



F-35 Lightning II Program Brief

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Program Executive Officer, F-35 Lightning II Program



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THE F-35 COALITION



F-35 LIGHTNING II PROGRAM TEAM

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Agenda

- **Program Overview**
- **Upcoming Milestones & Major Accomplishments**
- **F-35 Performance & Capabilities**
- **Logistics System**

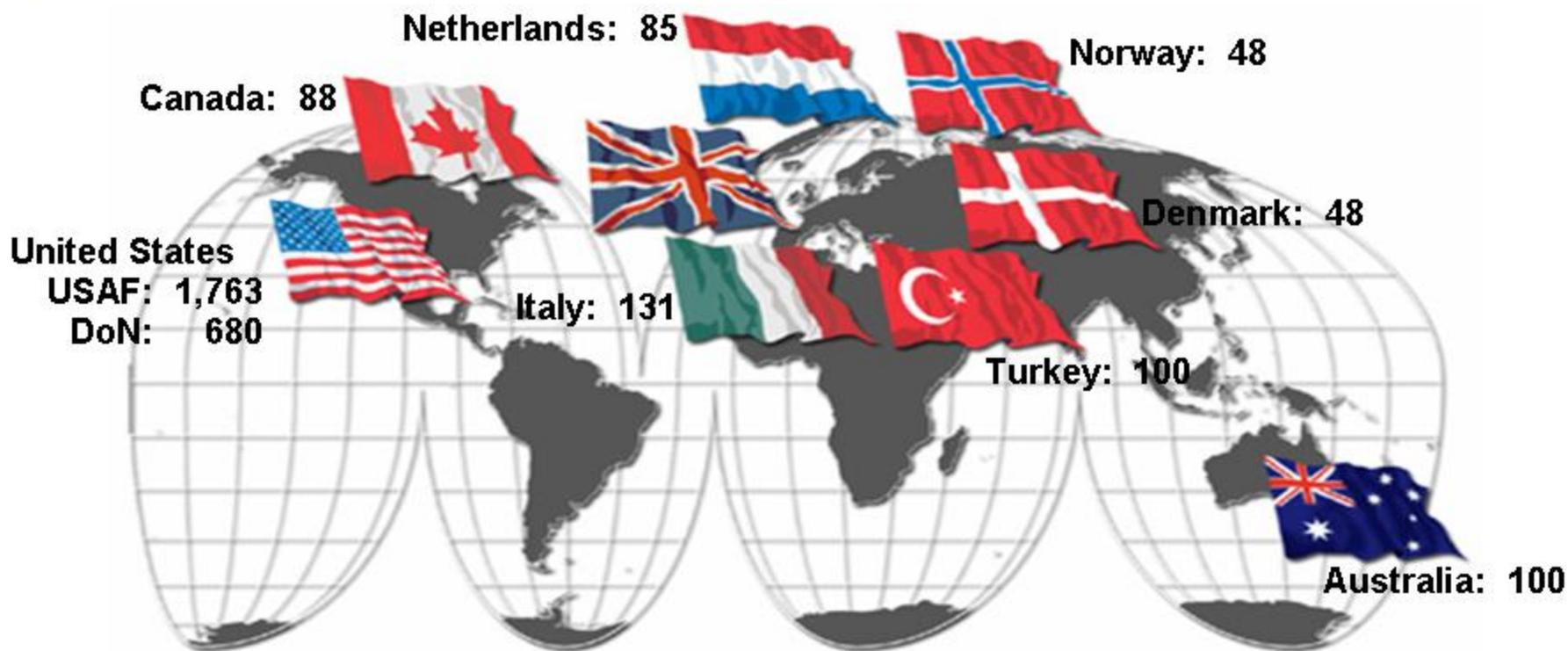


F-35 Lightning II Development Progress





Service & International Needs



- ⌚ **USAF:** Multi-role (primary air-to-ground) fighter to replace F-16 & A-10 & to complement F/A-22
- ⌚ **USMC:** Multi-role, short takeoff, vertical landing strike fighter to replace AV-8B & F/A-18C/D
- ⌚ **USN:** Multi-role strike fighter to complement the F/A-18E/F
- ⌚ **UK (RN and RAF):** Supersonic replacement for Sea Harrier and GR-7

2,593 US/UK JSFs > 2,000 International JSFs



JSF Family Of Aircraft

One Program -- Three Variants

Meeting Service and International Needs

**Conventional
Take-Off and
Landing
(CTOL)**

**Carrier Variant
(CV)**

**Larger Wing and
Horizontal Tail Area**

**In-Flight Refueling
Door (Boom)**

**Probe and Drogue
Refueling (Basket)**

**Internal
25mm 4-Barrel
Gatling Gun**

**Strengthened
Landing Gear
and Tailhook**

**Centerline
Gun Pod
with 25mm Gun**

**Short Take-Off and
Vertical Landing
(STOVL)**

**Wingfold and
Ailerons Added**

**Probe and Drogue
Refueling (Basket)**

**3-Bearing
Swivel Nozzle**

Lift Fan

Roll Posts

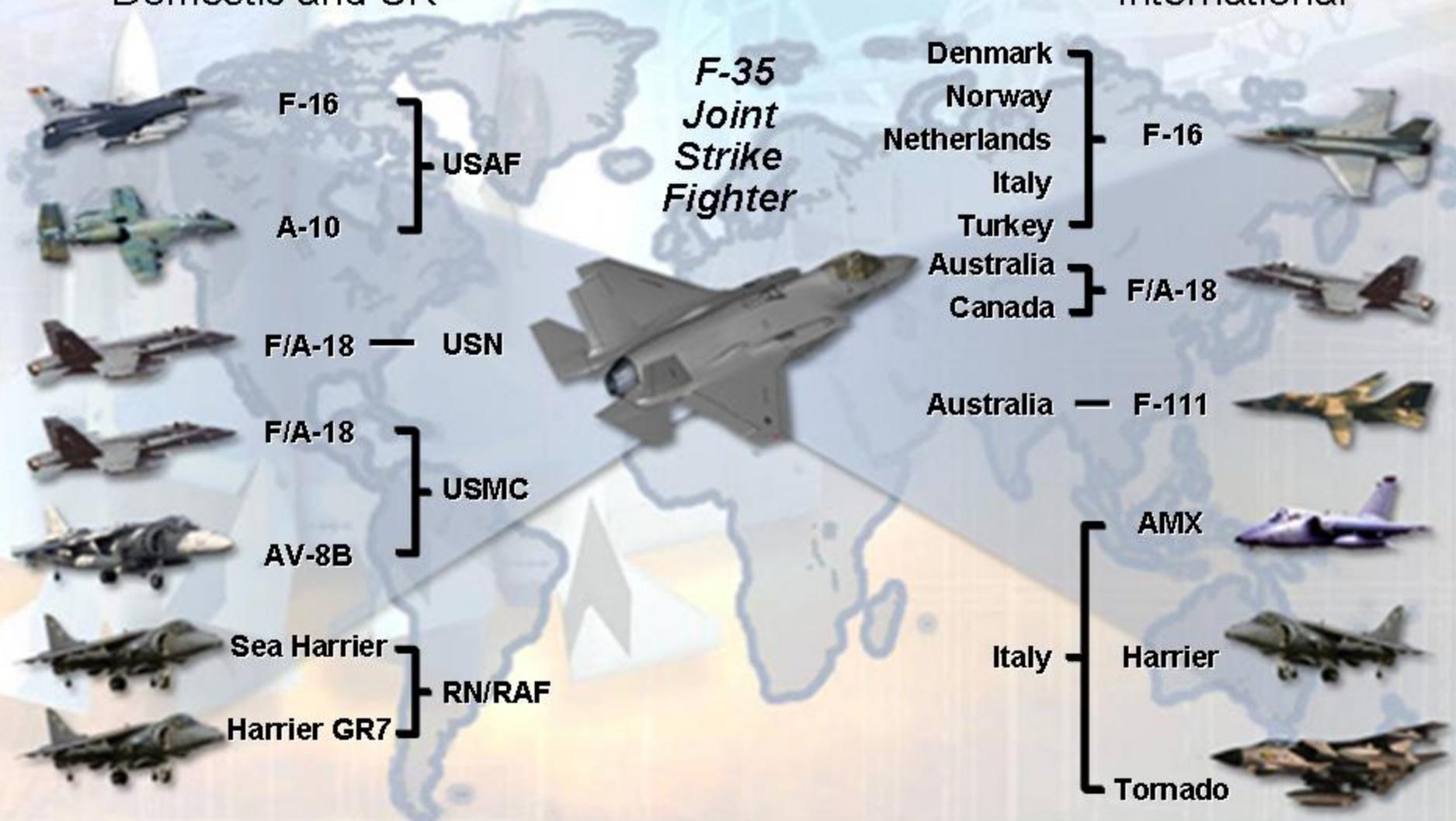
- All variants
- 450-600+ nm Range
- 1.6 Max Mach
- Stealthy
- Similar Weapons
- Same Avionics
- Similar Flight Envelope



