



# F-16V

THE MOST ADVANCED MULTIROLE FIGHTER FOR

# Greece





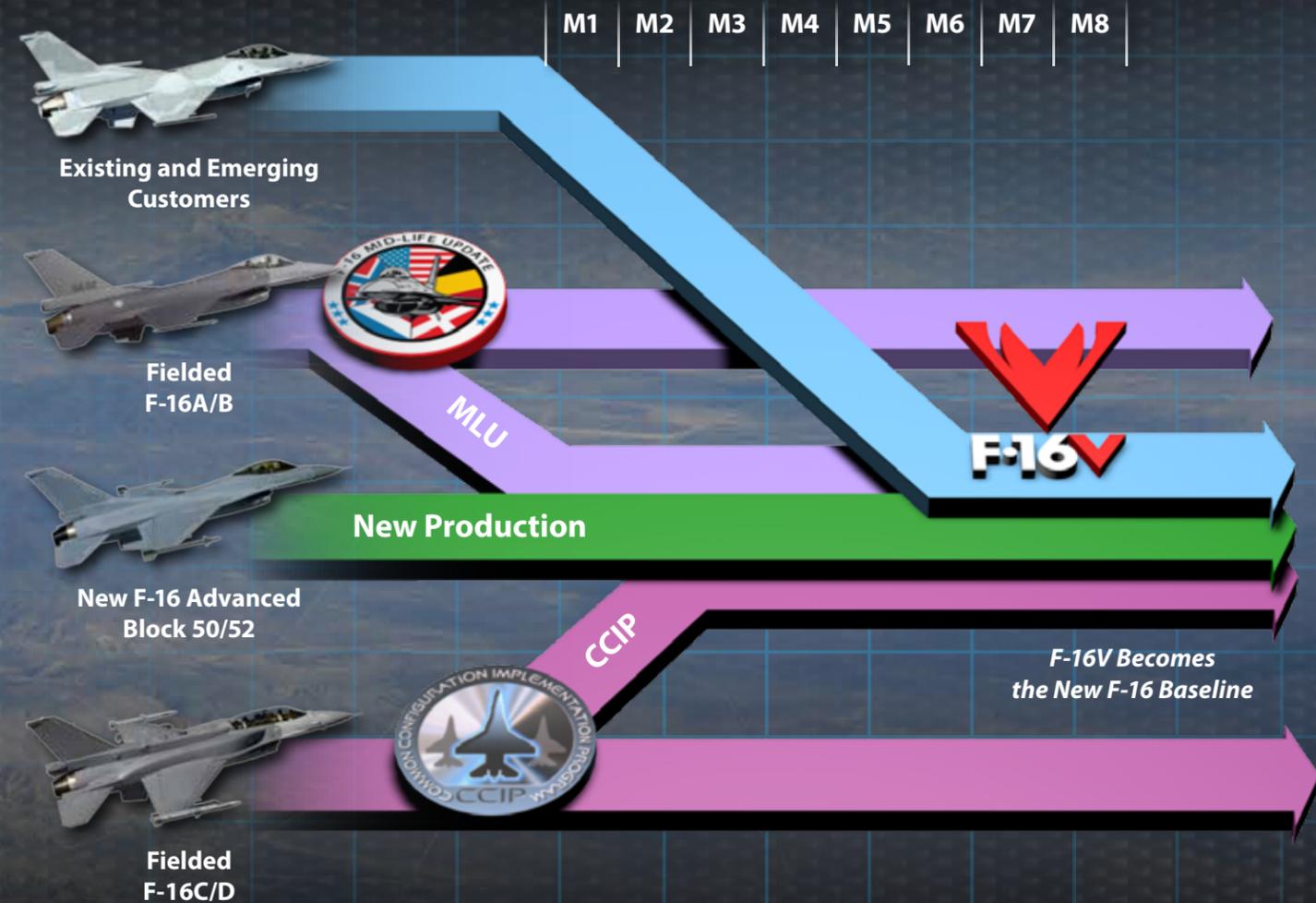
# Proven Upgrade Evolution

F-16V



# 4th Generation Roadmap

The F-16V is an evolution of the proven design of the Mid-Life Update (MLU) and Common Configuration Improvement Program (CCIP).



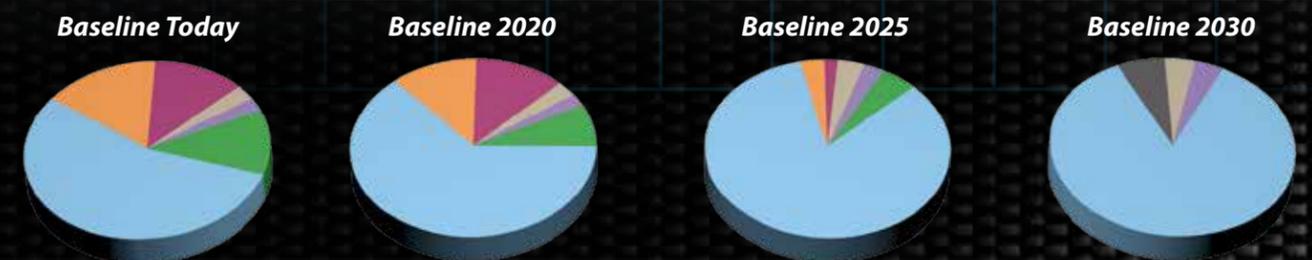
## The Next Generation F-16 Production and Retrofit Configuration

The F-16V upgrade is the next generation technology insertion that leverages a common worldwide sustainment infrastructure which supports nearly 2,000 aircraft. This new upgrade and production configuration will be the predominant configuration for the F-16 worldwide fleet. The new avionics configuration is the largest leap in F-16 combat capability and represents the most significant F-16 upgrade to date. For some F-16 users, this configuration forms the foundation for their avionics systems which will remain in service for years to come.

The Lockheed Martin F-16V configuration provides relevant combat capabilities in a scalable and affordable package with a high-volume, high-speed data bandwidth. The F-16V configuration is unique to Lockheed Martin, the F-16 original equipment manufacturer, which retains exclusive data rights, knowledge and expertise to affordably modernize the aircraft design.

## Planned F-16 Architecture Evolution

The evolving M-series operational flight program provides the affordable foundation for the F-16V.



The MMC Will Be the Preferred Mission Computer in the Future

- MMC
- CFCC
- EFCC
- AMC
- GAC
- IGAC
- AMC

# Advanced F-16V Fighter for the Future



# Latest Technology in Avionics Equipment To Meet Customer Requirements



ADTE



APX-126  
AIFF



CDEEU

- ADTE** – Advanced Data Transfer Equipment
- AESA** – Active Electronically Scanned Array
- AIFF** – Advanced Identification Friend or Foe
- CDEEU** – Common Data Entry Electronics Unit
- DFLCC** – Digital Flight Control Computer
- EGI** – Embedded GPS/INS
- IPDG** – Improved Programmable Display Generator
- JHMCS II** – Joint Helmet-Mounted Cueing System
- MIDS-JTRS** – Multifunction Information Distribution System - Joint Tactical Radio System
- NVIS** – Night Vision Imaging System

