Common Range Integrated Instrumentation System (CRIIS) Informational Briefing

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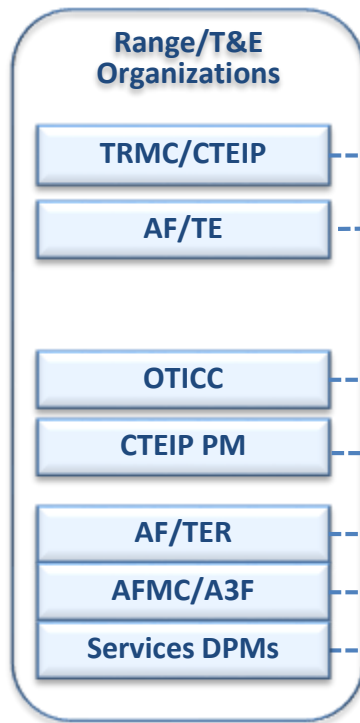
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CRIIS Overview

- **CRIIS is a Family of Systems for Airborne Data Collection**

  - **High Accuracy Time, Space, Position Information (TSPI)**

  - **Secure Datalink(s) Transmit Real Time TSPI and Aircraft Data**

  - **Multiple Independent Levels of Security**

  - **Participant Packages (Pod & 2 Internal Configurations) and Ground Systems**

  - **Integrated on F-15, F-16, F-18, F-22A (SIL) and F-35 (SIL)**

- **Development Funded by Central T&E Investment Program (CTEIP)**

  - **Replaces Existing GPS Based ARDS at Major Test Ranges – Interoperable System**

  - **$300M Development Program**

- **Production and Sustainment Funded by Each Service**
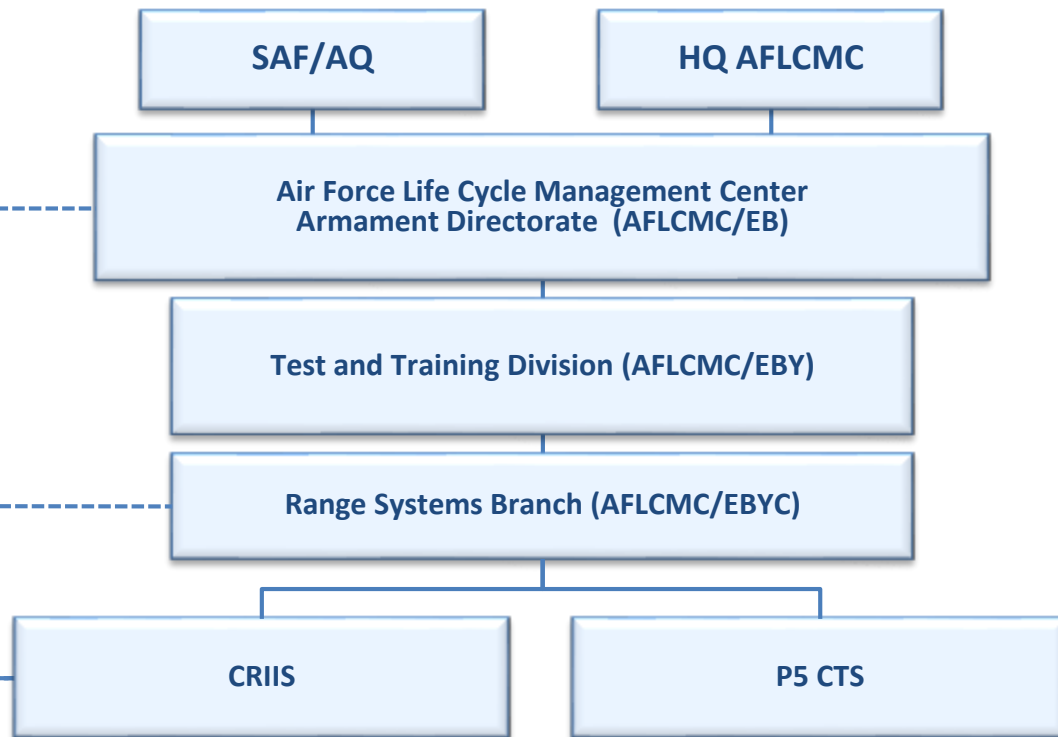
- **Prime Ktr: Rockwell Collins, Inc. (Cedar Rapids, IA)**

