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49th Annual NDIA Conference
Targets, UAVs & Range Operations Symposium & Exhibition

Boeing QF-16 Program – Ready for Test

QF-16 Full Scale Aerial Target
Boeing Global Services and Support
Maintenance, Modifications, & Upgrades
Aircraft Sustainment & Maintenance

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QF-16 Chief Architect
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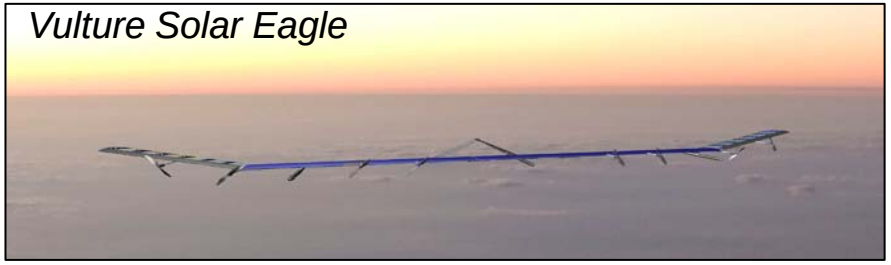
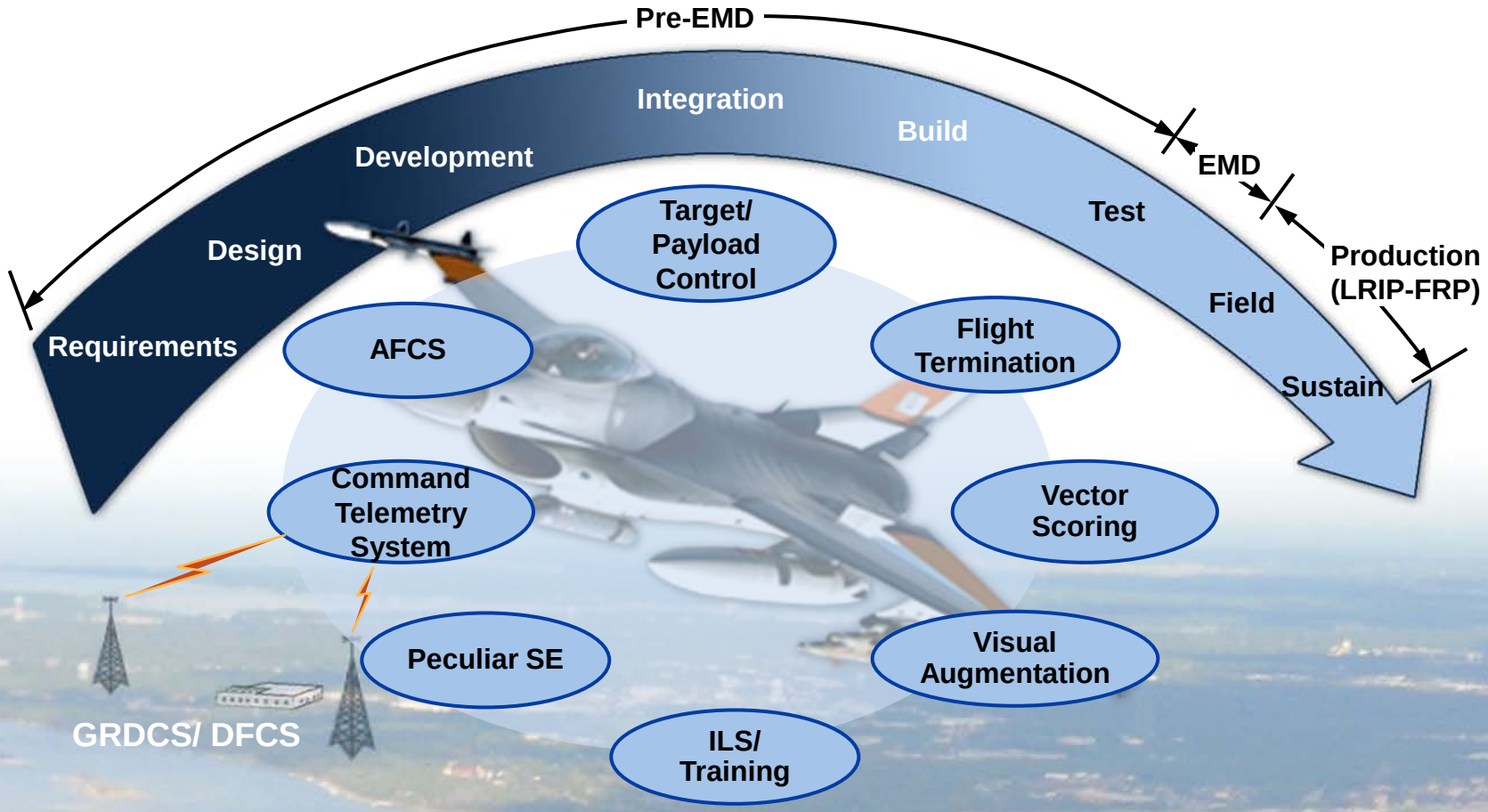
Boeing Targets / Decoys / UAS

