

Advanced Command Destruct System (ACDS)



Enhanced Flight Termination System (EFTS)



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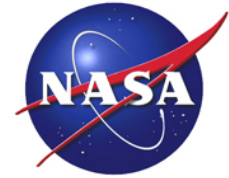
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Agenda



- **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)

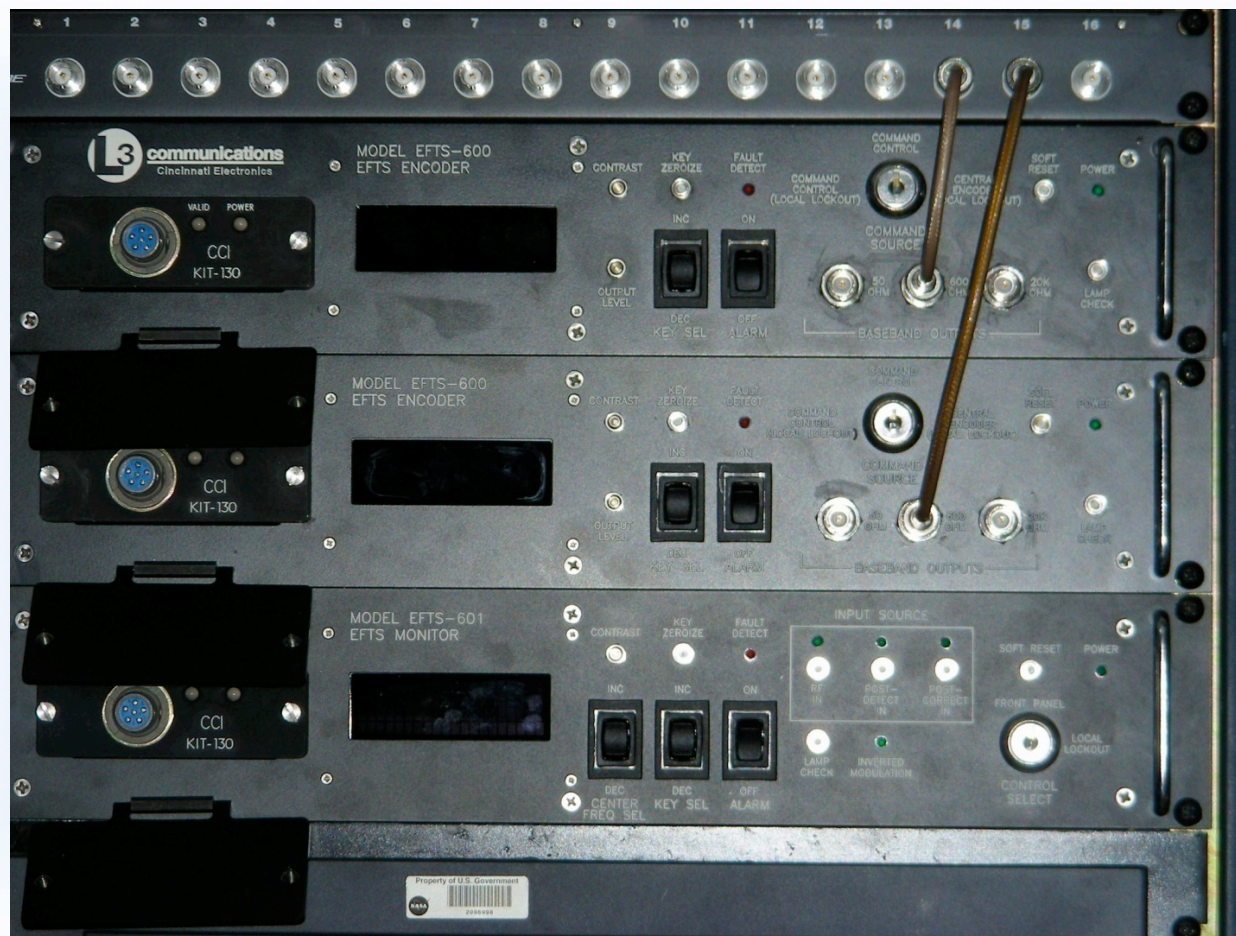


IOC Pictures - CC





IOC Pictures – Enc/Mon/ TDU





IOC Pictures – Portable EFTS Transmitter System (PETS)





IOC Pictures – EFTS FTR Test Case (EFTC)





IOC Picture – EFTS CC Software



EFTS Command Controller SVDI- <untitled>

File Controller Log Help

Command Controller Configuration

Map Command to Buttons

UNL De-Arm

SEQ ARM/TERM Terminate

NOP Standard

Test Status Outputs to Panel

C D A T Clear

Cmd Ctrl Name= SIDEB_EDU

Parameters Configured

Range ID

Transmit ID

Vehicle ID

User CMD

Counter

OPEN COM1

CSI Com Port

<=Upload

Download=>

Command Controller Status

Config Lockout

Local Control

Clear CC Errors

Parameters Sent

Range ID

Transmit ID

Vehicle ID

User Counter

Same EFTS Message Sent to Encoder 921

Inputs

Output

Check DeArm Arm Terminate Other

Encoder Status

No Errors

Clear Encoder Errors

Encoder Link Status

Receiving

115.2 kbps N81

CSI Link Status

Receiving

57.6 kbps N81

Time	Event
200:10:34:12.375 (SYS)	CMD START:
200:10:34:12.421 (SYS)	Received Mode Command, Mode=Configuration Mode, CC_Name='SIDEB_EDU' CC Counter Writes=6,176,834, CC Mission Writes=89,839, restarting same message counter.
200:10:34:12.437 (SYS)	Same EFTS Message Sent 1 times
200:10:34:12.500 (SYS)	CMD START
200:10:34:32.265 (SYS)	UPDATE.CMD: Sent 1,000 messages
200:10:34:40.890 (SYS)	Check SW ON=1111, Same Message Counter @ 1431
200:10:34:40.921 (SYS)	CMD END: Sent 1,432 messages
200:10:34:40.921 (SYS)	CMD START
200:10:34:40.984 (SYS)	Check SW OFF=0000, Same Message Counter @ 2
200:10:34:51.843 (SYS)	CC STATUS MESSAGE REPORTS ERROR ENCODER LINK ERROR ON CC=XXXXXXXXXX 1=LATE REQUEST RECEIVED FROM ENCODER, Same Message Counter @ 547
200:10:34:53.453 (SYS)	CC STATUS MESSAGE REPORTS ENCODER LINK ERRORS CLEARED, Same Message Counter @ 627