CRIIS is a Test Range Replacement of the Existing GPS Based ARDS with Advanced Datalink, TSPI, Security Features
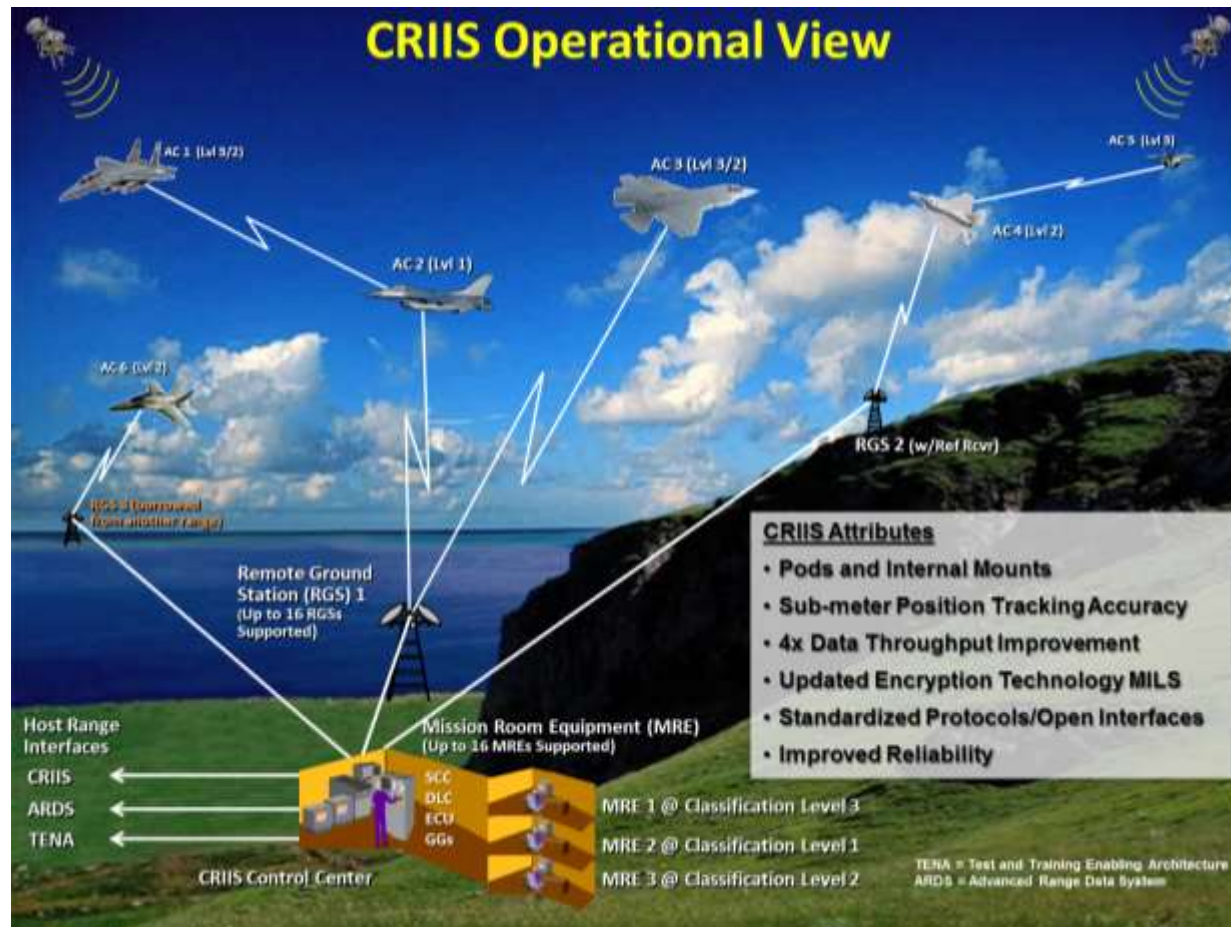
OSD - AFLCMC Relationship

Requirements/ Funding

Acquisition Authority

SAF/AQ

HQ AFLCMC

Range/T&E Organizations

TRMC/CTEIP

AF/TE

OTICC

CTEIP PM

AF/TER

AFMC/A3F

Services DPMs

Air Force Life Cycle Management Center Armament Directorate (AFLCMC/EB)

Test and Training Division (AFLCMC/EBY)

Range Systems Branch (AFLCMC/EBYC)

CRIIS

P5 CTS

CRIIS Description

CRIIS Operational View

CRIIS is a Family of Systems for Airborne Data Collection
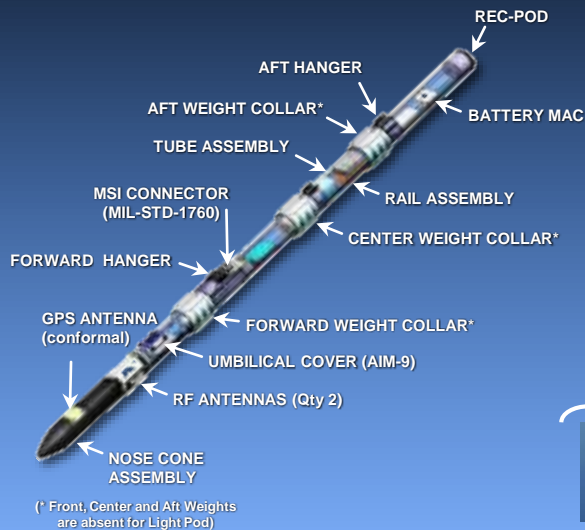
- **High Accuracy Time, Space, Position Information (TSPI)**

- **Increased throughput of Real Time TSPI and Aircraft Data**

- **Multiple Independent Levels of Security (MILS)**

- **Participant Packages (Pod & 2 Internal Configurations) & Ground Systems**

- **Integrating on F-15, F-16, F-18, F-22A (SIL) and F-35 (SIL)**

- **Replaces Advanced Range Data System (ARDS)**

Phase II locations: Pax River, Eglin AFB, WSMR, and Edwards AFB
Follow-on locations: China Lake, Nellis AFB, and Point Mugu

