



Design **Smartphone and Tablet Accessories**

FTF-SHB-F1197

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JUNE . 2015



External Use



Agenda

- Introduction
- Made For iPod (MFi) Accessories
- Apple HomeKit
- Apple CarPlay
- Android Accessories
- Android Auto
- Freescale Audio Solutions
- Summary
- Q & A



Session Abstract

This session will provide an introduction to designing audio and non-audio accessories for smartphones and tablets based on Kinetis MCUs and i.MX applications processors. Several demos will be included.



Introduction



Smartphone and Tablet Accessories & Audio Applications

Existing or Potential Smartphone and Tablet Accessories

Home Audio

- Gaming Headsets
- Audio Processors
- Networked Speakers
- Receivers
- Headphones
- Distributed Audio
- Pro/Prosumer Audio
- Mixers
- Telephony
- Speaker docks
- Clock Radios

Auto Infotainment

- Car Radio
- Smartphone adaptors
- Apple CarPlay
- Android Auto
- Instrumentation

Home Automation

- Lighting
- Power outlets
- Switches
- Security – monitoring systems
- Locks, garage doors, gates
- Thermostats
- Pool and Spa control
- Weather stations
- Irrigation systems
- Water leak monitoring
- Appliances;
 - Dish washers,
 - Washing machines,
 - Driers,
 - Fridges, Freezers,
 - Coffee machines
- Fire, Smoke, CO2 detectors
- Chicken coop doors
- Other?*

Other Consumer

- Sport Equipment
- Exercise Equipment
- Home Health
- Tools
- Toys
- Chargers



Made For iPod (MFi) Accessories



Introduction to MFi

- The development of most Accessories for iPhone[®], iPad[®] or iPod[®] devices requires an **MFi (Made For iPod) license** from Apple
- MFi licenses covers:
 - 30-pin dock connector accessories
 - Lightning dock connector accessories
 - Apple AirPlay
 - Apple HomeKit
 - Apple CarPlay
- iBeacon technology requires a separate iBeacon license



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/>

MFi Accessory Connection Options

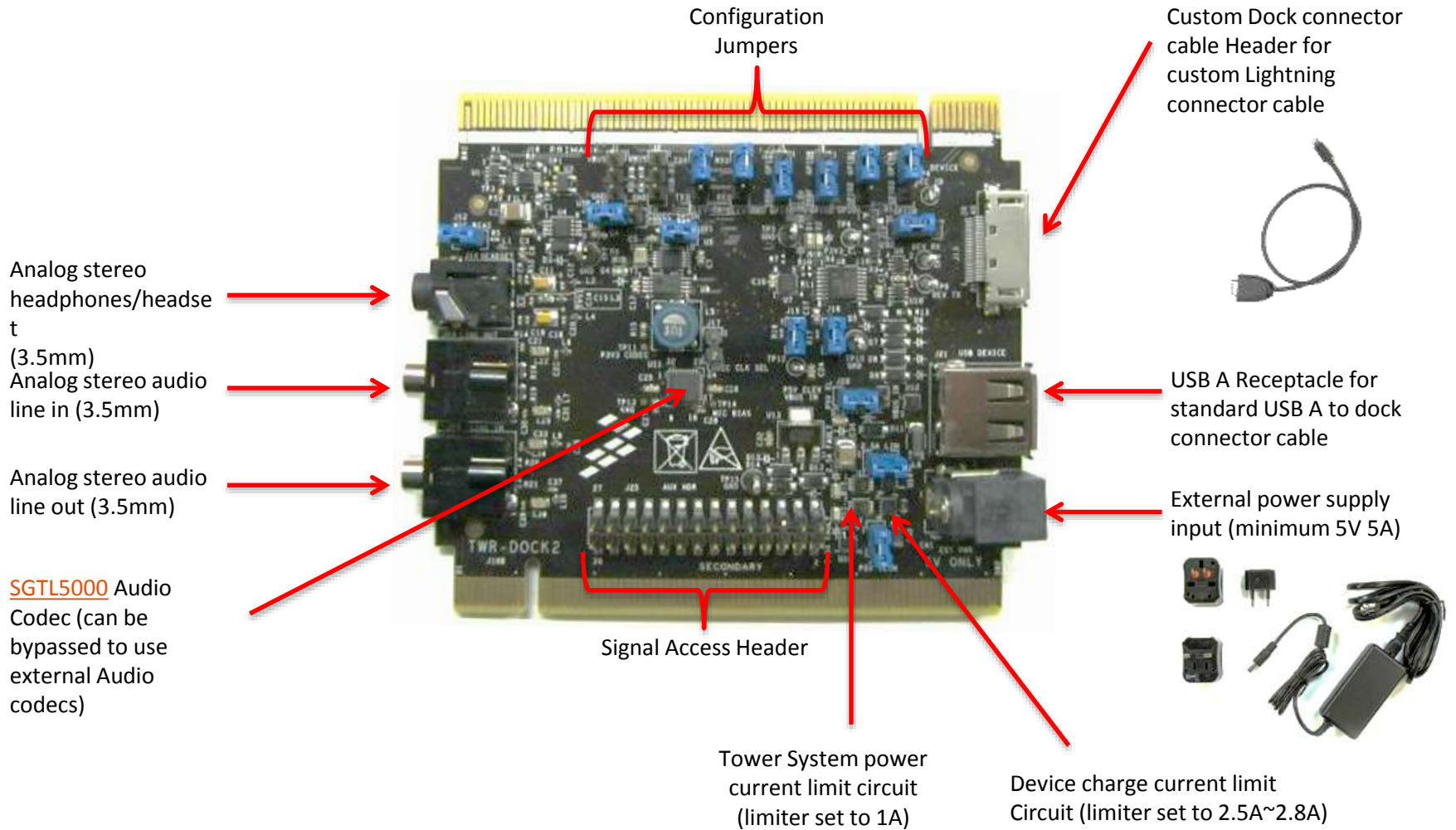
Connection	Wired		Wireless			
	Lightning	30-pin	BLE	BT	BT (MFi)	WiFi
						
License Required	MFi	MFi	MFi for HomeKit, iBeacon for beacons	No	MFi	MFi
Audio	Digital	Analog and Digital	No (except hearing aids)	Yes	Yes	Yes, with AirPlay and CarPlay
Notes/ Comments	Supports all MFi functions	Some MFi functions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

Freescal MFi Solution Philosophy

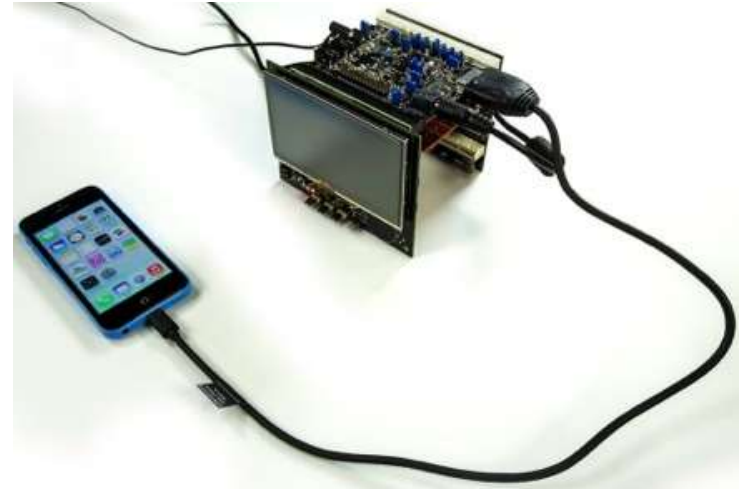
- Develop a flexible solution supporting the full range of possible accessories, including but not limited to audio
- Develop a solution supporting a wide range of existing Freescale MCU and MPU products, and capable of rapidly supporting new Freescale MCU and MPU products at introduction
- Architect the MFi solution to enable fast adoption of any MFi program software or hardware updates
- Make the Freescale MFi solution available to all eligible MFi licensees on the MFi portal



TWR-DOCK2: Tower MFi Interface Board – Available Now



TWR-DOCK2 Use Examples



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



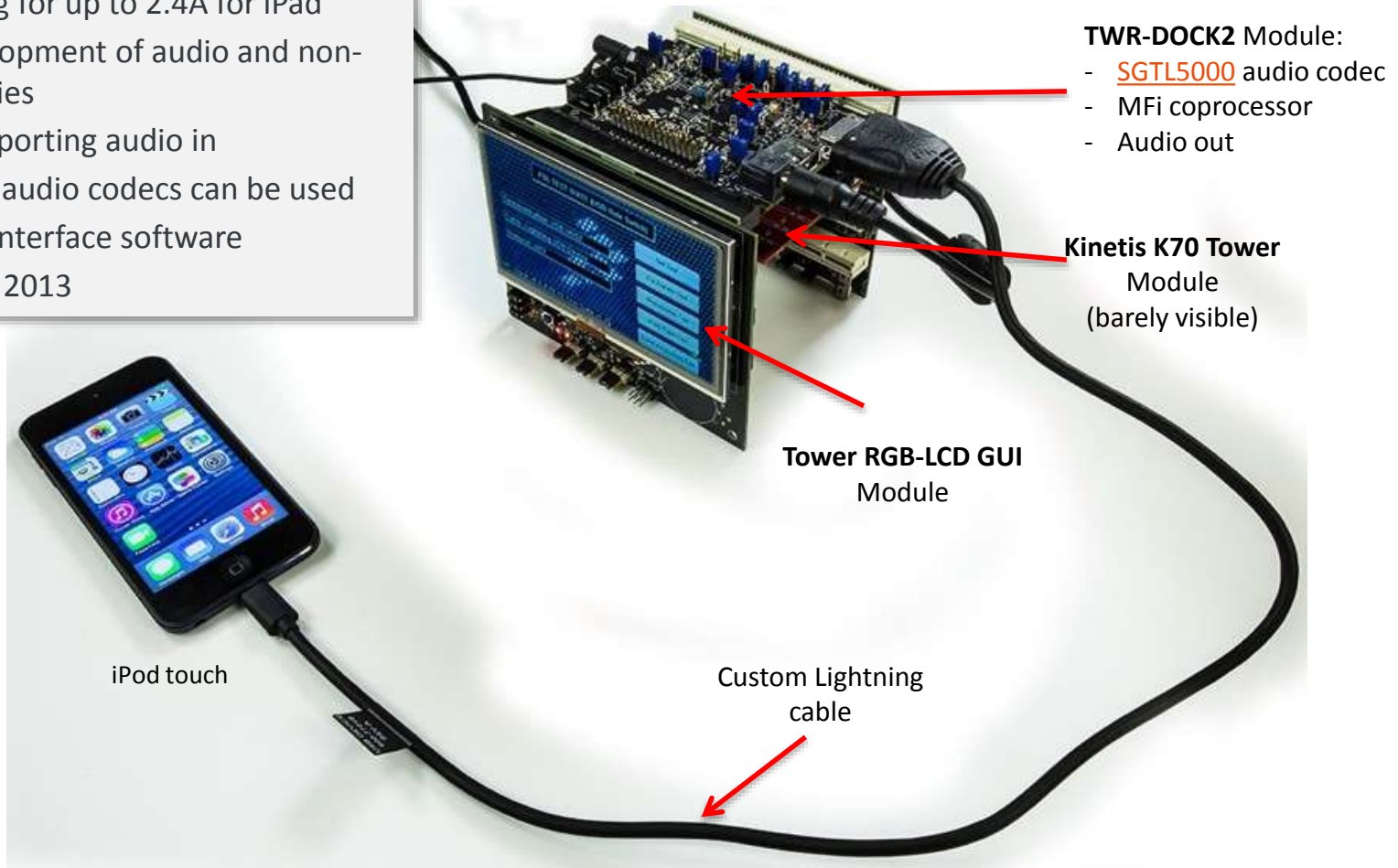
Custom 30-pin connector cable (USB and Serial connection)



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):




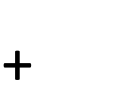













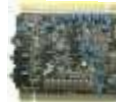






- [TWR-KL46Z48M](#): Development board for KL46 ARM Cortex-M0+ MCU
- [TWR-ELEV](#): Tower elevator
- [TWR-DOCK2](#): include MFi interface and Freescale [SGTL5000](#) audio codec
- Power supply
- Custom lighting connector



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

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

Kinetis KL26 MFi Audio Interface (MFI-KL26-AI) Module

Audio Interface Module for iPhone, iPad, and iPod devices with Apple Lightning™ connector



The MFI-KL26-AI provides line level analog audio input and output with basic playback control and charging for iPhone, iPad, and iPod devices with Apple Lightning dock connectors. It may be used as a reference design or basic development system.

