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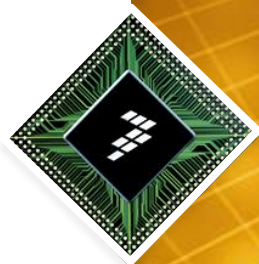
FREEDOM-KL25Z and OpenSDA

Hardware and Software Overview

Michael Norman
Enablement Technical Lead

Updated July 10, 2012

Kinetis L-Series Hardware Platforms

Tower System

- Richer feature set
- Standard Tower Controller Module
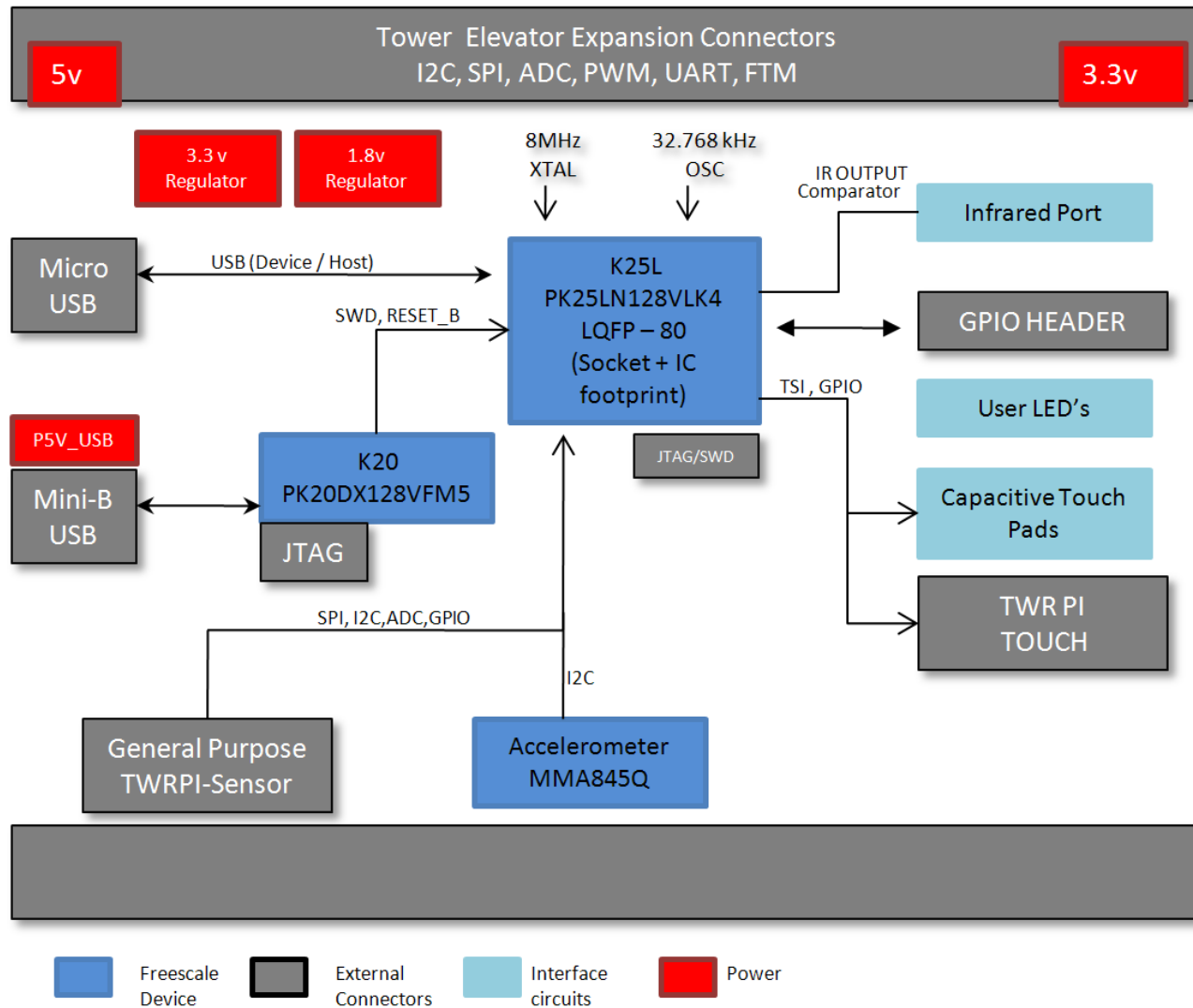- Compatible with existing Tower System peripherals

Freedom Platform

- Reduced feature evaluation and development hardware
- Works with existing Arduino shields (peripheral boards)
- Well suited for low-power applications

TWR-KL25Z48M Block Diagram

Tower Elevator Expansion Connectors
I2C, SPI, ADC, PWM, UART, FTM

5v

3.3v

3.3 v Regulator

1.8v Regulator

8MHz XTAL

32.768 kHz OSC

IR OUTPUT Comparator

Infrared Port

Micro USB

USB (Device / Host)

SWD, RESET_B

K25L PK25LN128VLK4 LQFP – 80 (Socket + IC footprint)