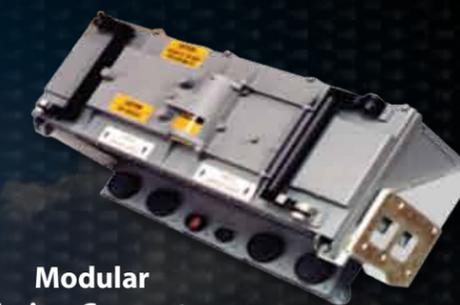
Group A  
Provisions  
for JHMCS



IPDG



Advanced Color Displays

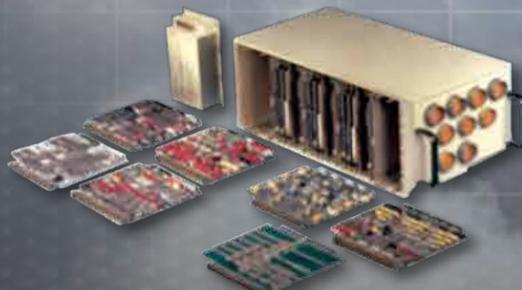


Modular  
Mission Computer



Full NVIS Compatibility

- Entire cockpit
- Exterior lights



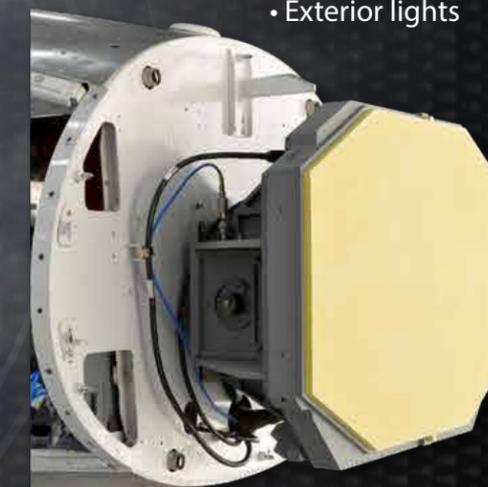
DFLCC



MIDS-JTRS Link-16



LN-260  
EGI



APG-83 AESA Radar

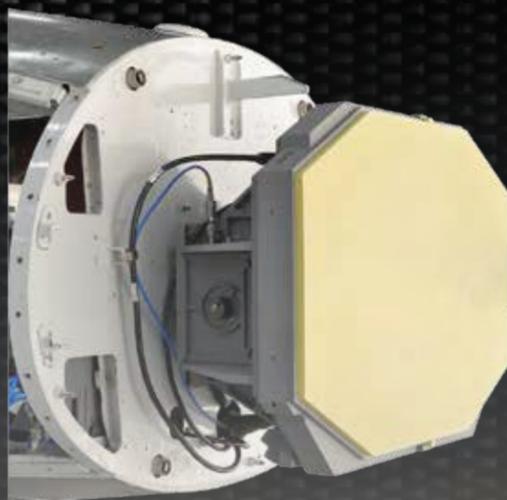
**Flexible To Integrate  
Customer Requirements**



# AESA Radar

## F-16V

Northrop Grumman's APG-83  
Scalable Agile Beam Radar (SABR)



### Next Generation Fighter Radar Capabilities for the F-16V

- Greater detection and tracking ranges
- Multiple target track (20+ quality tracks)
- High-resolution Synthetic Aperture Radar (SAR) maps for all-environment precision strike
- Interleaved air-to-air and air-to-surface mode operations for improved situational awareness, operational effectiveness and survivability
- Robust electronic protection for operations in dense RF environments
- Auto target classification and cueing
- Greater system reliability and availability (3–5 times over legacy MSCAN radars)
- Non-cooperative target recognition
- Advanced growth modes
  - Terrain following
  - Radar common data link
  - Inverse Synthetic Aperture Radar (ISAR)

Maintain At Least 20 Target Tracks  
Anywhere Within  $\pm 60$ -Degree Cone



High-Flying Targets

Low-Flying Targets

The APG-83 AESA radar provides long-range search and track capability against airborne targets, regardless of their aspect. Multi-target track provides good track quality on at least 20 targets within  $\pm 60$  degrees of the F-16 nose while continuing to support a designated scan pattern. The air combat mode automatically acquires and tracks the first target detected within the scan volume selected by the pilot.

The APG-83 can detect and track fixed and moving ground and sea targets. The high-resolution synthetic aperture mode enables autonomous, all-environment precision targeting.

Most of the air-to-air and air-to-surface modes can be interleaved on a scan-to-scan basis providing the pilot with increased situational awareness and operational effectiveness and survivability.

#### Air-to-Air

- All-aspect search
- High-aspect search
- Multi-target track (20 good quality tracks)
- High-priority track (6 tracks)
- Gunnery range track
- Air combat maneuvering
- Weather detection

#### Air-to-Surface

- Ground map (10–160 NM)
- Sea search
- Synthetic Aperture Radar (SAR) – long-range, wide-area, high-resolution mapping
- Fixed-target track
- Ground moving-target indicator
- Ground moving-target track (can be overlaid on map)
- Air-to-ground ranging

Ground Mapping

Moving-Target Detection/Track

Precision Weapon Support

#### Air-to-Sea

- Sea surveillance and search while track
- Surface target continuous track

The F-16V radar, the APG-83, is an Active Electronically Scanned Array (AESA) radar that provides multimode capability. The APG-83 beam agility enables interleaved air-to-air and air-to-surface operations that can be tailored to meet specific mission requirements. Approximately 95 percent of the APG-83 suite of operating modes have been ported directly from the latest generation AESA and have demonstrated outstanding capability to detect and engage the spectrum of air, surface and sea targets, even in the most challenging electronic warfare environments. The APG-83 is three to five times more reliable than legacy mechanically scanned radars, which means higher availability rates and lower sustainment costs.

The AESA radar tracks and maintains at least 20 air-to-air targets within scan volume ( $\pm 60$ -degree cone). When the radar is commanded to search targets with a specified search pattern (e.g., fixed number of elevation bars and azimuth scan width), the radar can still track targets outside of the specified search pattern using extended volume target track capability.

**Increased Operational Capabilities  
With Extensive Software Reuse**



# Center Pedestal Display



The Improved Programmable Display Generator (IPDG) adds the ability to display high-resolution, color video on the Center Pedestal Display (CPD). The IPDG shows color video on the Common Color Multifunction Displays (CCMFDs). The IPDG allows each display to operate alone, independent of any other display. The IPDG includes multiple core Central Processing Unit (CPU) technologies. The IPDG includes a new 3-dimensional graphics processor module that is an improvement over legacy video processing. Extensive use of commercial nonproprietary standards, data buses and software provides a built-in, industry-defined growth path that minimizes the impact of obsolescence and ensures a low-risk avionics system development program for indigenous upgrades.