- Cost Effectively Converting Highly Reliable, NDI Air Vehicles
- Providing Foundation for New Development Programs
- Boeing's Systems Integration Expertise and Teaming
- Application of Boeing Critical Technologies
- Synergy Among Our Targets, Unmanned Systems, and Weapons Programs



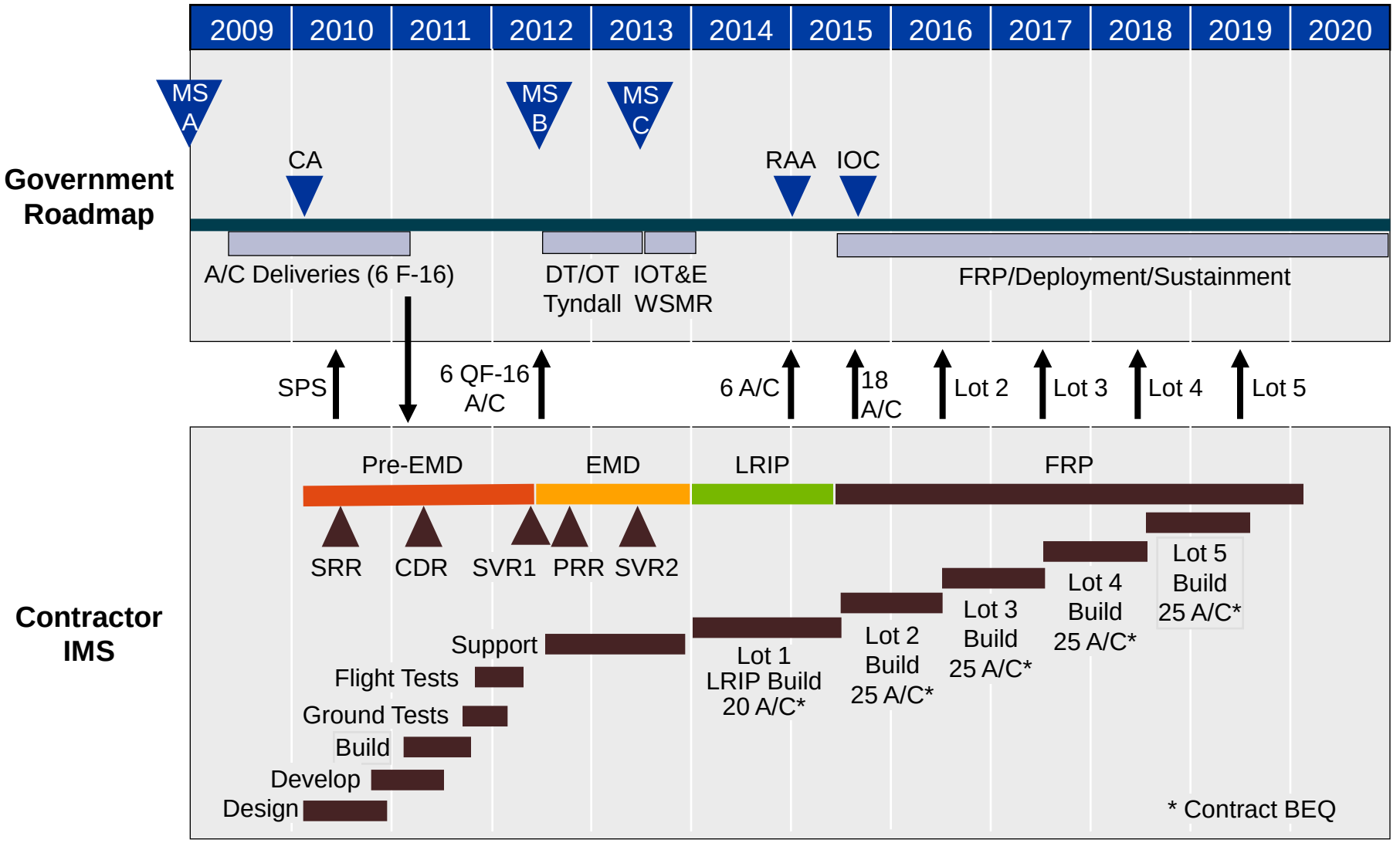
QF-16 Overview



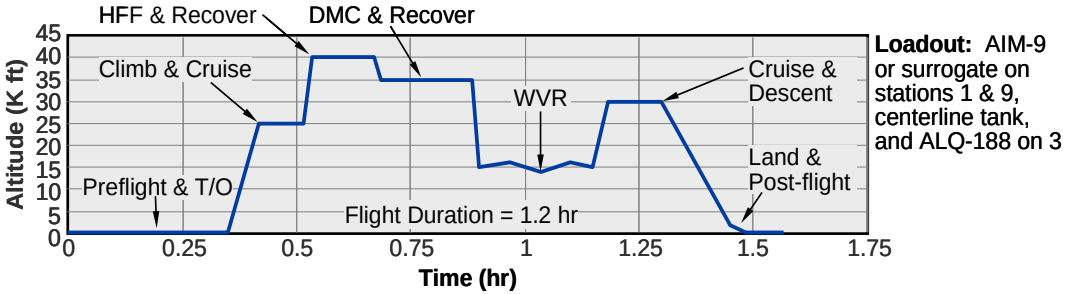
Key Features

- Follow on for QF-4 Program: Supersonic, High-G, Heavy Payload Capability
- Satisfies Title 10 "Live Fire/Lethality"
- Provides 4th Generation Threat Representation

