Advanced Command Destruct System (ACDS) Enhanced Flight Termination System (EFTS)

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13 May 2009

Agenda

- Program Overview / Background
- Initial Operating Capability (IOC)
- Final Operating Capability (FOC) - Advanced Command Destruct System (ACDS) - AFFTC and DFRC Combined Implementation
- Testing
- Questions

NASA DFRC EFTS Background

- Initial Operating Capability (IOC) - NASA DFRC started working towards single vehicle EFTS system January 2008
- Final Operating Capability (FOC) - NASA DFRC and AFFTC combined effort working towards FOC for multiple vehicle and multiple missions simultaneously – effort to be completed by end of 2011
- Several potential users – all UAVs

Initial Operating Capability

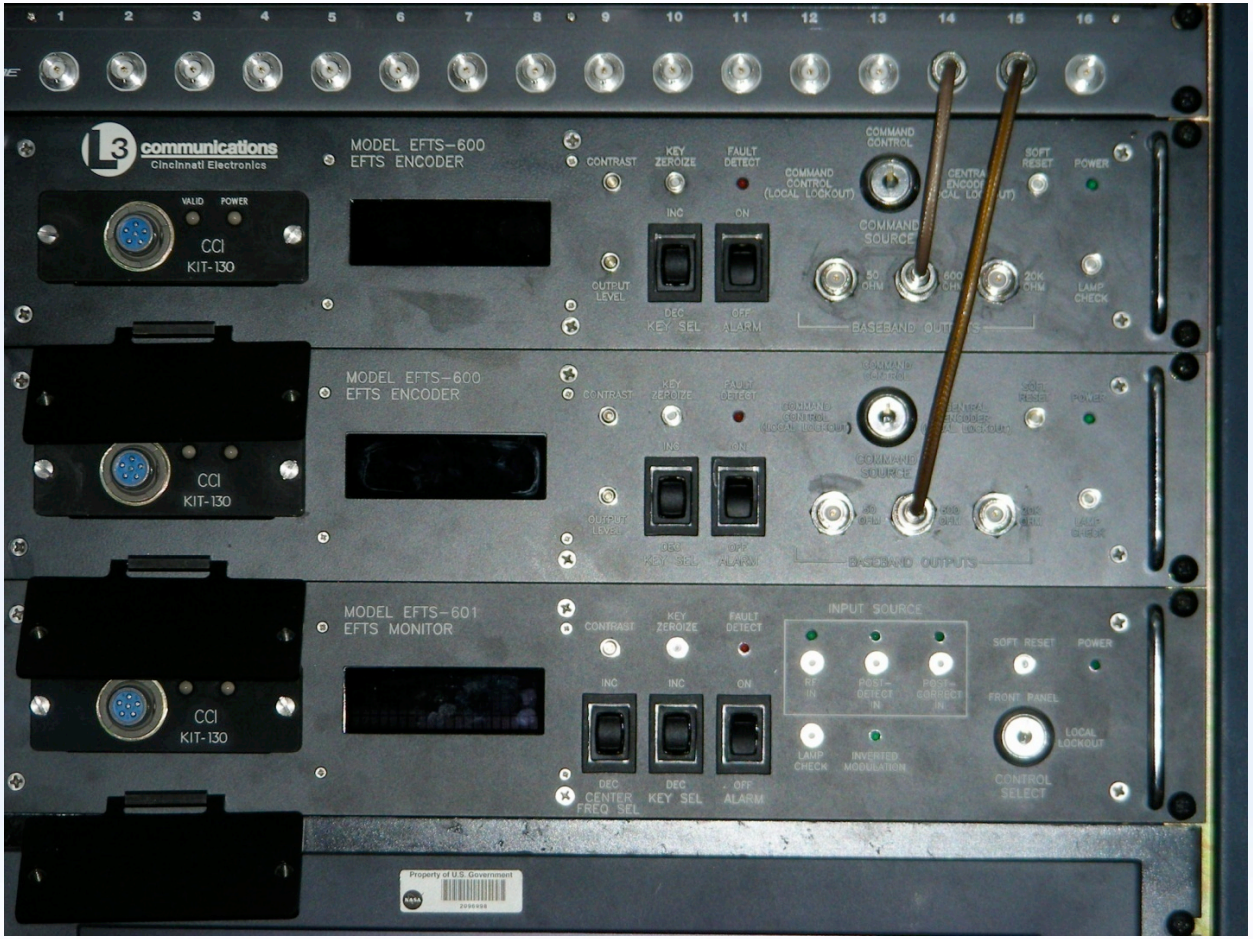
- Developed to support one vehicle per mission
- Developed to support one frequency per mission
- Planned to support Unmanned Aerial Vehicles (UAVs) at NASA DFRC
- Started development in January 2008
- Completed 95% of design and hardware builds by May 2008
- NASA DFRC software safety change of scope/ requirements caused delays after May 2008 to date
- IOC accepted as “Operational” ready by NASA DFRC – one test remaining; near complete