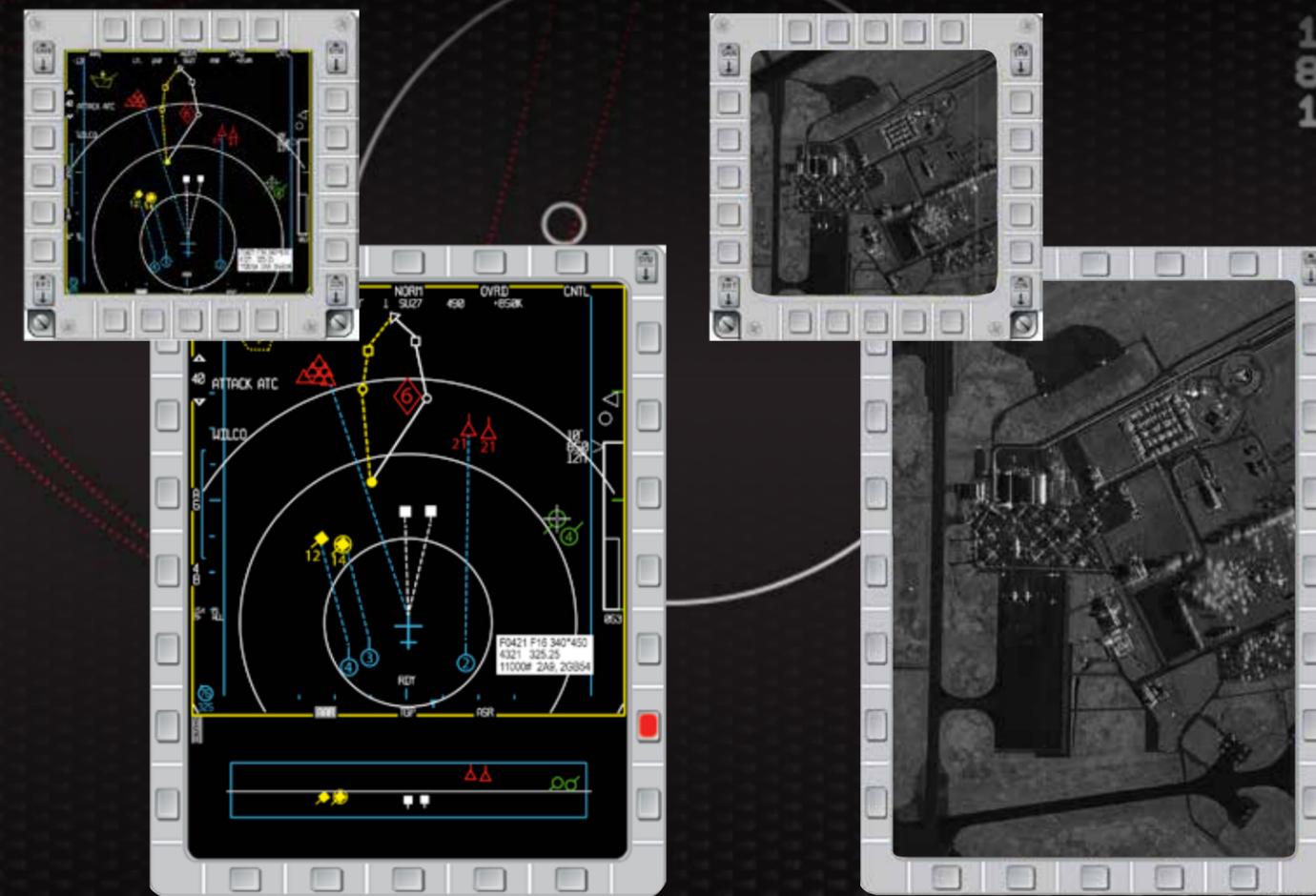
The IPDG includes CPU technology that allows vast amounts of data to be processed. This processing capability plans for substantial growth capacity for future applications and data processing, as the customer's needs change. Several cores of the CPU are reserved for future growth, which allows for more than 50 percent growth capability.

High-resolution video transmits on the Ethernet network by using Motion Picture Experts Group (MPEG) compression. MPEG is the standard used for compression. MPEG compresses the video format to the IPDG. The IPDG then decompresses the video using industry-standard video chipsets. The IPDG displays the video on the CPD or the CCMFDs. The compressed video allows for a lower recurring cost by limiting the amount of new cable installation necessary. Future growth is easier because subsystems transmit video for display by using the existing Ethernet cables rather than installing new video cables for each new video source.

The CCMFDs and CPD, in combination with the IPDG, display important mission-related information such as Active Electronically Scanned Array (AESA) radar information, Link-16 data link information and Color Moving Map (CMM) the LITENING Targeting pod is displayed on CCMFDs or CPD. High-resolution AESA Synthetic Aperture Radar (SAR) images are also displayed on CCMFDs or CPD.

## Center Pedestal Display

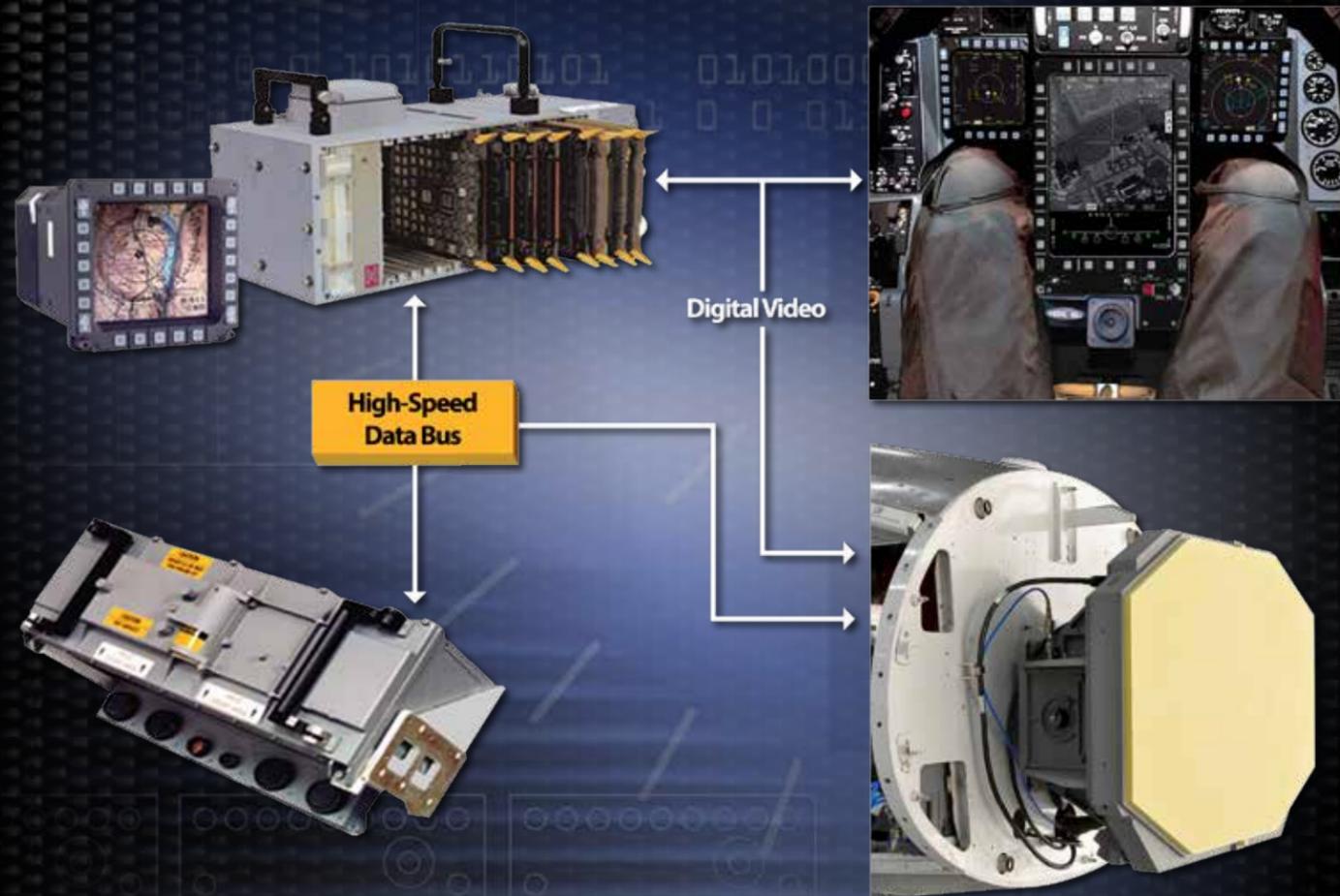
- New on-board and off-board sensors drive the need for a bigger and higher resolution display
- Increased viewing area display is 6 x 8 inches
  - Relative 1-ft SAR resolution provides 503,316 ft<sup>2</sup> more viewable SAR patch map area
  - A-A situation display is larger and easier to sort targets
  - A 2 x 6 pinup display can be used below the 6 x 6 format on the CPD