CRIIS Airborne & Ground Subsystems

Participant Packages

Configuration 4 Pod for Legacy Aircraft

- REC-POD
- AFT HANGER
- AFT WEIGHT COLLAR*
- BATTERY MAC
- TUBE ASSEMBLY
- MSI CONNECTOR (MIL-STD-1760)
- RAIL ASSEMBLY
- CENTER WEIGHT COLLAR*
- FORWARD HANGER
- GPS ANTENNA (conformal)
- FORWARD WEIGHT COLLAR*
- UMBILICAL COVER (AIM-9)
- RF ANTENNAS (Qty 2)
- NOSE CONE ASSEMBLY

(* Front, Center and Aft Weights are absent for Light Pod)

Configuration 5 Internal Mount Liquid Cooled for 5th Gen Aircraft

Configuration 6 Internal Mount Air Cooled for Legacy Aircraft

Threshold Platforms

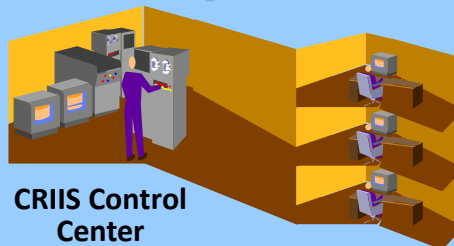F-22 | F-35 | F-15 | F-16 | F-18

5th Generation Aircraft | *Legacy Aircraft*

Ground Subsystems

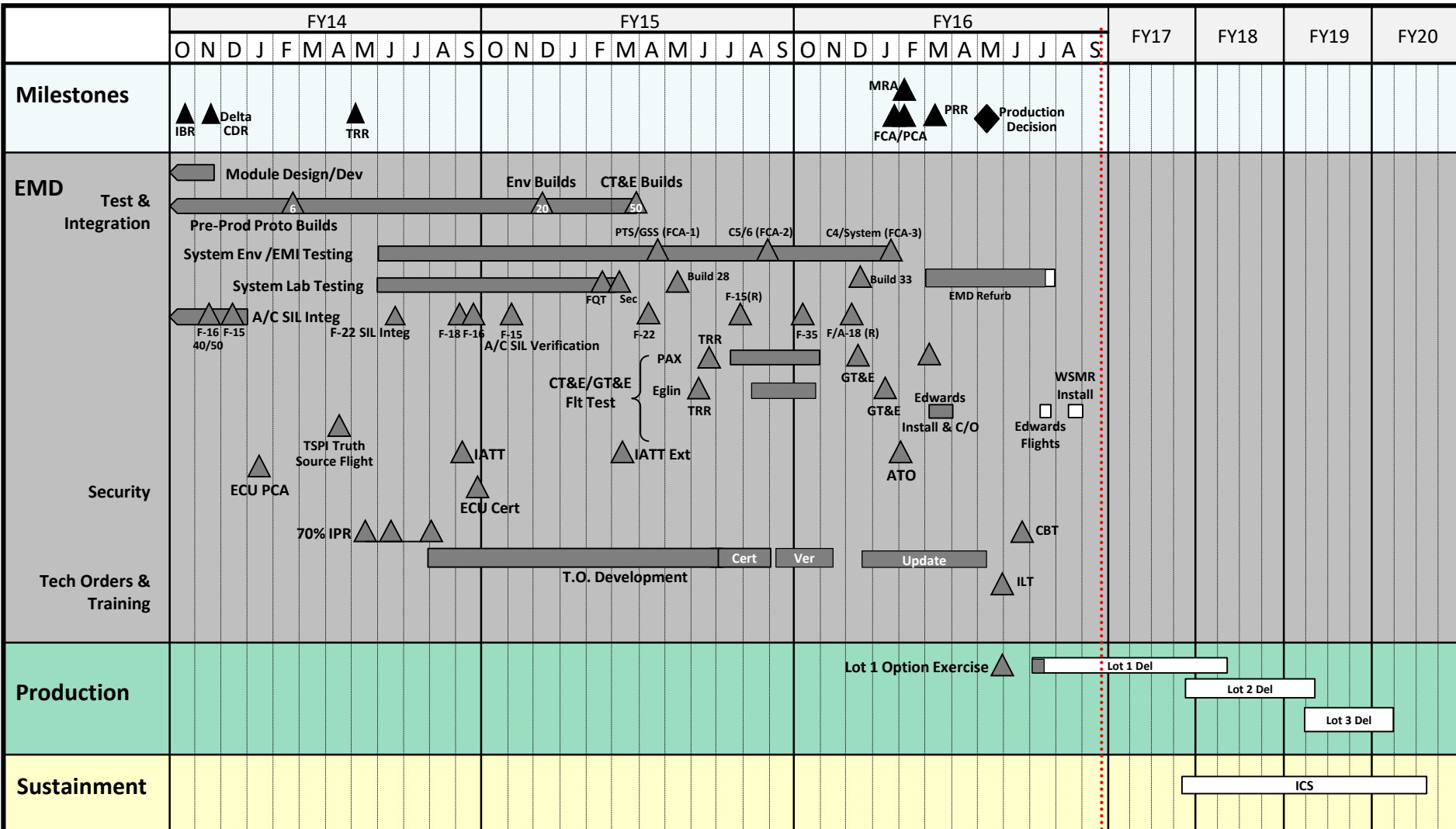Remote Ground Station & Reference Receiver
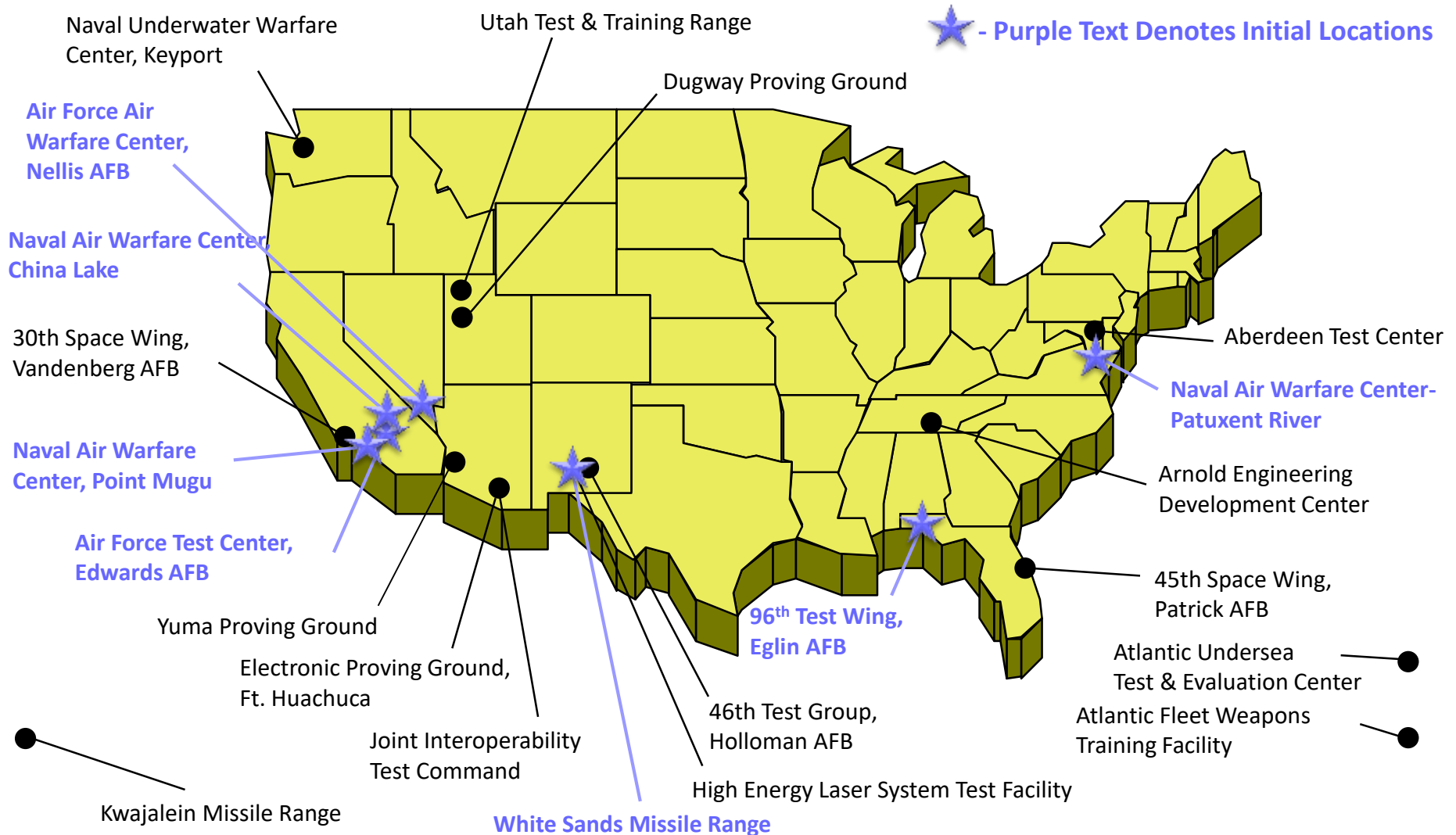
CRIIS Control Center

Mission Rooms

Portable Test Set

CRIIS Program Schedule (EMD Detail)

Major Range and Test Facility Base (MRTFB) and Initial Locations

Naval Underwater Warfare Center, Keyport

Utah Test & Training Range

Air Force Air Warfare Center, Nellis AFB

