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53rd ANNUAL FUZE CONFERENCE

"Next Generation Fuzing - Maximum Advantage for the Warfighter"

Joint Programmable Fuze Emulation

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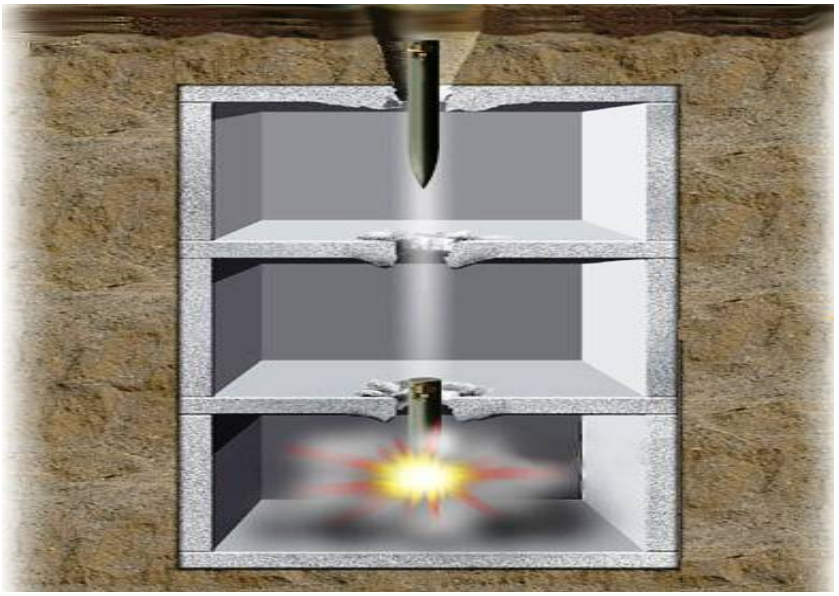
Purpose

- Discuss the Hard Target Void Sensing Fuze's (HTVSF) use of emulating the Serial Data Interface of the Joint Programmable Fuze (JPF)

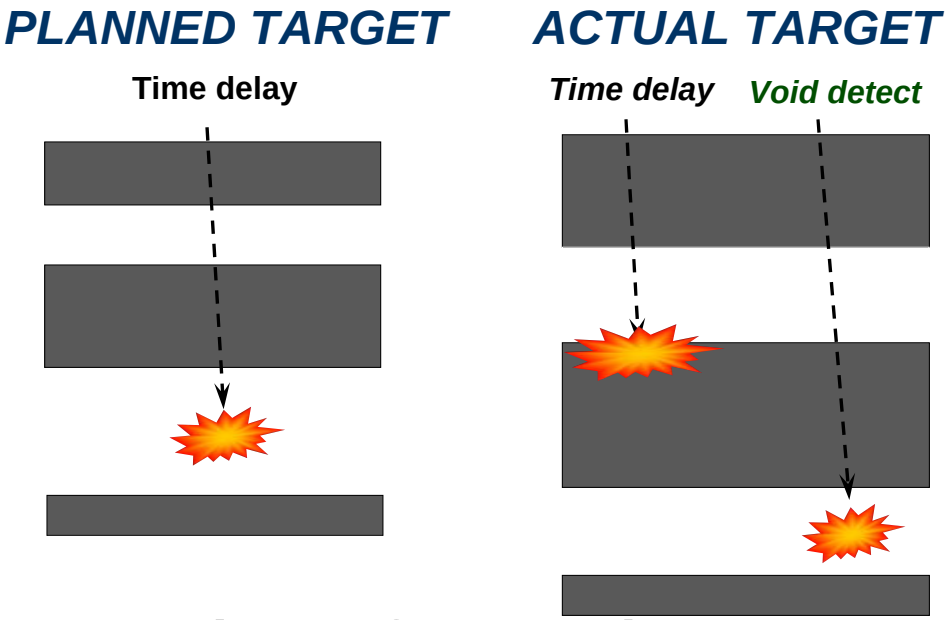


Outline

- Overview of HTVSF JCTD
- New Serial Data Interface (SDI) Issues
- HTVSF Solution to new SDI Issues
- Description of JPF Emulation Method
- Issues/Concerns Found
- Full Functionality
- Summary

Need for a Void Sensing Fuze

- **Inability to effectively attack high value hard and deeply buried targets (HDBTs)**



- **Contributing factors**
  - **Target characterization uncertainty – fuze settings frequently ineffective against mission space**
  - **Low fuze reliability at long time delays**

Solution: A reliable, survivable fuze that detonates the warhead in the desired location