**Greater Pilot Situational Awareness**



# Digital Video and High-Speed Data Bus



- The advanced architecture with high-speed Ethernet data network connects the mission computer, radar and display processor
- 90 percent data bus loading capacity growth via introducing high-speed Ethernet network
- Greater than 60 percent processing and memory growth in the mission and display computers
- The AESA radar provides air-to-air and air-to-ground mode interleaving and two digital outputs for multi displays (MFD and CPD)
- Our expertise on the AESA radar integration will minimize risks to the F-16 V Upgrade Program
- Color moving map capability with various types of maps: electronic maps, scanned maps and satellite images
- The F-16V upgrade includes EGI LN-260 with GEM6 (SAASM) capability
- Our M6 software provides a high degree of Link-16 interoperability, which provides improved cooperative engagement and increased pilot situational awareness



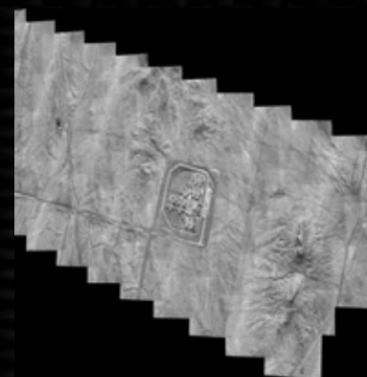
Multi-Target Track



Lead Laser Guidance



Maritime Tracker



Recce Imagery - FLIR



Sniper Advanced Targeting Pod

## Performance, Modes and Capabilities

- 1K FLIR and TV sensors
- Dual-mode laser designator
- IR marker/laser spot tracker
- Fully isolated optical bed/single aperture
- Self-contained boresight/unlimited roll
- Digital data link for time-sensitive targeting
- Recce imaging and full HD video recording
- Dedicated tracking modes: maritime, multi-track, air-to-air, moving targets
- SA-enhancing symbology: frag circles, speed/heading of tracked target, PIP
- Proven two-level maintenance

## Improved Mission Effectiveness

- Enhanced target ID via multispectral imaging and target-sharing tools
- Superior stabilization – long-range detect/ID
- Increased situational awareness
- Minimized collateral damage
- Precise J-series-quality geo coordinates
- Time-sensitive targeting enabler
- True NTISR enabler
- Data link enables seamless JTAC coordination
- Lowest life-cycle costs
- Best-in-class reliability and availability

**High Digital Video Improves Mission Effectiveness**



# Theater Tactical Data Link

## Unknown Tracks

Details of position, heading and sovereignty of air, land or sea track as received by surveillance platform

## Aircraft Status

Provides details of A/C platform status such as engagement status, remaining armament, fuel and equipment for friendly air platform participants

## Targeting Tracks

Provides exchange of target position data

## Command and Control Assignments

Allows Command and Control (C2) platforms to issue engagement orders to flight lead of an F-16 flight package. Typically, orders will vary between engagement against air tracks, return-to-base orders, attack orders against a ground/sea target, etc.

## Friendly Tracks

Details of position, heading, equipment status, identity, etc.

## Command and Control Messages

Typical C2 messages are used for vector commands, desired flight path point commands or commands to hand over control to second C2 unit. Messages can also be used to correlate local fighter radar tracks with those already identified on the C2 unit's sensors.





# Certified Advanced Weapons



## Most Payload Flexibility

- 11 store stations
- Takeoff capacity over 5,000 kg
- Certified for over 100 stores
- Rapid stores integration capability

### Air-to-Ground Missiles



### Air-to-Air Missiles



### General-Purpose Weapons



### Guided Weapons



# F-16

## Stores Capability

### Decoys



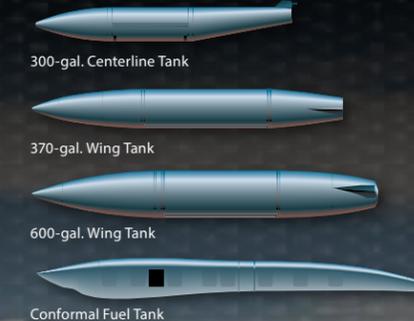
### Rocket/Gun Pods



### Dispensers



### Fuel Tanks



### Electronic Countermeasures



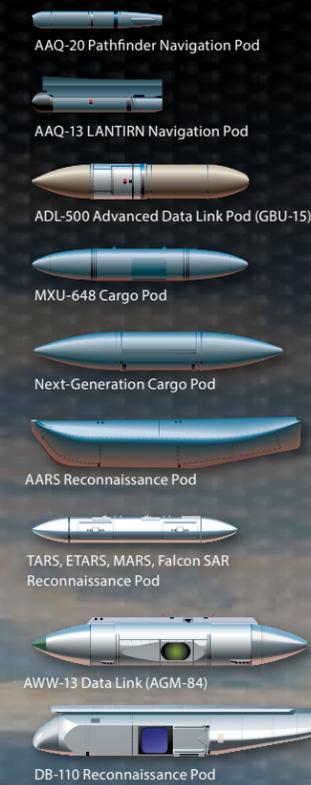
### Offensive/Defensive Training Systems



### Targeting Systems



### Navigation/Reconnaissance/Utility Pods



WEAPONS SUBJECT TO USG RELEASE POLICY

Air-to-air weapons are managed in the same fashion. The SMS base page and control page functions for both short-range missiles and medium-range missiles are organized identically. The missile Launch Zone (LZ) information in the Head-Up Display (HUD) and Joint Helmet-Mounted Cueing System II (JHMCS II) is similar across short-range missiles. Beyond Visual Range (BVR) missiles are presented in similar intuitive formats. The HOTAS functions for all weapons are similar; this allows quick and easy transition from one missile type to another.

Sensors and situational awareness displays follow the same philosophy. A hands-off switch action on the display or a HOTAS function for the radar or targeting pod are similar to the control and display functions for other formats, such as the Horizontal Situational Display (HSD). The controls from one targeting pod type to another are similar in location and accessibility.

The F-16 controls and displays have been carefully crafted and combat-tested. The F-16 controls and displays require less training and provide for enhanced pilot lethality and increased engagement opportunities in a high-tempo battle space. These display and control conventions for weapons and targeting pods are explained in more detail in following sections.

The F-16V software includes a robust pilot weapon delivery training simulation capability that covers all the requested weapons. The simulation training provides full training without the need to carry weapons on board the aircraft. The weapon delivery simulation provides full pilot display interaction capability and weapon delivery symbology including Launch Acceptability Region (LAR) displays.

Lockheed Martin has more than 36 years of weapon integration experience with the F-16. No other organization can match the weapons integration experience of Lockheed Martin. In concert with the USAF and multiple F-16 FMS customers, Lockheed Martin has certified > 3,300 carriage and release configurations for greater than 180 weapon and store types. Our experience as a weapon integrator has enabled the F-16 to develop into one of the most versatile multirole fighters. We have certified USAF common weapons as well as a large number of country-unique weapons onto the F-16. These weapons span multiple classes and categories of weapons which can be utilized over a broad range of missions. The result is a true simultaneous, multirole fighter with accurate, lethal, day and night, all-weather capabilities.