QF-16 FSAT Roadmap Meets All Government Milestones



Mission Requirements



Loadout: AIM-9 or surrogate on stations 1 & 9, centerline tank, and ALQ-188 on 3

QF-16 Design meets Mission Requirements

- 4th Gen Threat
- F-16 Maneuverability
- Minimized impact to RCS
- Countermeasures
- 120nm GRDCS datalink
- Weapon accuracy scoring
- Range Safety – Flt Termination
- Piloted & Unmanned
- Reliable
- Supportable – Test Equipment
- Growth – Phase II Air Superiority Target (AST)

The QF-16 is designed for Mission Success

Overview of DPE Installations

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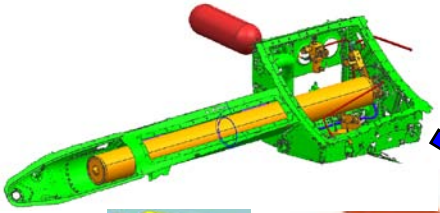
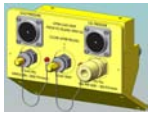
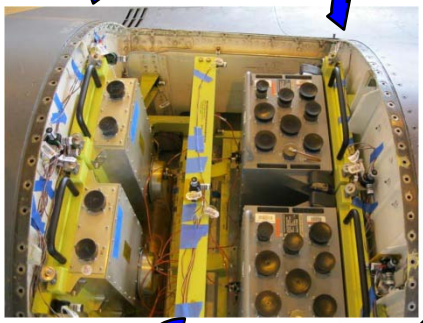
VAS – Visual Augmentation System