GPIO HEADER

TSI , GPIO

User LED's

P5V_USB

K20 PK20DX128VFM5

JTAG/SWD

Mini-B USB

JTAG

Capacitive Touch Pads

TWR PI TOUCH

SPI, I2C,ADC,GPIO

I2C

General Purpose TWRPI-Sensor

Accelerometer MMA845Q

Freescale Device

External Connectors

Interface circuits

Power

TWR-KL25Z48M Call-outs

Elevator Connectors

Potentiometer

GPIO Header

KL25 USB

JTAG Connectors

OpenSDA USB

8 MHz system crystal

32 kHz oscillator

Touch TWRPI connector

Generic TWRPI

User LEDs

Touch electrodes

Accelerometer

TWR-KL25Z48M Features

- KL25Z128VLK4—Cortex-M0+ MCU with:
  - 128KB flash, 16KB SRAM
  - up to 48MHz operation
  - USB full-speed controller
- OpenSDA—sophisticated USB debug interface
- 4 user LEDs
- 2 capacitive touch buttons
- Freescale MMA8451QR1 accelerometer
- Flexible power supply options
  - Power from either on-board USB connector
  - Power from elevators
  - Selectable 3.3v or 1.8v
  - Current input measurement jumper.
- Reset button
- Compatible with most TWR peripheral boards
- Demo software highlights all features of the board
- Configured by default to run without additional peripheral boards

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Freescale Freedom Development Platform

- **Ultra low -cost/power development platform**

- **Quick, simple development experience**

  - Easy access to MCU I/O

  - Battery-ready, power-measurement access points

  - Form factor compatible with Arduino platform

  - New, sophisticated OpenSDA Debug interface

    - Mass storage device flash programming interface (default) – no tool installation required to evaluate demo apps

    - P&E Multilink interface provides run-control debugging and compatibility with IDE tools

    - Open-source Data Logging application provides an example for customer, partner and enthusiast development on the OpenSDA circuit

- **Loaded with software:**

  - Processor Expert: stand-alone or IDE integrated

  - MQX Lite RTOS (via Processor Expert)

  - Ecosystem partner support

    - IAR, Keil, Code Red, Atollic, Rowley, Free GNU command-line tools with GDB server

Features:

- MKL25Z128VLK4 MCU – 48MHz, 128KB Flash, 16KB SRAM, USB OTG (FS)
- OpenSDA—sophisticated USB debug interface
- Capacitive touch "slider", MMA8451Q accelerometer, Tri-color LED
- Flexible power supply options – USB, coin cell battery, external source