# Flexibility To Engage Multiple Target Types and Scenarios



# Operational Capabilities

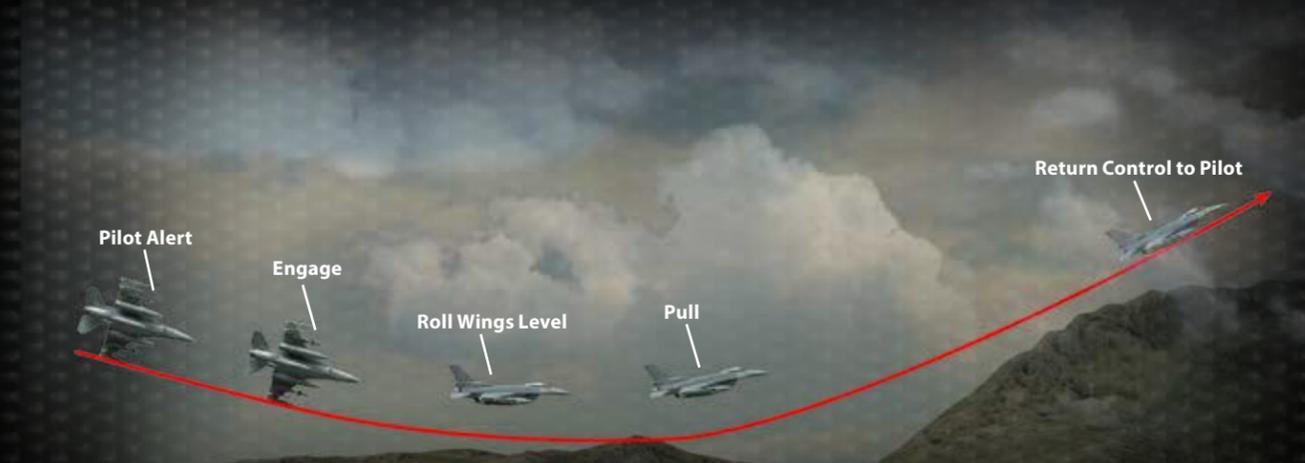
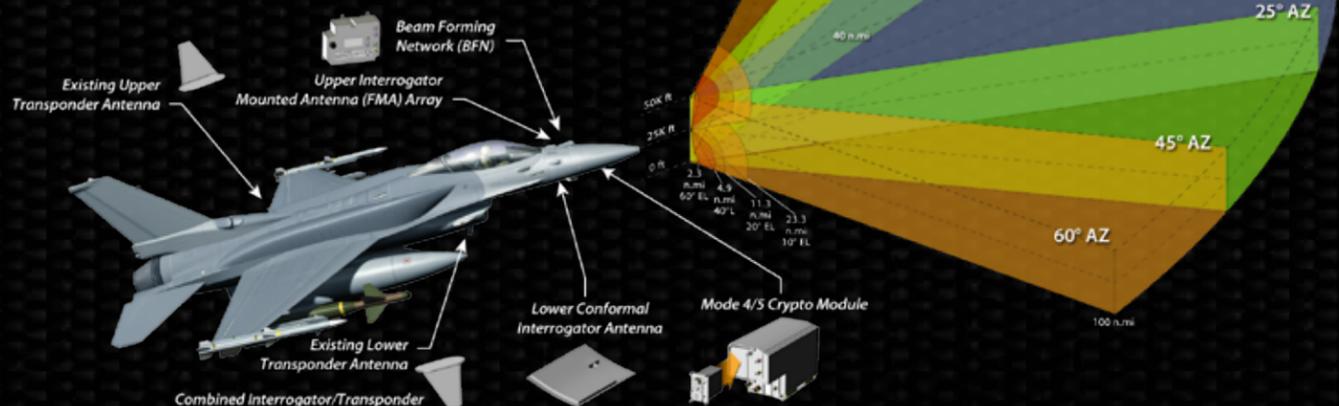


## Embedded GPS/INS

- Integral to precision SAR radar operation, LANTIRN, AGCAS
- Includes a 24-channel GPS receiver with a Selective Availability Anti-Spoofing Module (SAASM)
- High performance with low noise achieving unequaled navigation and Synthetic Aperture Radar (SAR) stabilization performance
- Robust GPS performance by tracking all-in-view satellites
- Improved atmospheric correction by tracking satellites on both frequencies
- Simplified key handling using unclassified keys; unit is unclassified when keyed
- 999 steerpoints, 100 additional mission planning points, DAFIF database, database searching, alphanumeric naming and searching, emergency airfields
- Reduced GPS jamming vulnerability
- ICAO/user-defined points for navigation/reference
- Emergency airfield mode to shorten decision cycle

## Advanced Identification Friend-or-Foe

- The AN/APX-126 AIFF that performs IFF Modes 1, 2, 3/A, C, 4, and Mode S ELS, supports Mode 4 with KIV-6 Crypto and upgradable to Mode 4/5 with KIV-78 Crypto
- 115-NM range capability
- Supports situational awareness and BVR weapons delivery
- Upgradable to secure Mark XIIA with growth to Mode 5 capability
- Upgradable to Automatic Dependent Surveillance-Broadcast (ADS-B)
- RF compatibility associated with internal EW and Data Link provides improved RFC capability between the AIFF and the rest of the weapon system



## Automatic Ground Collision Avoidance System

- Automatically prevents collision with the ground
  - Avionics project future aircraft trajectory over digital terrain
  - Avionics request an avoidance maneuver at last instance
  - Flight control systems automatically performs recovery
- Recovery model easily tailored to different aircraft
- No additional sensors required
- High authority autopilot momentarily takes control from pilot
- Embedded integrity monitoring prevents erroneous system behavior
- Pilot Selectable Recovery (PARS) for disorientation case
- Available for aircraft with digital flight controls

## Missionized Aft Cockpit for Reduced Pilot Workload

Aft Station Interface Unit (ASIU) and aft seat HUD monitor provides a missionized aft cockpit capability that fully integrates advanced F-16 weapon systems and two-man crew to maximize combat effectiveness and eliminate task saturation. ASIU provides increased capabilities for a front/aft cockpit team to share the mission tasking challenges to better employ a two-seat F-16.

- Aft Seat Interface Unit (ASIU) provides a common hands-on throttle and stick (HOTAS) mechanization for individual control of displays and/or sensors in either cockpit.
- Enables aft seat pilot/Weapon System Officer (WSO) to use HOTAS to autonomously manage radar displays, track air-to-air targets, slewing and track air-to-ground targets, and manage Navigation Pod (NVP) operations.
- Limited Dual Line-of-Sight (LOS) capability means front and aft cockpit can independently operate separate Fire Control Radar, Targeting Pod, or Weapon LOS controls for simultaneous employment of air-to-air and air-to-ground weapons.
- Front cockpit always has take-control authority and gets automatic display control through multiple mode changes and switch actions or a simple Display Management Switch (DMS)—aft.
- Aft cockpit ASIU panel provides a Flight or Avionics selection to define the use of the aft cockpit Side-Stick-Controller (SSC) for either training (flight controller) or combat (avionics controller):
  - Flight – SSC functions per baseline as flight controls from aft cockpit.
  - Avionics – SSC functions as a joystick for the SOI/DOI that aft cockpit controls.