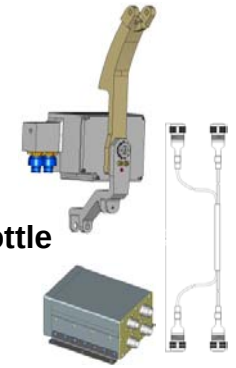


URAP – Universal Remote Auto Pilot

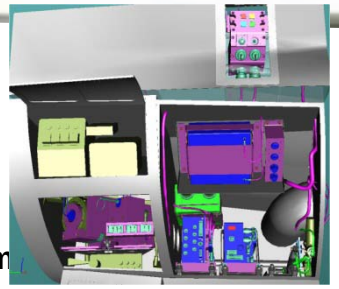
AFCC Automatic Flight Control Computer



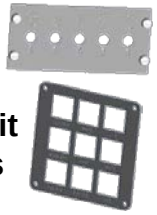
Autothrottle



PCS – Payload Control System

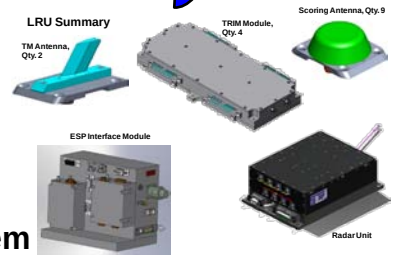


Cockpit Panels



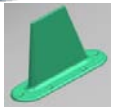
Backup Altimeter

FTS – Flight Termination System

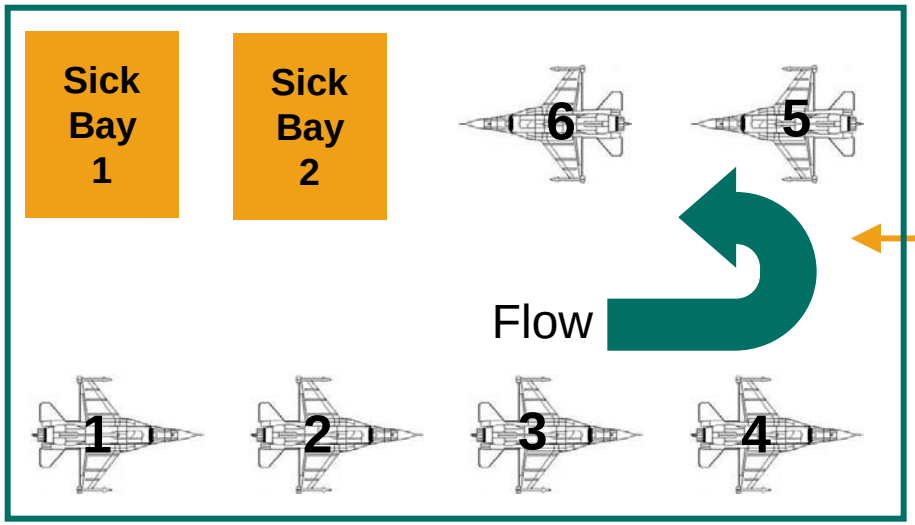


VSS – Vector Scoring System

CTS – Command Telemetry System



Drone Conversions Underway at Cecil

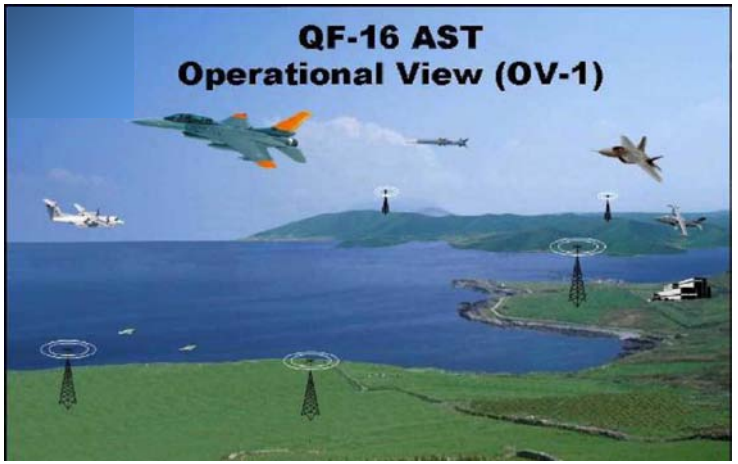


- **Cecil Field Recovery of first F-16**
  - **On time readiness**
  - **Trained and experienced support personnel**

Lean cellular production supports affordable, high quality, on time performance

Exceeding Expectations

Product Improvements



- CTS:
  - Improved TVI clock/position
  - Improved data latency
  - Improved frequency stability
  - Antenna switch feedback
  - Surge suppression
- Payloads:
  - Increased payloads power
  - All 8 wing stations active
  - Pre-wired spare payload discretes
  - Modular payload design for easy programmability
- Vector Scoring:
  - Improved scoring coverage
  - Shock isolated TRIM units for improved scoring accuracy
- Low profile antennas for RCS
- URAP available for improved navigation accuracy & GPS/TCS growth path
- More than double reliability
- Spare I/O available for growth
- Improved BIT and fault isolation/detection
- RCC-319 compliant Flight Termination System

The current QF-16 design improves on a successful QF-4 design

QF-16 Peculiar Support Equipment (PSE)

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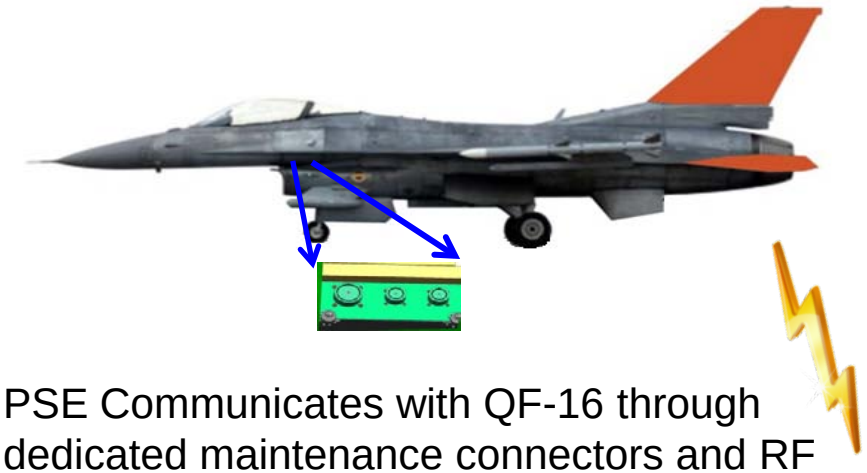
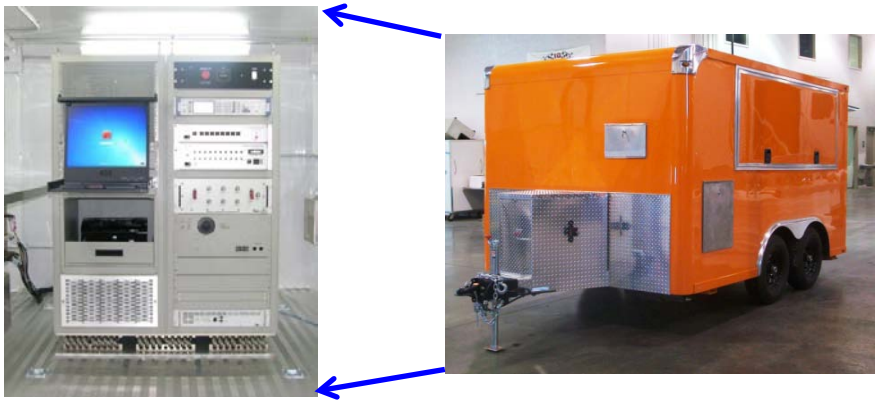
Ground Servicing Screen with B1 stand for safe cockpit exit after engine start