- Kinetis KL26 MCU pre-programmed with MFi and Audio Playback control software
- Connectivity;
 - Lighting dock connector
 - USB A receptacle for use with standard USB to Lighting cables
 - Note: Physical design prevents simultaneous use of above dock connector options
 - 3.5mm analog audio line output
 - 3.5mm analog audio line input
 - Barrel receptacle for 6 to 12V power supply
 - Auxiliary header for serial, GPIO and power lines access
 - Debug interface header for use with Kinetis L MCU development tools
- Capacitive touch pads, configured for playback control
- Standard configuration;
 - Analog line audio input and output with audio codec
- Charging current for connected device is limited to 2.4A

MFI-KL26-AI Module



6V~12V DC
Power input

Dialog DA7212
Audio codec

Kinetis KL26 MCU
pre-programmed
with MFi and
Playback control
software

Auxiliary header

Control
capacitive touch
pads

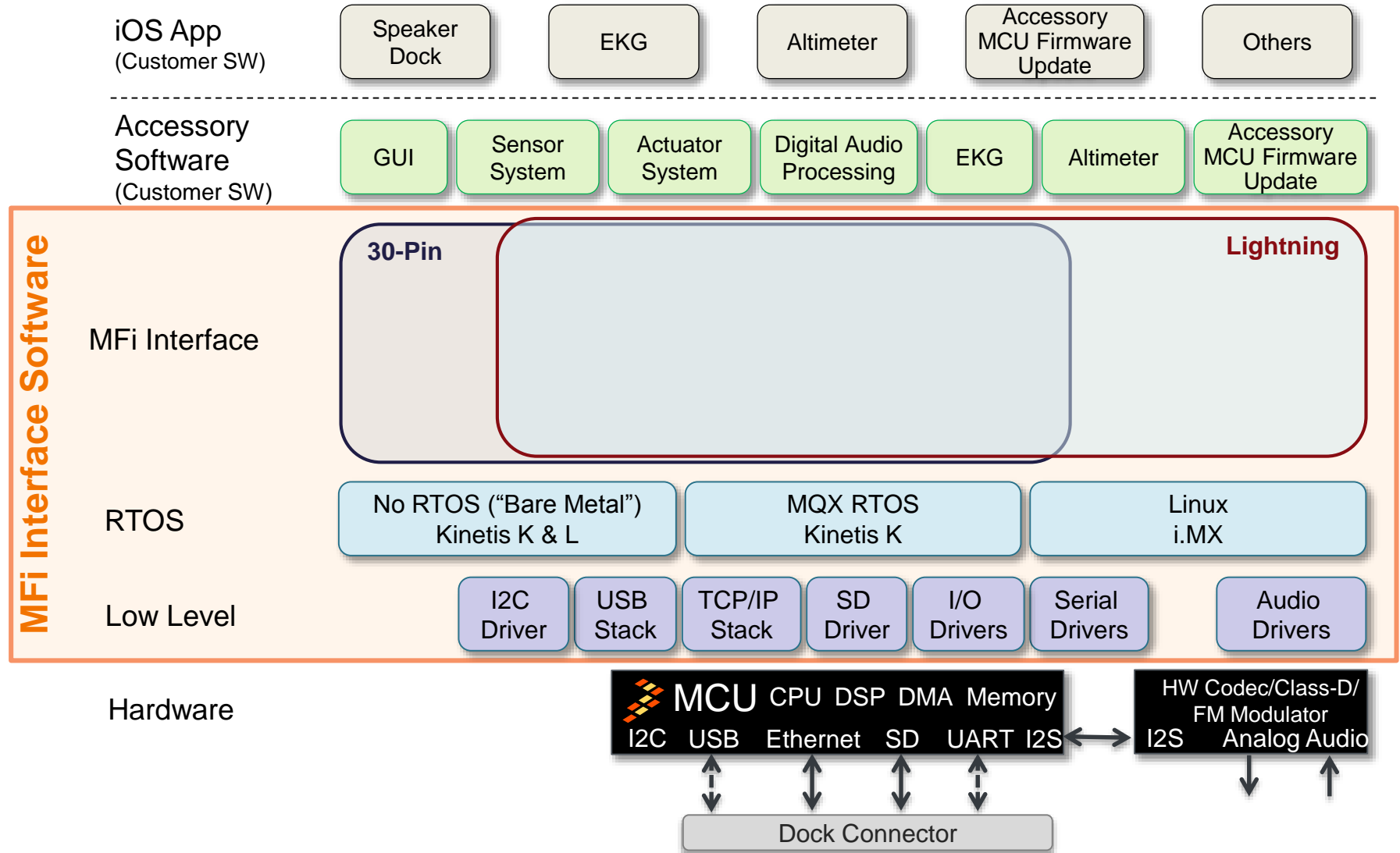
Line in

Line out

Debugger header

USB A Lightning

Freescale MFi Software



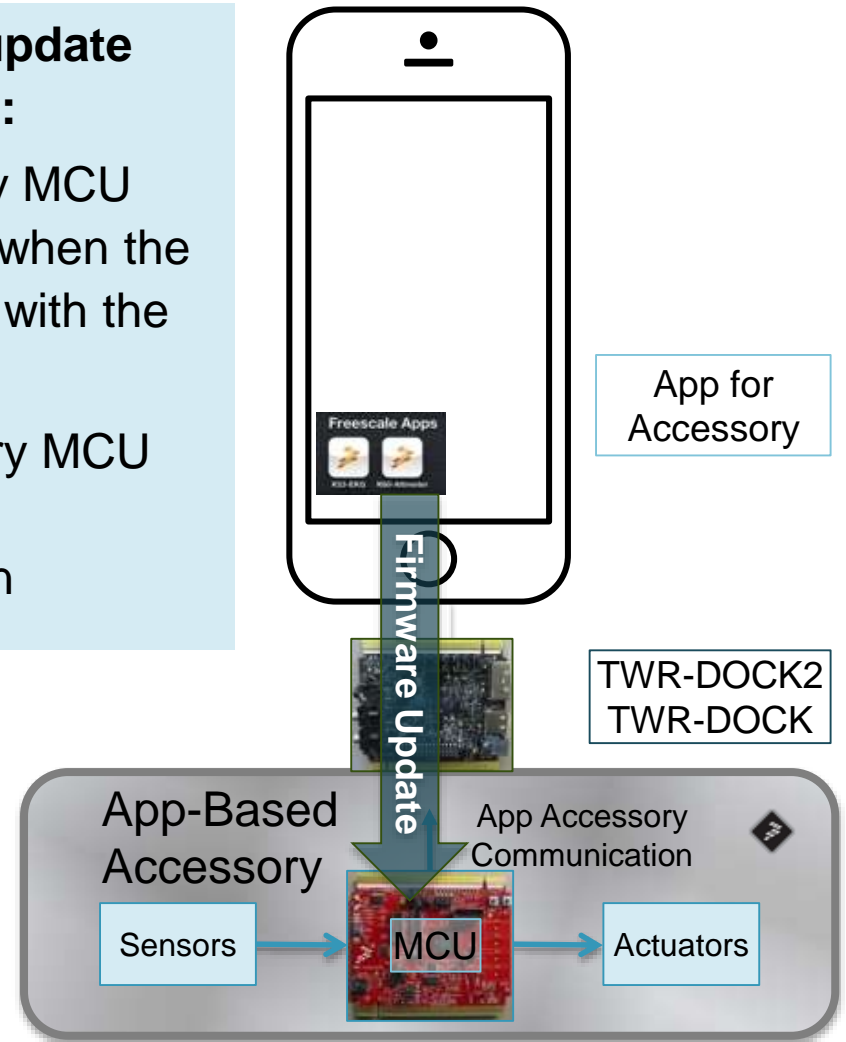
Freescale MFi Software Memory Requirements

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		

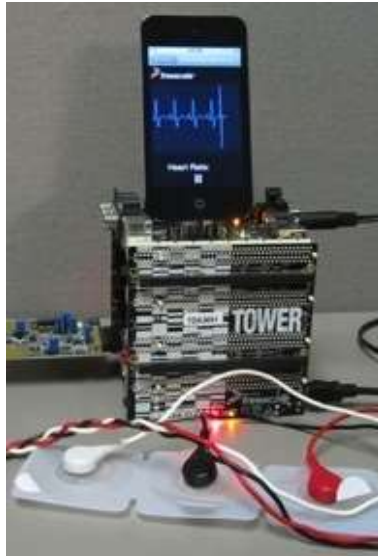
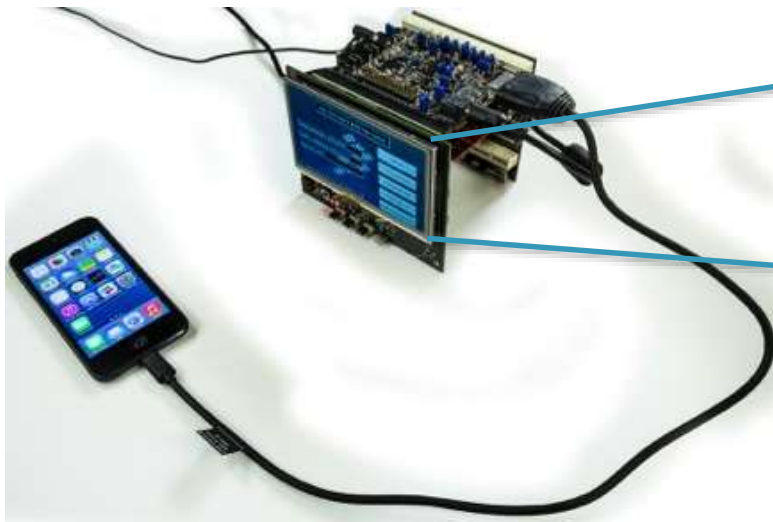
Accessory Firmware Update

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



Freescale'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 Freescale Web Page

freescale Location | 中文 | 日本語 | 繁體中文 | My Freescale | Login

Products Applications Design Resources Support Sample and Buy About

Keyword Product/Parameter/ Orderable Part Search by keyword

Rudolf's Freescale Login Annotate History My Recommendations Subscribe My Favorites

Freescale Tower System: Modular Development Platform Tower System General Peripheral Modules TWR-DOCK2

TWR-DOCK2: Tower System MFI interface Module

Overview Documentation Training & Support

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 ARM9 Cortex™-M4 based Kinetis MCU module, the TWR-KL46Z48M ARM Cortex-M3+ based Kinetis L MCU module, the TWR-LCD-ROB 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 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 connector.

Supported Devices

- Kinetis K Series MCUs
- Kinetis L Series MCUs

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-K7BLCD** kit contains:
 - TWR-DOCK2 module with power supply
 - TWR-K70F120M Kinetis K70 MCU module includes on-board 3-axis accelerometer MMA8451Q
 - TWR-LCD-ROB 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
 - TWRPI-MPL115A barometer plug-in
 - TWRPI-KEYPAD 12-key capacitive touch keypad plug-in
 - TWRPI-ROTARY capacitive touch rotary plug-in
 - TWR-ELEV elevator modules
 - Quick Start Guide

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

Related Software and Tools

CW-MCU10: CodeWarrior for MCUs (Eclipse IDE) - CodeFire, 56000E DSC, Kinetis, CoriVx S6ex, RS08/100, S12E

PE_DRIVER_SUITE: Processor Expert Software, Microcontroller Driver Suite

Buy Now

MFI Program: TWR-DOCK2 is available for order only through the MFI Portal.

Tower Geeks

Interact. Explore. Create. Join the online community for designers using the Tower System.

Like Tower Geeks on Facebook. Follow Tower Geeks on Twitter.

For more information and the TWR-DOCK Fact Sheet, visit:
<http://www.freescale.com/mfi>

Link to Apple MFi developer web page

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)



Freescal 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!

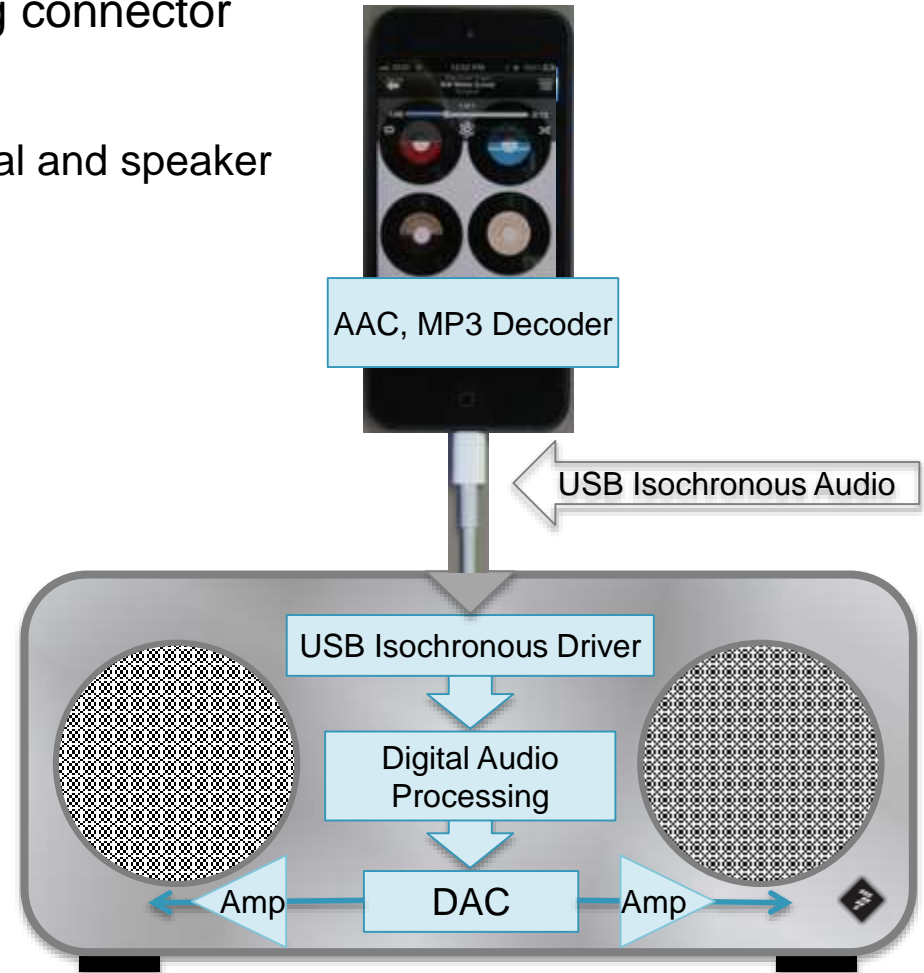
Target application areas:

- 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



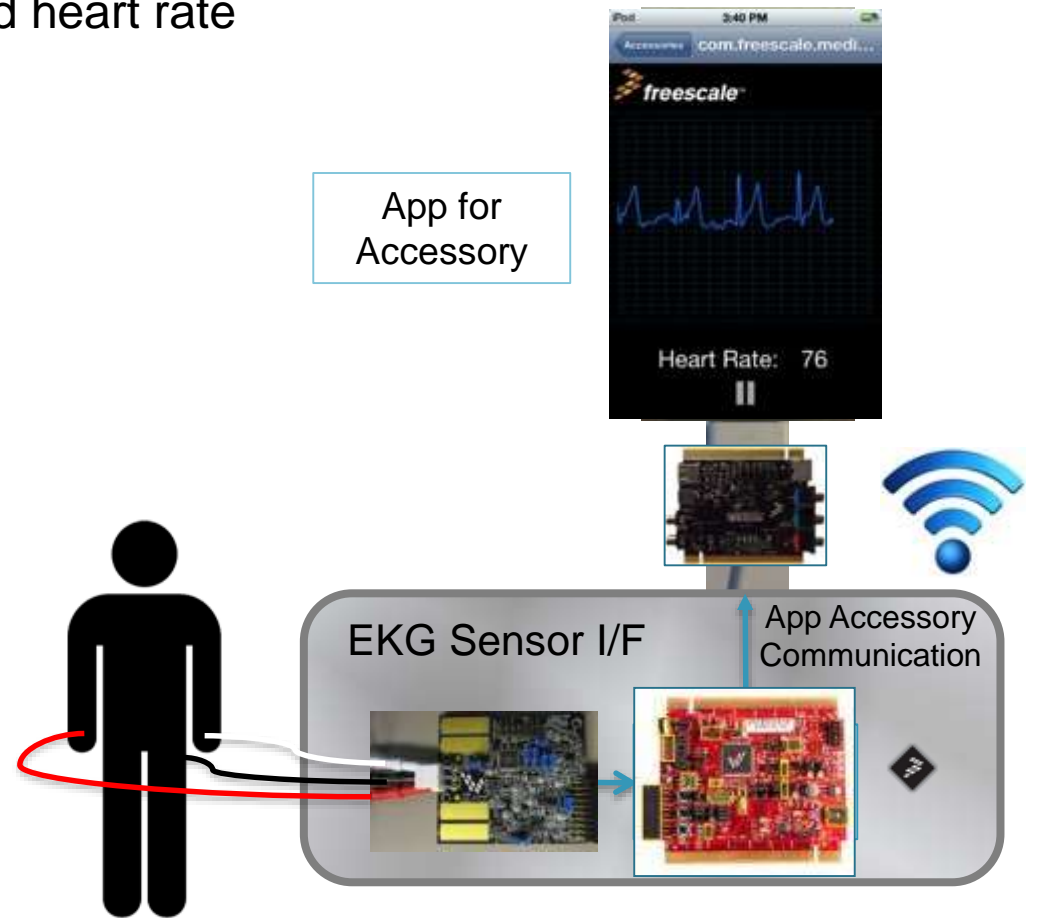
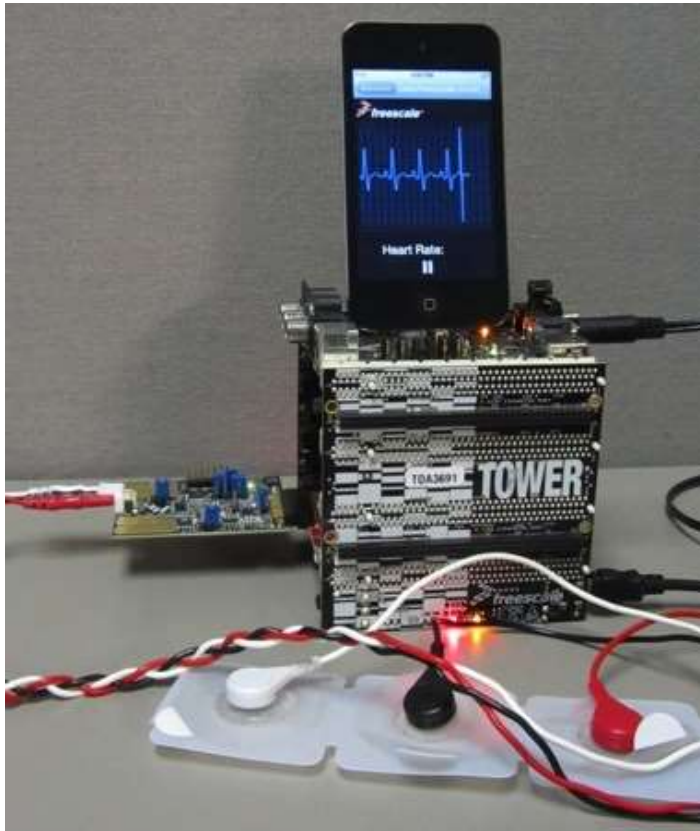
App-Based Speaker Dock

- 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



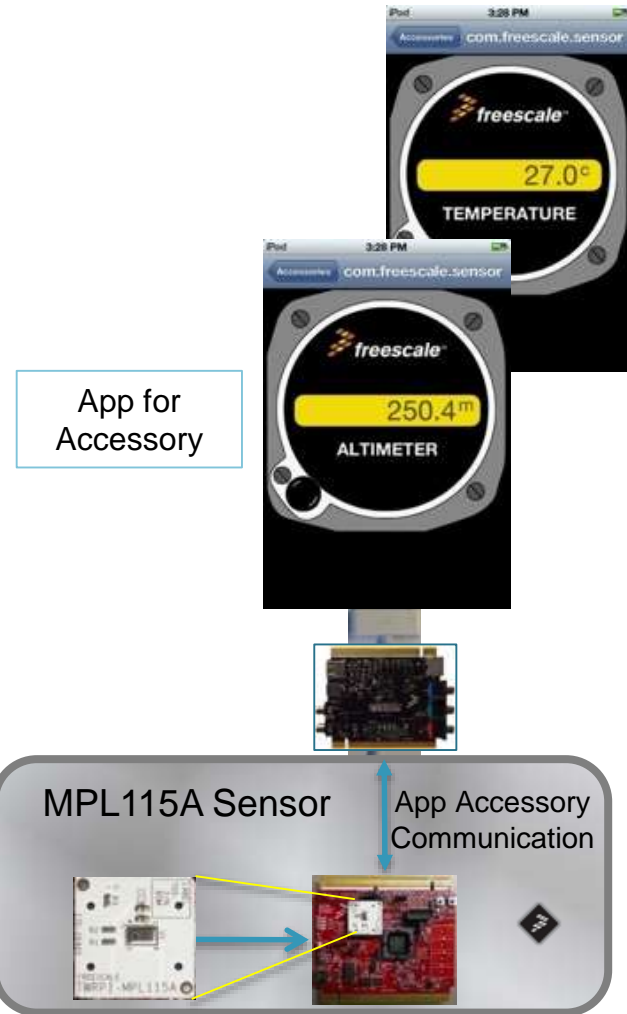
Demo Example: EKG - Electrocardiogram

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



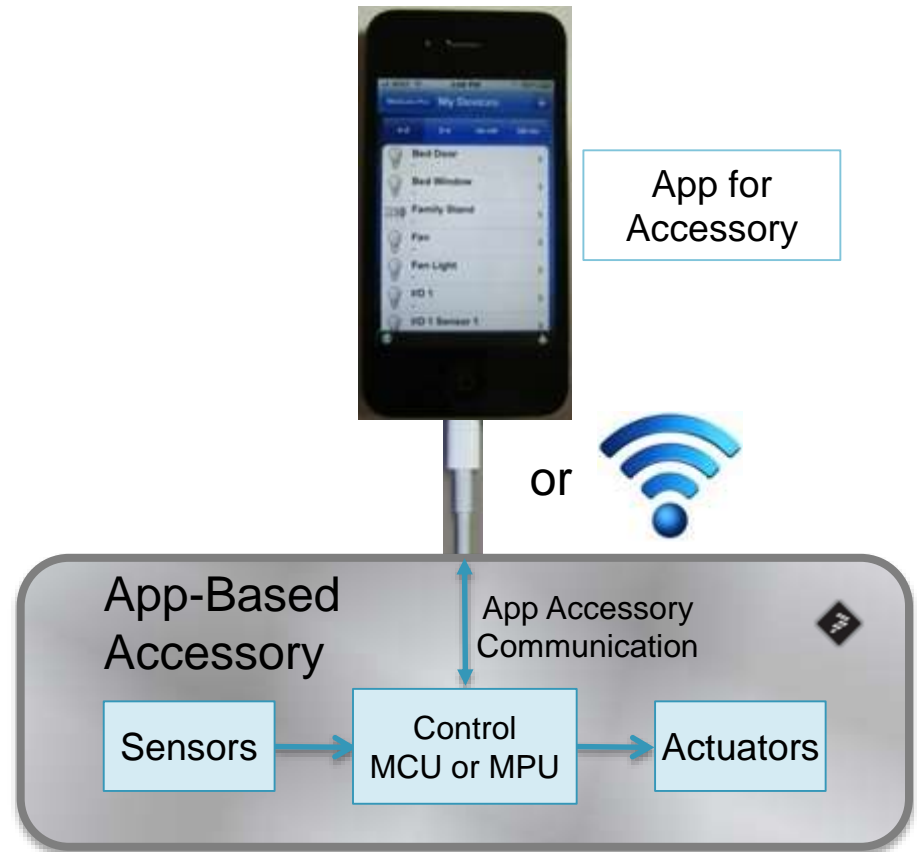
Demo Example: Altimeter

- 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



iOS Apps

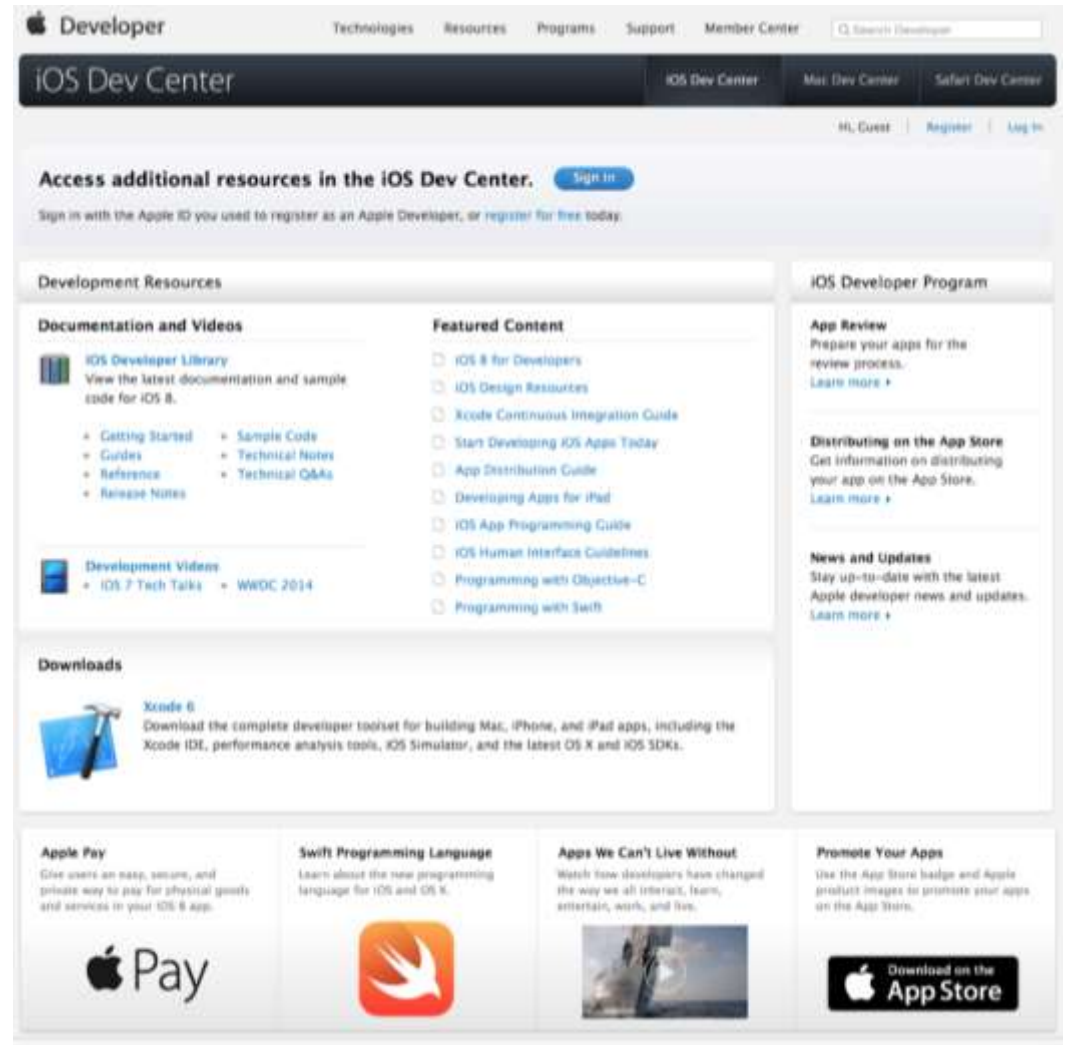
The iOS App Developer Program supports the development of iOS Apps

