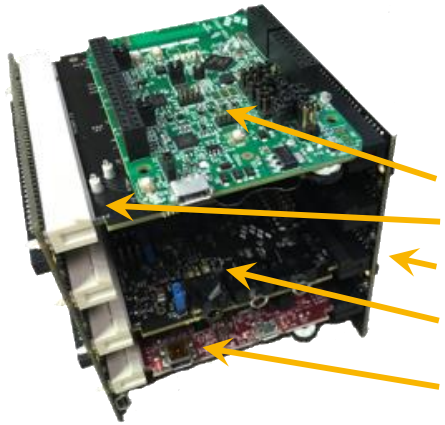
- FRDM system (Arduino compatible) is available now, supporting a range of Kinetis application MCUs
- Next HomeKit SDK release will add support for TWR system and TWR-DOCK2
  - Adding support for QN9020 BLE MCU
  - FRDM and TWR systems include hardware support for BLE, Ethernet and Wi-Fi transpor
- Developing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

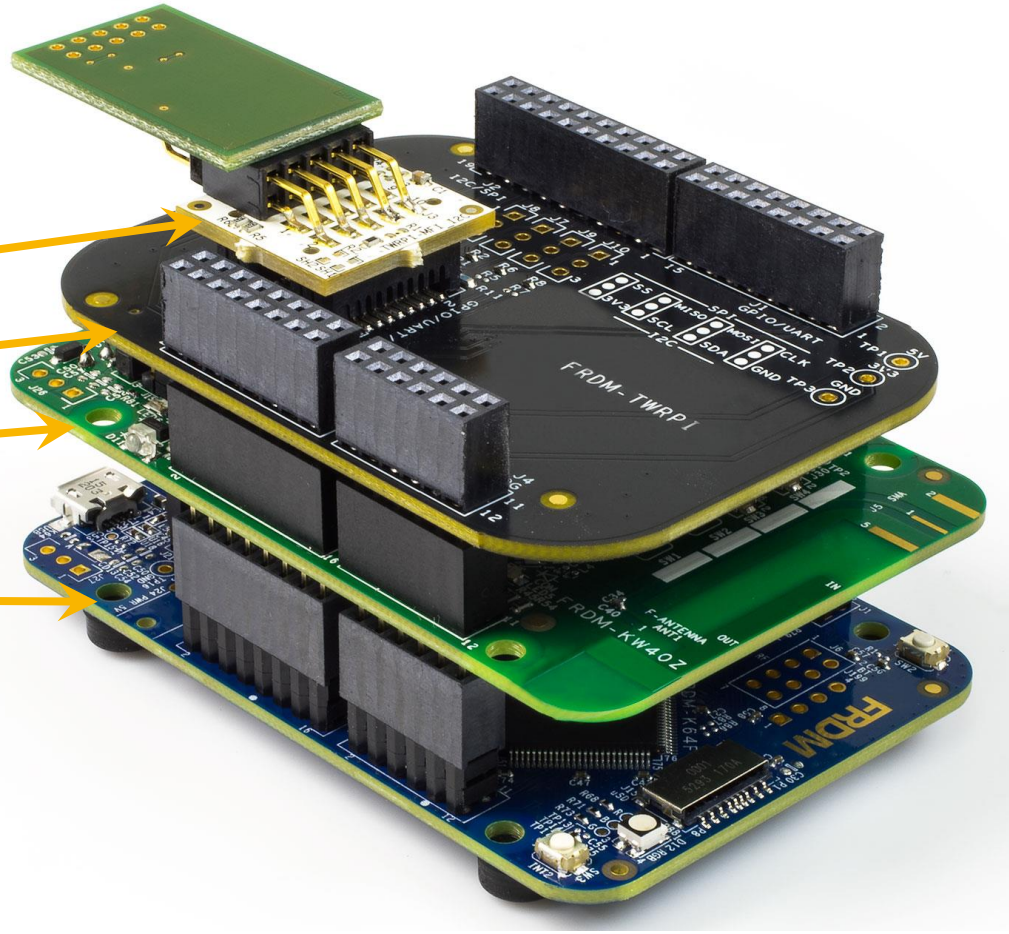
TWR-K64F120M: Host processor

# HomeKit Software Development with NXP Freedom Boards

Available **Now**

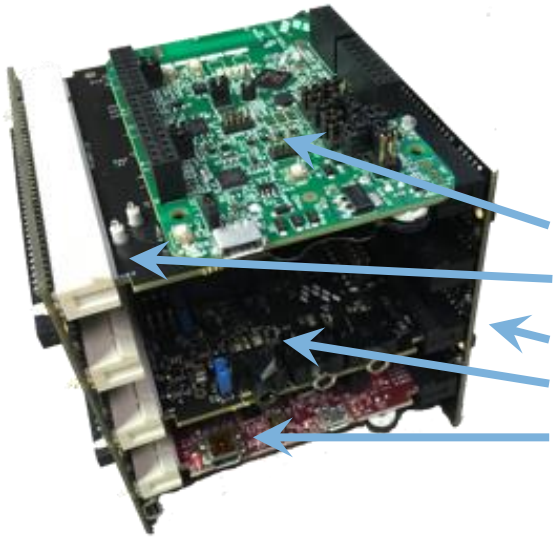