PSE Communicates with QF-16 through dedicated maintenance connectors and RF

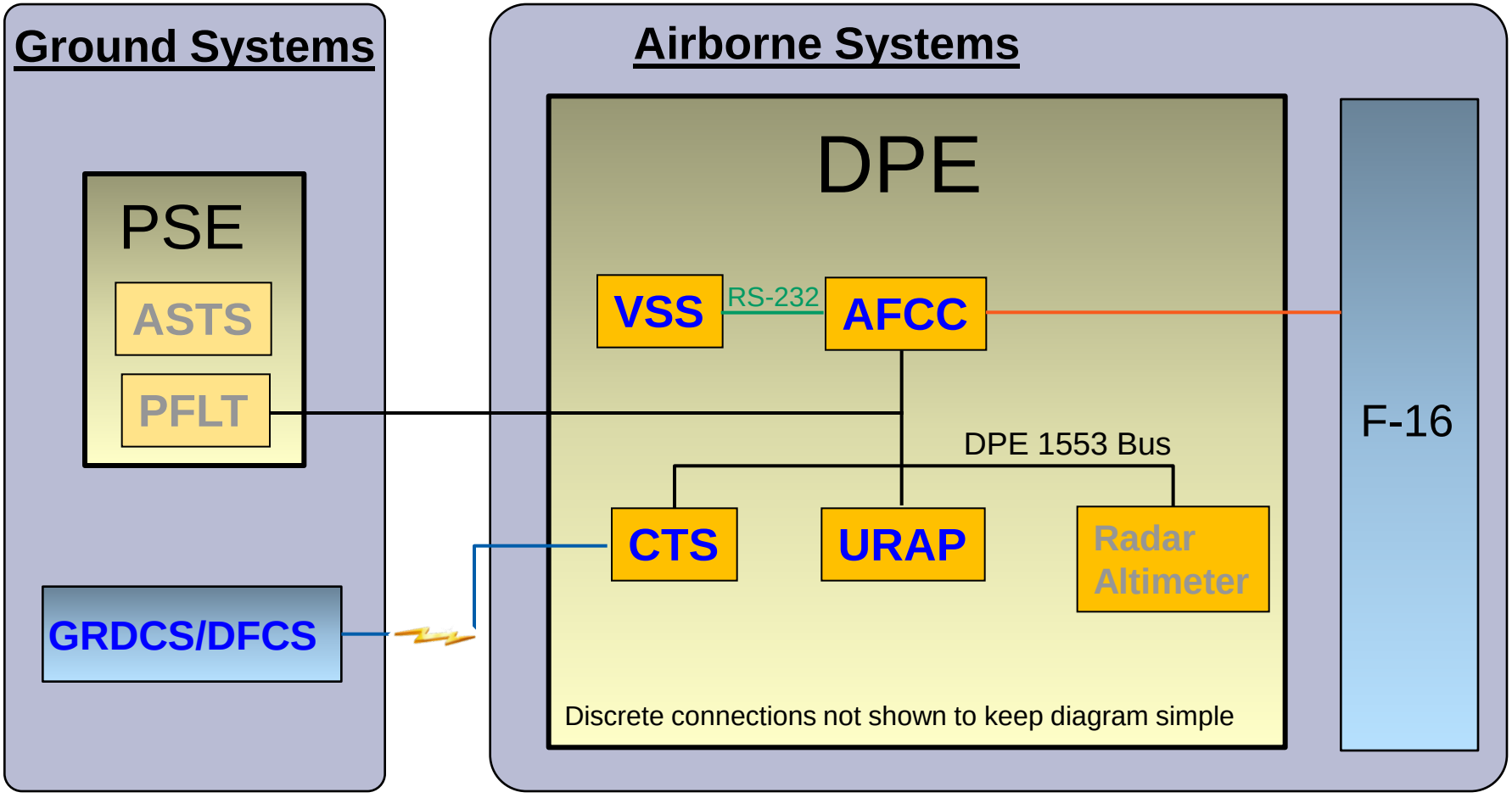
Portable Flight Line Tester for OFP load, system initialization, and diagnostics