- 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>



Freescale 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	

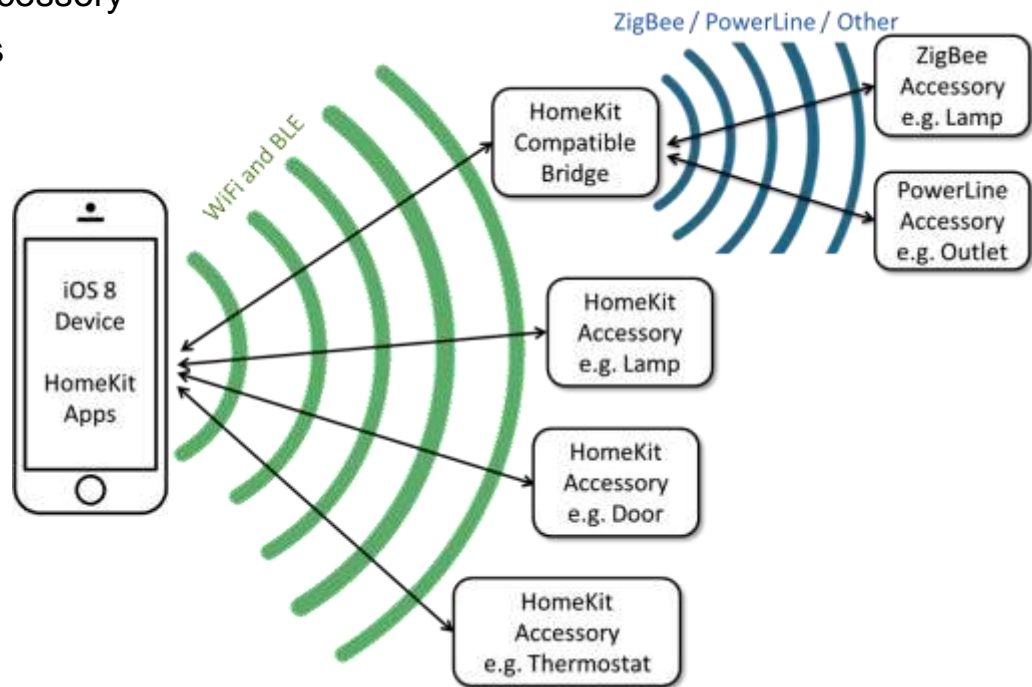
Apple HomeKit Accessories



Apple HomeKit – Overview

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

- Defines standard interface between iOS and Home Automation accessories
- Directly supports WiFi and BLE (4.0) transports
- Supports multiple other transports such as ZigBee, Z-Wave, Thread and PowerLine via an accessory Bridge
- 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 accessories
- HomeKit support available from iOS8

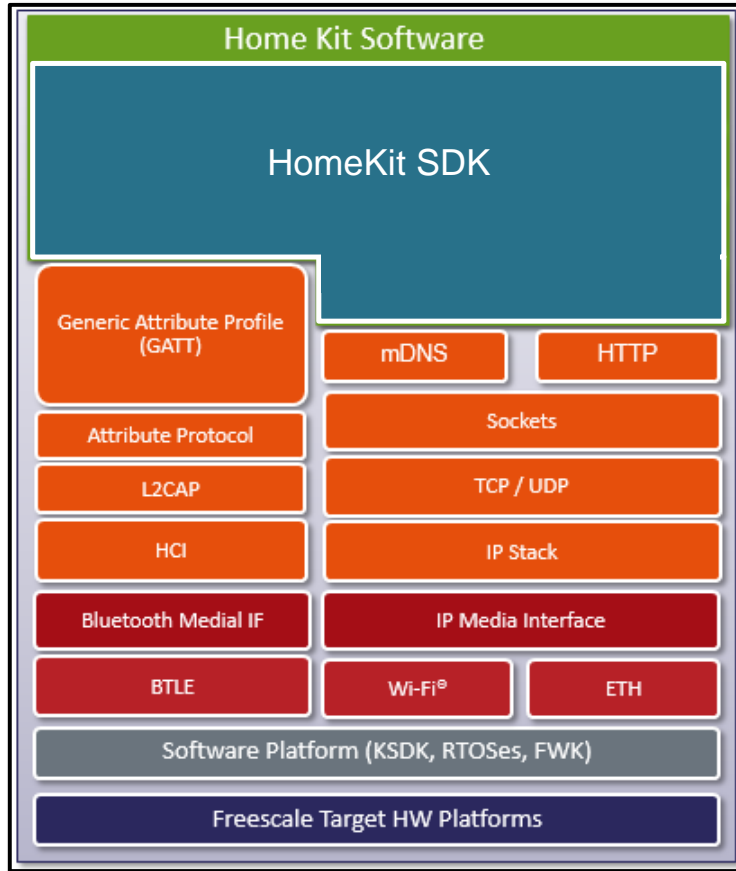
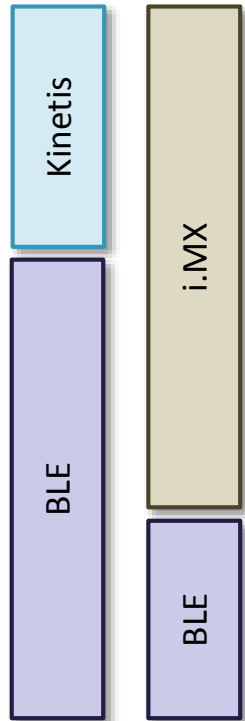


WWDC 2014 HomeKit relevant sessions:

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

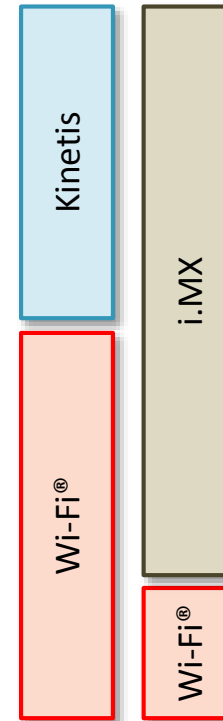
Apple HomeKit Software Block Diagrams

Bluetooth Low Energy 4.0 (BLE) Transport



IP Transport

Wi-Fi®



Ethernet



HomeKit System Recommendations

Minimum CPU requirements:

- ARM Cortex-M4 at 50 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

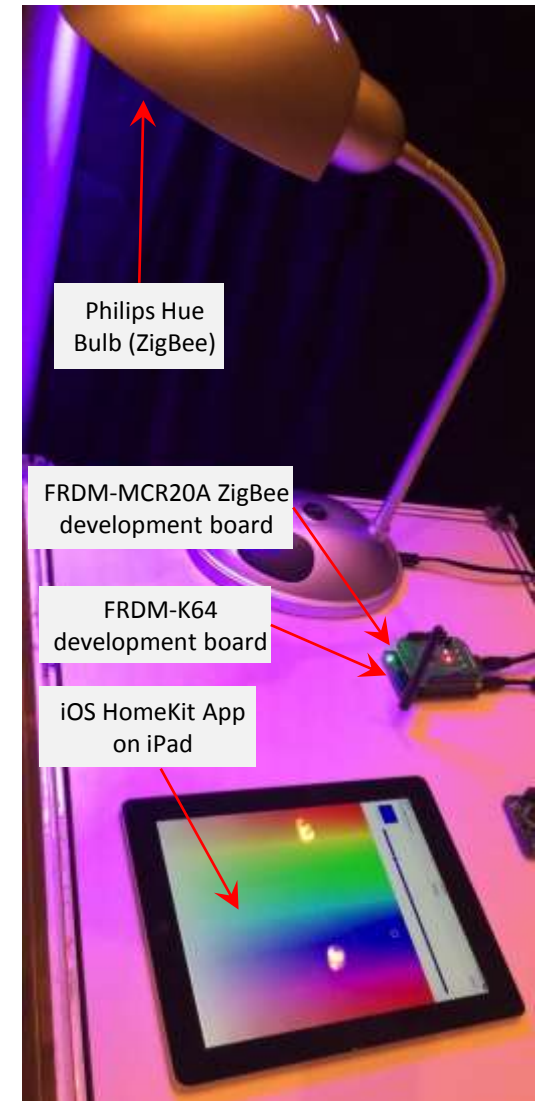
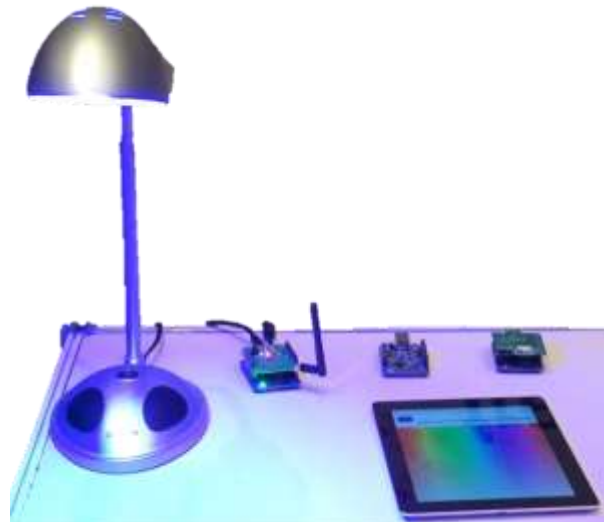
	Platform	Flash	SRAM	Comments
Typical System Recommendations	HomeKit over Wi-Fi	512 KB	64 KB	128 KB SRAM will benefit some systems
	HomeKit over BLE	256 KB	64 KB	512KB Flash recommended if running a full BT stack (including controller and host) on same device
Estimated SDK only	HomeKit over Wi-Fi	256 KB	48 KB	
	HomeKit over BLE	160 KB	32 KB	If full BT (with controller) stack: 230/48 KB

HomeKit Bridge to ZigBee Demo

Overview:

- Allows HomeKit control of Philips Hue bulb via a HomeKit Bridge from IP to ZigBee (replaces Philips bridge)
- Option of Ethernet or Wi-Fi connection
- Consists of;
 - FRDM-K64 development board
 - FRDM-MCR20A ZigBee development board
- iOS HomeKit App controls On, Off, Brightness and Color hue

Note: Requires TWR-DOCK2

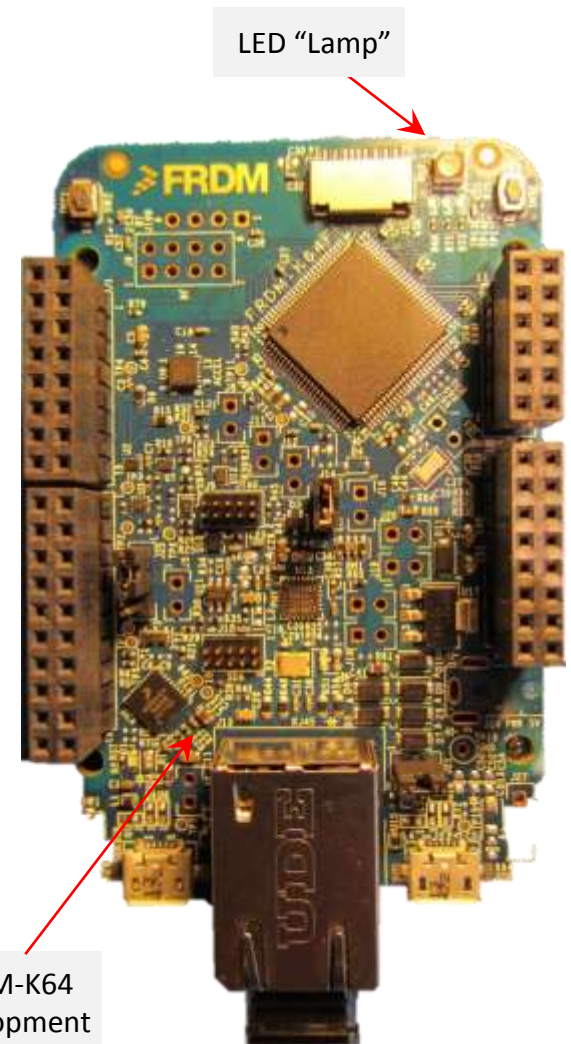


HomeKit Simple Lamp Demo

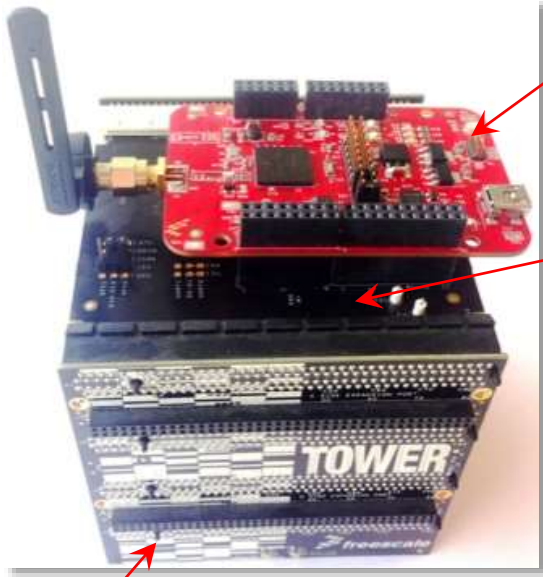
Overview:

- HomeKit control of LED “Lamp”
- Option of Ethernet or Wi-Fi connection (Ethernet shown)
- Consists of FRDM-K64 development board
- iOS HomeKit App controls Lamp On and Off