Available: 25 Sept 2012
$12.95/€10 SRP

Processor Expert Software

IAR SYSTEMS

KEIL An ARM® Company

GNU

PE micro

code_red

atollic

Rowley

freescale™
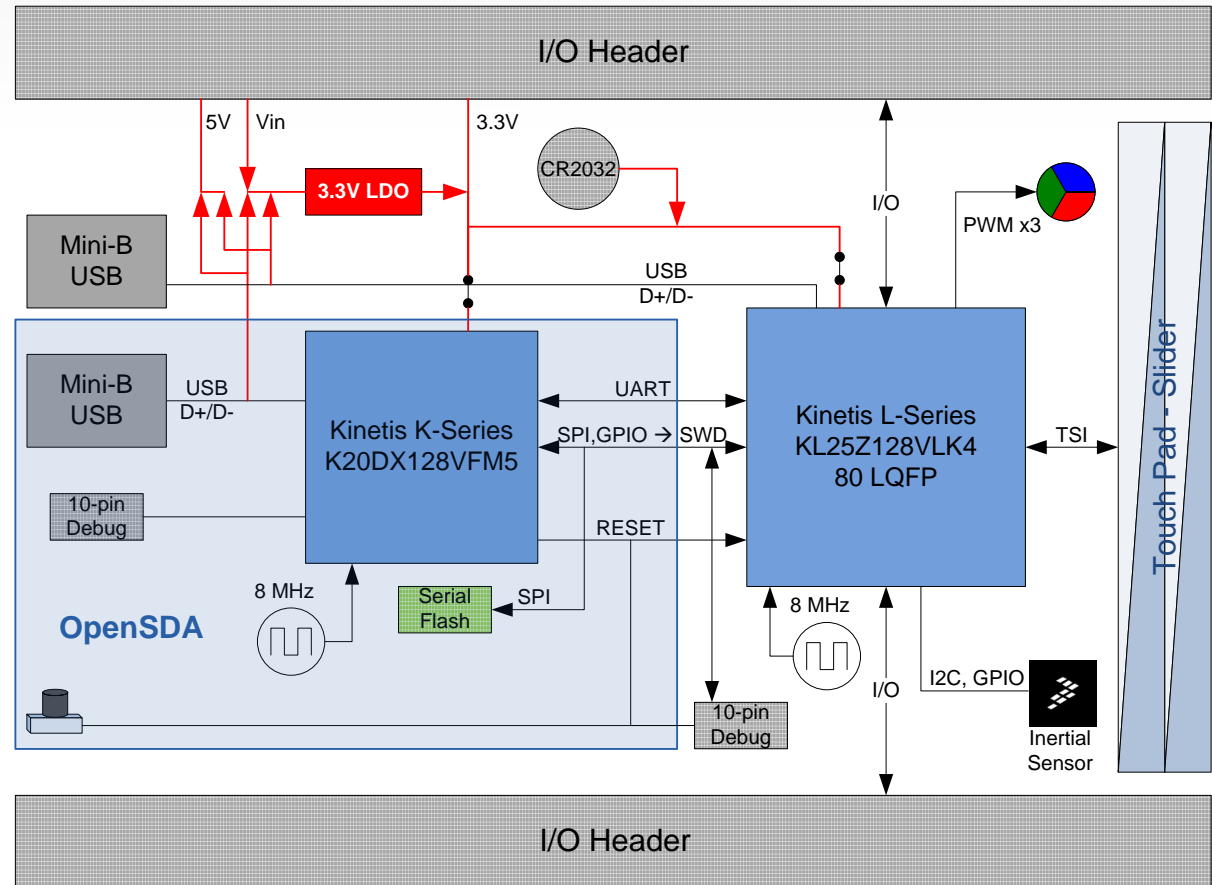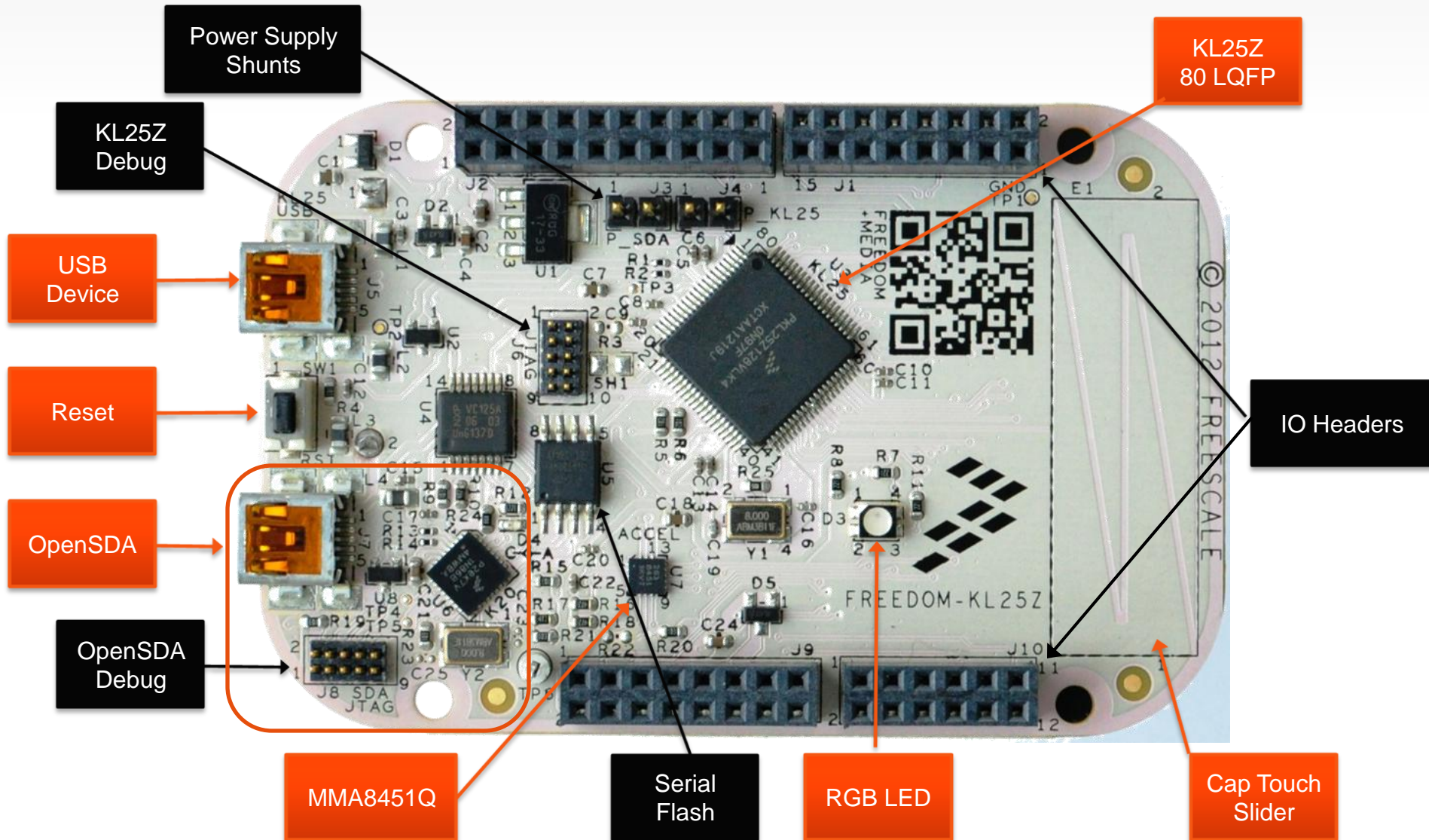
KL25Z Freedom Block Diagram, FRDM-KL25Z

Features:

- KL25Z128VLK4—Cortex-M0+ MCU with:
  - 128KB flash, 16KB SRAM
  - up to 48MHz operation
  - USB full-speed controller
- OpenSDA—sophisticated USB debug interface
- Tri-color LED
- Capacitive touch "slider"
- Freescale MMA8451QR1 accelerometer
- Flexible power supply options
  - Power from either on-board USB connector
  - Coin cell battery holder (optional population option)
  - 5-12V Vin from IO header
  - 5V provided to IO header
  - 3.3V to or from IO header
- Reset button
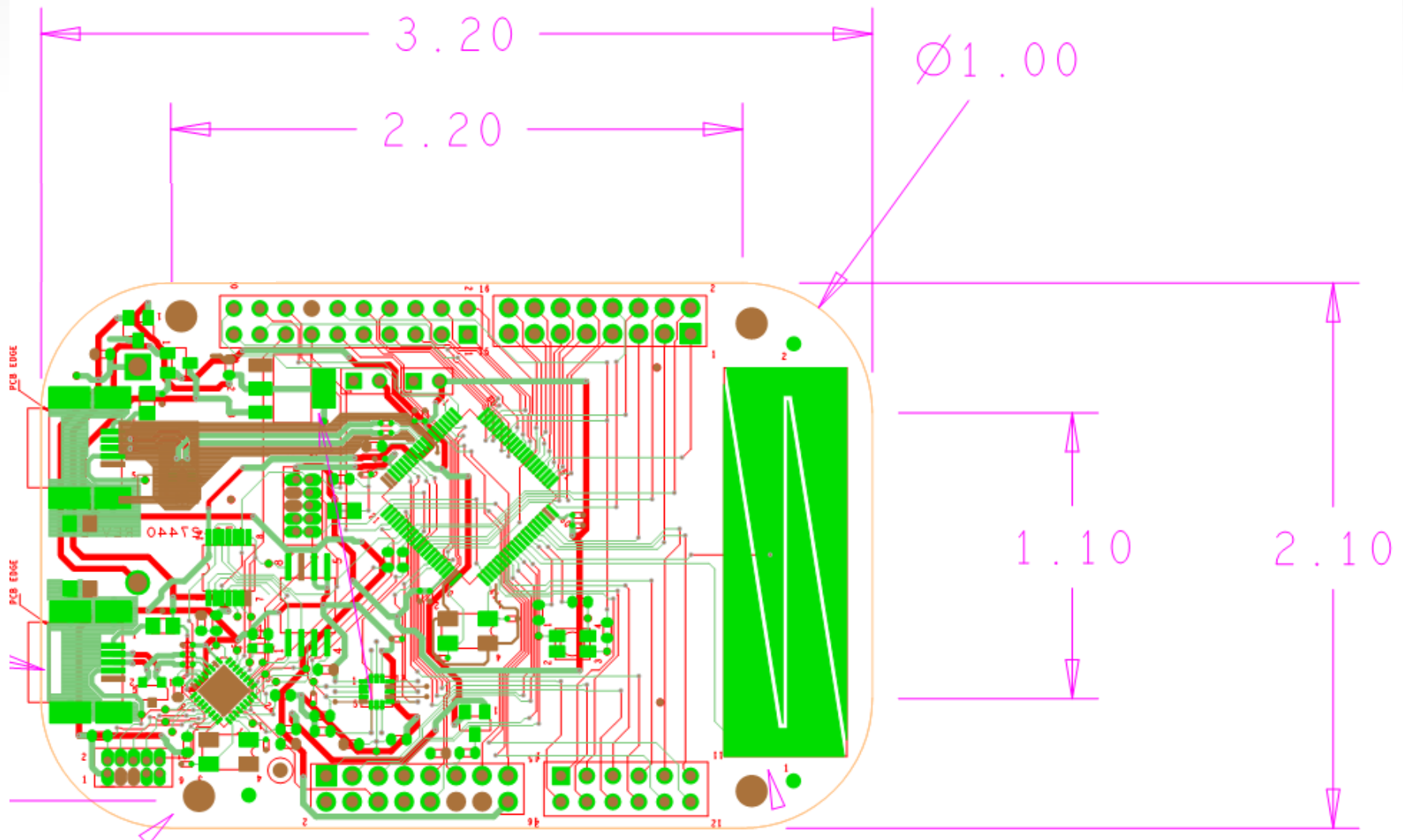- Expansion IO compatible with the Arduino Uno form factor