F-35 Enables True Joint/Coalition Operations

Domestic and UK

International





Configuration 240-4

CTOL	STOVL	CV
Span (ft) 35 Length (ft) 51.4 Wing Area (ft ²) 460	Span (ft) 35 Length (ft) 51.1 Wing Area (ft ²) 460	Span (ft) 43 Length (ft) 51.4 Wing Area (ft ²) 668
<p>Gun Fairing</p> <p>F-16</p>	<p>AV-8B</p>	<p>Folded Span 31.1 ft</p> <p>F/A-18C</p> <p>Wing Fold</p>
Weight Empty (lb) 29,036 * Internal Fuel (lb) 18,480	Weight Empty (lb) 32,161 * Internal Fuel (lb) 14,003	Weight Empty (lb) 32,072 * Internal Fuel (lb) 20,085
All Mission Fuel Internal -- Very large Fuel Fraction Support Extended Range Requirements In VLO		



CTOL Comparison



240-1.1



Length	49.7 ft
Span	31 ft
Wing Area	300 ft²
Internal Fuel	7,162 lb

Length	51.1 ft
Span	35 ft
Wing Area	460 ft²
Internal Fuel	18,480 lb

Length	62.1 ft
Span	44.5 ft
Wing Area	840 ft²
Internal Fuel	



STOVL Comparison



240-1.1



Length	56 ft
Span	37.4 ft
Wing Area	400 ft²
Internal Fuel	10,800 lb
Spot factor	1.0

Length	51.1 ft
Span	35 ft
Wing Area	460 ft²
Internal Fuel	14,003 lb
Spot Factor	1.14

Length	47.4 ft
Span	30.3 ft
Wing Area	239 ft²
Internal Fuel	7,915 lb
Spot Factor	.82



Carrier Comparison



240-1.1



Length	56 ft
Span	37.4 ft
Wing Area	400 ft²
Internal Fuel	10,800 lb
Spot Factor	1.0

Length	51.4 ft
Span	43 ft
Wing Area	668 ft²
Internal Fuel	20,085 lb
Spot Factor	1.17

Length	60.38 ft
Span	42 ft
Wing Area	500 ft²
Internal Fuel	14,708 lb
Spot Factor	1.24



First Flights Status



CTOL AA-1

4th Qtr '06



CATB

4th Qtr '06



STOVL (BF-1)

1st Qtr '08



CTOL (AF-1)

3rd Qtr '08



CV (CF-1)

1st Qtr '09



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F-35 AA-1 rolls into hangar 8 before the inauguration event



Ongoing F-35 System Testing





Major Accomplishments

- **AA-1 First Flight Status**
 - 0.1a "Mission Alpha" combined Vehicle Systems/Mission Systems Laboratory executed Aug 06
 - 20 Integrated Power Package starts – no SW updates
 - 12 Engine Run Tests from idle to full AB – 18 Sept 06
 - Accomplished 676 formal flight controls test cases
- **Production Status (15 Sep 06)**
 - Aircraft:**
 - Center Fuselages: 8 (5 STOVL, 3 CTOL) in assembly
 - Forward Fuselages: 4 (4 STOVL) in assembly
 - Wing Section: 2 (2 STOVL) in assembly
 - Aft Fuselage: 2 (2 STOVL) in assembly
 - Engines:**
 - Ground Test: 9 Delivered, 1 in assembly
 - Flight Test Engines: 3 Delivered, 4 in assembly
- **Subsystems development on-track**
 - 4 Radar working in MS Integration Lab and Aircraft testbed
 - Delivered 655 VS parts for 1st A/C build
 - Block 1 Integrated Core Processor powered-up, configured, and booted
 - Panoramic Cockpit Display (PCD) System Processor On-Track for delivery
- **F135 – 5,667 total hrs on 11 engines (as of 6 Sep 06)**
- **F136 – 240 Total Test Hours on 2 engines (SDD & Phase IIIB)**





AA-1 Actual Weights vs Calculated

	CTOL AA-1 Component Category	Total Calculated (lb)	Total Actual (lb)	Percent of Total Weight	Variance (lb)	Variance (%)
	Airframe	9260.9	9333.6	58%	72.7	0.78%
	Systems	4282.4	4162.6	69%	-119.8	-2.80%
	Grand Total	13543.2	13496.1	61%	-47.1	-0.35%

No Propulsion

SR124 11/21/05

AA-1 Actual Weight Measurements Demonstrate High Confidence in Weight Calculations



AVD Maturity Statistics

August 06

STOVL Air Vehicle Weight Growth since SWAT (Oct 2004): + 363 lb.

45,140 hrs (93.3%)
of Wind Tunnel Testing Conducted

11,836 Total Rounds Fired
Longest Burst: Full Fire out of 181 Rounds

2.04 Million (83%) Lines of Code
Developed for Block 0.1

1.41 Million (64%) Lines of Code
Developed for Block 0.5

10 S/W Releases
(OFP Loads) to AA-1

4 Engine Installs
Accomplished to AA-1

9 Escape System Tests Conducted
- Up to 450 kts

23,632 (61%) Drawings
Frozen (Cum for All Variants)

386 LRCs in SOF Testing (VS)

325 (84%) LRCs have
COMPLETED SOF Testing (VS)

4 Radars in Test
65 Flt Hrs on Radars

5796 Engine Test Hours
Completed

969 Lift Fan Test Hours
Completed

18,992 Total Parts Delivered

790 of 831 System Parts Del.

