Cypress FX3 firmware for INI Sensors

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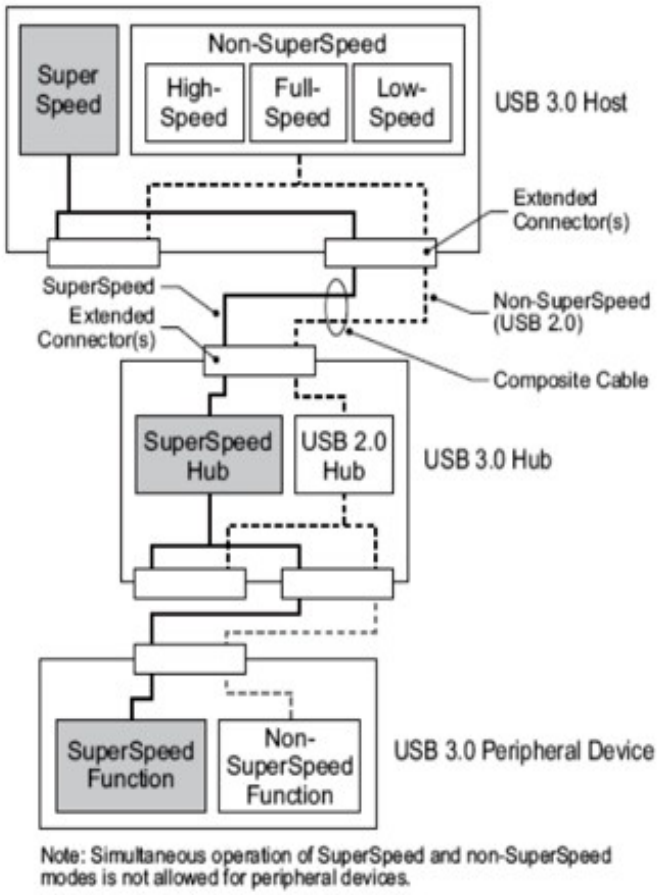
Overview

- USB 3.0
- Cypress FX3
- FX3 SDK + Tools
- FX3 Firmware
- FX3 jAER integration

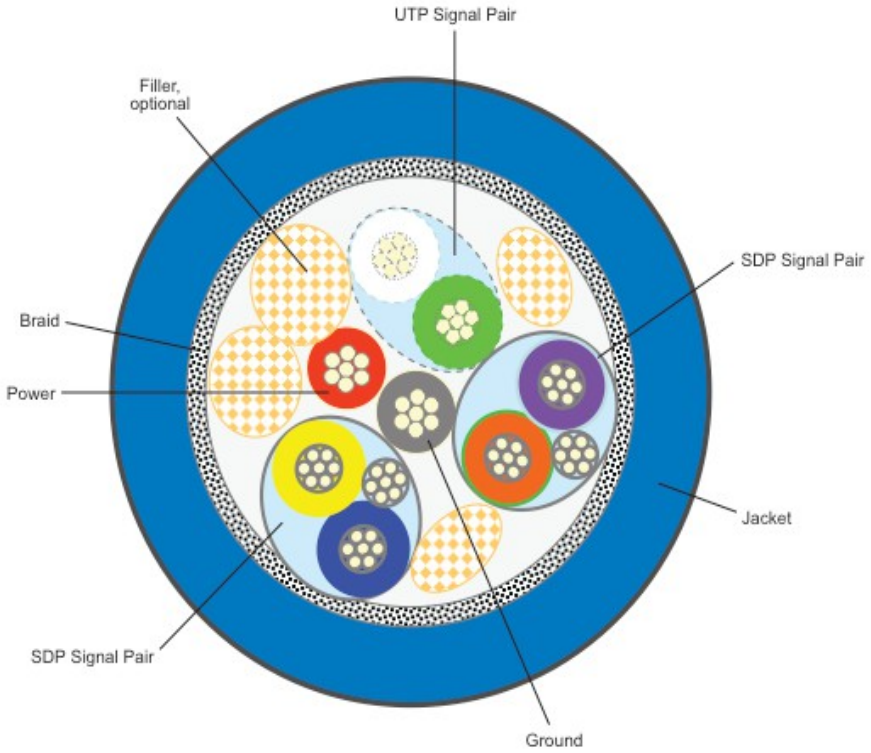
USB 3.0

- Since end of 2008, but spread started only 2011-2012
- More bandwidth: Super Speed 5Gbit/s
- Better power management: new power states (U0 to U3)
- New features: Bursts, Streams, …
  - Asynchronous notifications
  - Traffic only to target device
- Dual Bus Architecture: everything is supported!