Overview of HTVSF JCTD

- Basic Attributes of HTVSF
  - Programmable from aircraft cockpit
  - Detect more than one void and detonate in desired void
    - > 50% of warhead in void space
    - Operate with void sensing as primary mode with back-up time delay
  - Function after time delay of instantaneous to 255 ms (programmable in 1ms increments)
  - Survive 5K-15K PSI reinforced concrete (BLU-109, BLU-113).
  - Physically compatible with BLU-122

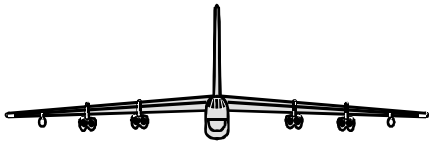
New Serial Data Interface Issues

- Cockpit Programmability Requirements
  - Ability to select different function modes
    - Void mode and Time Delay Mode
  - Ability to select void count
  - Ability to select 256 time delay options
  - Selectable back-up timer in void mode.
  - Selectable Arm times: Arm(min) to 30 seconds in 1 second increments.

- Currently no aircraft has this capability
  - Will require Operational Flight Program (OFP) updates in at least 5 aircraft
    - Not enough funding and Warfighter still needs capability ASAP

HTVSF Solution to New SDI Issues

- JPF Emulation
  - Pretend to be a JPF
  - Warfighter gets limited capability at fraction of cost
  - Fuze will always be capable of operating in Full Functionality (all settings) or JPF Emulation Mode (limited settings)



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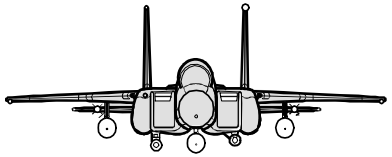

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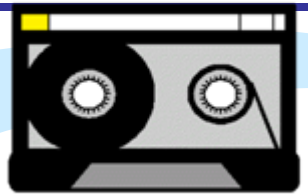
Full Functionality

- Full Functionality Interface Control Document (ICD) will be written by Boeing
- Will enable fuze to program its full range of capabilities
- Compatible with Universal Armament Interface (UAI), and MIL-STD 1760 A/C
- USN F/A-18 will only be compatible with Full Functionality Interface (OFP update required)

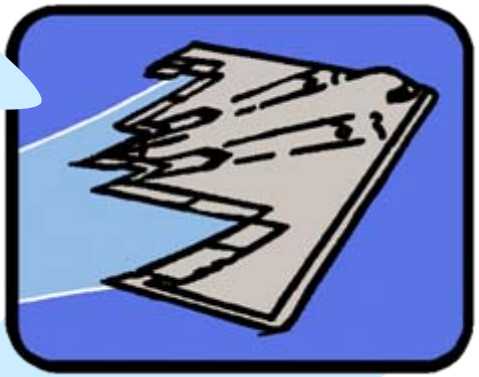
Basic JPF Programming Scenario

Mission Planning System

- Generate Target and Fuze Setting Information
- Settings Correlated to Planned Targets & Targets of Opportunity



Data Transferred to Aircraft Via the Data Transfer Cartridge



Fuze and Target Data are Transferred to the JDAM During Flight Via Mil-Std-1760 Interface

JDAM GCU

RS-422 UART Interface

Serial Data Microcontroller ⟷ Arming Microcontroller

FMU-152A/B Joint Programmable Fuze

Description of JPF Emulation Method

- JPF has fewer options than are required with HTVSF
  - JPF has 16 Arm Times and 20 Delay Times
  - HTVSF Arm Requirement
    - Minimum time of flight of 20 sec to 30 sec (1 sec increments)
  - HTVSF requires 256 different delay times, approximately 10-15 void settings, and 256 back-up timer settings

Description of JPF Emulation Method

- HTVSF will map its Arm Times to JPF's 16 available Low Drag Arm Times
- HTVSF will need to map a subset of the required Delay Time and Void Settings to JPF's 20 available Delay Times
- Subset decided by Targeting Weaponeering Assistance Cell (TWAC)
- Pilot will need translation sheet

JPF fuze settings	HTVSF
Short time delays	Short time delays
0 ms	10 ms
5 ms	15 ms
15 ms	20 ms
25 ms	25 ms
35 ms	30 ms
45 ms	45 ms
60 ms	60 ms
90 ms	75 ms
180 ms	90 ms
240 ms	105 ms
Long time delays	
15 Min	120 ms
30 Min	150 ms
45 min	180 ms
60 min	210 ms
4 hrs	255 ms
8 hrs	Void 1--60 ms
12 hrs	Void 2--60 ms
16 hrs	Void 3--75 ms
20 hrs	Void 4--90 ms
24 hrs	Void 5--120 ms