Dugway Proving Ground

⭐ **- Purple Text Denotes Initial Locations**

Naval Air Warfare Center China Lake

30th Space Wing, Vandenberg AFB

Aberdeen Test Center

Naval Air Warfare Center- Patuxent River

Naval Air Warfare Center, Point Mugu

Air Force Test Center, Edwards AFB

Arnold Engineering Development Center

Yuma Proving Ground

45th Space Wing, Patrick AFB

Electronic Proving Ground, Ft. Huachuca

96th Test Wing, Eglin AFB

Atlantic Undersea Test & Evaluation Center

Joint Interoperability Test Command

46th Test Group, Holloman AFB

Atlantic Fleet Weapons Training Facility

Kwajalein Missile Range

White Sands Missile Range

High Energy Laser System Test Facility

Key Performance Parameters

Requirement	Status
0.5 meter horizontal RMS accuracy on fighter aircraft	✓ Met
Top Secret encryption capability	✓ Met
Datalink throughput greater than or equal to 400kbps per frequency within ARDS occupied bandwidth	✓ Met
Mass properties consistent with ARDS, within constraints	✓ Met
Fits internally in F-35 and F-22	See Notes*
Fits on F-18 6L Bay Door	✓ Met
Compatibility with Global Information Grid (through TENA)	✓ Met