USB 3.0 (2)

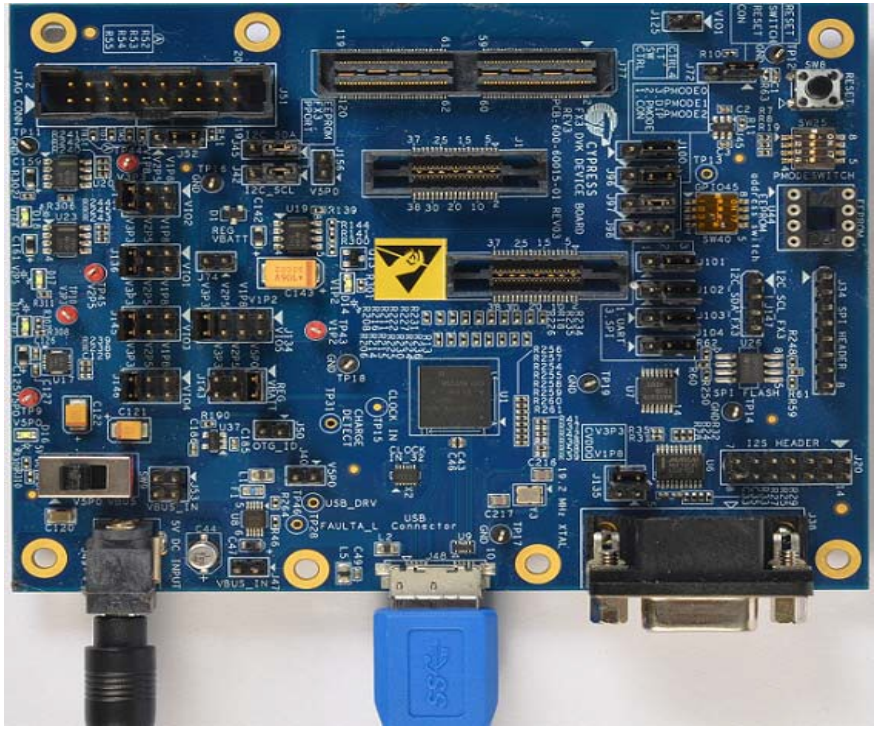
- Electrically different, six new wires!
- Backwards compatible to USB 2.0
  by also having the old wiring



- XHCI (eXtensible Host Controller Interface)
- Drivers from Host Controller vendors for Windows 7, (XP)
- Integrated driver starting with Windows 8
- Linux >= 2.6.31, Mac OS X >= 10.8

Cypress FX3

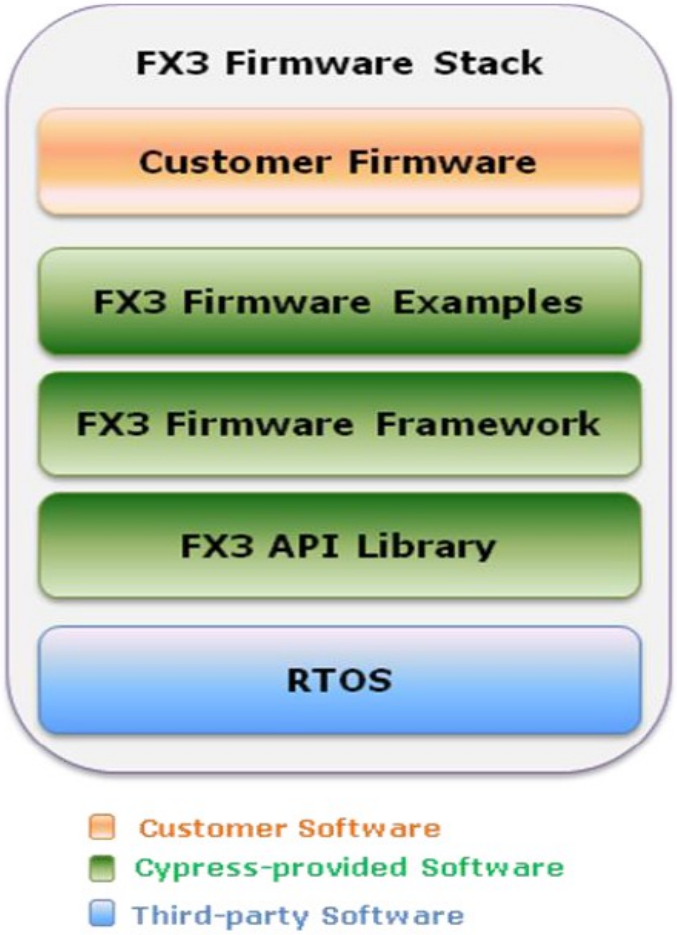
- Supports USB 3.0
- Up to 32 endpoints (16 IN, 16 OUT)
- 32-bit, 200 MHz ARM CPU, 512 KB SRAM
- Boot from USB, I2C, SPI, GPIF2 (+ support for I2S, UART)
- GPIF2: 100 MHz operation, 8/16/32-bit data bus
- DMA-Engine
- ThreadX RTOS



