F-16 Fighting Falcon
Derek Crane
F-16 Familiarization

- Identifying Attributes
  - Single Intake
  - Single Engine
  - Single Tail Fin
  - Wing Shape
F-16 Familiarization

• Fast Facts:
  ▪ 50ft long, 30ft+ wingspan, 16ft tall
  ▪ Weight: 18.9K lbs – 26.5K lbs
  ▪ Mach 2+
  ▪ Armaments
    ▪ 20mm gatling
    ▪ Rockets
    ▪ Missiles
    ▪ Bombs
  ▪ http://en.wikipedia.org/wiki/F-16
F-16 Familiarization

- Fast Facts Continued:
  - First Flight February 1974
  - Introduced August 1978
  - 4450+ built
  - Cost 14.5 Million – 18.8+ Million
  - Developed by General Dynamics
  - Taken over by Lockheed Martin

F-16 Familiarization

- Blocks (like models)
  - F-16A/B
    - 1,5,10,15,20
  - F-16C/D
    - 25,30/32,40/42
    - 50/52
  - F-16E/F
    - 60

F-16 Familiarization

- World Usage: USAF + 25 other countries
- Bahrain, Belgium, Chile, Denmark, Egypt, Greece, Indonesia, Iraq, Israel, Italy, Jordan, Morocco, Netherlands, Norway, Oman, Pakistan, Poland, Portugal, Taiwan, Singapore, South Korea, Thailand, Turkey, United Arab Emirates, Venezuela
Acronyms

- DED - data entry display
- FCC - fire control computer
- HOTAS - hands on throttle and stick
- HUD – heads up display
- ICP – interface control panel
- MMC – module mission computer
- MFD – Multi-function display
F-16 Cockpit View
Example Block Diagram

Bus Controller

MMC

Peripherals

MUXBUS A

RADAR

NAV

STORES

MUXBUS B

Bridge

MUXBUS C

LINK16

MFD

ICP

MUXBUS C

HUD

DED

HOTAS
MMC

- "Hot-swap"
- Multiple cards
  - MIPS like uPs
- Bus Controller
- Replaced 3 components: FCC, HUDEU, CIU
- "Brains of the beast"
MMC

- The MMC performs algorithmic tasks for weapon delivery, energy management, and navigation. It also performs avionics fault collection and reporting. It has built-in diagnostics fault detection up to Line Replaceable Module level.

- The MMC is divided into 4 functional blocks:
  - Data Processing Set (DSP) : weapons control and mux bus control.
  - Avionics Display Set (ADS) : interface with Head-Up Display.
  - Avionics I/O Set (AIOS) : interface with avionics.
  - Power Set (PS) : MMC power supply and conditioner and HUD low voltage power supply.

MIL-STD 1553

MIL-STD-1553 is a military standard published by the United States Department of Defense that defines the mechanical, electrical, and functional characteristics of a serial data bus. It was originally designed for use with military avionics, but has also become commonly used in spacecraft on-board data handling (OBDH) subsystems, both military and civil. It features a dual redundant balanced line physical layer, a (differential) network interface, time division multiplexing, half-duplex command/response protocol, and up to 31 remote terminals (devices).

Event Queues & Timers

**Events**
- Similar to Interrupts
- Have to "sign-up" for events
- When event "fires" notify registered units

**Multiple Timers**
- Sign up if you need to be executed repeatedly
- Timers are multiples of each other
  - Ex: 100Hz, 50Hz, 25Hz, etc
Tool Chain

xUML → Code Generator → Compiler → Debugger
xUML

- Executable Unified Modelling language
  - Subset of UML
  - Create Classes, Member variables/methods
  - Use a Scripting language to attach functionality
  - Abstraction helps organization
  - Process Independent Design (PID)
  - Used in Aerospace, Automobile, Telecom, Healthcare, Nuclear Management
  - Can do some testing on models
Code Generation

- Take PID and make it Platform Dependent
  - From xUML and scripts generate a highlevel language such as C++, Jovial, Ada
  - Can/have to perform some hand modification
Compiler/Linker

- HUGE Makefiles
  - You thought our linker scripts were bad....

- Specialized Compilers
  - Highly optimizing
  - Reason it's called "nightly" build – it takes awhile
  - Can compile specific areas only for testing

- Creates Operational Flight Program (OFP)
  - Some RTOS functionality, but not full-fledged
  - Gray Area
TESTING

- Debugger
  - Similar to SoftConsole
  - One debugger per card in MMC
  - Not on hardware–simulated

- Desktop Simulator
  - Run compiled code on simulator to test for functionality/errors
  - ERROR....look at generated code, try modifying to see if can figure out a fix. Then go back to xUML/scripts to see if you can fix it there. Regenerate, Recompile, Resimulate
TESTING Phase 2 & 3

- Add in some Hardware
  - Peripherals/Sensors are hardware
  - MMC still simulated
  - If errors/issues, fix & repeat
- Add in Mostly hardware
  - MMC, Peripherals/Sensors are hardware
  - Still have some simulated things

Test stands
  - Think of it as a cockpit without the rest of the jet
Flight Test

- Hopefully by this phase most of the bugs are found, but some can still crop up
- New OFP loaded into a jet and an actual pilot takes to the air to test for new/improved functionality
- After flight test passes then new OFP can be deployed to other jets.
Join SMXG @ HILL AFB

- Good pay & benefits & fitness leave
- Multiple Projects in the SMXG
  - F-16
  - Testers
  - ICBMs
  - SION
  - Workloads increasing
- USAJOBS.com &
- Email resume to: derekcra@gmail.com
Questions?