FRDM System consisting of:

- 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**

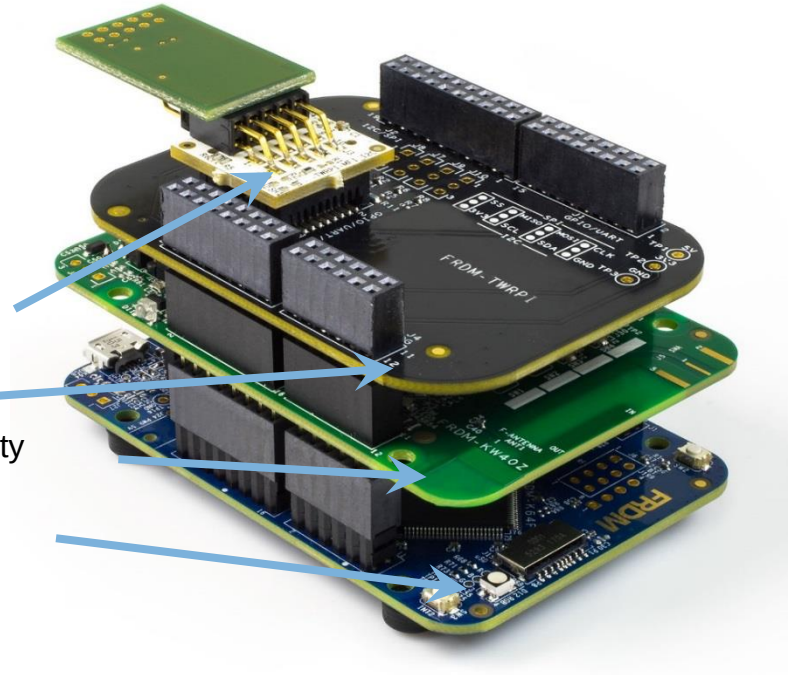
Richer feature sets

TWRPI-I2C* adaptor board

FRDM-TWRPI adaptor

FRDM-KW40Z: BLE Connectivity

FRDM-K64F: Host Processor

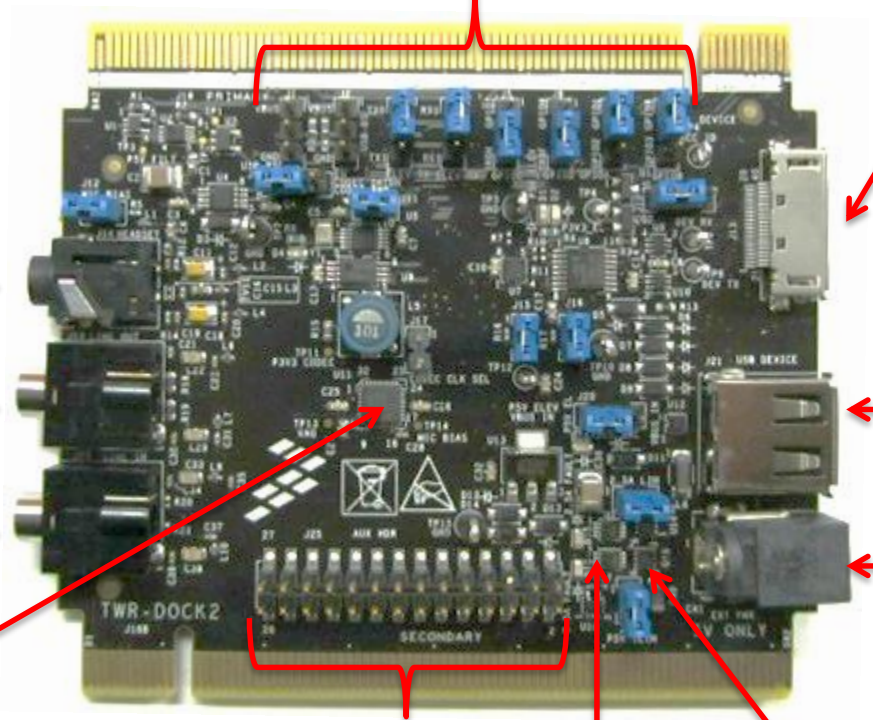


**Freedom System**

Lower cost

# TWR-DOCK2: Tower Module for HomeKit and MFi Development

Available **Now**




Configuration Jumpers

Custom Dock connector cable Header for custom Lightning connector cable

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)

