Microcontroller Framework for Radar Module Control

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Microcontroller Software Framework

![Diagram of Microcontroller Software Framework](image-url)
Example Platform: GPS Coherence
Coherence Module
Coherence Module

- Design by Frank Lind, James Marchese
- Features
  - PIC32MX695 microcontroller
  - Analog Devices AD9548
- Now under electrical test
Carrier Board Emulation

- The carrier board microcontroller and Ethernet controller were simulated using the Ethernet Starter Kit.
- An evaluation board for the Maxim USB multiplexer was used to route commands to selected modules.
- A u-blox LEA-6T evaluation kit provides timing functionality.
- A Microchip USB Starter Kit II was used to simulate a coherence module.
Carrier Board Firmware

- The carrier board firmware makes use of the Microchip TCP/IP stack and USB Host stack, as well as components from the Microchip TCPIP Demonstration Application.

- The Ethernet Starter Kit is used to implement an HTTP server for web-based configuration of attached modules.

- Commands and new firmware may be sent to add-on modules:
  - Passed from web browser to carrier board via HTTP POST.
  - Passed from carrier board, through multiplexer, to modules via USB transfer.

- The carrier board firmware configures the GPS module for PPS and 10MHz timepulse operation.
Microchip Ethernet Starter Kit

- PIC32MX795
  - 512KB Program Memory
  - 128KB RAM
- USB debugging support
- 10/100 Mbps Ethernet
- PIC32 selected due to low cost
  - Less than $7 in large qty.
Module Emulation/Firmware

- Microchip USB Starter Kit II used to simulate an add-on module
- USB interface
- Runs a modified Microchip bootloader
  - Accepts USB-CDC commands
- Remote firmware update through carrier board’s web interface
u-blox LEA-6T GPS receiver

- Two independently configurable timepulses—1Hz to 10MHz
- Fixed mode operation
  - Superior timing accuracy
- ARM7 microcontroller
  - USB communication
  - On-the-fly reconfiguration
Maxim USB Multiplexer

- USB hub initially used in carrier board design
  - Not supported by Microchip USB stack
- Analog 3:1 multiplexer
  - One upstream host
  - Up to three attached devices
  - Only one device connected to host at a time
- All devices powered simultaneously
Command Interface

Manually issue a command to an attached GPS module.
Device requirements: u-blox LEA-6T or equivalent, firmware version 7.xx, USB connection
Message requirements: UBX format message in hexadecimal format, with checksum, no spacing, 100 character max

UBX HEX CMD: 00400000010000000000809999919000000006F0000002F1S
Apply command to: Module 1 Module 2 GPS module
Upload firmware for add-on module(s).
Each module must be programmed with USB-CDC bootloader v1.0 or higher.

Format: Intel hex file, as produced in MPLAB. See Microchip AN1388 for more information.

Upload a File

File: E:\new_firmware.hex
Apply FW update to: □ Module 1 □ Module 2

After programming, restart each module manually using CMD 0105A5504.
Future Work

- Further testing and validation
- Firmware for coherence module PICs
  - SPI devices, AD9548 control
- Host side improvements
  - USB to USART, flash data storage
- Support for additional modules
  - Tuners (upconverters/downconverters)
  - Calibration sources
  - ADC/DAC Serial Control
References

- Analog Devices Application Note 1002
- Axelson, Jan. *USB Complete, Third Edition*
- Microchip Application Notes 833, 1247, 1388; microchip.com
- u-blox GPS Compendium
Thanks

- My mentors, Jim Marchese and Bob Schaefer
- Phil Erickson and Frank Lind
- Ching Lue
- Will Rogers
- Atmospheric Science Group
- KT Paul and Haystack Observatory
- REU Class of 2011
- NSF REU