Note: Requires TWR-DOCK2



Examples of Tower Development Platforms for HomeKit



FRDM-KW40

Kinetis KW30/40 development platform

TWR-SHIELD

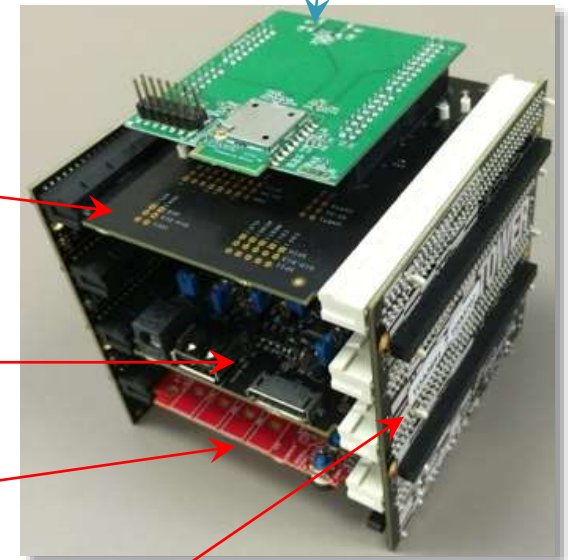
Tower adaptor for Wi-Fi module

TWR-ELEV

Tower elevator

GT202 Wi-Fi Freedom Shield

Qualcomm QCA4002 module



TWR-SHIELD

Tower adaptor for Wi-Fi module

TWR-DOCK2

MFi interface

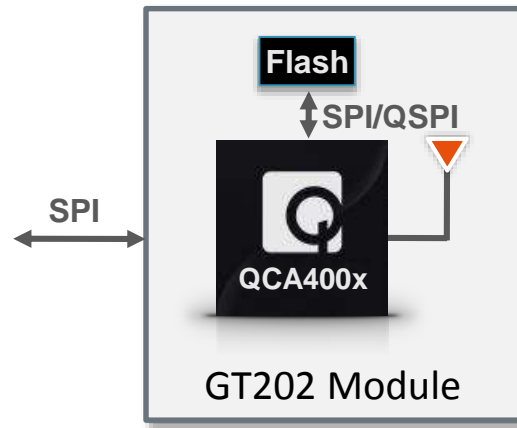
TWR-K22F120M

Kinetis K22 MCU development Platform

TWR-ELEV

Tower elevator

GT202 Thin-Client Wi-Fi Module from Arrow



- Highly integrated Thin Client (No MCU) Wi-Fi module for development of products based on QCA4002
- Drivers for Kinetis K-series and L-series MCU's
- 2.4 GHz Single-band, single antenna
- Regulatory Certified for fast time-to-market
- Integrates with Freedom board for evaluation and development
- Cloud connect solution with 2lemetry
- Low power modes with fast boot from serial flash
- Choice of PCB antenna or external antenna
- Available now

Arrow GT202 Thin-Client Module Development Kit

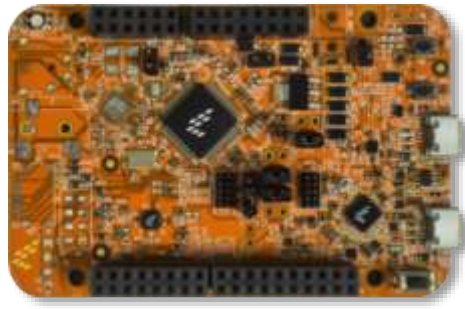
Freedom Development Kit Options

- Kit 1: [GT202 Wi-Fi Freedom Shield](#) – Available Now
- Kit 2: GT202 + [FRDM-K22F](#) (MQX RTOS) – Available Now
- Kit 3: GT202 + [FRDM-KL46Z](#) (MQX-Lite) – Jan'15



GT202 Wi-Fi Shield

+



Freescale K22F or K64
Freedom Board

=



GT202 Development Platform

GT202 Wi-Fi Shield can be integrated into Tower development system using [TWR-SHIELD](#) adapter

HomeKit Wi-Fi Reference Module

- HomeKit reference module based on:
 - Kinetis K22 MCU
 - Qualcomm QCA4002 WiFi SoC
- Peripherals
 - 1 x USB OTG
 - 3 x UARTs, 1 LPUART, including hardware flow control
 - 1 x SPI, 1 x I2S, 2 x I2C, GPIOs, 2 x ADC, 2 x DAC
- Wi-Fi 802.11a/b/g/n
- CPU: 120MHz with 128K RAM, 512K Flash
- PCB: 4 layers with Industry Grade
- Operation voltage: 3.3V
- Available end **2015** from:
 - MFi authorized distributors
 - Large volumes available from MFi authorized CM



HomeKit Wi-Fi® Reference Module Base Board



HomeKit Target Home Automation Applications

- Lighting
- Power outlets and switches
- Security – monitoring systems
- Locks, garage doors (including chicken coop doors), and gates
- Thermostats
- Pool and spa control
- Weather stations
- Irrigation systems
- Water leak monitoring
- Appliances; Dishwashers, washing machines, dryers, fridges, freezers, coffee machines
- Fire, smoke, CO2 detectors
- *More, Be creative!*



Freescal HomeKit Software

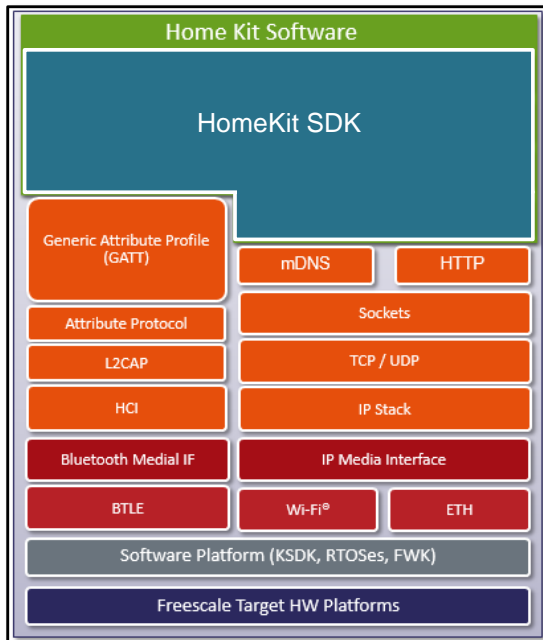


HomeKit interface software including protocol stacks



Targeted applications

- Home automation (lightning, thermostats, security, smoke detectors....)
- HomeKit end-points
- HomeKit bridges



Key features

- HomeKit interface software
- Support for IP transport (Wi-Fi and wired Ethernet) and BLE transport
- Production ready reference design with Kinetis K22 MCU and QCA4002 WiFi module
- BLE solution based on Kinetis KW30 BLE SoC
- HomeKit unoptimized binary for IP/Wi-Fi is estimated at 280KB of Flash and 26KB of SRAM
- Paid-for-download with unlimited production license
- Premium Support and Professional Services available

Products Supported

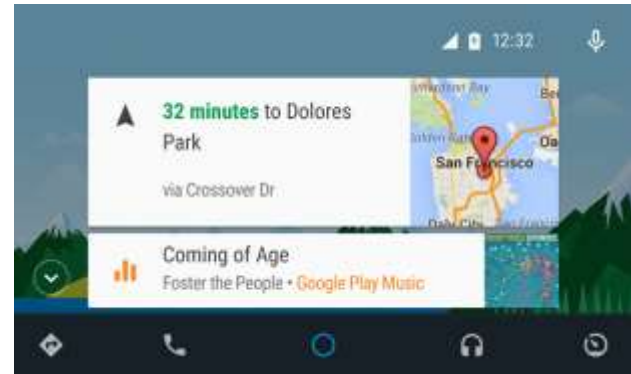
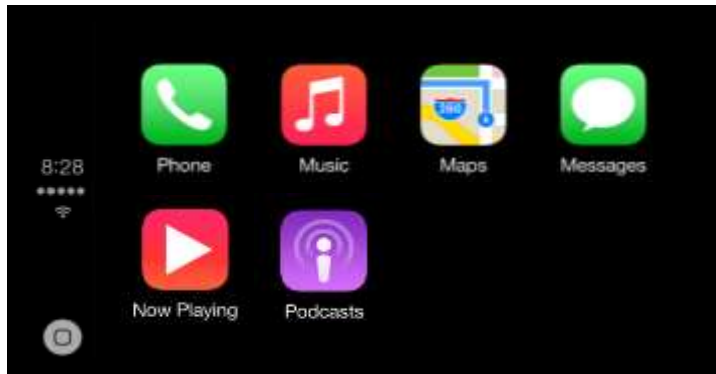
	OS	
Kinetis K ARM Cortex-M4 MCUs	Wi-Fi	FreeRTOS
	BLE	No OS FreeRTOS
i.MX 6 Series ARM Cortex-A9/A7 Applications processors	Wi-Fi	Linux
	BLE	Linux



Apple CarPlay Systems



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

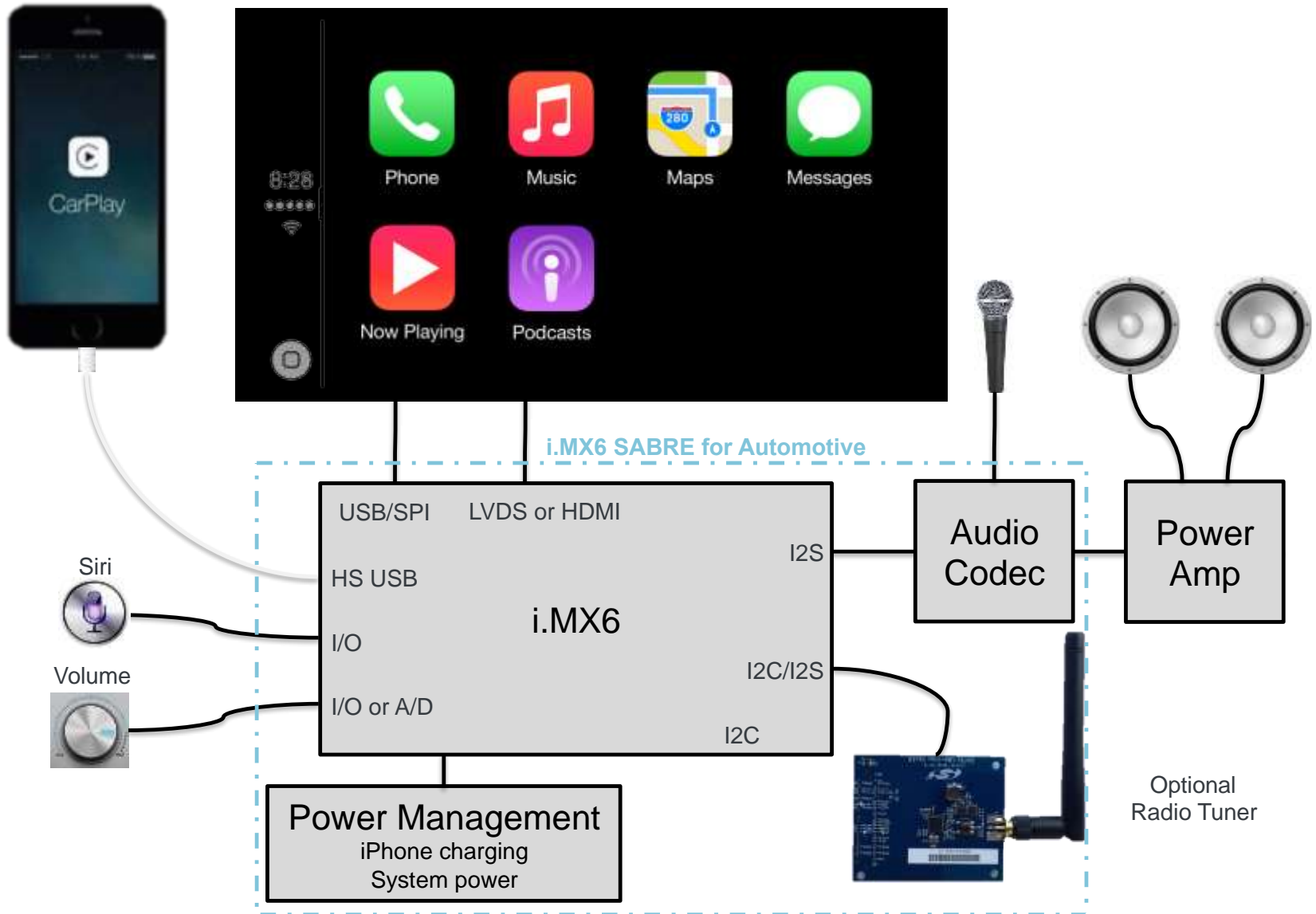
Head Unit Functions

- 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



Freescale 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

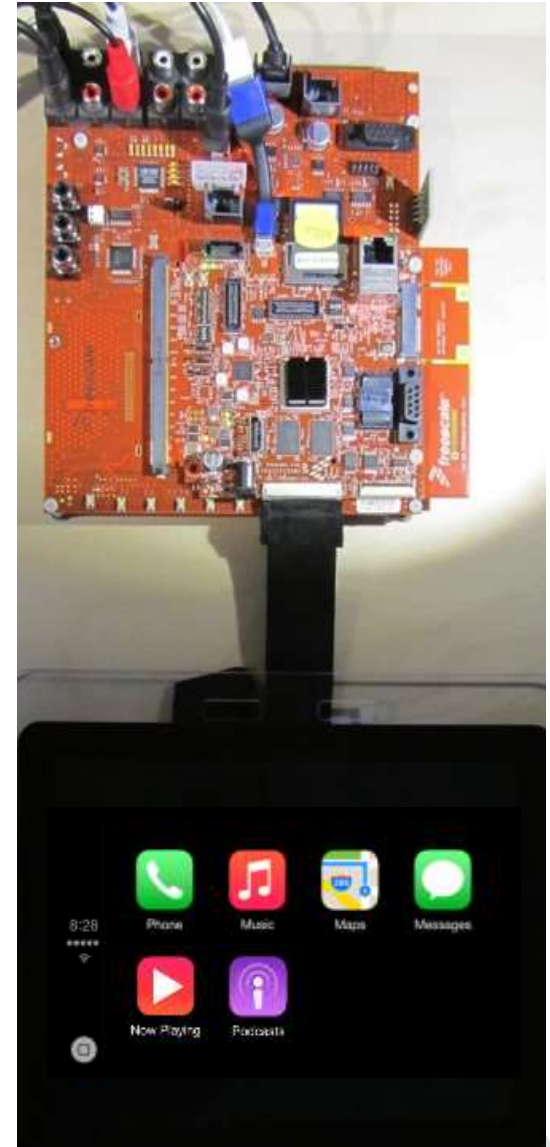


Apple CarPlay 3rd Party Implementations

- 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>



Freescale 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 <u>CS42888</u>)	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