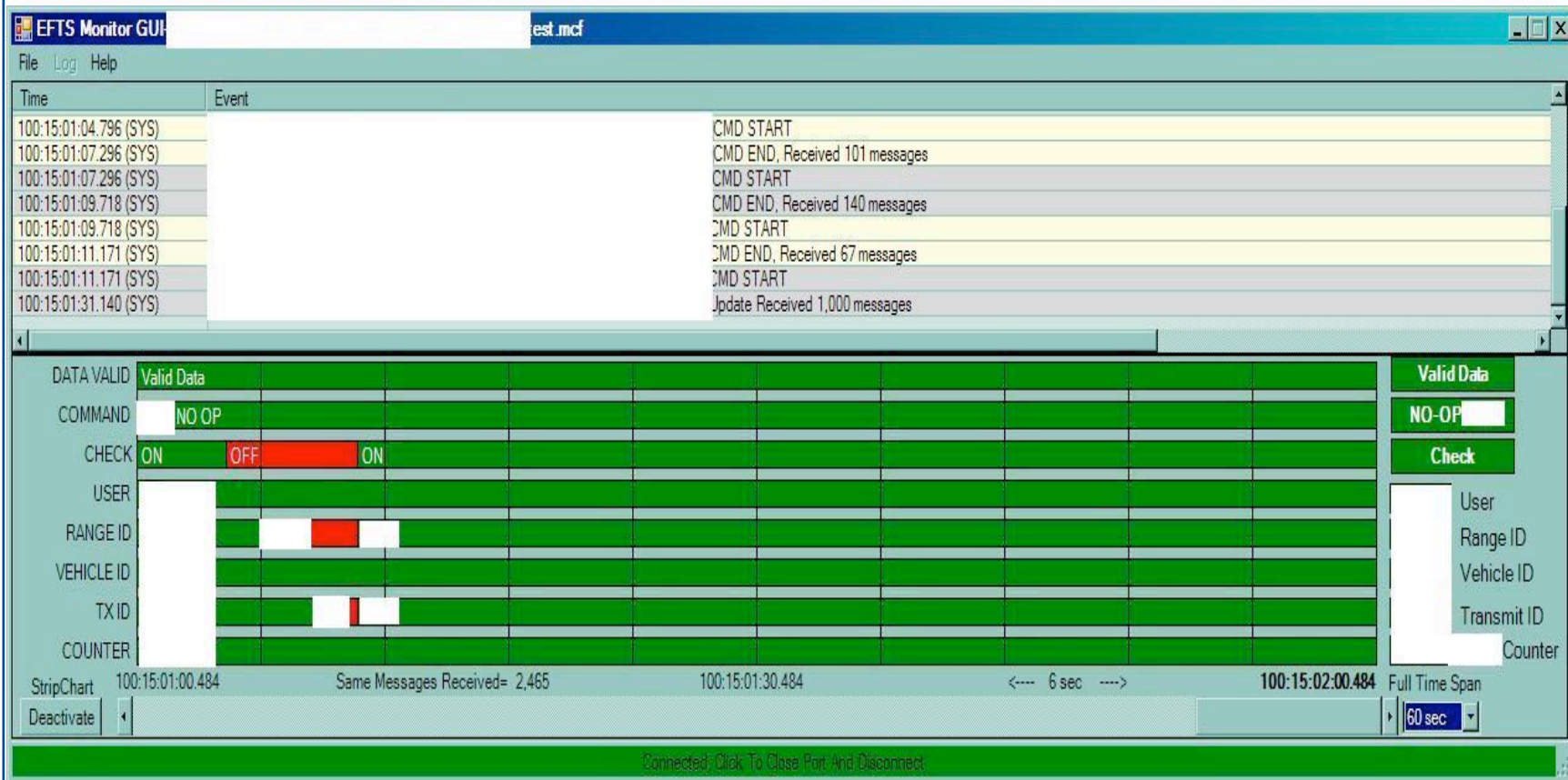
Connected, Click To Close Port And Disconnect

Receiving on CSI

Operations Mode, Click To Enter Configuration Mode



IOC Picture – EFTS Monitor Software





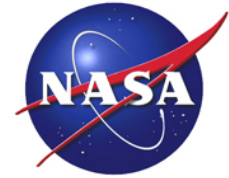
Final Operating Capability



- **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**



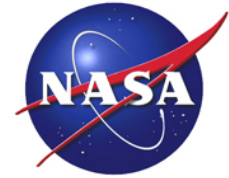
Requirements Summary Cont.



- **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**

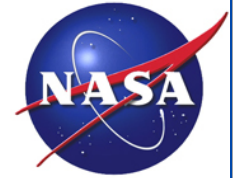
- End to end testing – open loop and closed loop – see next slide



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
 - g 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

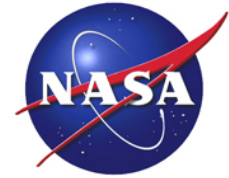


Questions??

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**