Missionized Cockpit

**Expanding Operational Effectiveness and Safety**



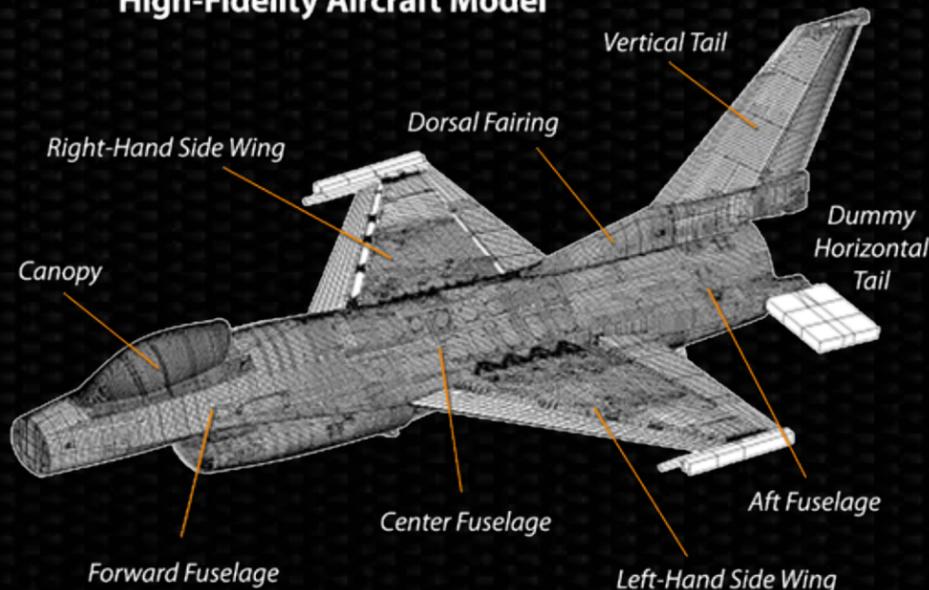
F-16V

# Essential Data and Facilities

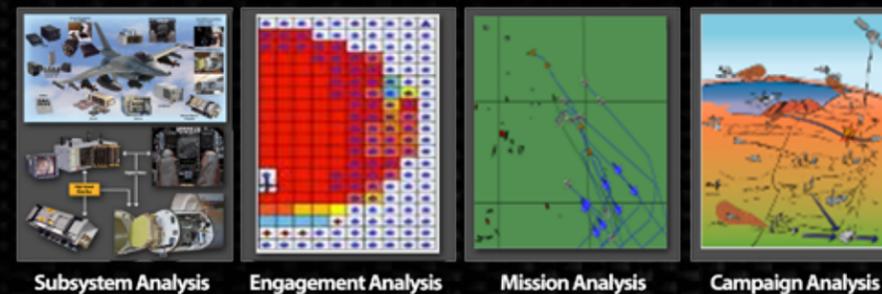
## Examples of Lockheed Martin Technical Data

- Drawings (e.g., harness and structural drawings)
- Tool designs
- Aircraft, subsystem and interface specifications
- Engineering source data
- Structural design and analysis
- Electrical loads
- Mass properties
- Software tools
- Supplier technical data (e.g., SDRs)
- Weapon certification tools
- Flight hazard fault tree analysis tool
- Support analysis tools
- Aero performance mission analysis performance system
- Electromagnetic capability/safety of flight/radio frequency compatibility procedures
- Thermal analysis tools
- Flight control and air data system simulations
- OFP source code protected under the USG SORAP agreement

## High-Fidelity Aircraft Model



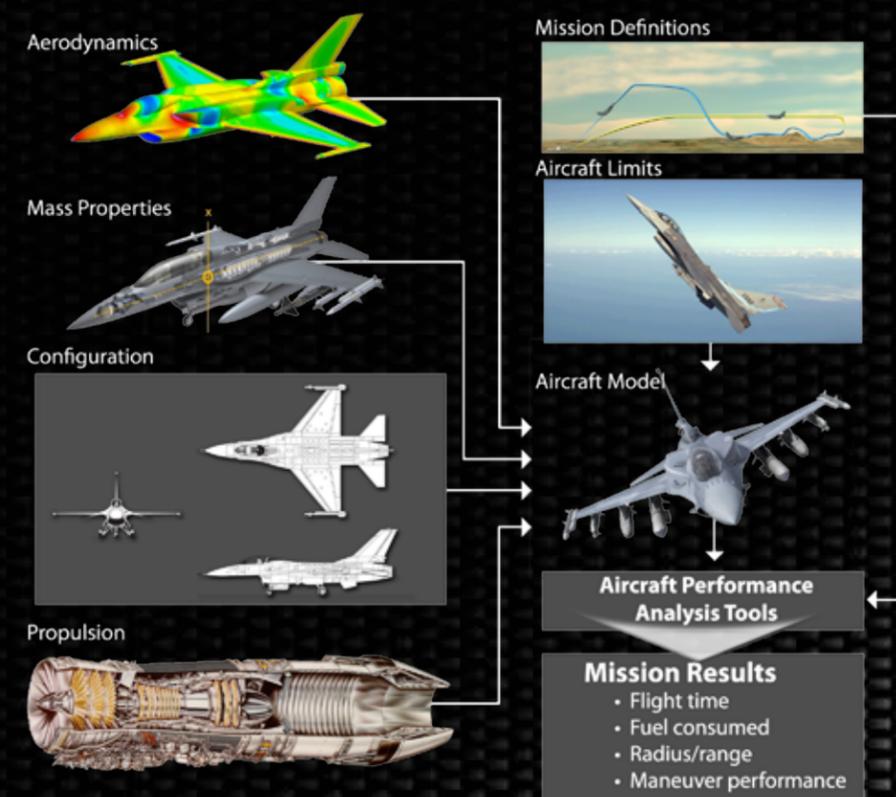
## Warfighter Requirements/Operations Analysis Drive Solution



All-Weather Target Discrimination, Longer Range A/A in Jamming Environment, Small Target Threats, Increased Situational Awareness, Higher Survivability

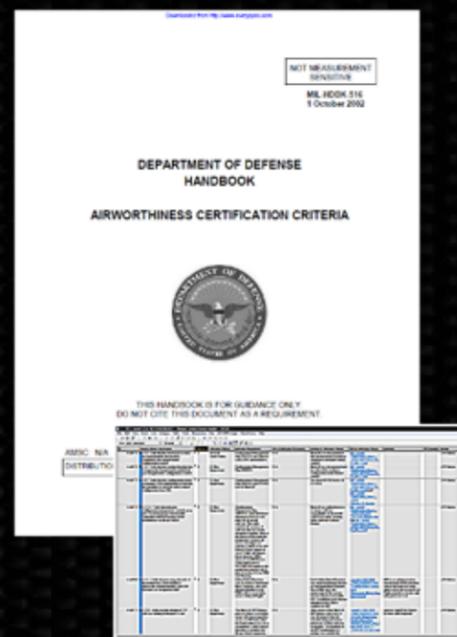
AESA, CPD, EW

## Lockheed Martin Aircraft Performance Analysis Methodology



## Airworthiness Certification

Airworthiness Effort Flows From U.S. DoD Criteria to Fielding Letter



## Key Attributes of the Airworthiness Program

- Airworthiness planning
- Verification of system design attributes
- Assessment of airworthiness during all phases
- Documentation throughout the certification process



Airworthiness Certification Plan

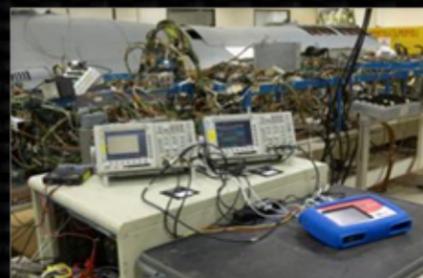
## Lockheed Martin Core Processes

- CERTWG defines and implements airworthiness tasks
- Utilizes management database tools for efficiency