* Notes:
1. Design meets volume requirements defined in SPS at EMD start
2. F-22 aircraft configuration changes (post CRIIS EMD start) will require follow-on integration effort for physical fit.
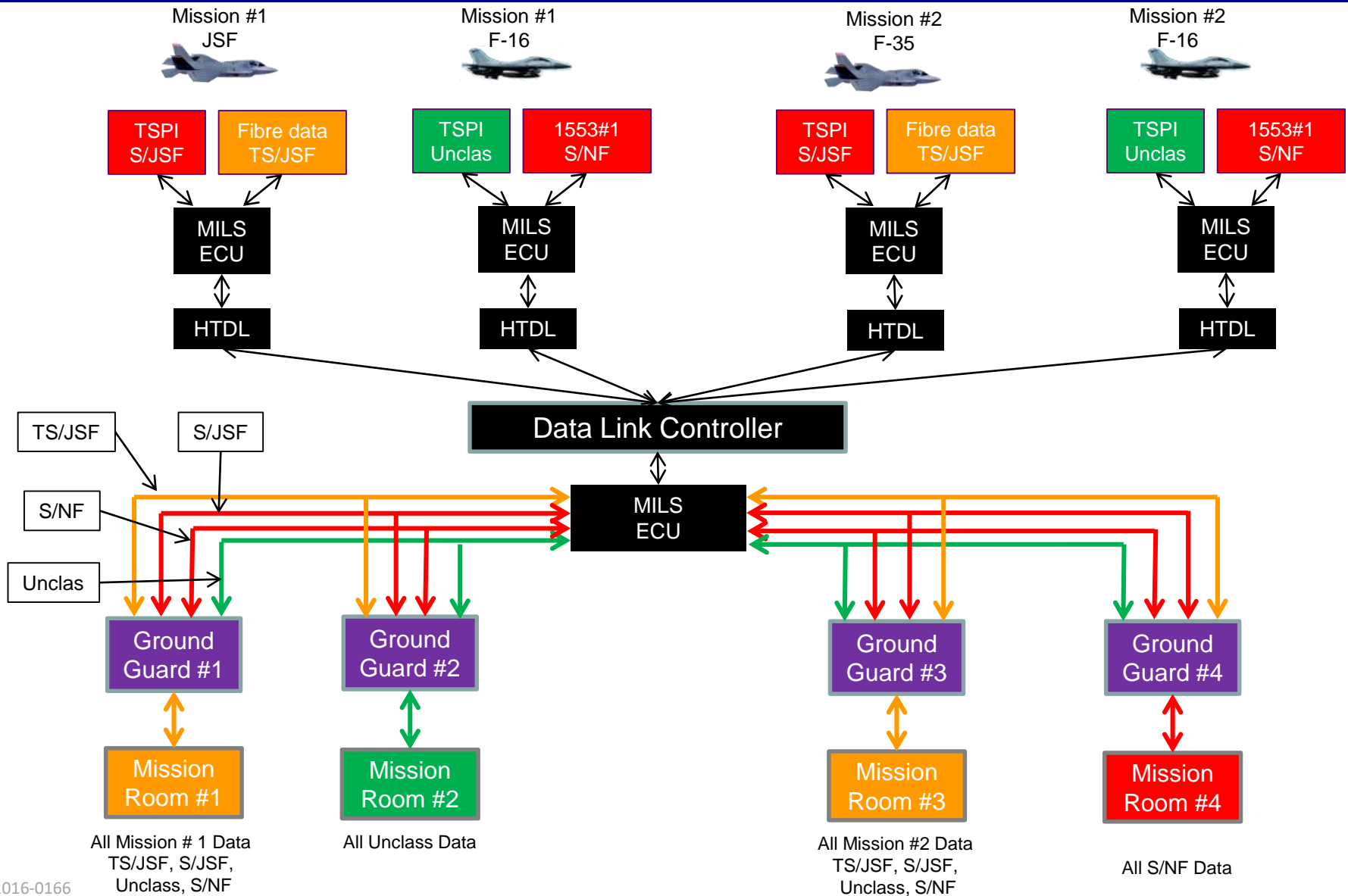
Airworthiness and SIL Testing

- **SIL Testing Approach**
  - **Demonstrate Aircraft Interface Capability for All Threshold Aircraft**

- **CTE/GTE Flight Clearance Approach**
  - **Obtain Interim/Local Flight Clearances for Flights**
    - **Prioritize Qualification Testing needed for these Clearances**
    - **Subset of Artifacts/Data Needed for Full Fleet Certification**