3500 Lab Parts Delivered

10,000+ Lab Test Hrs
so far in 2006

Lab Maturity:

100% VSIF (AA-1)	100% VIF
75% VSIF (BF-1)	100% FSS (AA-1)
50% MSIL	50% OASIS

150 of 191 (79%)

Building Block Tests
Completed

Comprehensive Analysis and Testing Provide Design Confidence



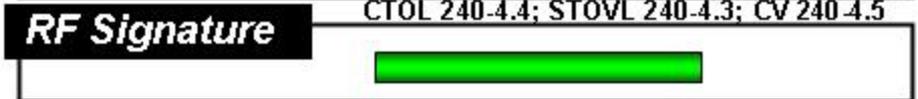
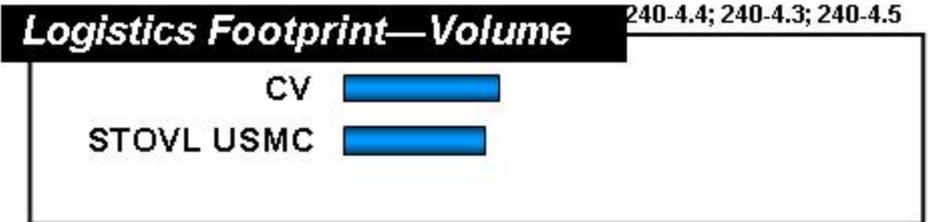
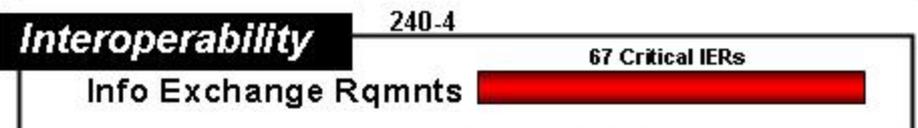
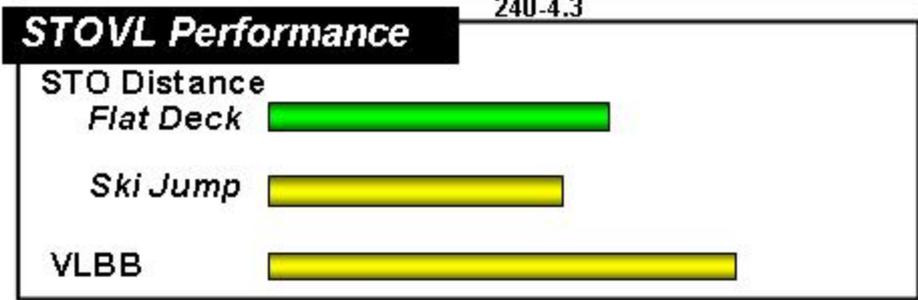
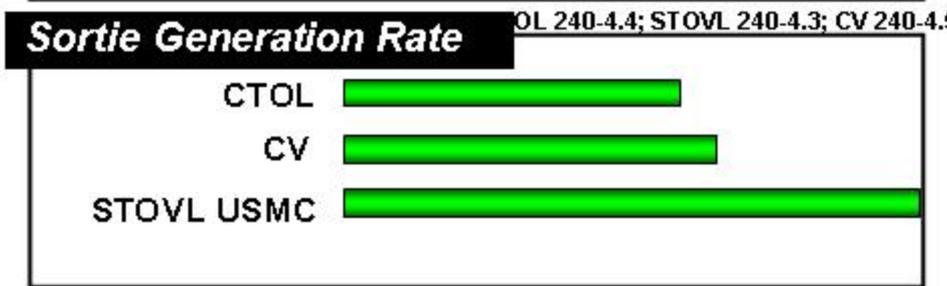
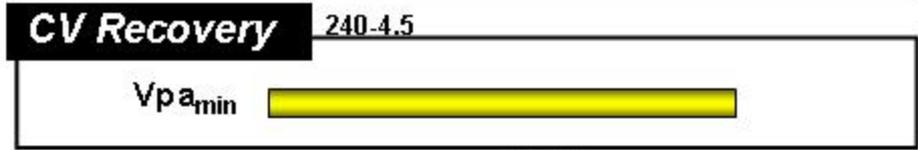
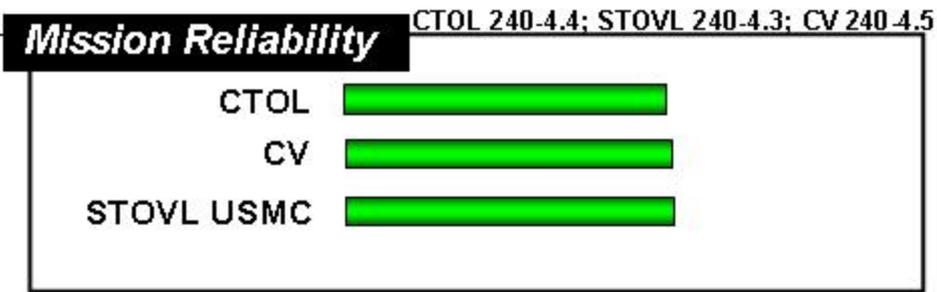
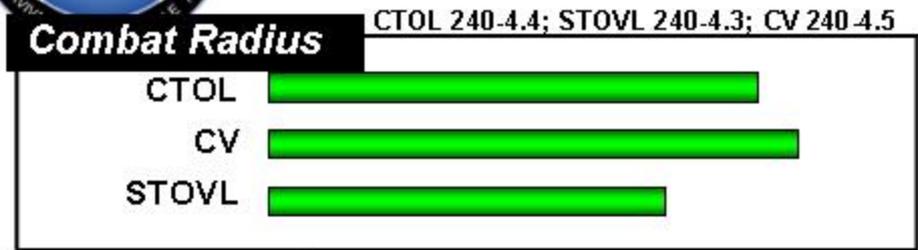
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Key Performance Parameter Status

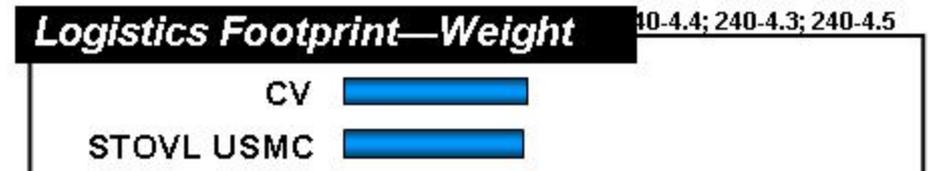
(As of 24 August 06)



- CTOL 240-4.4; STOVL 240-4.3; CV 240-4.5 unless noted
- Contract Engine Deck
- Projected IOC Weight Empty based on WSR 154 CE + 3% Growth
- Data as of 8-24-06