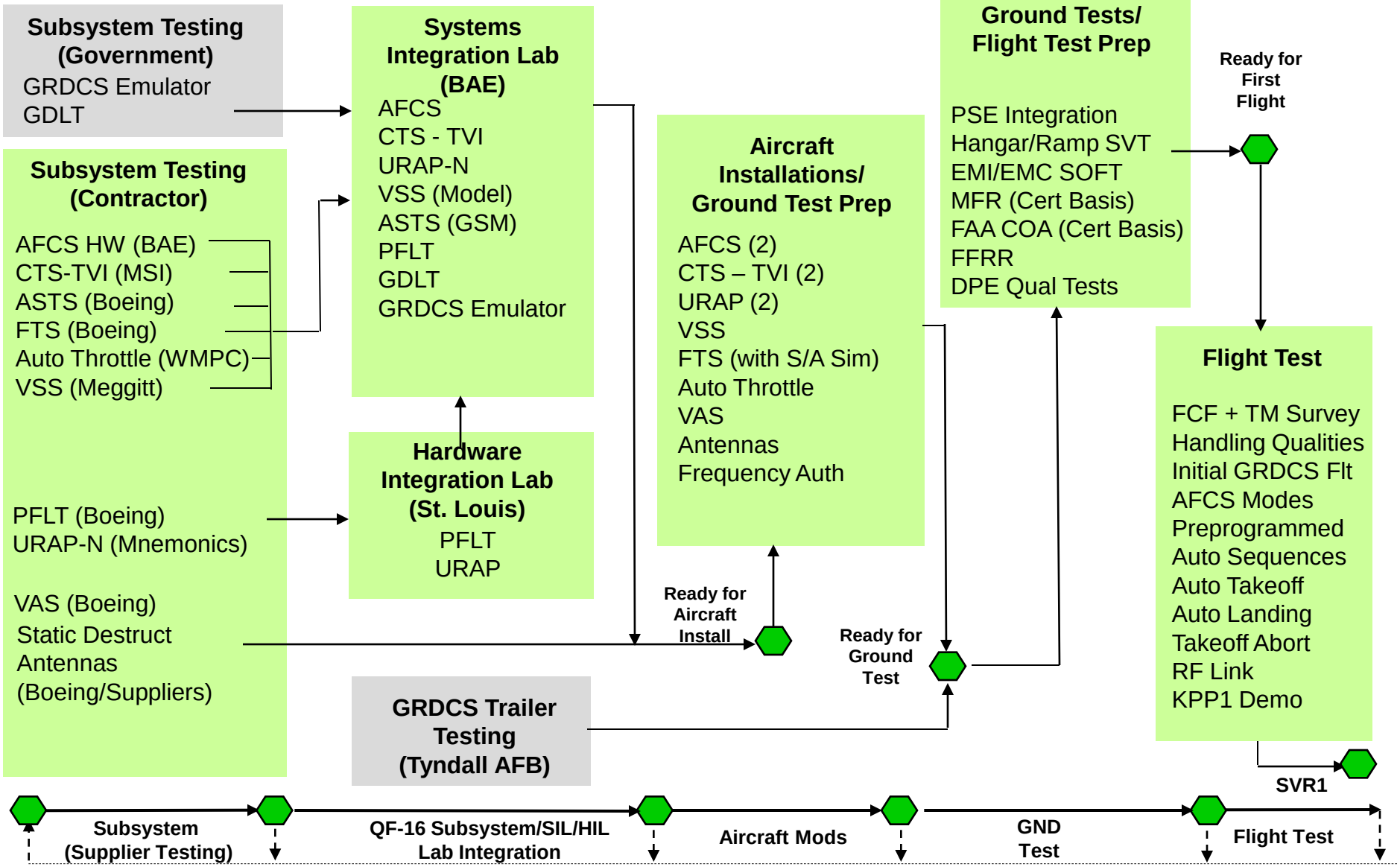
Trailer-mounted Automated System Test Set for Acceptance and Pre-Mission Testing

Airborne System Architecture (Software View)

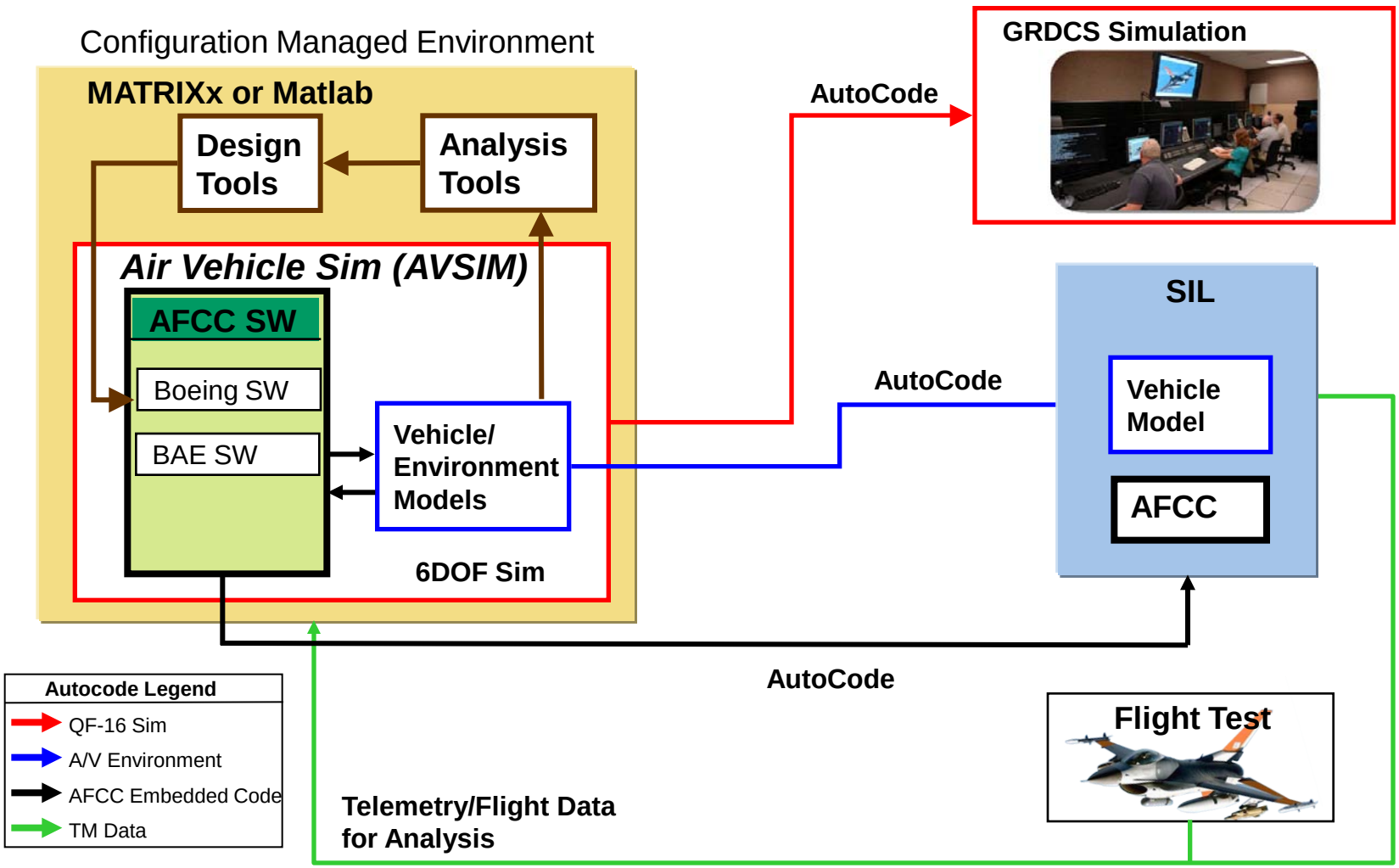
Systems With Major Airborne Software Components Highlighted in **Blue**