I/O Header

5V Vin   3.3V

3.3V LDO   CR2032

Mini-B USB   I/O

PWM x3

USB D+/D-

Mini-B USB   UART   Kinetis L-Series KL25Z128VLK4 80 LQFP

USB D+/D-   Kinetis K-Series K20DX128VFM5   SPI,GPIO → SWD   TSI

10-pin Debug

RESET

8 MHz   Serial Flash   SPI   8 MHz

OpenSDA   I/O   I2C, GPIO

10-pin Debug   Inertial Sensor

Touch Pad - Slider

I/O Header

Hashed blocks indicate optional items that will not be populated by default

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FRDM-KL25Z Callouts

Power Supply Shunts

KL25Z Debug

KL25Z 80 LQFP

USB Device

Reset

OpenSDA

OpenSDA Debug

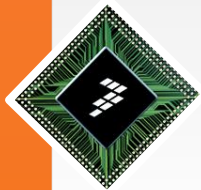IO Headers

MMA8451Q

Serial Flash

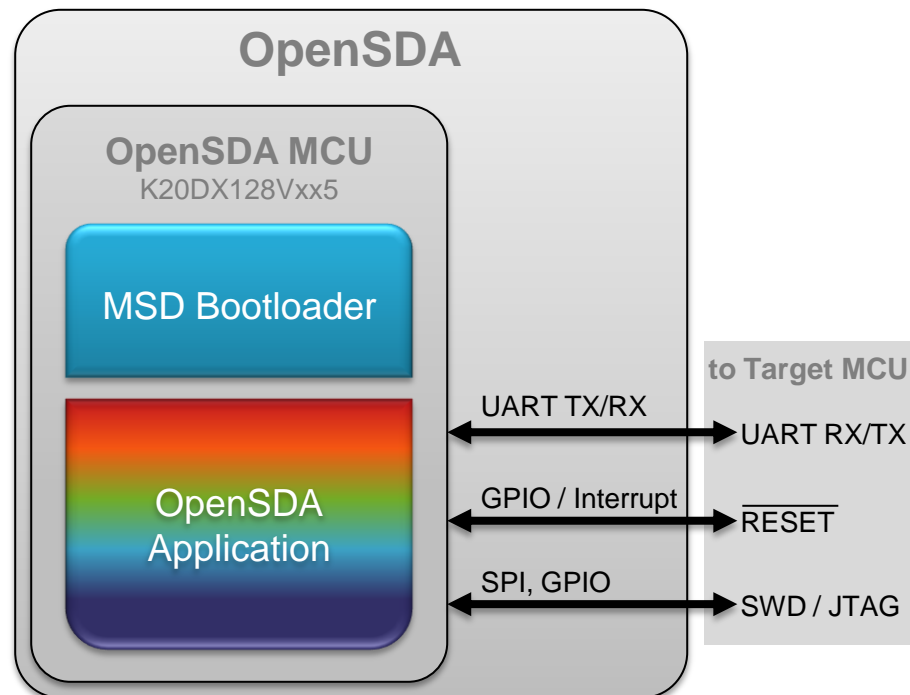RGB LED

Cap Touch Slider

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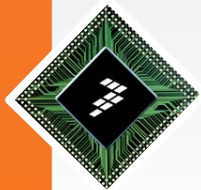# FREEDOM-KL25Z Layout and Dimensions

OpenSDA Overview

- Open-standard serial and debug adapter
    - New standard for embedded debug circuit supporting SWD and JTAG
    - Open hardware platform with proprietary and open-source software
    - Built on K20DX128 50MHz CM4
    - Provides serial channel and debug interface to the target MCU
- Mass-storage bootloader used to load new applications into the OpenSDA
- A mix of proprietary and open-source OpenSDA Applications will be available free-of-charge from Freescale
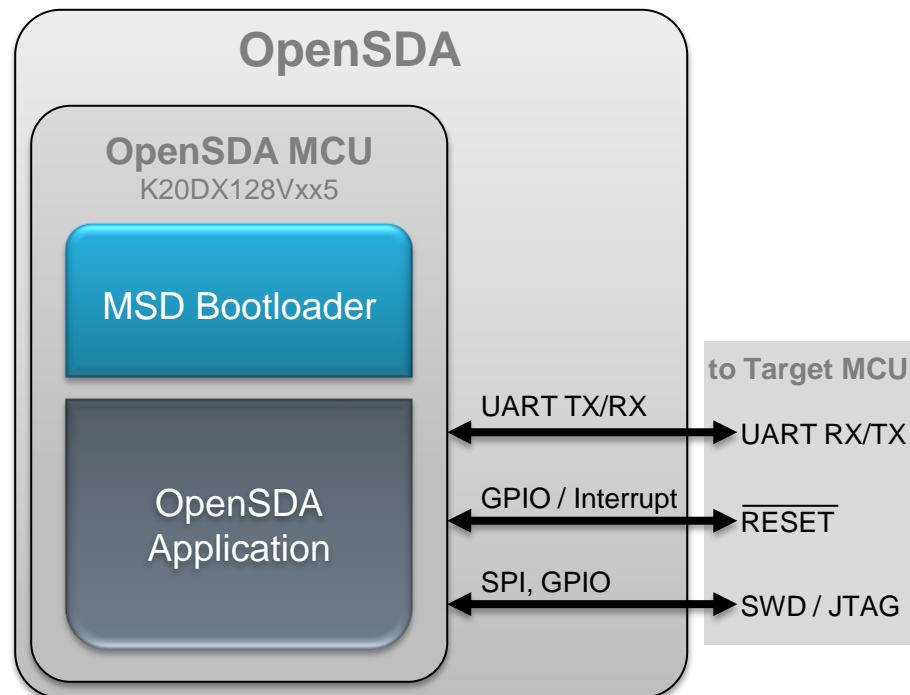   - Customers and partners can develop their own Applications as well.

OpenSDA

OpenSDA MCU
K20DX128Vxx5

MSD Bootloader

OpenSDA Application

to Target MCU

UART TX/RX → UART RX/TX

GPIO / Interrupt → $\overline{RESET}$

SPI, GPIO → SWD / JTAG
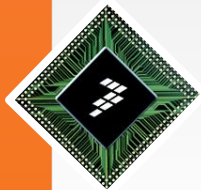
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OpenSDA MSD Bootloader

Bootloader Overview:

- Flash resident bootloader

- Mass-storage USB device—no custom host drivers required

- Simple copy/paste or drag/drop interface for programming an Application into the OpenSDA MCU.