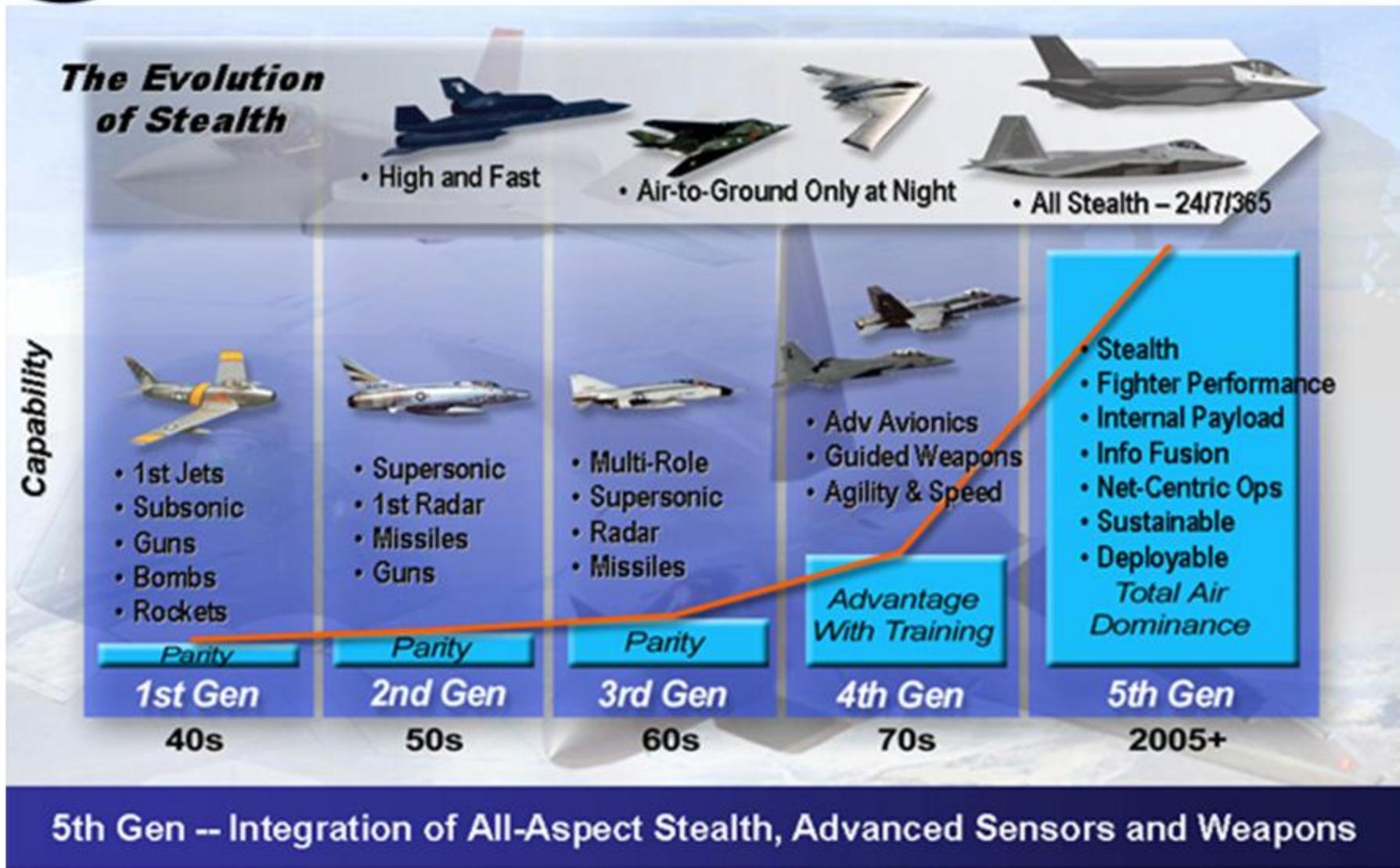
Threshold Requirement CE Performance

- Exceeds ORD Objective
- Meets Rqmt/Exceeds Tripwire
- Meets Rqmt/In Tripwire Band
- Does Not Meet Requirement





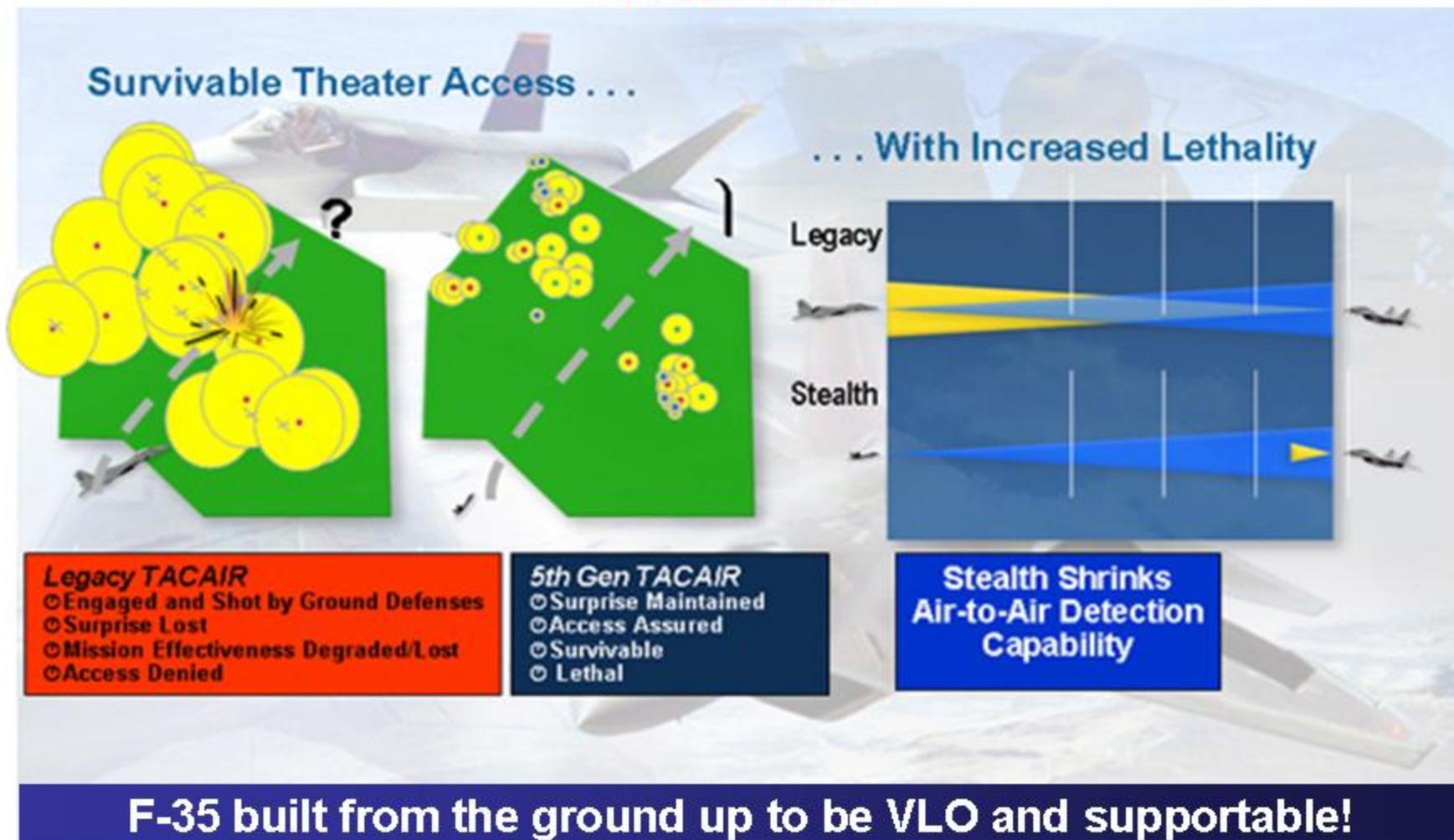
Fighter Aircraft Generations





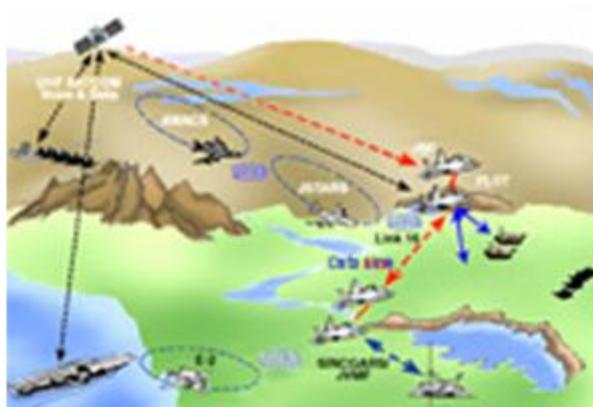
F-35 Survivable & Lethal

F-35 Leveraged all of the F-22 State of the Art VLO Technology and Design Lessons Learned