System Verification Flow

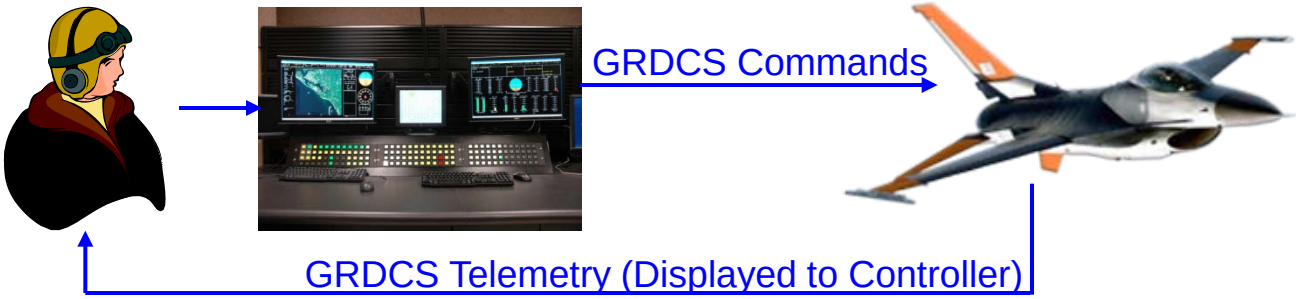


All QF-16 Sim Models and Products Autocoded From Central Simulation



GRDCS Operations

GRDCS Manual Mode



- Controller inputs manual command (e.g. stick, throttle)
- Controller flies autopilot modes (e.g. altitude hold, speed hold)
- Controller initiates maneuvering

GRDCS Auto Mode

- GRDCS computes required commands (e.g. stick, throttle)
- GRDCS is controlling aircraft flight path
- Controller still initiates maneuvering (breaks Auto mode)
- Onboard software behaves the same whether in auto or manual mode

Onboard Auto Sequences

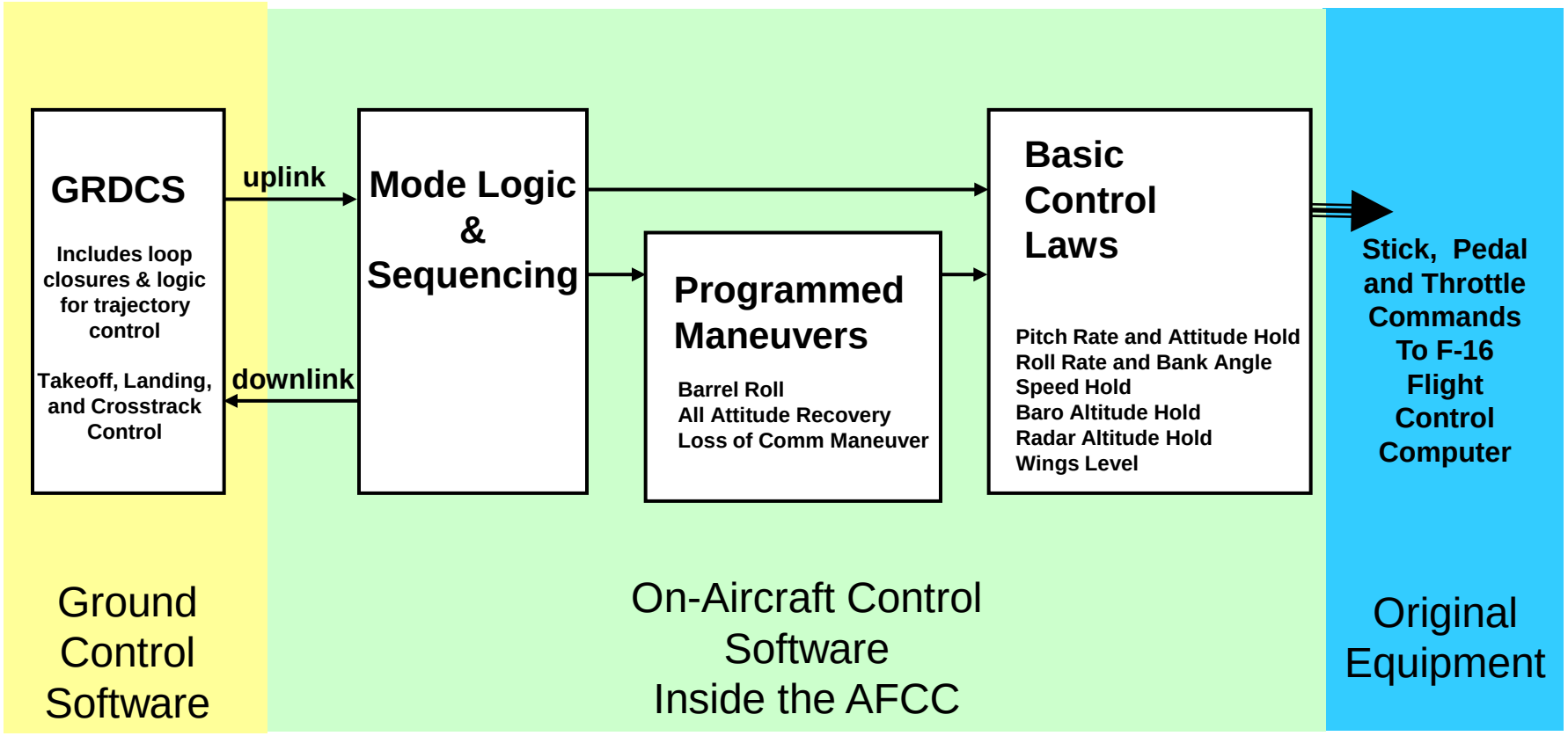
- All Attitude Recovery (AAR)
- Automatic Takeoff (ATO)
- Takeoff Abort (TOA)
- Escapes
- Autonomous (e.g. Loss of Comm)