JPF Fuze Status Data Table

Byte Number	Contains	Values
00	Checksum Result	Not Done, Passed Type 1 or Type 2, Failed
01	Low Drag Arm Time	Binary Pattern
02	High Drag Arm Time	Binary Pattern
03	Delay Time	Binary Pattern
04 and 05	Control Word 1 & 2	Echoes Back Modes and Settings Used by Arming Controller
06	Selected Power	Echoes Back Mode
07 thru 09	Post Arm Data	Bit Pattern Sent to Delay Module
10	Arm Status Word	Armed or Not Armed
11	Dud Word	Retain Fuze Dud Codes
12	Time Zero Status	Detect Fuze Power Up
13	Test Fire Status	Test Function *(Factory)*
14 and 15	Reserved	FFh

Issues/Concerns Found

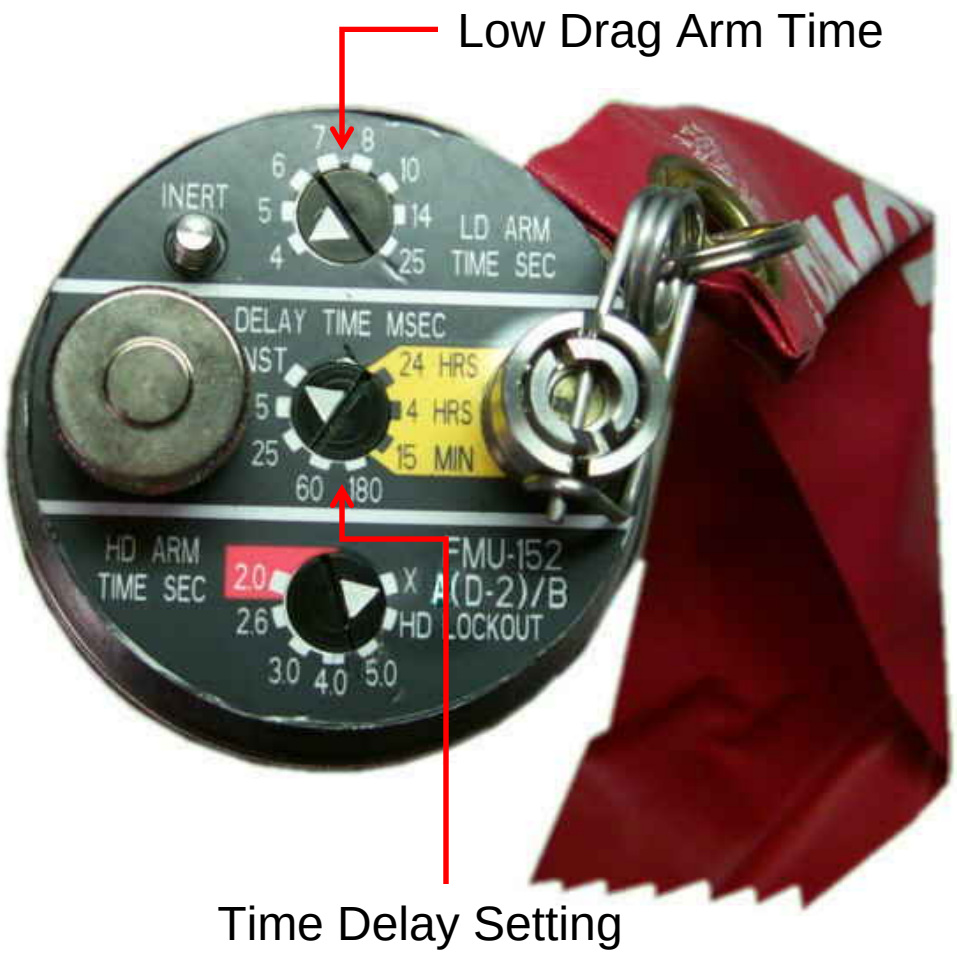
- Safety Concerns
  - Mapping Arm Times
  - Method to prevent Fuze from unintentionally operating in incorrect mode
    - JPF Emulation vs. Full Functionality

JPF Arm Time (sec)	HTVSF Interpretation (sec)
4	20
4.5	21
5	22
5.5	23
6	24
6.5	25
7	26
7.5	27
8	28
8.5	29
9	30
9.5	30
10	30
14	30
21	30
25	30

Revision A of HTVSF Annex to JDAM-JPF SDI

JPF Default

- JPF defaults to face plate settings
- HTVSF has no face plate setting requirement
  - Hard Code Defaults
    - Arm Time: 30 sec
    - Function: Void 1, 60 ms