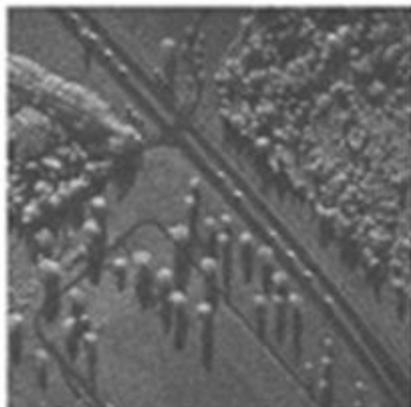




F-35 Lightning II Warfighter Capability



**Cooperative Ops
Off-Board Connectivity**



Multi-Function AESA

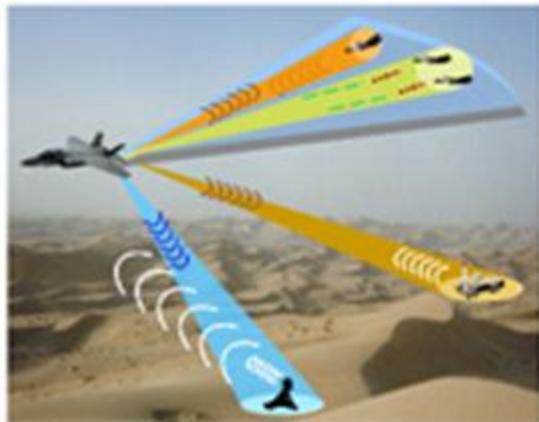
EO Targeting



**Versatile Weapons
Capability**



All Around Situation Awareness



**Passive Precision Emitter
Location and Targeting**

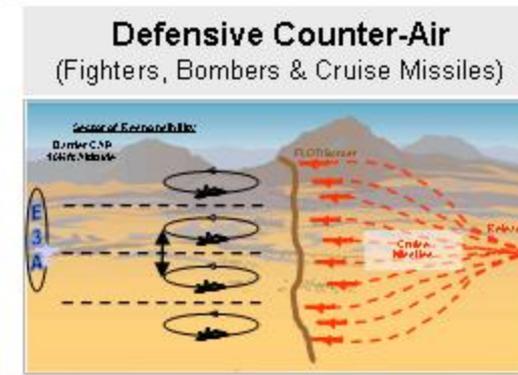
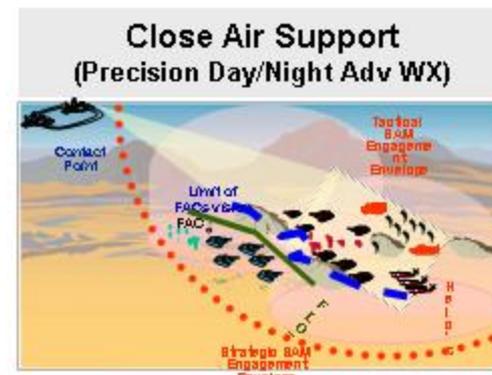
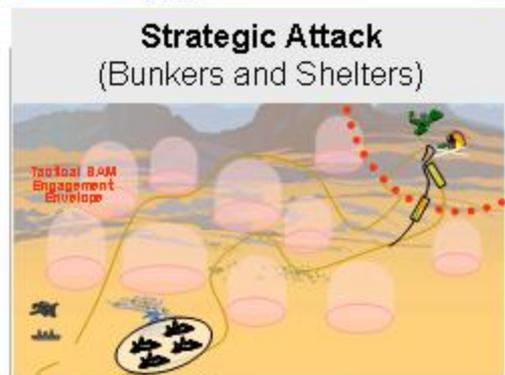
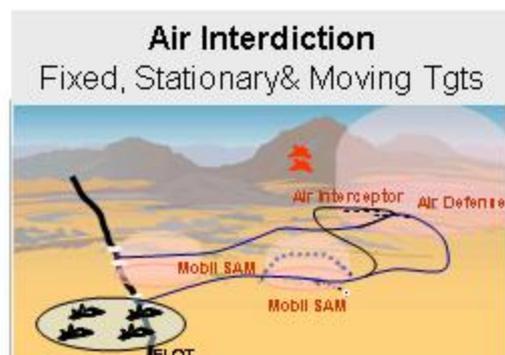


**Fused, Coherent Common
Operational Picture**



What F-35 Provides to the Warfighter

- Day "One" Stealthy (VLO) Supersonic, Multi-Role Fighter designed to execute Air-to-Air and Air-to-Ground missions in high threat areas:



**Versatile fighter which fulfills multiple missions;
These are six of the twelve core missions.**



What F-35 Provides to the Combatant Commander

Day One Stealthy (VLO) Long Range, Interoperable, Multi-Role Coalition Fighter which can be deployed from Main Operating Bases, Aircraft Carriers, "L" Class Ships and Austere Air Bases