IOC Cont.

- **Development included:**
  - Command / interface panel (updated development)
  - Command controller (CC) (updated development)
  - Encoder (existed under EFTS)
  - Monitor (existed under EFTS)
  - Triple Data Encryption Standard (DES) Unit (TDU) (existed under EFTS)
  - Configuration software (updated development)
  - Logging software (updated development)
  - Test equipment (new development)
  - Existing transmit equipment (no development)

IOC Pictures - CC

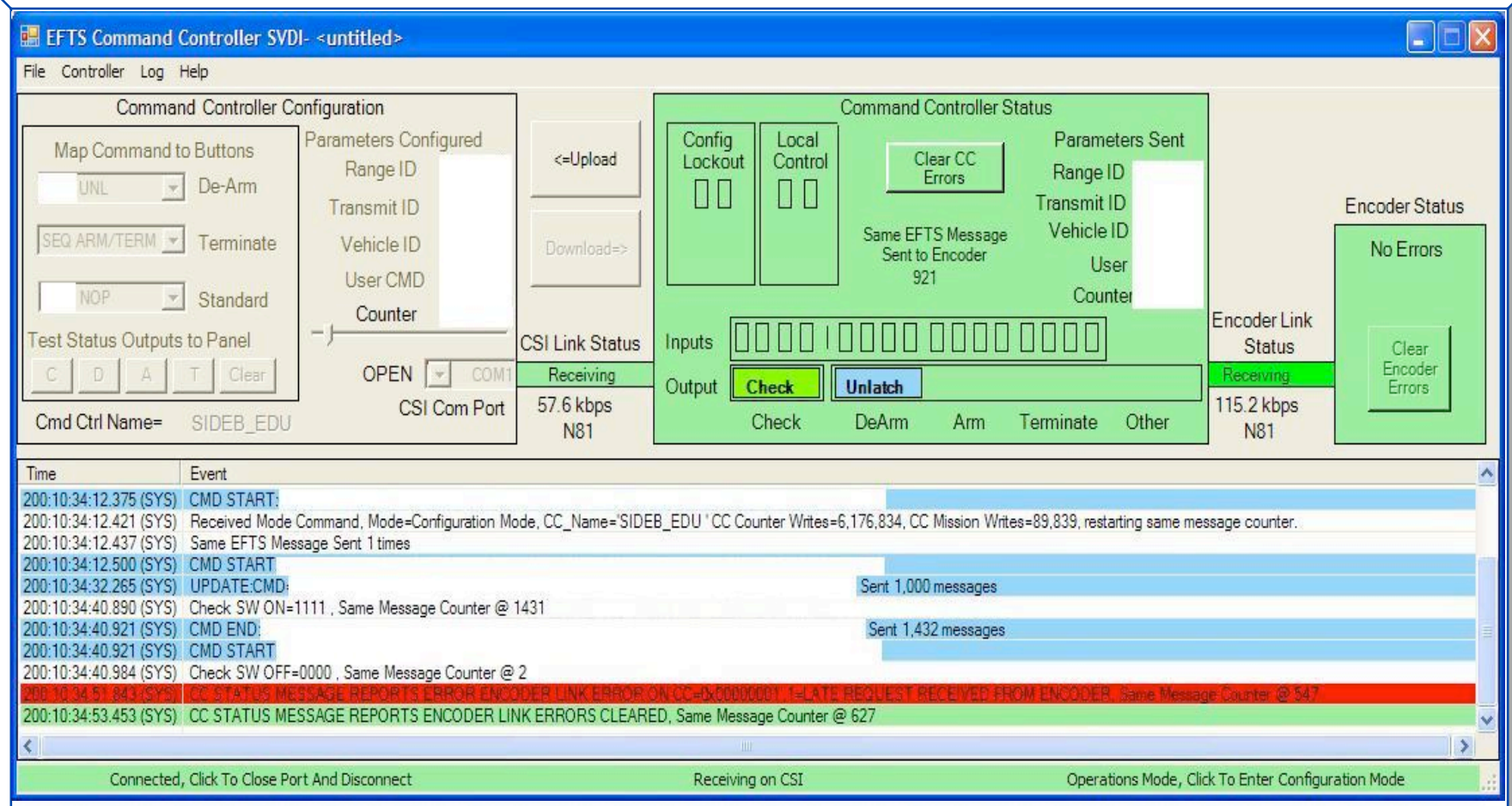
IOC Pictures – Enc/Mon/ TDU



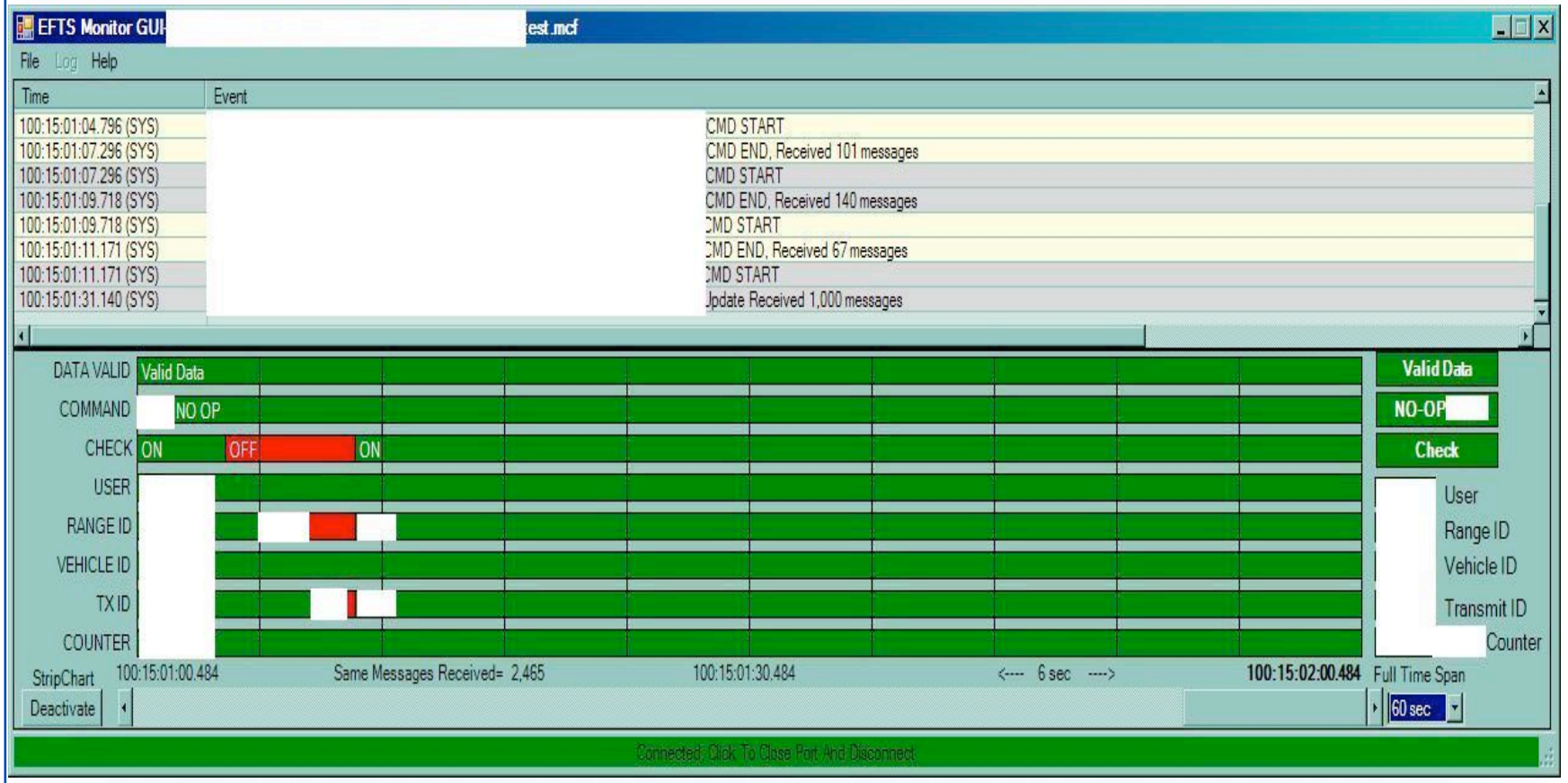
IOC Pictures – Portable EFTS Transmitter System (PETS)