## Robust Facilities



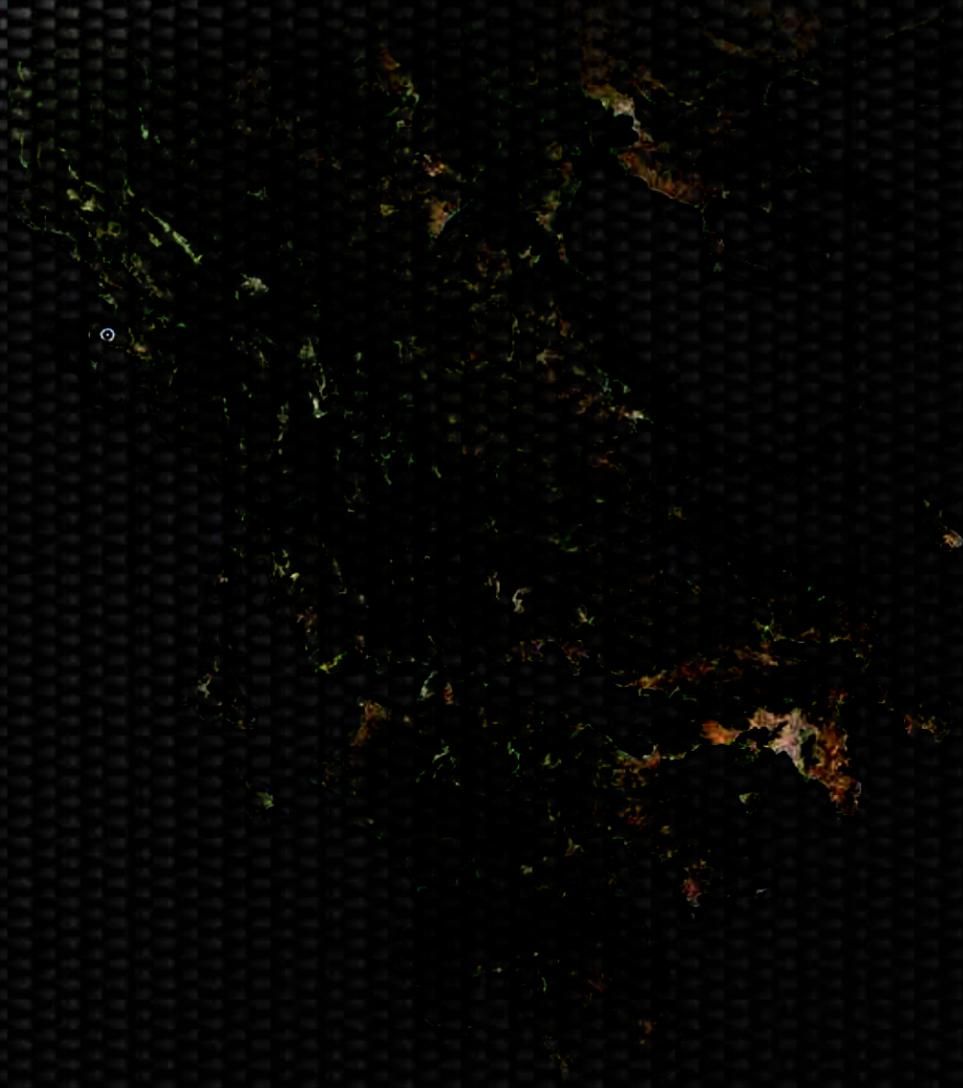
## and Laboratories



OEM Technical Expertise and Depth



# Addressing HAF Requirements



Lockheed Martin Has the Ability To Upgrade Any HAF Configuration



PX I



PX II



PX III



PX IV

Lockheed Martin Has the Ability To Address HAF Requirements

### Defend the Nation From Emerging Air-to-Air (A-A), Air-to-Ground (A-G) and Maritime Threats

- Increase weapon system lethality
- Increase weapon system survivability

### Maintain a Sustainable Fleet

- Technology refresh resolves supportability issues
- Utilize removed/replaced assets in PX II and PX I (APG-68(V)9)

### Maintain Recognized, Regional Operational Superiority

- Autonomous or deployable capability

### Maintain Industrial Base Involvement and Capability

- Maintain HAI partnership
- Leverage HAI upgrade expertise

### Increase Operational Effectiveness

- Increased common capability within the force structure
- Increased interoperability with U.S. Air Force and coalition forces

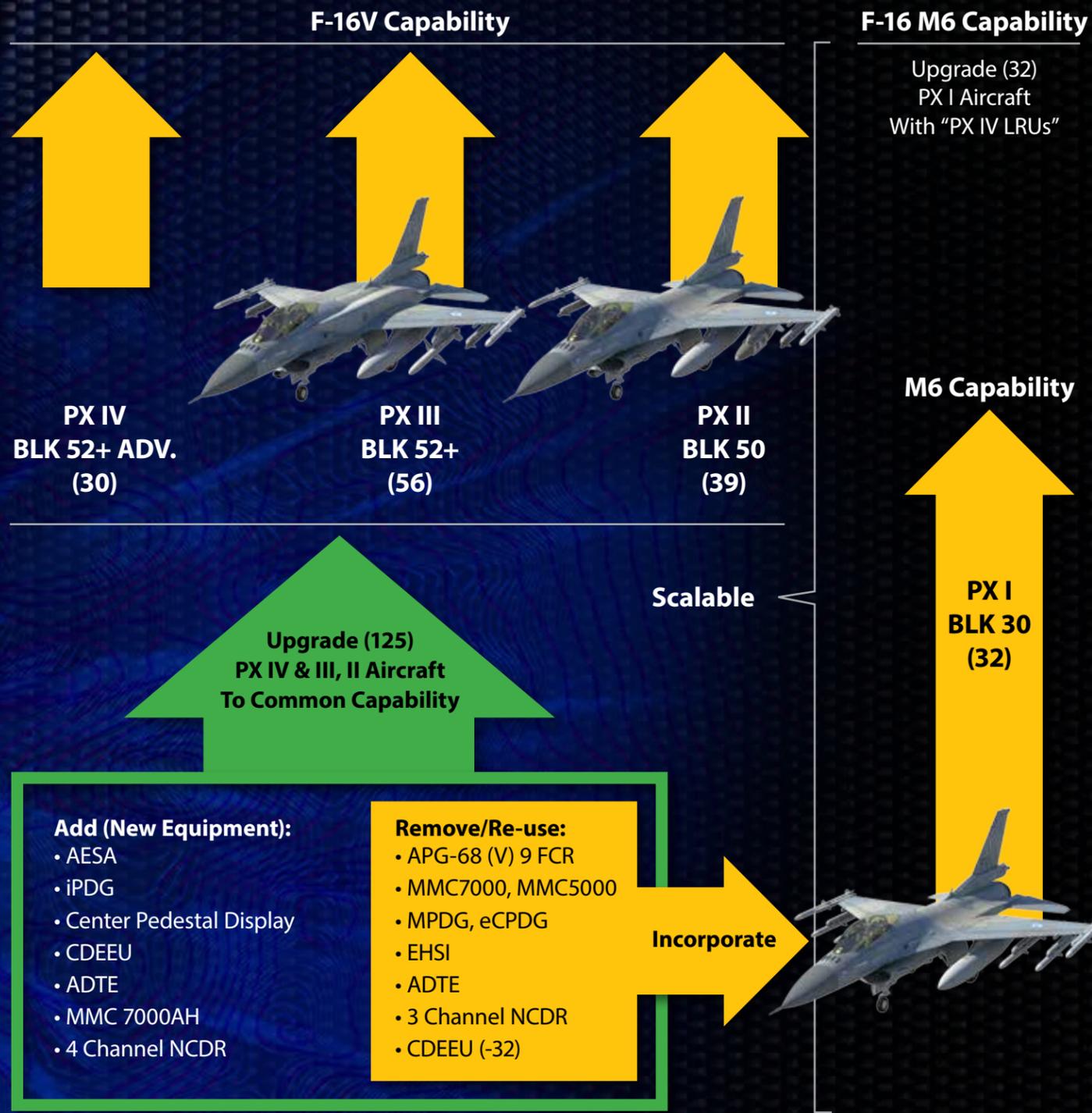
- Avionics
- Vehicle systems
- Structure
- Weapons
- Sensors
- Integration

- Anechoic chamber
- Flight test
- Handling qualities simulation
- Weapon certification
- Service life extension
- Air worthiness certification
- Technical orders