Android Accessories



Android Accessories Introduction







General Android Accessories do not require licensing from Google, but several interface approaches are used

- Android Open Accessory Protocol (AOAP), version 2.0
 - Optionally supported on Android 4.1 (Jelly Bean) and above
- USB Mass Storage Device (file access only)
 - Requires MP3 etc decoding, and does not support device based playback control
- Some manufacturers use USB OTG, allowing the Android device to act as Host and stream digital audio compatible with USB Audio Class 2.0

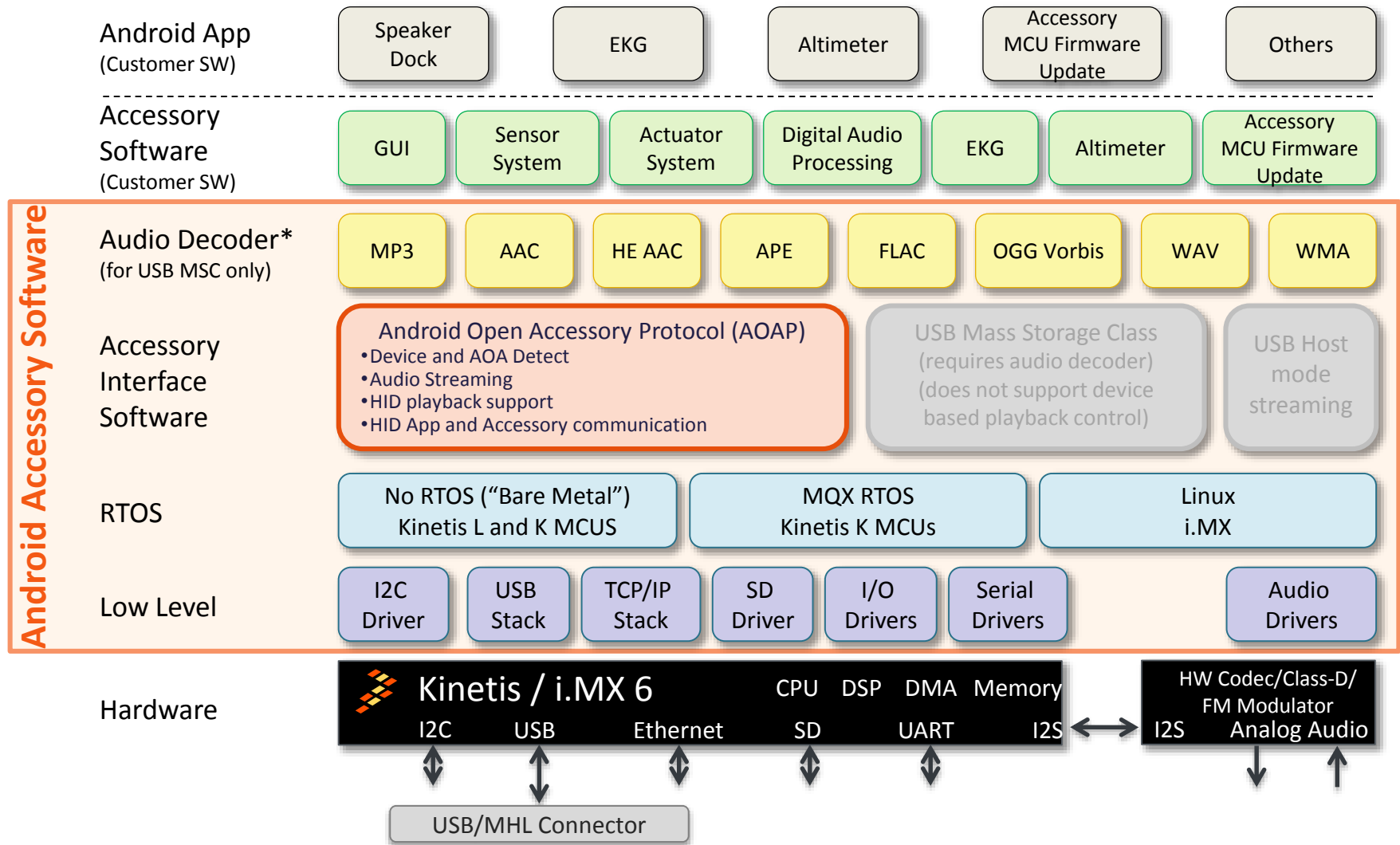
Connectors

- USB (mini or micro) are the standard connectors, with the Android device generally being the USB Device, although some support USB OTG in order to support USB Audio Class 2.0
- Mobile High-Definition Link (MHL) is a new connector option (5 or 11 pin) that supports “HDMI” video and audio, and USB OTG
- **No special interface hardware is required for Android devices**

Android Accessory Connection Options

Connection	Wired			Wireless		
	USB mini	USB micro	MHL	BLE	BT	WiFi
						
Audio Supported	Digital	Digital	Digital	No	Yes	DLNA, WiFi Direct, Miracast
Video Supported	No	No	Yes ("HDMI")	No	No	DLNA, WiFi Direct, Miracast
Notes/Comments	AOAP is optional from Android 4.2	AOAP is optional from Android 4.2	Video and USB Host mode audio	Wearables and Home Automation	A2DP audio, Handsfree	Requires MirrorLink for control

Freescale Android Accessory Software



i.MX 6 Android Tablet Streaming Audio to Kinetis KL46

i.MX 6 SABRE CDP
Running Android 4.3
With AOAP 2.0

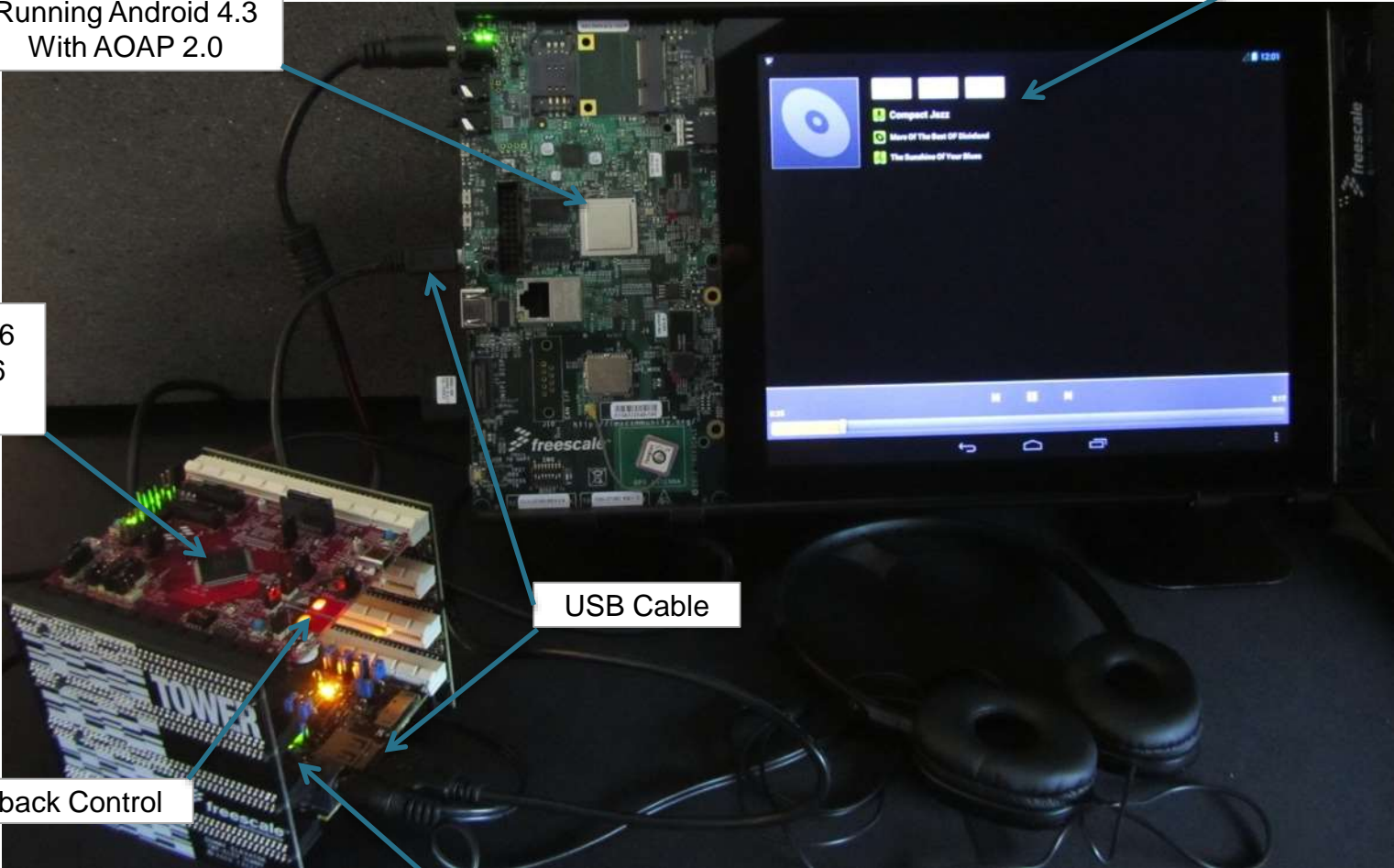
Digital Audio Streaming over
USB using AOAP 2.0

Kinetis KL46
TWR-KL46
Module

USB Cable

Touch Playback Control

Audio Codec Module



Reference Design: Audio Interface Module for AOAP



AOAP-KL26-AI Module

Kinetis KL26 AOAP Audio Interface:

- Provides **line level analog audio input and output with basic playback control and charging** for Android devices via the USB connector.
- Based on Kinetis KL26 MCU pre-programmed with AOAP and Audio Playback control software
- Connectivity:
 - USB A receptacle for use with standard USB cables
 - 3.5mm analog audio line output
 - 3.5mm analog audio line input
 - barrel receptacle for 6 to 12V power supply
 - auxiliary header for serial, GPIO and power lines access
 - debug interface header for use with Kinetis L MCU development tools
- Capacitive touch pads, configured for playback control
- Charging current for connected device is limited to a maximum 2.4A
- May be used as a reference design or basic development system

Freescale AOAP – Development Hardware

Combination of processor, audio and specific boards supported:

Processor		2 Audio and Specific Boards
Processor	Dev. Platform	
Kinetis MCUs	<u>Kinetis FREEDOM</u> Low-cost Kinetis development Platform	- One of the 3 boards below: - <u>TWR-AUDIO-SGTL</u> : Freescale audio codec (SGTL5000) - <u>TWR-AUDIO-DA7321</u> : Dialog audio codec (DA7321) - <u>TWR-DOCK2</u> : Freescale audio codec (SGTL5000) and MFi interface - <u>FRDM-TWRPI</u> : Freedom to Tower adaptor - <u>TWR-ELEV</u> : Tower elevator
	<u>Kinetis TOWER</u> Kinetis modular development Platform	- One of the 3 boards below: - <u>TWR-AUDIO-SGTL</u> : Freescale audio codec (SGTL5000) - <u>TWR-AUDIO-DA7321</u> : Dialog audio codec (DA7321) - <u>TWR-DOCK2</u> : Freescale audio codec (SGTL5000) and MFi interface - <u>TWR-ELEV</u> : Tower elevator

Android Auto Systems



Introduction

- The development of Android Auto requires membership in the Open Automotive Alliance (OAA), the Google Automotive Link (GAL) program
- Android Auto implementations require the inclusion of authentication keys
- The following links show the latest members:
 - <http://www.openautoalliance.net/#press>
 - <http://www.android.com/auto/>