FX3 SDK + Tools

- Eclipse + GCC for ARM-based !!!
- Various tools: GPIF2 Designer, ControlCenter
- Easy install & automatic updates

- Lots of examples
- Good documentation
- Well defined API Library



FX3 SDK + Tools: API Library

FX2:

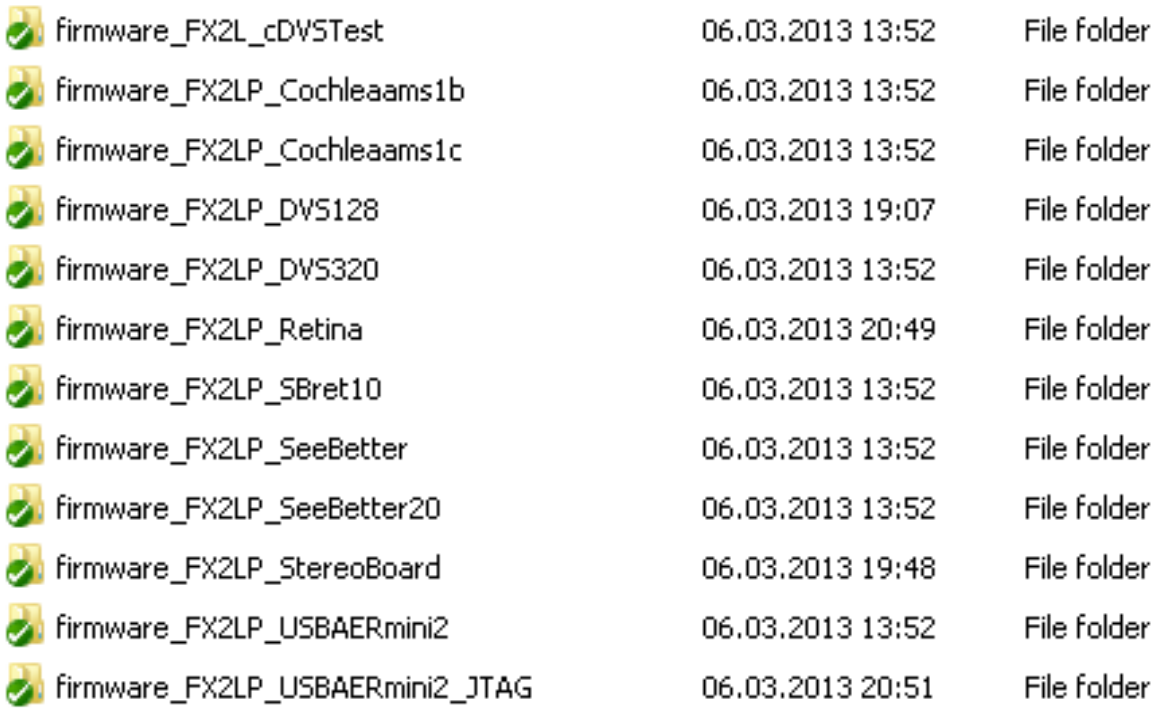
```
EP0BUF[0] = SETUPDAT[1];
EP0BUF[1]= TIMESTAMP_MASTER; // PC1 (Port C Pin 1)
EP0BCH = 0;
EP0BCL = 2;
EP0CS |= bmHSNAK;
```

FX3:

```
uint8_t Buffer[2];
Buffer[0] = bRequest;
CyU3PGpioGetValue(GPIO_ID, &Buffer[1]); // GPIO Pin
CyU3PUsbSendEP0Data(2, &Buffer);
```