USB A Receptacle for standard USB A to dock connector cable

External power supply input (minimum 5V 5A)

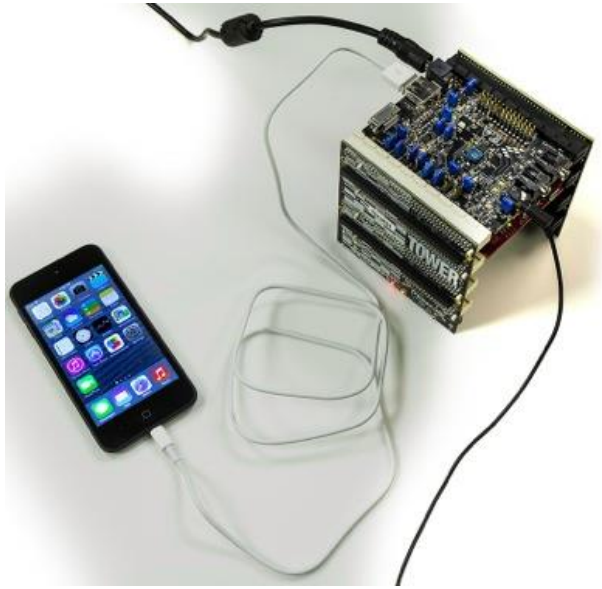
Signal Access Header

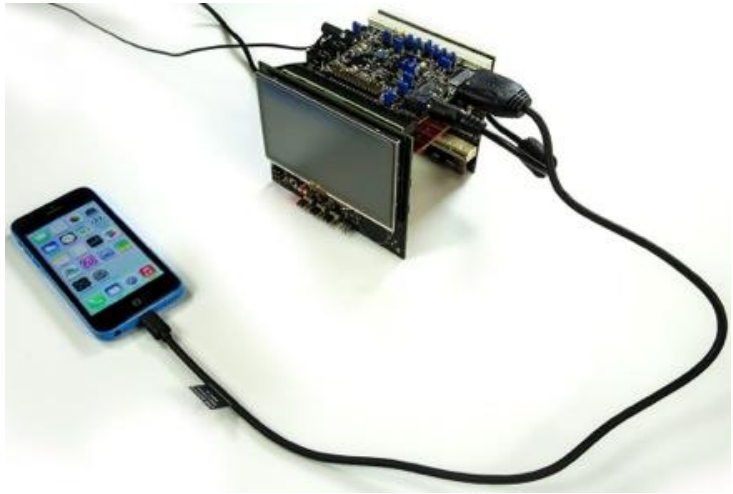
Tower System power current limit circuit (limiter set to 1A)