1760 Control Word (Word 8)

1760 Message Word 8 (Core Interface)

bit 00	bit 02	bit 05	bit 09	bit 10	Default
Function on Impact	Function on Delay After Impact	Function on Proximity	Long Delay Enable	Go To Default	
0	0	0	0	0	Goes to Defaults (see paras 7.2.2, 7.2.3, and 7.3).
x	x	x	x	1	Goes to Defaults (see paras 7.2.2, 7.2.3, and 7.3).
1	0	0	0	0	0 milliseconds after impact. (Note 1)
x	x	x	1	0	Long Delay after Impact - Delay Time Set to Word 11 Value. (Note 2)
x	x	1	0	0	Short Delay after Proximity w/Impact Backup - Delay Time Set to Word 11 Value. (Notes 3,4)
x	1	0	0	0	Short Delay After Impact - Delay Time Set to Word 11 Value. (Note 5)

x - Don't Care

Table 10 Control Word Bits / Default Decision Table

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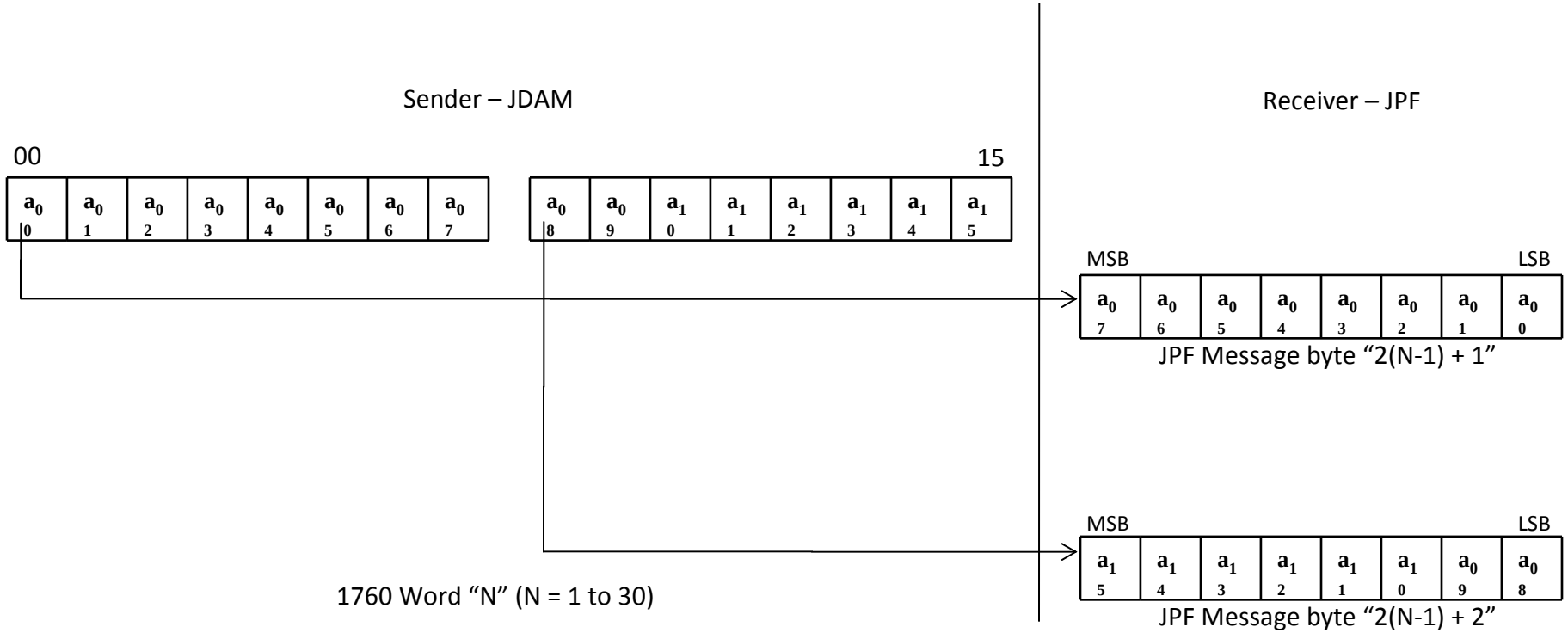
JDAM-JPF Settings Message

- Requires fuze vendors to emulate communication protocol they did not design
- Must emulate every aspect of the interface



Summary

- Warfighter needs cockpit programmable void sensing fuze ASAP
- Limited funding for aircraft OFP updates
- HTVSF solves problem with JPF Emulation
- UAI is the long term solution for full functionality without an OFP update

Questions?

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