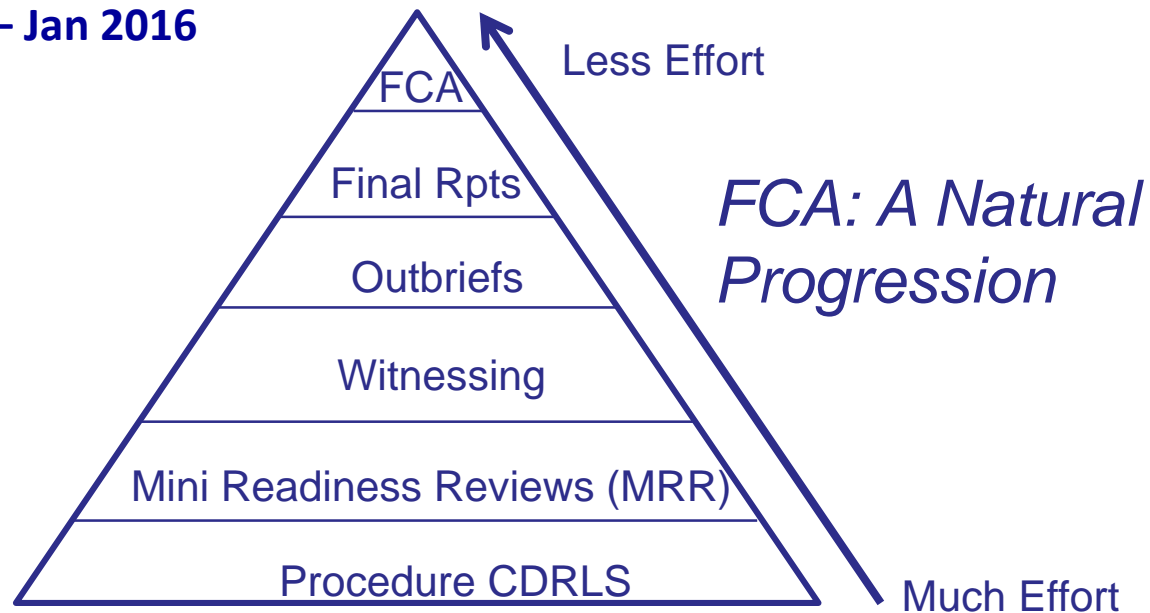| Aircraft	SIL Objectives
F-15	Cfg4, Cfg6 Power & 1553 Bus Interface
F-16	Cfg4, Cfg6 Power & 1553 Bus Interface
F/A-18	Cfg4, Cfg6 Power & 1553 Bus Interface
F-22	Cfg5 Power & 1553 Bus Interface
F-35	Cfg5 Fiber Channel Bus Interface

CRIIS MILS Architecture
Data Sorted By Classification/Caveat or Mission Number (Notional)

All Mission # 1 Data
TS/JSF, S/JSF,
Unclass, S/NF

All Unclass Data

All Mission #2 Data
TS/JSF, S/JSF,
Unclass, S/NF

All S/NF Data

Getting to FCA

- **Adopted Incremental FCA Approach**
  - **DoD 5000 accepted practice**
  - **Volume of Requirements conducive to incremental approach**
  - **Identifies issues early**
- ✓ **FCA 1 (GSS/PTS) – Apr 2015**
- ✓ **FCA 2 (Config 5/6) – Aug 2015**
- ✓ **FCA 3 (System) – Jan 2016**

Less Effort

FCA

Final Rpts

Outbriefs

Witnessing

Mini Readiness Reviews (MRR)

Procedure CDRLS

Much Effort

FCA: A Natural Progression

Physical Qual Tests

- **Testing was performed against multiple product configurations**
  - **Gen 2: Flight Test Configuration**
  - **Gen 3: Production Configuration**
- **Since TRR, over 10,000 hours of Physical Qual Testing**
  - **EMI, 704, TEMPEST, Dynamics, Climatics**
- **Physical Qual Testing Complete & Reports Approved**
  - **Ground: TEMPEST, EMI, ENV**
    - **CCC, MRE, RGS, RRS, PTS**
  - **Cfg 4: TEMPEST, EMI, ENV**
  - **Cfg 5: TEMPEST, EMI, ENV**
  - **Cfg 6: TEMPEST, EMI, ENV**
- **Variances Captured**

Functional Qual Tests

- **Testing was performed against multiple Software Baselines**
  - **Lab FQT: Builds 16, 17, 18, 19, 20, 21, 26**
  - **Lab Regression FQT: Build 28**
  - **Lab Regression FQT: Build 33**
- **Since TRR, over 10,000 hours of Functional Qual Testing**
- **Lab FQT Complete & Reports Approved**
  - **Lab FQT Report**
  - **Build 28 Regression FQT Report**
  - **Build 33 Regression FQT Report**
- **Variances Captured**

The Process

Rockwell Collins Verification Requirements Traceability Matrix (VRTM)