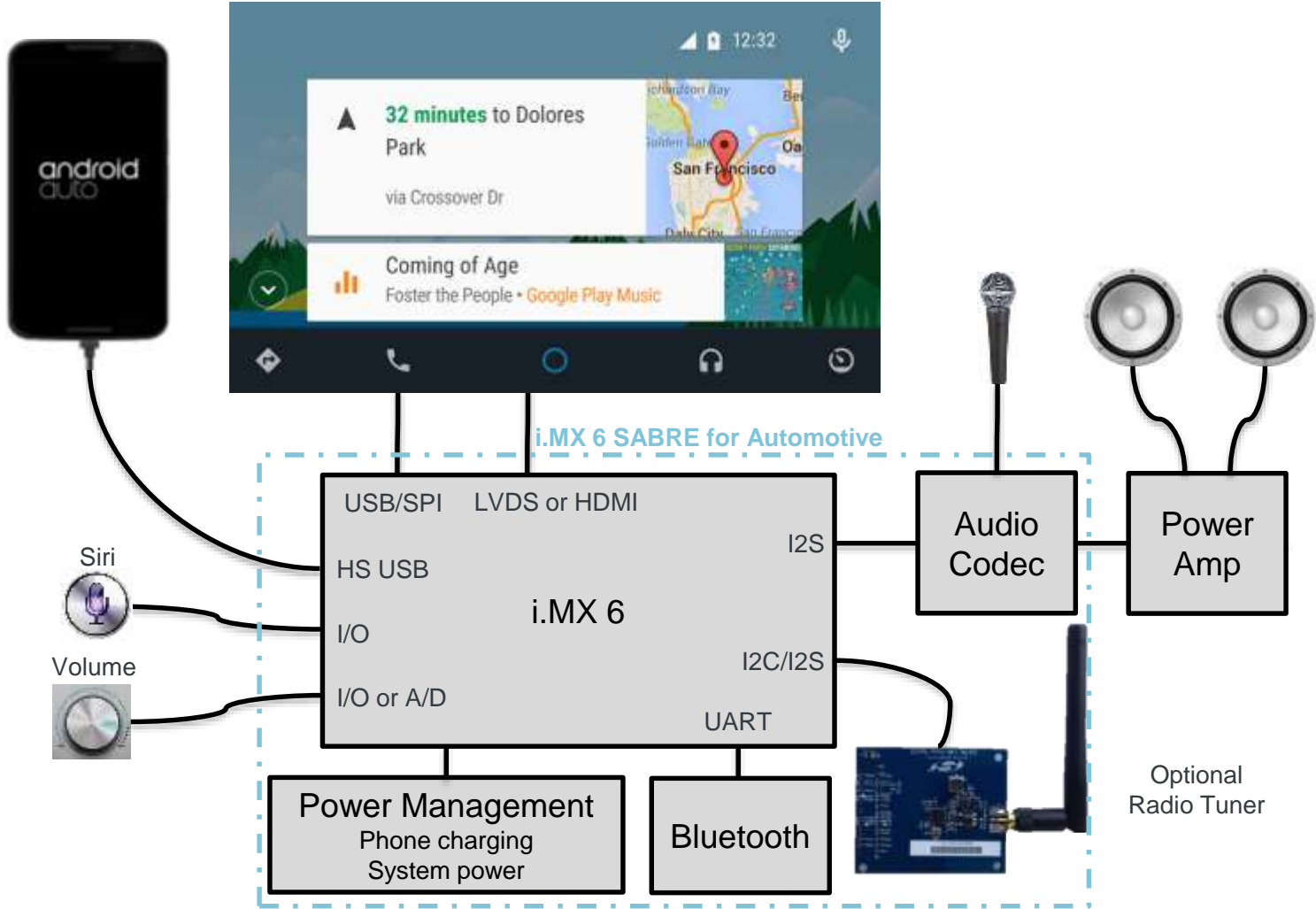
- Alpine
- Bentley
- Clarion
- CloudCar
- Delphi
- FIAT Chrysler
- Ford
- Freescale
- FUJITSU TEN
- HARMAN
- Infiniti
- JVCKENWOOD
- LG
- Maserati
- Mazda
- Mitsubishi
- Nissan
- Panasonic
- Parrot
- Pioneer
- Renault
- Renesas
- SEAT
- Škoda
- Subaru
- Suzuki
- Symphony Teleca
- Volkswagen
- Volvo

Android Auto Implementation Key Functions

- Display GUI
- Capture user input from touch screen or hardware buttons and provide to Android phone
- Manage audio streams, instructions and calls from phone, audio entertainment from phone, Radio tuner or other source
 - *Note: Connection to the phone for phone calls is via Bluetooth, so Bluetooth must be supported by the system*
- Voice input for Google Now and phone calls
- GPS and vehicle movement data sharing between phone and vehicle (for OEM radios)
- 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 and authentication
 - *Note: Wireless connection option is expected in the future*



Android Auto System



Android Auto Comparison to Miracast and MirrorLink

- Android Auto is optimized for use by the driver
 - Does not support functionality that would be distracting to the driver, such as video entertainment and text entry
- Miracast is designed to mirror the display of a phone on another device like an in car entertainment system, and as such is only suitable for rear seat passengers
 - It is intended for entertainment consumption
- MirrorLink is intended to provide an alternative (larger) user interface and as such supports both display mirroring and user input from the alternative device
 - It is intended for entertainment consumption and interaction with multiple Apps
 - MirrorLink requires additional licensing

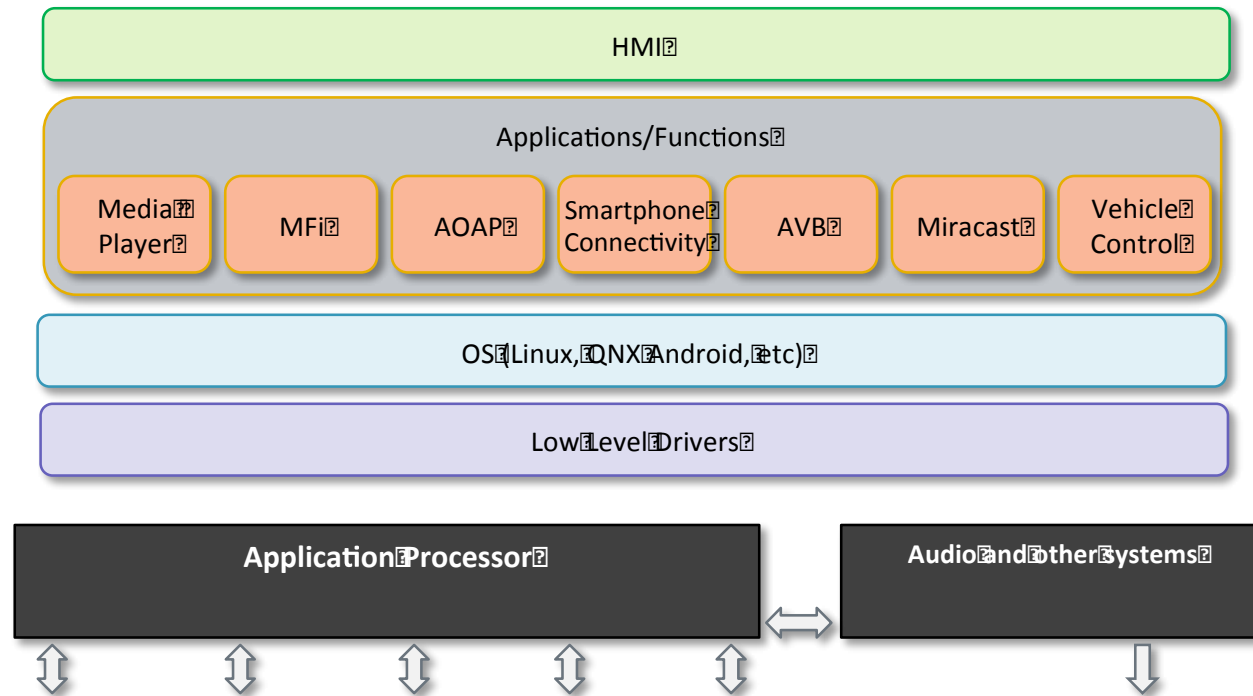


Freescale Audio Solutions



Introduction to Audio and Auto Infotainment Solutions

- Audio and Auto Infotainment consist of many standard and standards based functions, but the combination, user interface, functionality, and look and feel vary by product
- Freescale Professional Services has a large library of developed and tested functions available for customization and integration into a final product



Freescale Professional Services Solutions

Use of pre-developed and pre-tested functional modules significantly reduces product development time and cost

Available Services:

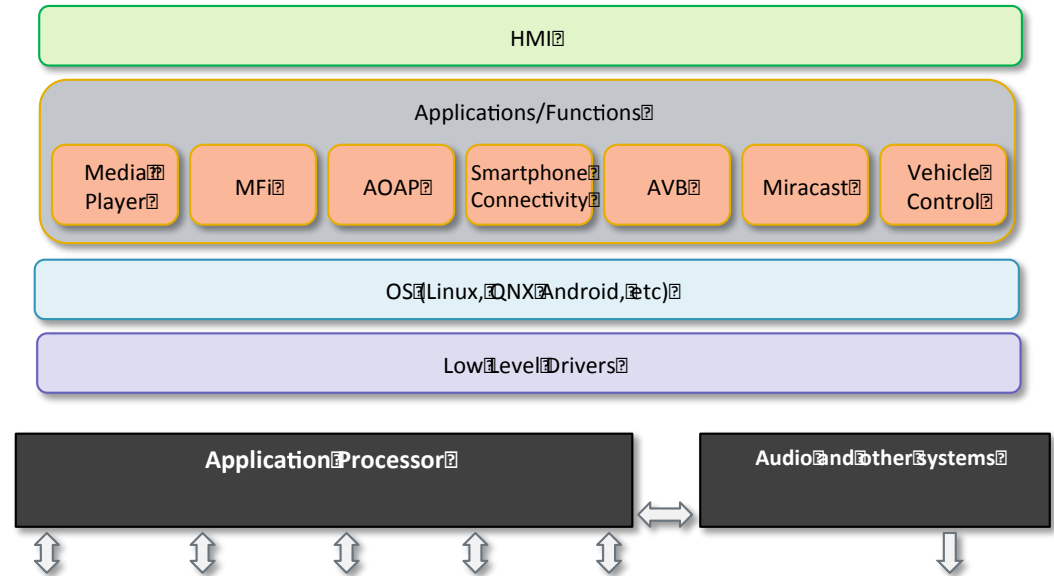
- Customization
- Integration
 - Of available functions from Freescale into a full system
 - Of selected Freescale functions into customer's system
- Development of new functions
- Porting
- Optimization
- Schematic and layout optimization & review
- System Testing and preparation for required Certifications

Note: Some software modules are subject to production licenses

Summary of Available Audio and Auto Infotainment Functions

Functions:

- Media Player
 - Media library support
 - Media devices support
 - Bluetooth
 - Wi-Fi
 - Radio tuner
 - Media streaming
 - Audio codecs
- Audio Video Bridging (AVB)
- Made For iPod (MFi)
- Android Open Accessory Protocol (AOAP)
- Smartphone connectivity
- Miracast
- User interface



Supported MCU/MPU families:

- Kinetis
- Vybrid
- i.MX

Note: Not all functions are supported on all MCUs/MPUs

Freescale Media Player Introduction

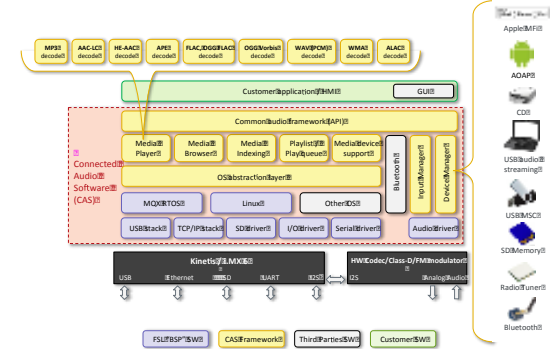
The Freescale Connected Audio Software (CAS) is a flexible audio media player solution based on a configurable framework available for Kinetis MCUs and i.MX application processors available together with target product customization from Freescale Professional Services

Suitable for:

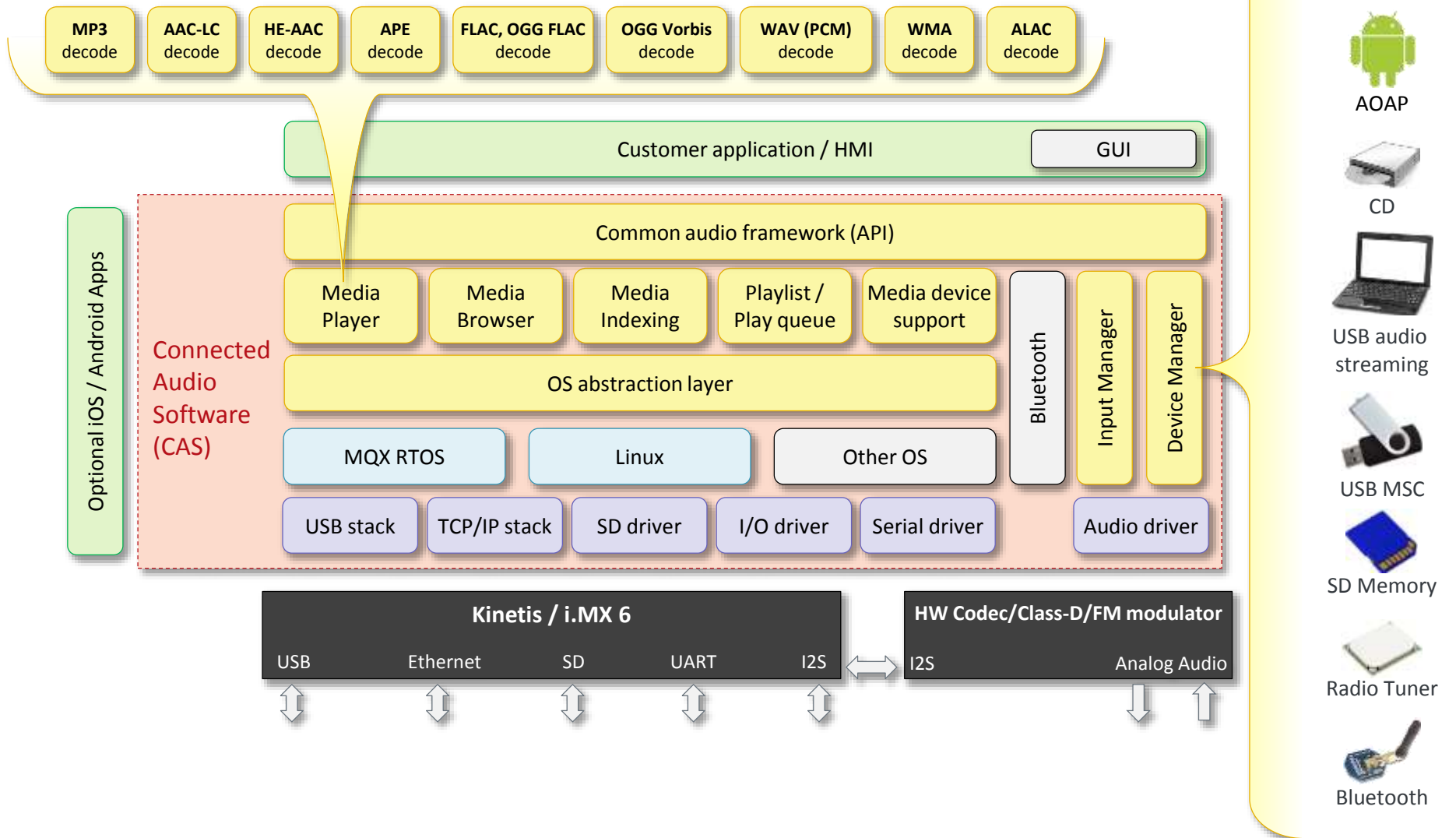
- Automotive infotainment
- GUI digital audio
- Portable audio
- Commercial and professional audio