USN Nimitz Class Carrier CV



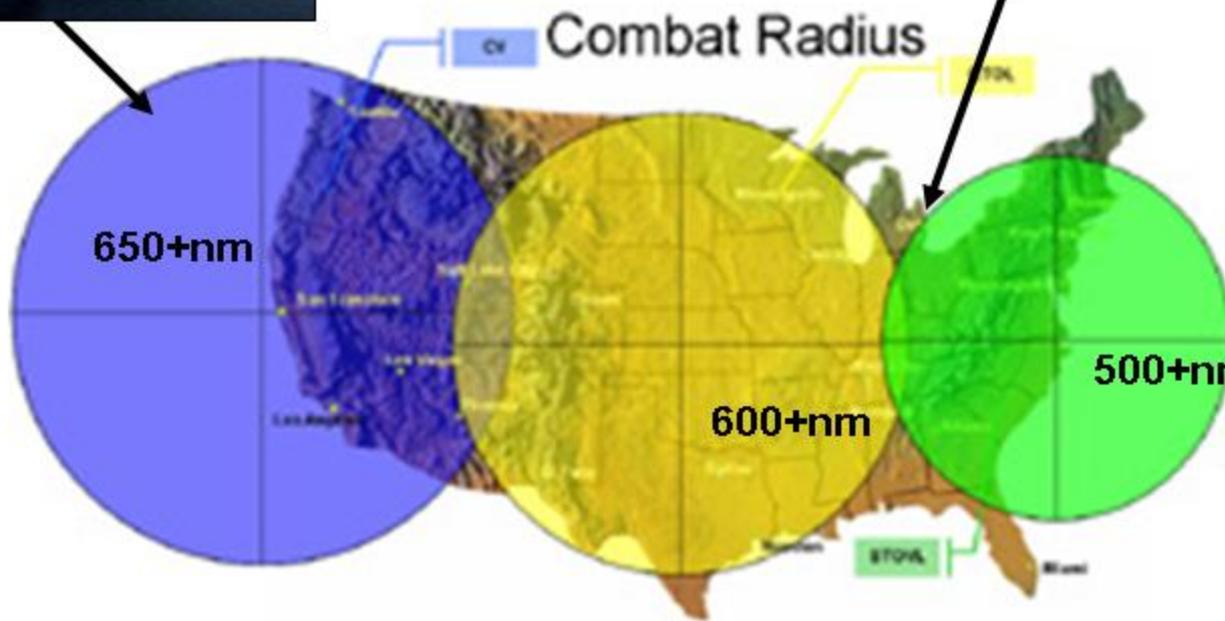
Main Operating Base CTOL



USMC Austere Basing STOVL

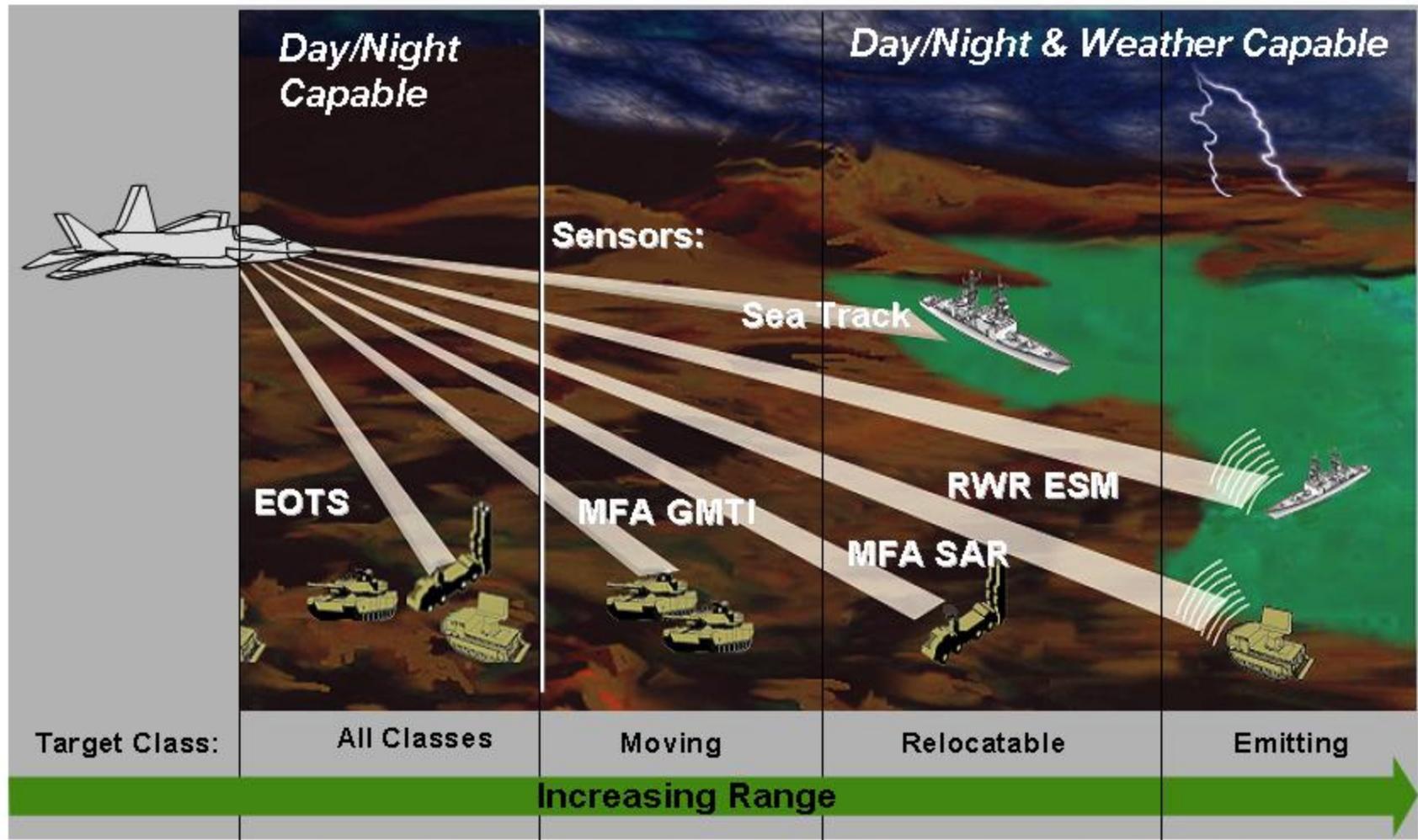


USMC "L" Class Ship STOVL





Surface Target Detection, Track, Classification And Identification



JSF Is Autonomous, Long Range, and Weather-Capable



APG-81 Advanced Electronically Scanned Array (AESA) Radar

High Res SAR

High Res Spotlight SAR

LOW

Med

High