- Bootloader runs if there is no Application installed or if forced by user (Reset button pressed during power on) or host-side software (method depending on Application implementation)
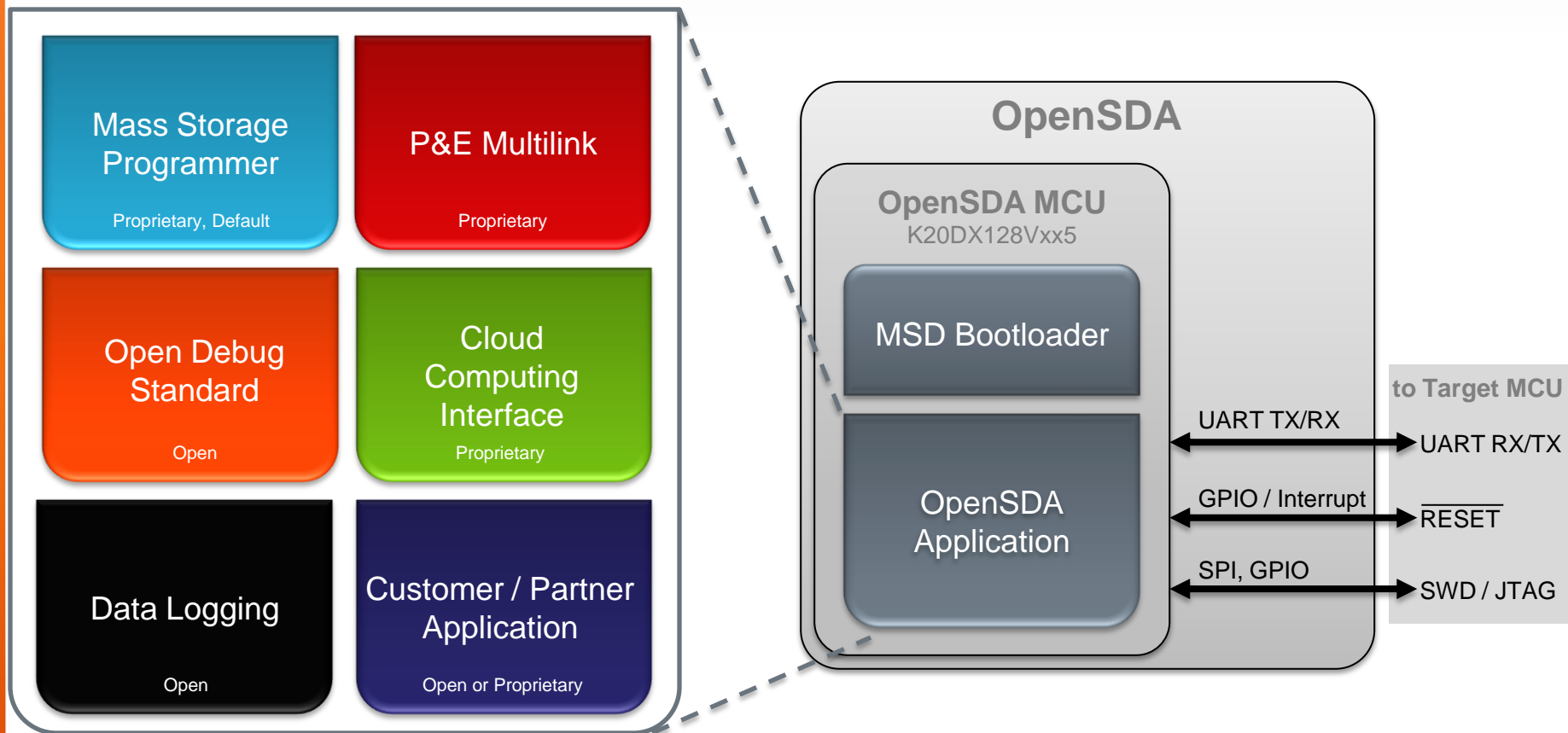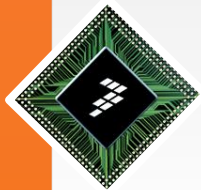
Two versions available:

- Open-source, non-proprietary version:
  - Posted to online-repository (e.g. Google Code or github)

- Closed-source, proprietary version:
  - Based on open-source code base
  - Only used on Freescale hardware
  - Will accept encrypted, proprietary binary
  - Allows for protection of proprietary software that can only run on official Freescale hardware

OpenSDA

OpenSDA MCU
K20DX128Vxx5

MSD Bootloader

OpenSDA Application

UART TX/RX → UART RX/TX

GPIO / Interrupt → $\overline{\text{RESET}}$

SPI, GPIO → SWD / JTAG

to Target MCU

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OpenSDA Applications Overview

Mass Storage Programmer
Proprietary, Default

P&E Multilink
Proprietary

Open Debug Standard
Open

Cloud Computing Interface
Proprietary

Data Logging
Open

Customer / Partner Application
Open or Proprietary

OpenSDA

OpenSDA MCU
K20DX128Vxx5

MSD Bootloader

OpenSDA Application

to Target MCU

UART TX/RX → UART RX/TX

GPIO / Interrupt → RESET
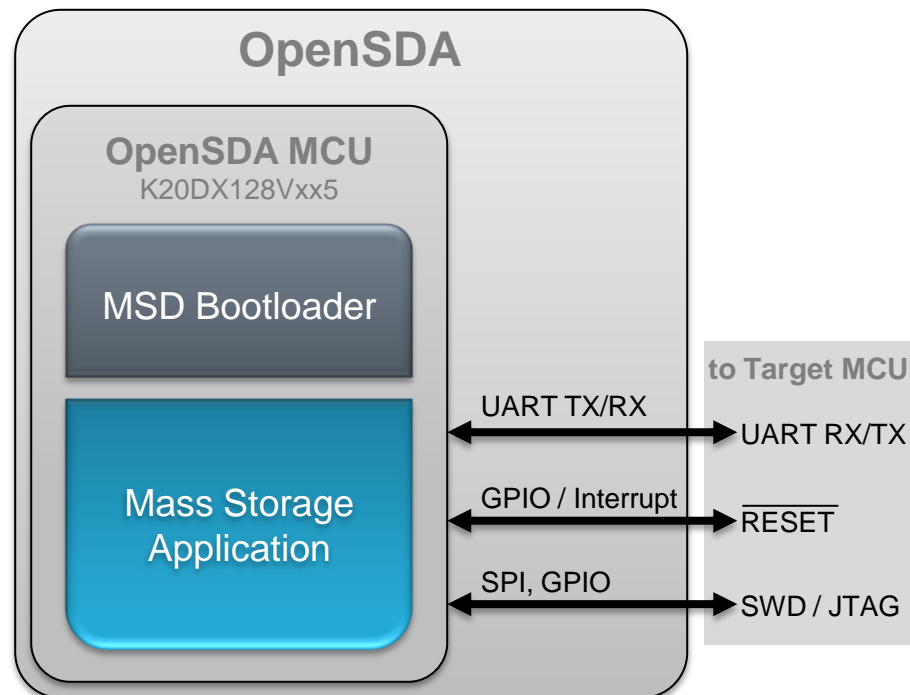
SPI, GPIO → SWD / JTAG