Key functions are:

- Full audio SW framework with streamer that supports playback control and streaming or decoding of audio
- Decoding of various audio formats supported for audio files stored on internal or external media
- Playback control and digital audio streaming from iPhone, iPad, iPod and Android™ devices
- USB streaming from external devices such as PCs and Macs
- Support of external SD and USB media storage
- Control and audio I/O of external DSP and/or codec
- Management of external devices connection and disconnection
- Audio metadata indexing and database management allowing configurable browsing and querying of files for all supported audio devices
- Management of various user inputs to control the application using an Input Manager
- Management of persistent data storage



Freescale Media Player



Audio Video Bridging (AVB)



Audio Video Bridging (AVB) Software

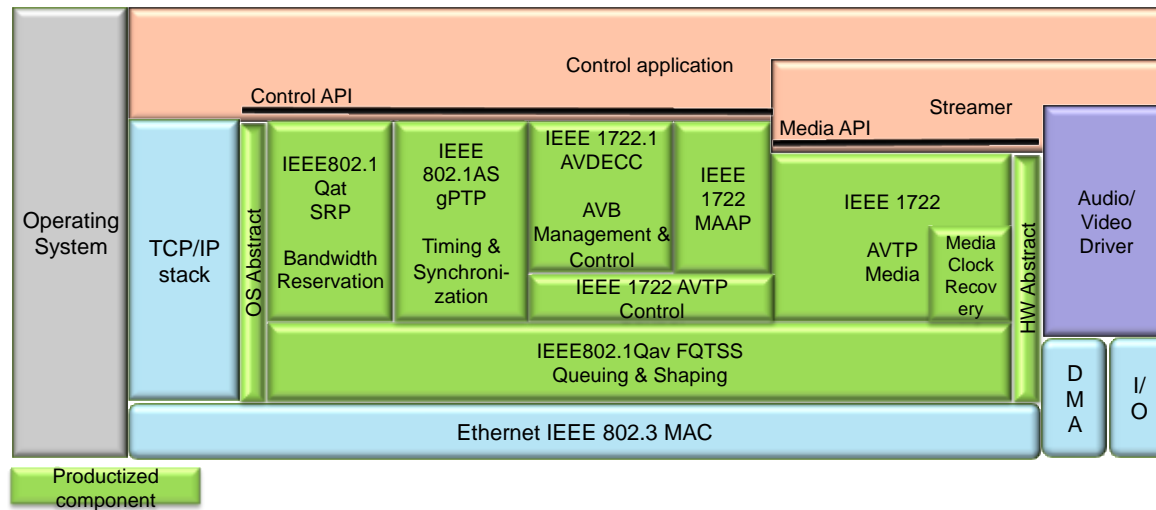


Application Areas

- Automotive infotainment
- Professional AV equipment

Functions

- Media clock synchronization
- Audio/Video talker and listener with Media Clock Recovery
- Short latency
- Media streamer
- Network interface
- End point implementation for IEEE 1722 AVTP, 802.1AS gPTP, 802.1Qav FQTSS, 802.1Qat SRP, 1722.1 AVDECC
- Compliance to the Ethernet AVB IEEE specification
- API exposing transport, control and synchronization services
- Media Application integration with ALSA and gstreamer



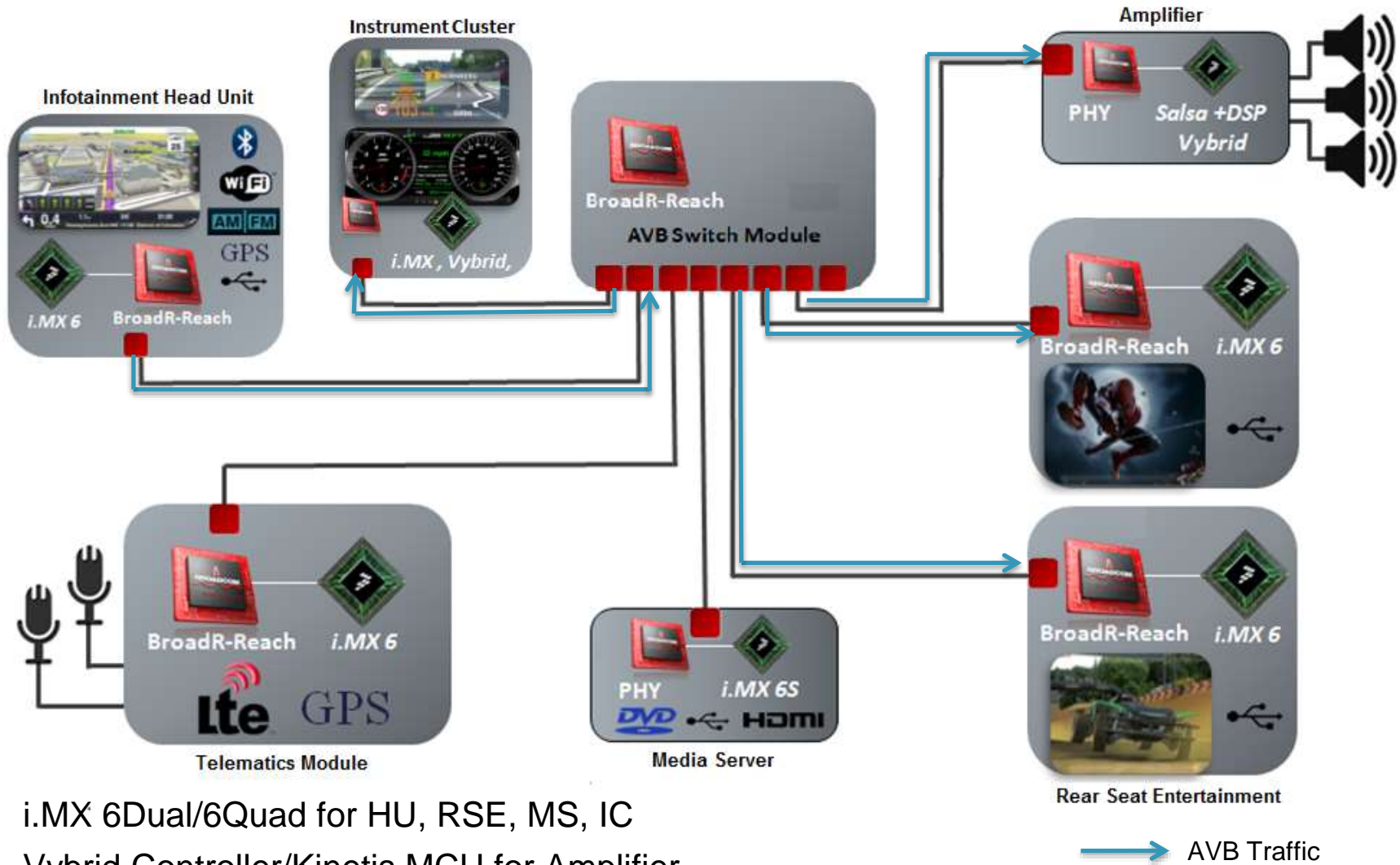
Freescale **AVB** Development Hardware

- SABRE Automotive Infotainment Rev2 CPU Card with i.MX 6Quad
- New “Flexible Ethernet Expansion” Card with options for:
 - Atheros Gb PHY (same PHY as on current SABRE hardware for software compatibility)
 - 10/100 Broadcom BroadR-Reach PHY
 - 10/100 Broadcom BroadR-Reach 4-port switch
- First hardware available April 2014
- Final boards available October, 2014



Automotive Hardware for True Automotive AVB Development

Infotainment over Ethernet AVB



i.MX 6Dual/6Quad for HU, RSE, MS, IC
 Vybrid Controller/Kinetis MCU for Amplifier

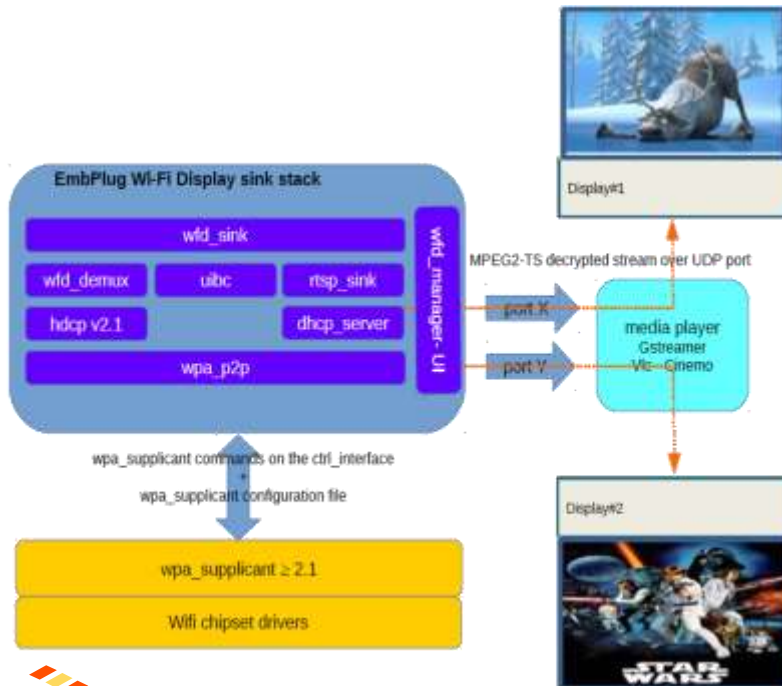
→ AVB Traffic

Miracast Software

Miracast Software

Application Areas

- Automotive infotainment:
 - OEMs and after-market systems
 - Standalone application or integration into an (existing) infotainment system

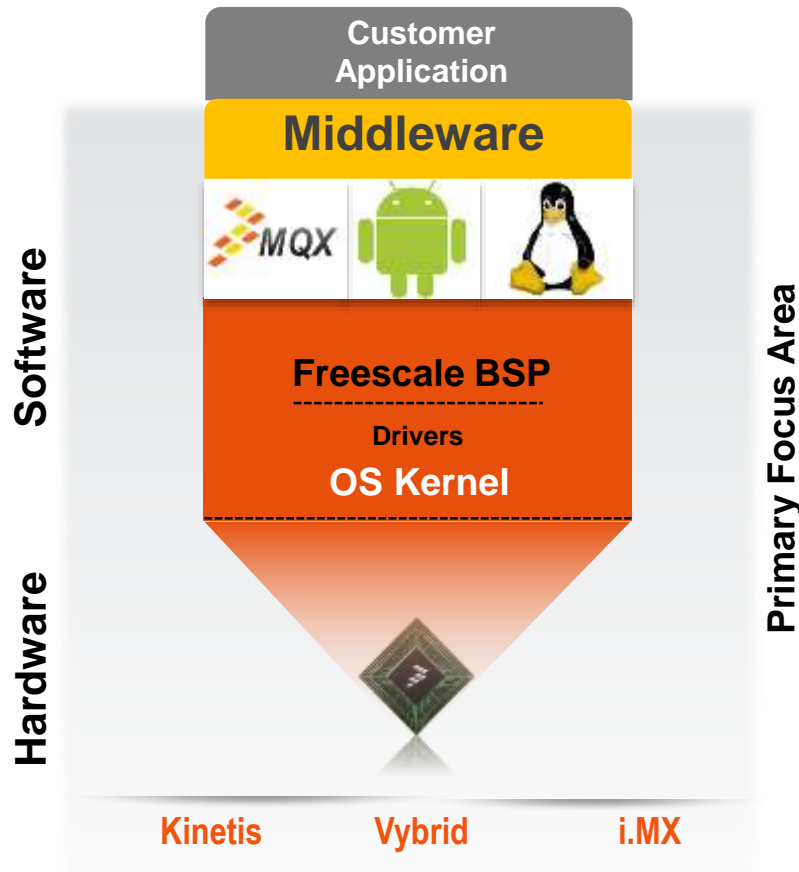


Functions

- Multiple Sources and Displays
 - Up to three media sources
 - Up to three HDMI displays
- User controls and source selection
- Wi-Fi Direct support
- Support for HDCP 2.1 specification
- Secure receiver HDCP2.1 private keys storage options:
 - Fully secure TrustZone implementation
 - CAAM HW block to encrypt and decrypt the private key through key blobs feature, storing the encrypted key version in non volatile memory
- H.264 AAC support
- MPEG2-TS support
- Gstreamer
- Tested devices:
 - Samsung S3/S4/S5
 - Galaxy tab 2
 - Note 2
 - Galaxy tab pro
 - Nexus 4/5/7/10
 - Sony Xperia Z and T
 - Windows 8.1 Surface Tablet
 - Motorola X
 - HTC one M8
 - Nokia Lumia windows 8.1



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

Q & A





www.Freescale.com