Ability To Address All Configurations

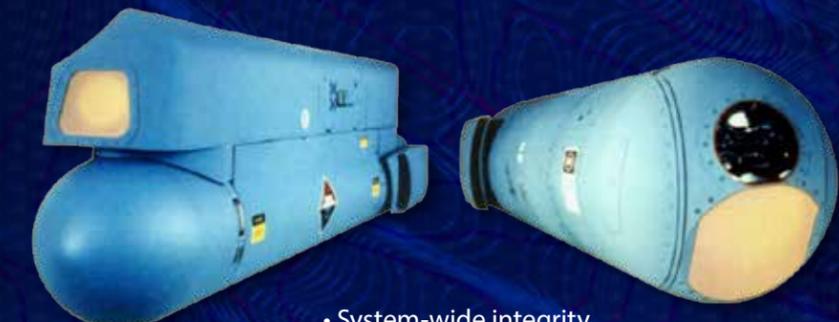


# Reusing Existing Equipment To Lower Cost



### ASPIS II

- Anechoic chamber RF compatibility testing
- Lab integration
- Optimized proprietary interfaces

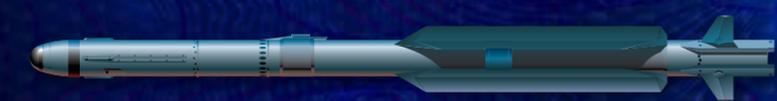


- System-wide integrity management for safety
- Anechoic chamber RF compatibility testing
- Lab integration
- Optimized proprietary interfaces



### GBU-50

- Certified for carriage and employment
- Lab integration
- Launch zones incorporated
- Mission planning



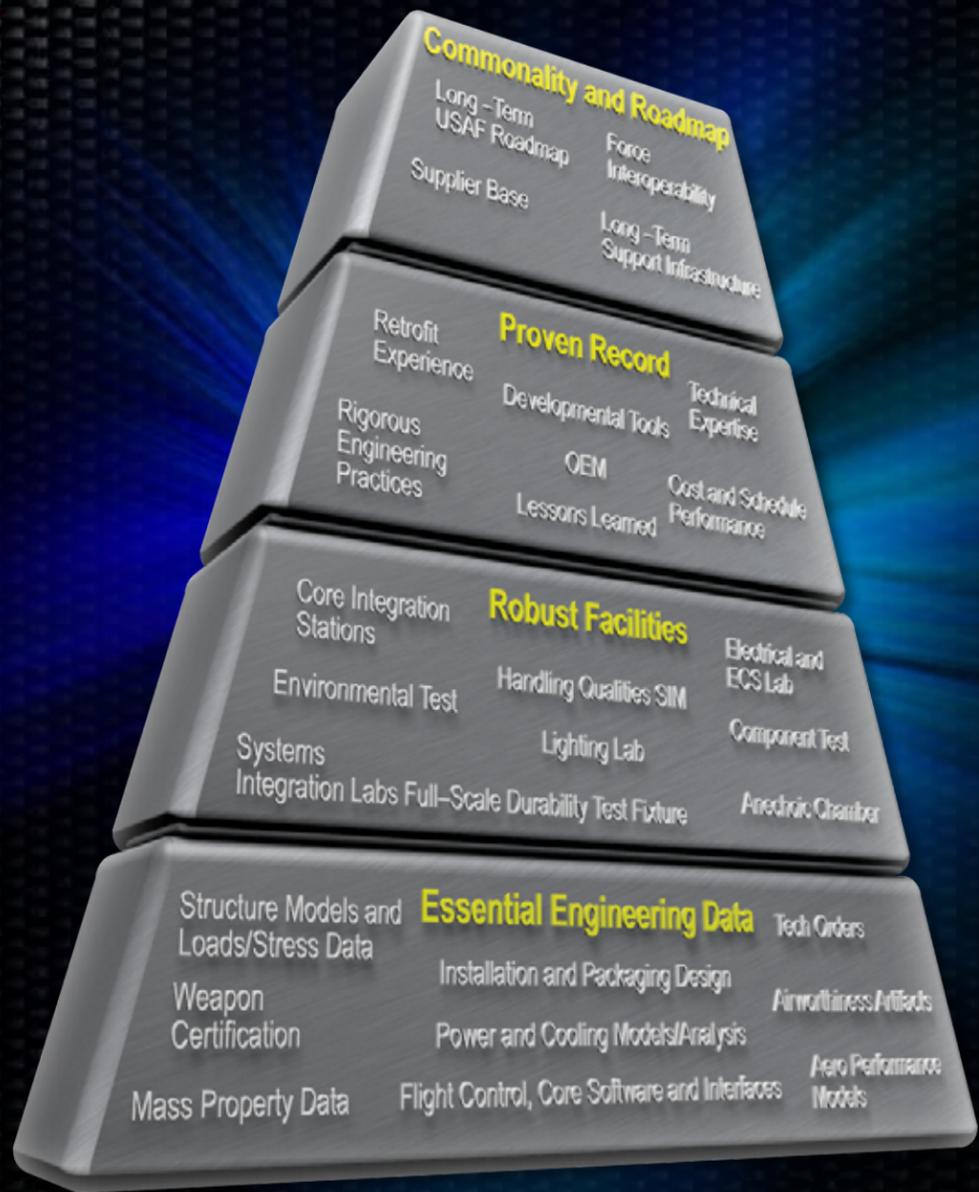
### IRIS-T

- Certified for carriage and employment
- Lab integration
- Launch zones incorporated
- Mission planning

## Integration of HAF Requirements



## Proven Expertise



As the Original Equipment Manufacturer (OEM), Lockheed Martin is uniquely qualified as the design authority for the F-16. Lockheed Martin has decades of unique development and integration experience which can be applied to lower the risk and cost to any F-16 development, production or upgrade program.

Furthermore as the F-16 OEM, Lockheed Martin has the essential engineering data as the design authority for providing evidence of structural air worthiness and validation of the entire F-16 weapon system.

Lockheed Martin has available a robust array of facilities that includes system and subsystem test facilities and development laboratories along with optimized process and procedures.

Lockheed Martin has a proven record and a proven working relationship with all required F-16 suppliers which can be applied to the timely implementation of any production, upgrade or sustainment program.

The F-16V represents the latest evolution of the F-16 roadmap. With the common Lockheed Martin roadmap, F-16 users will continue to benefit in the future from shared development, interoperability and a large common support infrastructure.



### Contractor Past Performance Record for Avionics Modernization Programs

The U.S. Department of Defense (DoD) annually evaluates Lockheed Martin's contract performance on large contracts via a Contractor Performance Assessment Report (CPAR). The CPAR is a management tool. The CPAR documents a contractor's past performance evaluations during program execution and is based upon recent, relevant experience. The intention is that the CPAR is a communication tool between the U.S. Government (USG) and the contractor to improve performance on current contracts.

Lockheed Martin's CPAR rating for performing on MLU/CCIP retrofit contracts on F-16 aircraft for the USG, including Foreign Military Sales (FMS), has been Very Good or Exceptional. The Exceptional rating indicates that the contractor has exceeded many requirements, that there have been a few minor contract problems and that the contractor's corrective actions have been highly effective.

### Production Continues – 4,535 Aircraft Delivered in 26 Countries

#### Modernization Programs Under Way

- USAF plus six international programs
- Seven additional in development

#### New Sustainment Programs in Development

- Structural certification to 10,000/12,000 flight hours
- New/refurbished F-16 wings



**Keeping the F-16 at the Forefront of International Security for Decades To Come**



## 4th/5th Generation Roadmap

### Meets Current Need

### Facilitates Seamless Transition to the F-35



**F-16**  
Best Value To Meet Current Need

**F-35**  
Premier Strike Fighter of the 21st Century

- Relationship with U.S. Air Force and F-16 operators
- Best capability for lowest total ownership cost
- Large global customer base

- Weapons commonality with F-35
- Fast track to 5th Gen capability

**Lockheed Martin Is the World Leader in Aircraft Design**