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OpenSDA Mass Storage Application
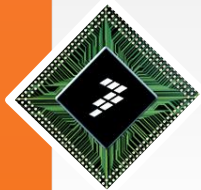
Application Overview:

- Closed source proprietary application

- Controls the serial and debug interfaces to the target MCU

- Mass-storage USB device providing a simple target MCU flash programmer and a virtual serial port (composite device)

Goal: Simple interface for serial communications and reprogramming of the target MCU. Perfect for quick programming of example applications.

Note: Can be used to program off-board devices within the same product family as the on-board Target MCU

OpenSDA

OpenSDA MCU
K20DX128Vxx5

MSD Bootloader

Mass Storage Application

to Target MCU

UART TX/RX → UART RX/TX

GPIO / Interrupt → $\overline{RESET}$

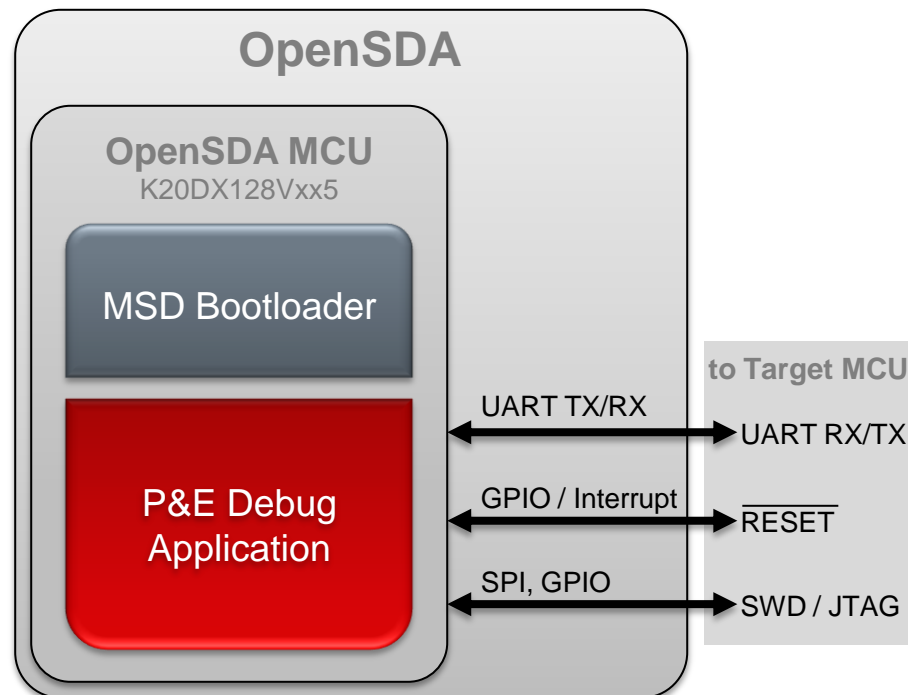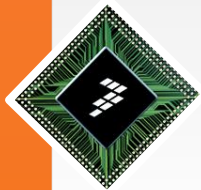SPI, GPIO → SWD / JTAG

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OpenSDA P&E Debug Application

Application Overview:

- Controls the serial and debug interfaces to the target MCU

- P&E Multilink compatible debug interface with CDC virtual serial port (composite device)

- Transparently supported by the P&E's UNIT library

- Supported by P&Es GDB Server

- Supported by P&Es NGS layer
  - Used by IAR, Keil, Atollic, etc.

Goal: Provide a traditional debugger interface that is already supported by Freescale and Ecosystem Partner IDE tools.