Very High

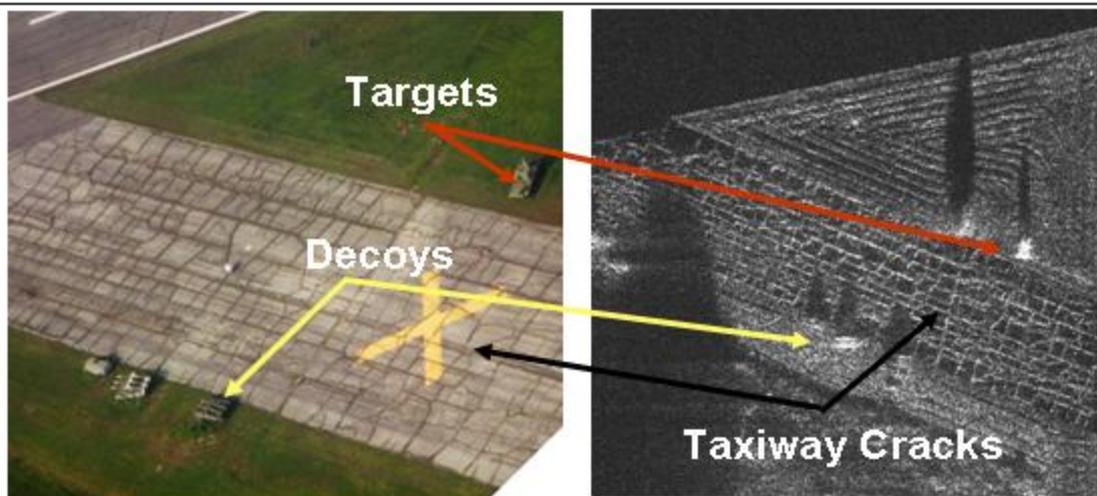
SAR Res Step Up Example

Target Classification

Near Precision Adverse Weather Self-Targeting Capability



Target Details Are Clear with F-35 APG-81 SAR



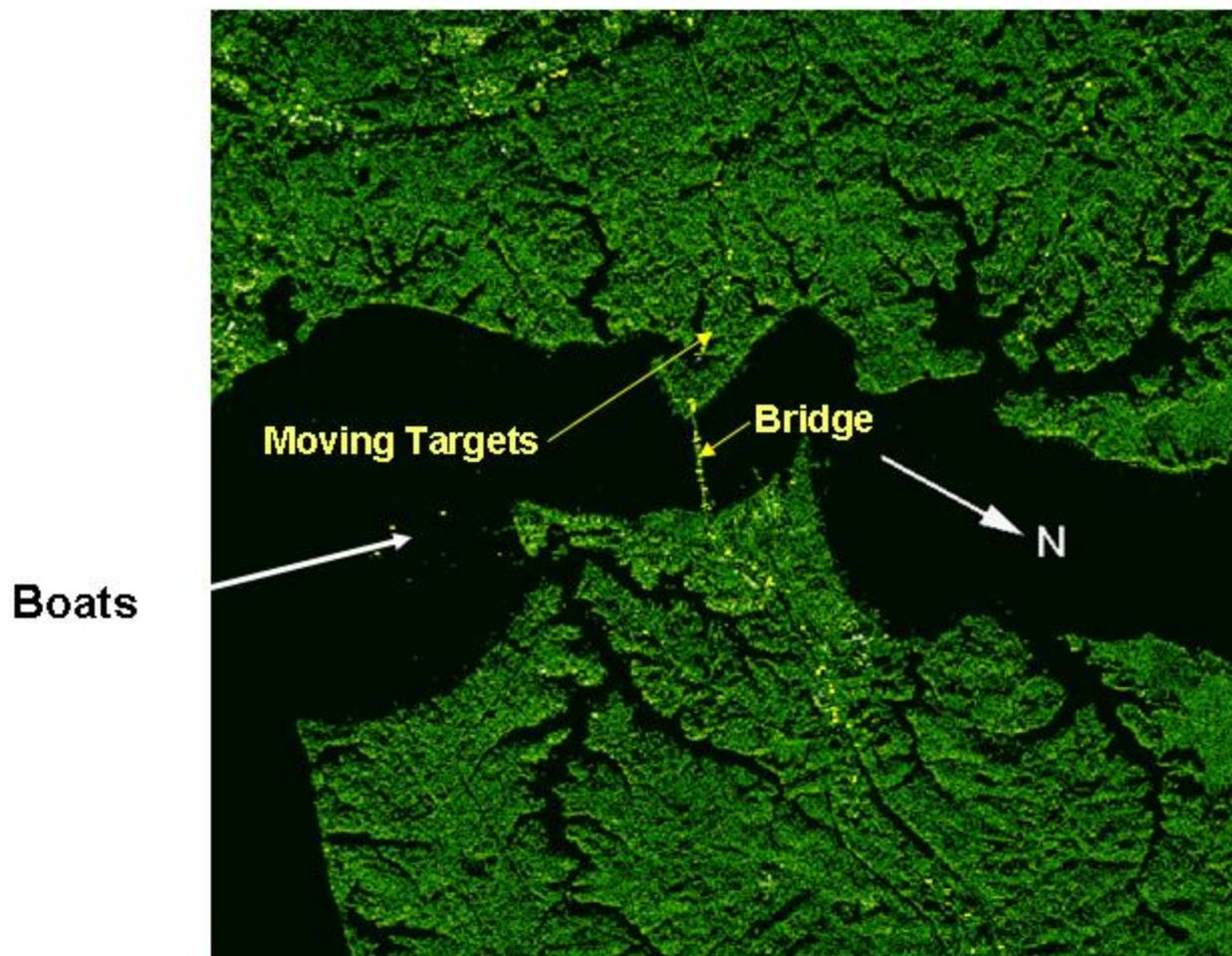
APG-81 High Resolution SAR Imagery



APG-81 Provides Exceptional Target and Context Detail



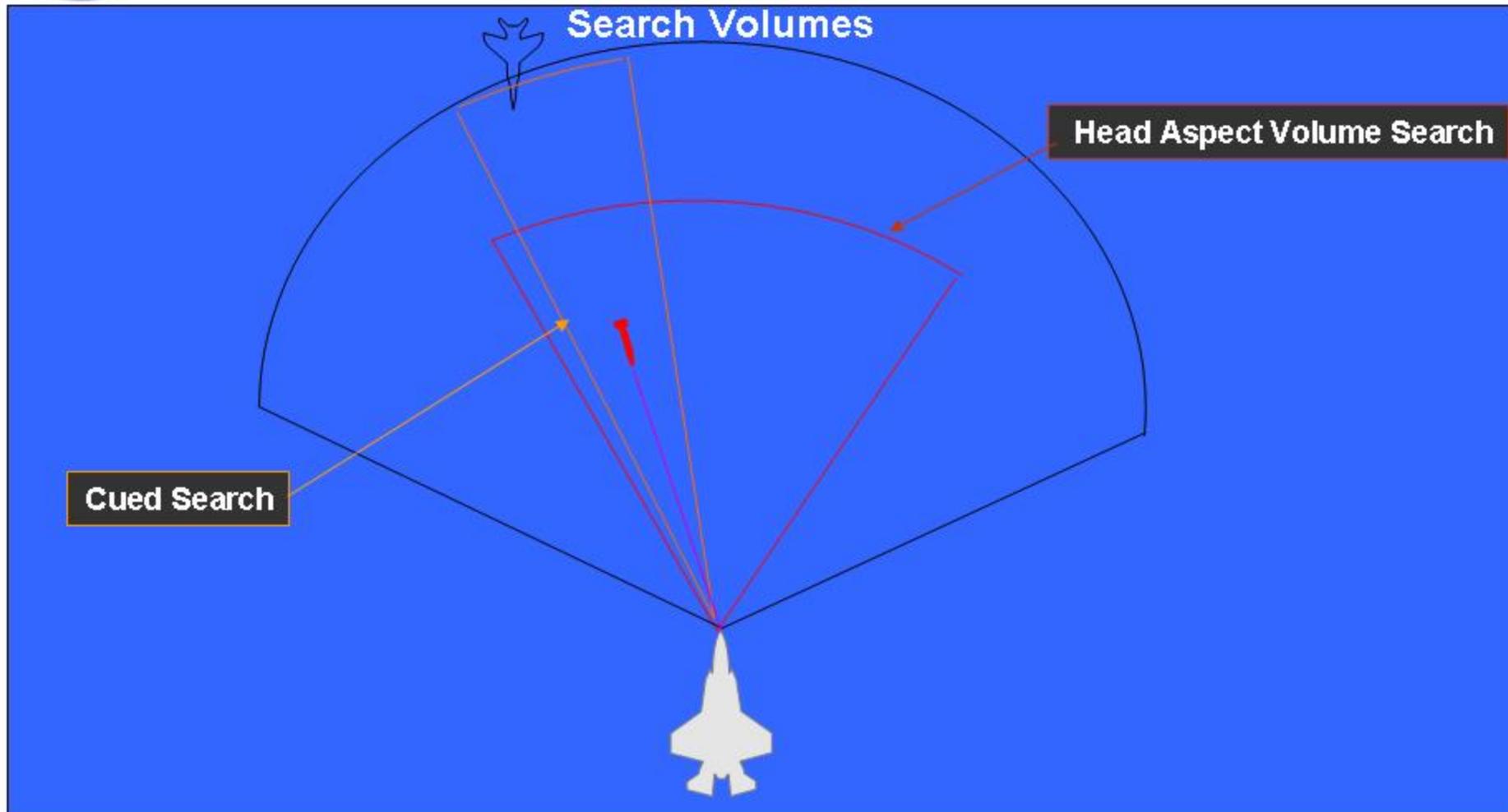
Precise Alignment of GMTI Targets on SAR Map