Requirement (Customer Requirements: Attachment 2-SPS v3 1 thru P41 Located under contract Docs>Attachements)	RC SPS ID	Verif	Associated L2s (Strikethrough indicates no Verif case in DOORS for L2)	Artifact	RC Pass / Fail	Eglin Concurrence	Comments
The HTDL shall detect the presence of message errors in real-time.	SPS-1903	**Verif-686** GSS Network Control and RF Interface	**L2-1328** The Ground Subsystem shall provide the capability to control and monitor all SR-DLTs, MR-DLTs, ER-DLTs, and HT-DLTs simultaneously that are defined as part of the CRIIS system for a specific range.	Lab FQT Rpt 26 (946-9164-001)	Pass	30-Jul-15	HTDL FQT Test Case 09-01
		Verif-2708 HTDL Test	**L2-1218** The MAC Participant Package shall detect the presence of received message errors in real-time. **L2-5016** The Ground Subsystem HTDL network shall detect the presence of message errors in real-time.	HTDL FQT Rpt (946-4267-001)	Pass	30-Jul-15	HTDL FQT Test Case 09-01
		Verif-2710 HTDL Analysis	**L2-1218** The MAC Participant Package shall detect the presence of received message errors in real-time. **L2-1826** The MAC Participant Package shall have an undetected erroneous message rate of less than one per 16 million. **L2-4550** The Ground Subsystem HTDL shall have an undetected erroneous message rate of less than one per 16 million.	HTDL FQT Rpt (946-4267-001)	Pass	30-Jul-15	HTDL FQT Figure 3-241

CRIIS Program Office Artifacts Review

Meet 2-3 times a Week w/ Ktr

Functional Configuration Audit Results

- **Incremental FCA approach allowed for earliest possible flight testing**

- **FCA-1 28-29 Apr 2015**
  - **125 SPS Requirements accepted as complete after variances and actions closed**

- **FCA-2 on 26-27 Aug 2015**
  - **20 SPS Requirements accepted as complete after variances and actions closed**

- **FCA-3 on 27-28 Jan 2016**
  - **69 SPS Requirements accepted as complete after variances and actions closed**

214 SPS REQTS APPROVED AS PRODUCT BASELINE

Flight Test Overall Summary

Flight Test Summary

- **Flight Test and SIL Execution Summary**
  - **21 Total Flight Test Events**
  - **F-15, F-16, F/A-18, L-29 and 4 Low Dynamic Aircraft**
  - **CRIIS System Successfully Integrated into Pax River and Eglin Range Infrastructure**
  - **SIL Completed for F-15, F-16, F/A-18, F-22 and F-35**

- **Flight Test Results Summary**
  - ✓ **All TSPI Performance Requirements Successfully Verified**
  - ✓ **All Datalink Networking and Reliability Requirements Successfully Verified**
  - ✓ **On-Aircraft MILS Demonstration Conducted Successfully**
  - ✓ **Aircraft Interface Requirements Successfully Verified at SIL**
  - ✓ **All Planned Flight Clearances Obtained and Airworthiness Data Completed**

Eglin Flight Testing

	Aircraft	CRIIS Equipment	Objective	Execution Date(s)
~~Eglin 1-4~~	~~F-15~~	~~TMAC (Cfg5, Cfg6) Cfg4 x 2~~	~~TMAC TSPI Performance + Cfg4 TSPI Characterization~~	N/A
Eglin L29	L-29	TMAC (Cfg5, Cfg6) Cfg4 x 1	TMAC TSPI Performance + Cfg4 TSPI Characterization	10 Aug – 04 Sep 2015
Eglin 5	F-16	Cfg4 x 2	Cfg4 TSPI Characterization	20 Oct 2015
MILS Demo	F-15	Cfg4 x 1	MILS Demonstration	30 Sep 2015
Regression	As Needed	As Needed		N/A – No Regression Necessary

- **Eglin Changes from Plan**
  - **F-15 Unavailable and Replaced 4 F-15 Flights with 13 L-29 Flights for TSPI Verification**
    - **Alternate F-15 Not Available due to Extensive Mod Required for TMAC Installation**
    - **L-29 Evaluated Against Planned Flight Cards to Ensure Representative High Dynamic Performance**
  - **No Regression Test Required**

Eglin Flight Test (TSPI Verification)

- Two airborne systems on-board
- Scored against TSPI "Truth Plate"
- 13 test flights
- 197 total maneuvers

KPP (0.5 meter Real Time horiztonal RMS)

Real Time TSPI (positional & non-positional)

Post Mission Processed TSPI

Maneuver	#
2-6 G turns	46
3-5 sec level inverted flight	31
Aileron rolls	28
Steep climbing or diving	24
Immelmann	14
2-4 G Figure-8	11
Cuban 8	10
Descending turns	10
Barrel rolls	9
Split S	8
High speed straight and level	6
Total	197

Patuxent River NAS Flight Tests

	Aircraft	CRIIS Equipment	Objective	Execution Date(s)
Pax 1	1 Baron, 3 x King Air	Cfg6 x 4	Multi-Hop, Datalink Routing & Message Reliability	16 July 2015
Pax 2A	F-18 1 x King Air	Cfg6 x 2	Datalink Distance & Message Reliability (2 RGS)	23 Sep 2015
Pax 2B	1 x King Air	Cfg6 x 1	Datalink Distance & Message Reliability	9 Sep 2015 22 Sep 2015 16 Oct 2015
Pax 3A	F-18 1 x King Air	Cfg4 x 2 Cfg6 x 1	Datalink Distance & Message Reliability (1 RGS)	30 Oct 2015
Pax 3B	2 x King Air	Cfg6 x 2	Datalink Distance & Message Reliability (1 RGS)	11 Sep 2015
Regression	1 x King Air	Cfg6 x 1	Message Reliability Confidence Flight (1&2 RGS)	03 Feb 2016