OpenSDA

OpenSDA MCU
K20DX128Vxx5

MSD Bootloader

P&E Debug Application

to Target MCU

UART TX/RX → UART RX/TX

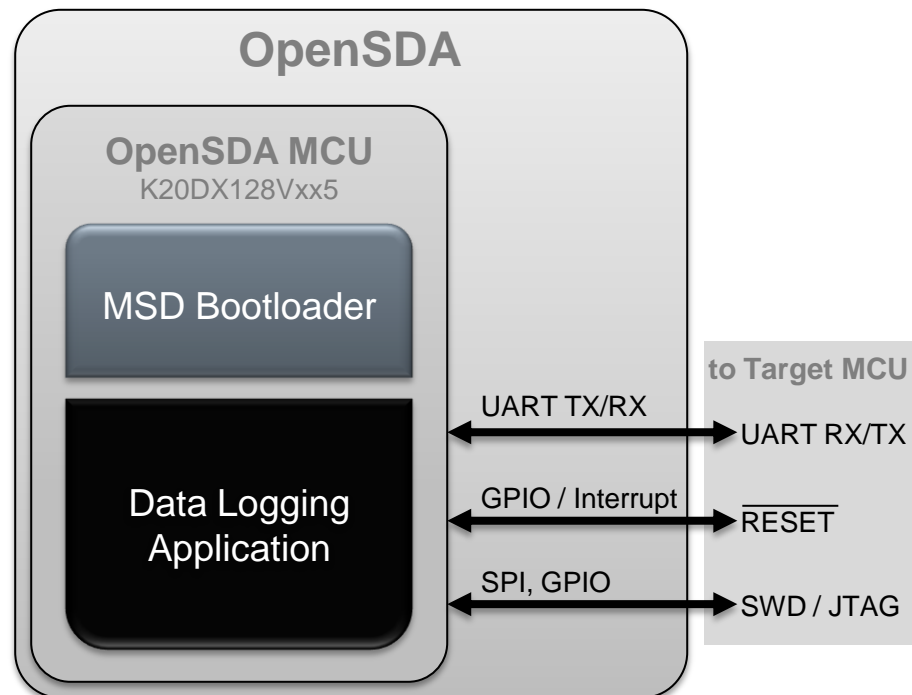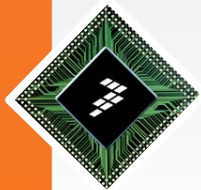GPIO / Interrupt → RESET

SPI, GPIO → SWD / JTAG

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OpenSDA Data Logging Application
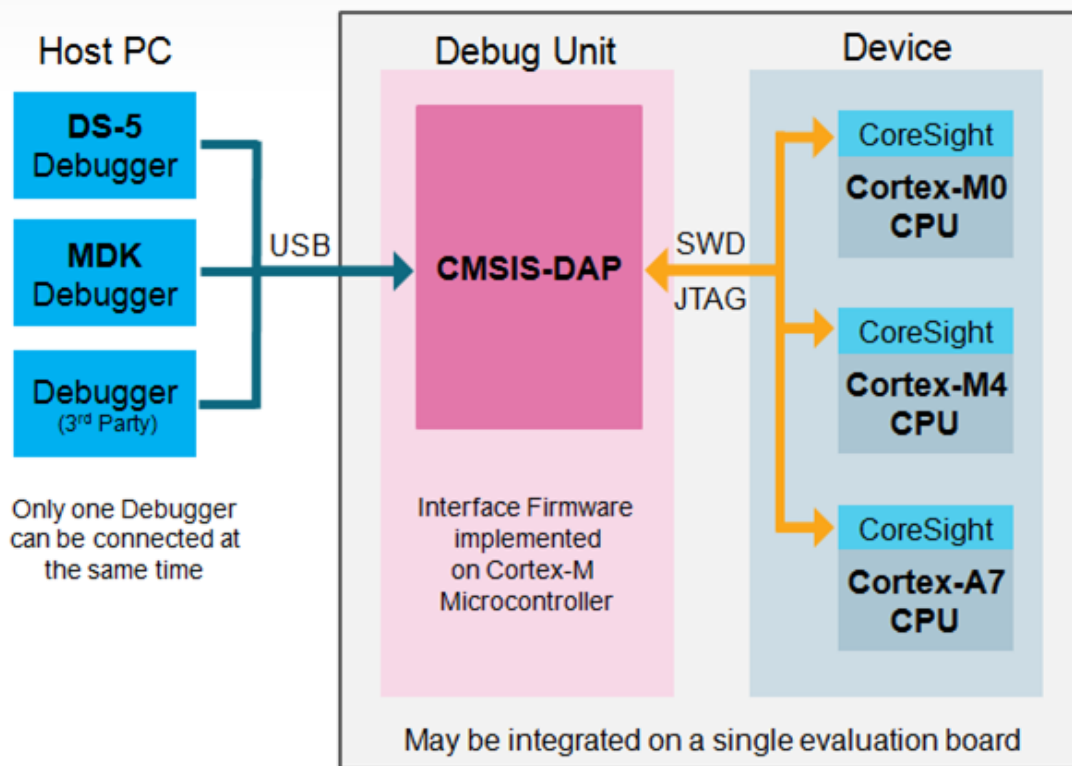
Application Overview:

- Virtual serial port communications to the target MCU

- Basic debug control (SWD/JTAG) of the target MCU

- Simple serial commands providing the ability to control and monitor the target processor

- Commands: start, stop, write memory, reset

Goal: Provide a simple, open-source OpenSDA application that provides a good framework for innovation.

OpenSDA

OpenSDA MCU
K20DX128Vxx5

MSD Bootloader

Data Logging Application

to Target MCU

UART TX/RX → UART RX/TX

GPIO / Interrupt → $\overline{RESET}$

SPI, GPIO → SWD / JTAG

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OpenSDA + CMSIS-DAP

CMSIS-DAP is the interface firmware for a Debug Unit that connects the Debug Port to USB. Debuggers, which execute on a host computer, connect via USB to the Debug Unit and to the Device that runs the application software. The Debug Unit connects via JTAG or SWD to the target Device. ARM Cortex processors provide the CoreSight Debug and Trace Unit. CMSIS-DAP supports target devices that contain one or more Cortex processors.

http://www.keil.com/support/man/docs/dapdebug/dapdebug_introduction.htm