FX3 Firmware: FX2 Analysis

- FX2 firmware: heavy fragmentation!
  - Different names, ports, …
  - But everyone kinda does the same!



firmware_FX2L_cDVSTest	06.03.2013 13:52	File folder
firmware_FX2LP_Cochleaams1b	06.03.2013 13:52	File folder
firmware_FX2LP_Cochleaams1c	06.03.2013 13:52	File folder
firmware_FX2LP_DVS128	06.03.2013 19:07	File folder
firmware_FX2LP_DVS320	06.03.2013 13:52	File folder
firmware_FX2LP_Retina	06.03.2013 20:49	File folder
firmware_FX2LP_SBret10	06.03.2013 13:52	File folder
firmware_FX2LP_SeeBetter	06.03.2013 13:52	File folder
firmware_FX2LP_SeeBetter20	06.03.2013 13:52	File folder
firmware_FX2LP_StereoBoard	06.03.2013 19:48	File folder
firmware_FX2LP_USBAERmini2	06.03.2013 13:52	File folder
firmware_FX2LP_USBAERmini2_JTAG	06.03.2013 20:51	File folder

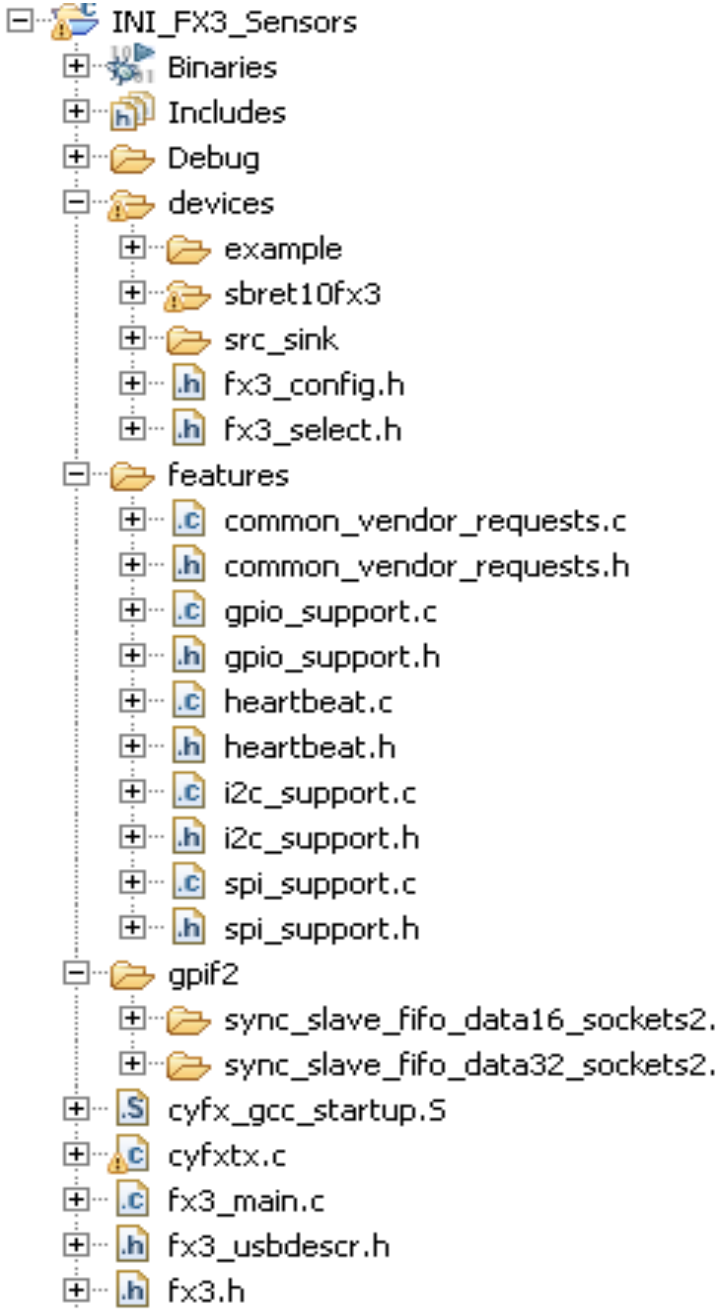
FX3 Firmware: Framework

– Solution: one framework, common core, additional features as options

→ Configurations for each device!

```
#define GPIF_32BIT_SUPPORT_ENABLED 0
#define I2C_SUPPORT_ENABLED 1
#define SPI_SUPPORT_ENABLED 1
#define GPIO_SUPPORT_ENABLED 1

gpioConfig_DeviceSpecific_Type cfg[] = {
  { 26, 'I'}, // GPIO 26 is an IN
  { 27, 'P'}, // GPIO 27 is an IN, and
  will interrupt on POS_EDGE ('N' NEG_EDGE,
  'B' BOTH_EDGES, 'L' LOW, 'H' HIGH)
  { 28, 'O'}, // GPIO 28 is an OUT
  { 45, 'E'}  // GPIO 45 is a LED
};
```