Verifying Integration of GRDCS and DPE Software is an Important Development & Risk Reduction Activity

SIL Lab Layout Diagram – Pilot Station

- Cockpit View
- Observer View
- CsGTI PC
- COTS Stick
- COTS Throttle
- COTS Pedals

QF-16 Levels of Vehicle Control and General Control Law (CLAW) Architecture

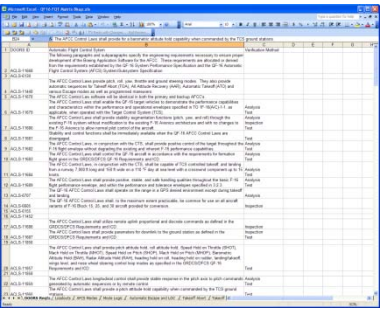


Three Levels of Controlling the QF-16

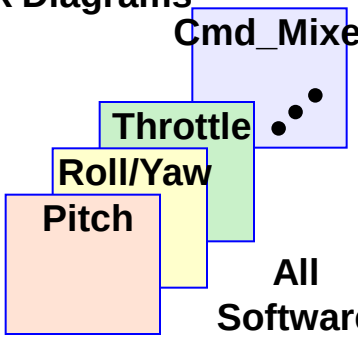
FQT Test Definition Process

Requirements ⟷ **Traceability** ⟷ **Test**

DOORS QF-16 Software Requirements



Block Diagrams



All Software Components

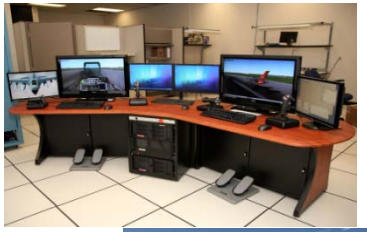
Test Matrix DB

FQT Test Definitions

Verification Testing

Test Allocation To Test Environment

AVSIM & BAE Desktop



SIL

Flt Test

Component and System Level Tests

All Aspects Are Under Configuration Controlled

Requirements Verified In:
- ***Verification Tests***
- ***System Level Tests***

Growth Potential

- **GPS Navigation -**
  - Accurate aircraft state estimation during all flight phases
  - Accurate heading and gyro bias estimation reduces risk
  - Mature navigator used on X-45, Phantom Eye, JDAM, SDB, others
- **Leverages Boeing's experience and proven autonomous system software**
  - Guidance, Navigation, and Control Software
    - Autocode development process improves quality, reduces costs and schedule
  - Autonomous System Operation
    - Reduced manpower costs in support of QF-16 FSAT CONOPS
    - Improved mission assurance and first time quality
    - Improved safety, accuracy, and repeatability
    - GRDCS controlled autonomous system operation
- **QF-16 Operation at Alternate Test Ranges**

Program Summary

- **The Boeing QF-16 Program leverages QF-4 supply base and maximizes the use of existing hardware and software capabilities to provide a low risk drone peculiar equipment solution.**
- **QF-16 Equipment in qualification testing. Software progressing towards Formal Qualification Testing. Aircraft Integration and Checkout beginning at Cecil Field. First Flight planned for Feb 2012**

Non-OEM Experience

System Integration Experience

Unmanned Experience

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