■ Pax River Changes from Plan

- – Pax 2 and Pax 3 Separated into Two Parts to Ease Aircraft Scheduling Issues

- – Additional Confidence Flight Added for Message Reliability Added

Pax River Flight Test (Datalink Verification)

1
- 100 nm (Baron to KA)
- 130 nm
- 100 nm
- 100 nm
- 100 nm

Obj 1: Networking
Obj 2: Range
Obj 4: Multi-Hop

2a
F/A-18
- 50 nm
- 70 nm (to KA)

Obj 2: Range
Obj 5: Message Reliability (↑ ↓ ↔)

2b
- 130 nm (to KA)
- 130 nm
- 130 nm

Obj 1: Networking
Obj 5: Message Reliability (↑ ↓)

3a
F/A-18 w Pods
- 70 nm
- 50 nm (to KA)

Obj 2: Range
Obj 5: Message Reliability (↑ ↓ ↔)

3b
KA
- 100 nm (to KA)

Obj 1: Networking
Obj 3: Egress/Ingress
Obj 5: Message Reliability (↔)

Legend:
- **Obj 1: Networking (1, 2b, 3b)**
- **Obj 2: Range (1, 2a, 3a)**
- **Obj 3: Egress/Ingress (3b)**
- **Obj 4: Multi-Hop (1)**
- **Obj 5: Message Reliability** (2a, 2b, 3a, 3b)

Meet with Build 33 software (2b Refly)

Phased PCA Approach

- **Phase I: GSS/PTS HW (16-18 Nov 2015)**
  - **FCA-1 and FCA-2 Completed Prior to Event**
  - **HW Only…No HW changes to GSS/PTS Expected**

- **Phase II: C4/C5/C6 HW (20-21 Jan 2016)**
  - **FCA-1, FCA-2 and Regression Testing Completed Prior to Event**
  - **Identified 4 Potential Variances from FCA**

- **Phase III: System SW/Final HW (2-4 Feb 2016)**
  - **FCA-1, FCA-2 and FCA-3 Completed Prior to Event**

Results

- **Reviewed 327 HW & SW Parts with No Critical Issues Found**
  - **Minor Configuration and Documentation Updates**

- **Confirmed All Subsystems Consistent with Production Documentation**

- **Confirmed all Subsystems Functionally Equivalent with FCA Config**
  - **Includes FCA Known Potential Variances**

- **Completed Audit of SW and HW for All Subsystems**
  - **Changes to these Parts Requires CCB**

- **Verified SW Load Procedures for All Field Loadable CPINs**

Successful PCA!

CRIIS Upgrade/Integration

- **Lot 1 Production Contract Awarded 20 May 2016**

- **IDIQ - CRIIS software upgrade for advanced capabilities and to further mature integration with range infrastructure and aircraft bus messaging**

- **Initial Scope (Phase 1): 12 month effort to field CRIIS software upgrade**
  - **Modify CRIIS software to enable aircraft/range message handling**
  - **Datalink Power Switching for 5th Gen aircraft**

- **Follow-on efforts : F-15, F-16, F/A-18, F-22, F-35 integration verification**

F-22-CRIIS Integration

- **Configuration 5 (2-Box) Targeted for 5th-Gen Aircraft**
  - **Pre-CRIIS RFP analysis ID'd Air to Air Range Instrumentation (AARI) location**
  - **Operational Reqts superseded the available space forcing instrumentation relocation (ARIP)**
    - **Identified as the preferred location for CRIIS**
  - **Two CRIIS Config 5 installed as is in select A/C**

- **CRIIS and F-22 Program MOA established to integrate onto F-22**

- **F-22 ID'd emerging ARDS obsolescence and spares issues**

Fwd Fus RH Lower Aft Equipment Area

GPS Equip Instl
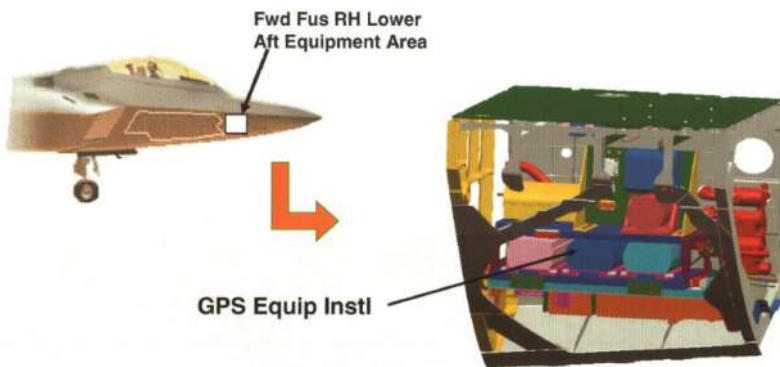
ARIP

Summary

- **CRIIS is next generation test range instrumentation system**
  - **5x data throughput**
  - **4-20x TSPI accuracy**
  - **Legacy and 5th Gen platforms**

- **CRIIS completed successful EMD; production deliveries started**

- **Follow-on efforts ongoing to continue to grow capability**