FX3 Firmware: Features

- Core: 16-bit GPIF Slave FIFO interface (Data EP2),
  USB debugging (Status EP1), default Vendor Requests (Control EP0),
  Heartbeat functionality (status messages, flashing LEDs, ...)
- Optional:
  - 32-bit GPIF Slave FIFO interface
  - MS Feature Descriptor (WCID, WinUSB)
  - I2C support (EEPROM access or commands)
  - SPI support (Flash access or commands)
  - GPIO (configurable pins, IN/OUT, debug LED, …)
  - Device-specific initialization (load data from flash, ...)
  - DMA callbacks for Data EP2 to process/manipulate data

FX3 Firmware: Features (2)

– Implemented default Vendor Requests:

VR_TEST	VR_LOG_LEVEL
VR_FX3_RESET	VR_STATUS
VR_SUPPORTED	(ON, OFF, TOGGLE, TIMED, RECURRING)
VR_GPIO_GET	VR_GPIO_SET
VR_I2C_CONFIG	VR_I2C_TRANSFER
VR_SPI_CONFIG	VR_SPI_CMD
VR_SPI_TRANSFER	VR_SPI_ERASE

– Can define device-specific Vendor Requests (override default)

```
CyBool_t CyFxHandleCustomVR_DeviceSpecific(
  uint8_t bDirection, uint8_t bRequest,
  uint16_t wValue, uint16_t wIndex,
  uint16_t wLength);
```

FX3 Firmware: Devices

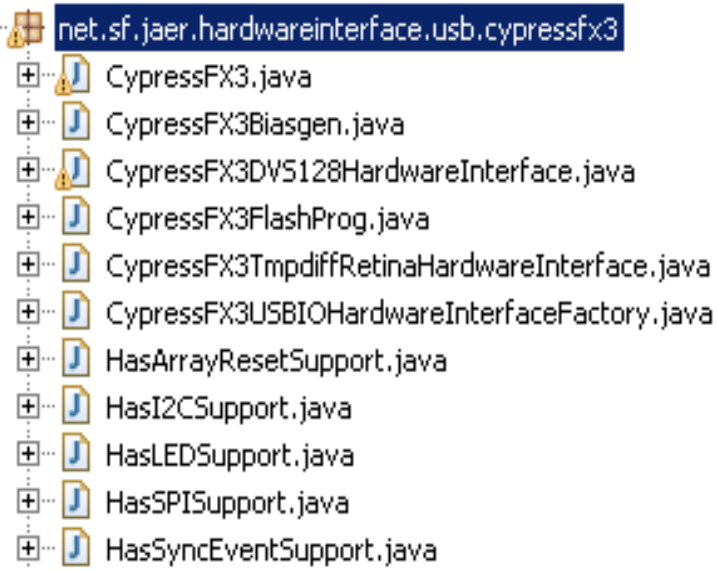
- Example (based on dev-kit, general testing):
  - SPI Flash (4 Mbit), GPIO toggle, static S/N setting

- Src_Sink (based on dev-kit, transfer testing):
  - SPI Flash (4 Mbit), DMA overrides, MS Feature Descriptor

- SBRet10FX3 (based on data-sheets for new board):
  - SPI Flash (8 Mbit), SPI FPGA (Lattice ECP3-17), I2C (IMU access), GPIO (controls, LED), S/N setting from Flash (init), FPGA configuration from Flash (init), FPGA configuration while running (vendor requests), MS Feature Descriptor

FX3 jAER integration

- PROOF OF CONCEPT ONLY, soon to be deprecated!
- New HardwareInterface package: cypressfx3
- New Chip package: retina3
- Code clean-up, re-factoring
- Uses Thesycon USBIO library for easy USB communication
  - v 2.71.0 (14.11.2012) used
  - "The USBIO driver is designed to support USB 3.0 devices with super speed" *(Thesycon Manual v 2.71.0)*



Done!

Thanks for your attention!

Any questions?