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

Made for iPod iPhone iPad

# TWR-DOCK2 Use Examples





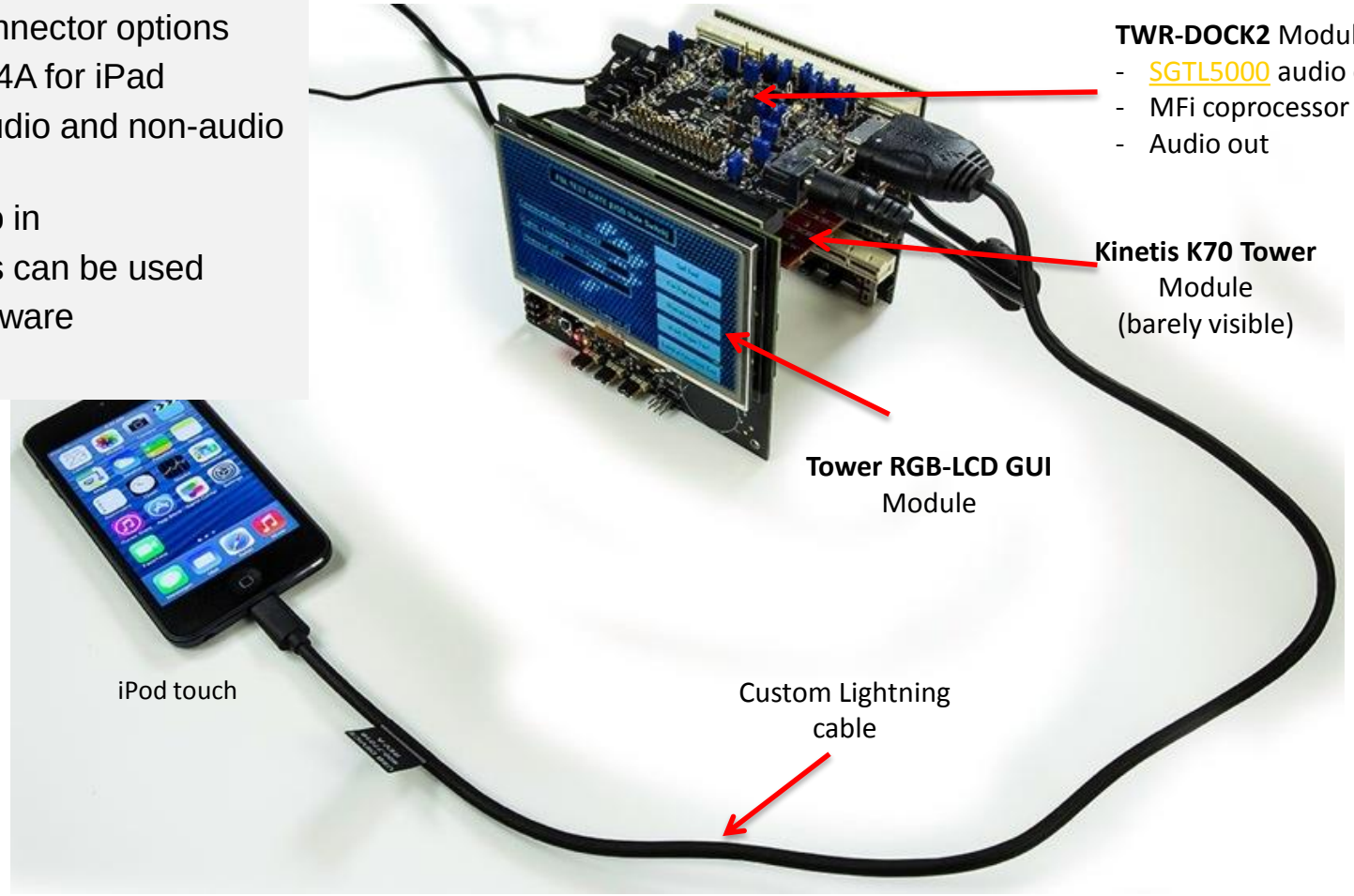
iPhone, iPad or iPod connected to Tower system via TWR-DOCK2 and custom Lightning or 30-pin connector cable

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

Custom Lightning connector cable

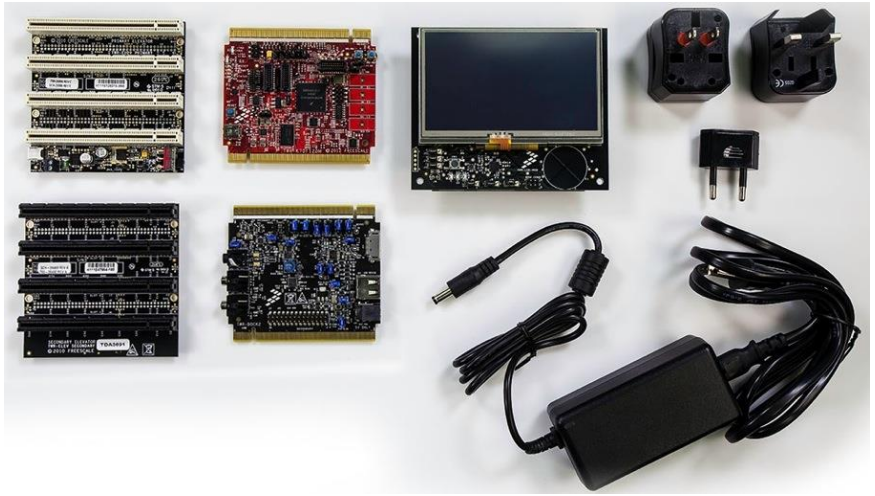
# TWR-DOCK2 – Made For iPod (MFi) Development System

- 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 | | | | | | | | | | X | | | | X | X |
| K22FN512 | FRDM-K22F | | | | | | | | | | | X | X | X | | |
| | TWR-K22F120M | SDK 1.0 | SDK 1.3 Mainline | KDS 3.0 or IAR | FreeRTOS | KW40Z or KW30Z | SDK 1.3 Mainline | IAR only | Bare Metal or FreeRTOS | FRDM-KW40Z | 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

# 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