IOC Pictures – EFTS FTR Test Case (EFTC)

IOC Picture – EFTS CC Software



IOC Picture – EFTS Monitor Software



Final Operating Capability

- Upgrading / refurbishing some existing equipment
- Request for proposal (RFP) for full integration
- FOC development work and requirements based upon the work done on the IOC

Requirements Summary

- ACDS system setup time < 1 hour
- EFTS mission configuration manual setup
- Pre-launch FTR checks done via portable test sets
- ACDS FTR key loading
- ACDS system take down < 30 minutes
- Situational awareness – monitor RF status
- Status feedback – command panel
- Status feedback – signal in < 500 ms

Requirements Summary Cont.

- Data logging – command panel output
- Data logging – unencrypted EFTS message
- Data logging – monitor data
- Data logging – signal transmission
- Data logs – storage and archival
- Data logs – time source – IRIG-B
- Primary control sites – RMCC
- Primary control sites – NASA DFRC

Requirements Summary Cont.

- Primary mission control able to support 4 command panels
- Backup control sites
- Transmitted signal power 1 kW
- Operating frequency range (420-450 MHz)
- Operating frequency range (370-380 MHz)
- Two operational transmitter sites
- Antenna – high gain directional
- Antenna – omni-directional

Requirements Summary Cont.

- Universal Command Panel – EFTS and IRIG
- Commands on Command Panel – Arm, Terminate, Check, +1-5 optional commands
- Simultaneous missions – two
- Support IRIG until 2015
- One vehicle per frequency for IRIG
- Four vehicles simultaneously for EFTS
- Remote sites
- One vehicle per command panel
- One command panel per RSO

Requirements Summary Cont.

- No commercial operating system in command path
- System response time < 500 ms
- RCC 208-06 compliant
- System redundancy – triple
- ACDS IV&V
- FTS physical security

IOC Testing

- **Component level testing**
  - Fully tested each individual command path component
  - Exercised every possible error mode that could be thought of
  - Exercised every known and expected function
  - Test procedures
  - Recorded data – electronically and manually
- **System level testing**
  - End to end testing – open loop and closed loop – see next slide

Testing at NASA DFRC

- **Full end-to-end system testing completed**
  - Included exercising of RSO command panel through entire FTS network; transmitted out and fed into monitoring device to verify properly transmitted FTS commands
    - Viewed EFTS command signal response via the EFTS FTR and EFTS Monitor
- **Test item testing**
  - PETS – full functionality
  - EFTC – full functionality
  - End to end testing with test items – output of PETS; into EFTC; verified with EFTS Monitor simultaneously

Questions??

Backup Slides

Documentation

- Requirements for System
- Functional and Performance Requirements Document (FPRD) for all EFTS components of system
- Software Requirements Specification (SRS) for CC
- Analysis of Alternatives (AoA) for System
- Design Review Packages for all EFTS equipment
- Training Guide for EFTS equipment
- Software Design Document (SWDD) for CC
- Software Hazard Analysis for CC
- User's Guide for CC
- System Verification Plan
- System Verification Report
- Reliability Analysis for System and CC
- COMSEC Briefing (CSOP-13, dated 14 Feb 2007)
- Acceptance test reports, user's guides for EFTS hardware
- EFTS ConOps