GMTI Superimposed on SAR Map for Target Context



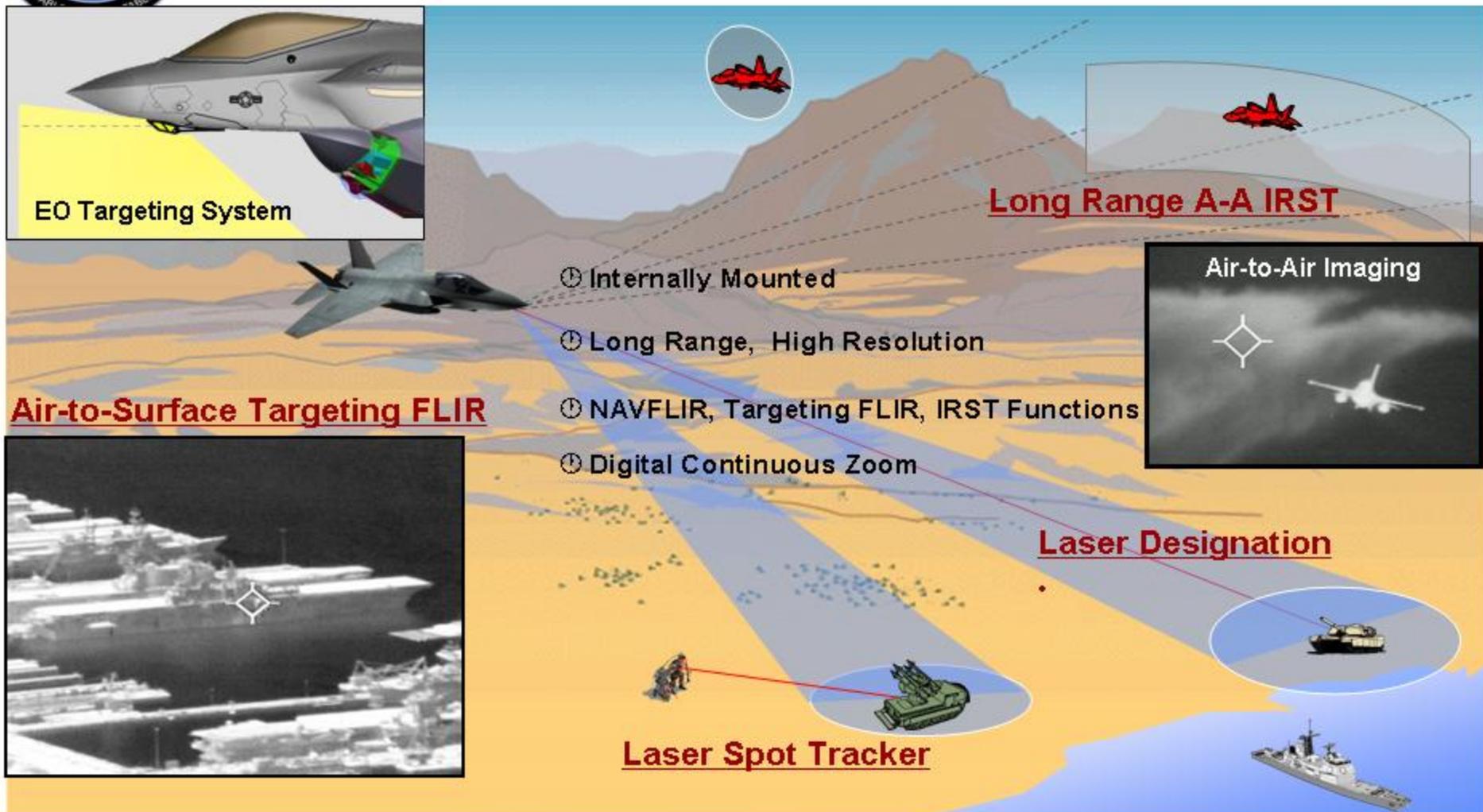
APG-81 Provides Rapid and Increased Search Volume and Track Accuracy in Air-to-Air Modes



Enhanced Search Range and Performance Advantage over Legacy



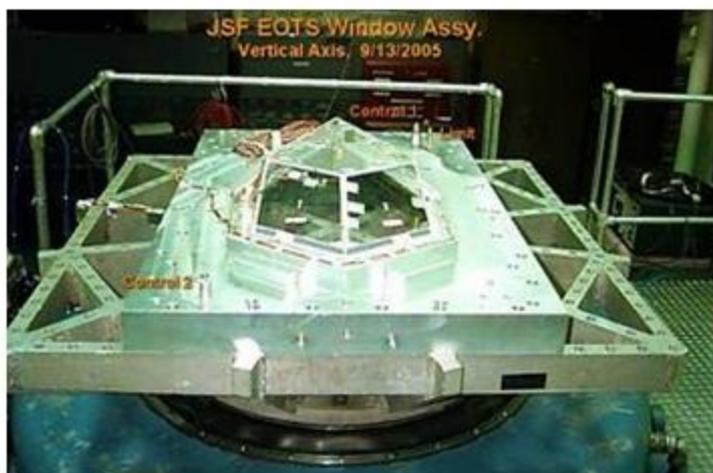
Electro Optical Targeting System Operational Capabilities



The Advanced EOTS Provides Passive Multi-Spectral A/A and A/G Capabilities As Well as Enhanced A/G Target ID Capability



EOTS System Summary (U)



EUO #2 Test Article in Fixture

Functions

Air-to-Air Tracking

- Infrared Video Imaging
- Image Track

Long Range IRST

- Target Tracking

Air-to-Surface Targeting

- Infrared Video Imaging
- Target Search, Cue, and Image Track

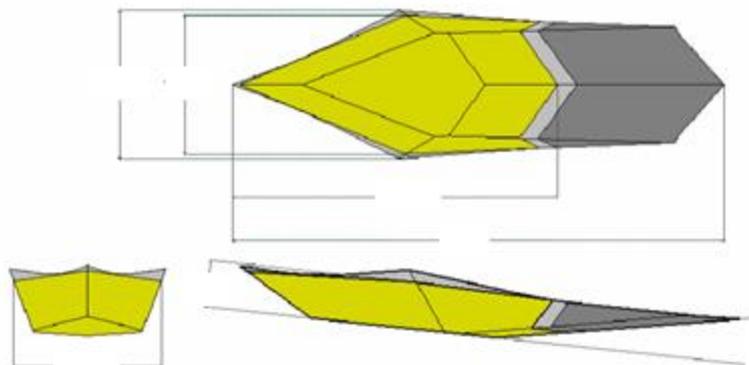
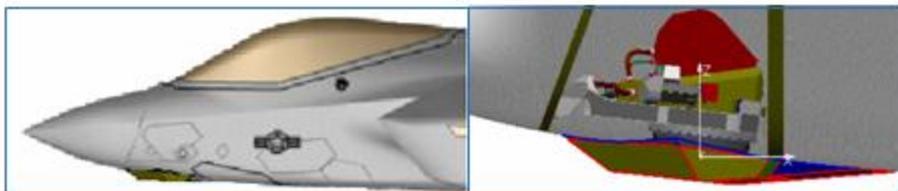
Multi-Function Laser

- Target Designation
- Laser Range Measurement

Laser Spot Tracker

- Target Search & Cue

“DAY 1” FIXED CHIN INSTALLATION WITH FACETTED WINDOW





Distributed Aperture System (DAS) Summary (U)

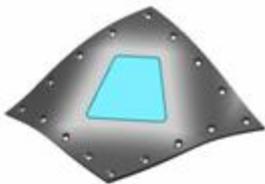
Test DAS Sensor Image



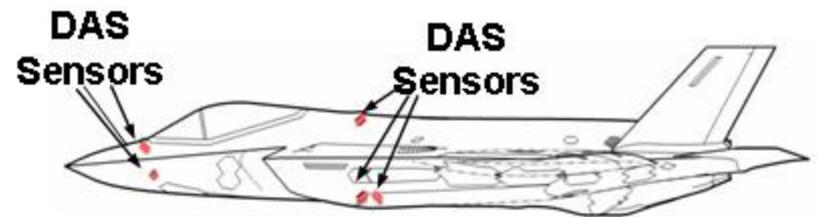
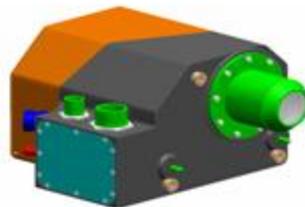
DAS Provides All Functions Simultaneously



DAS Window Panel

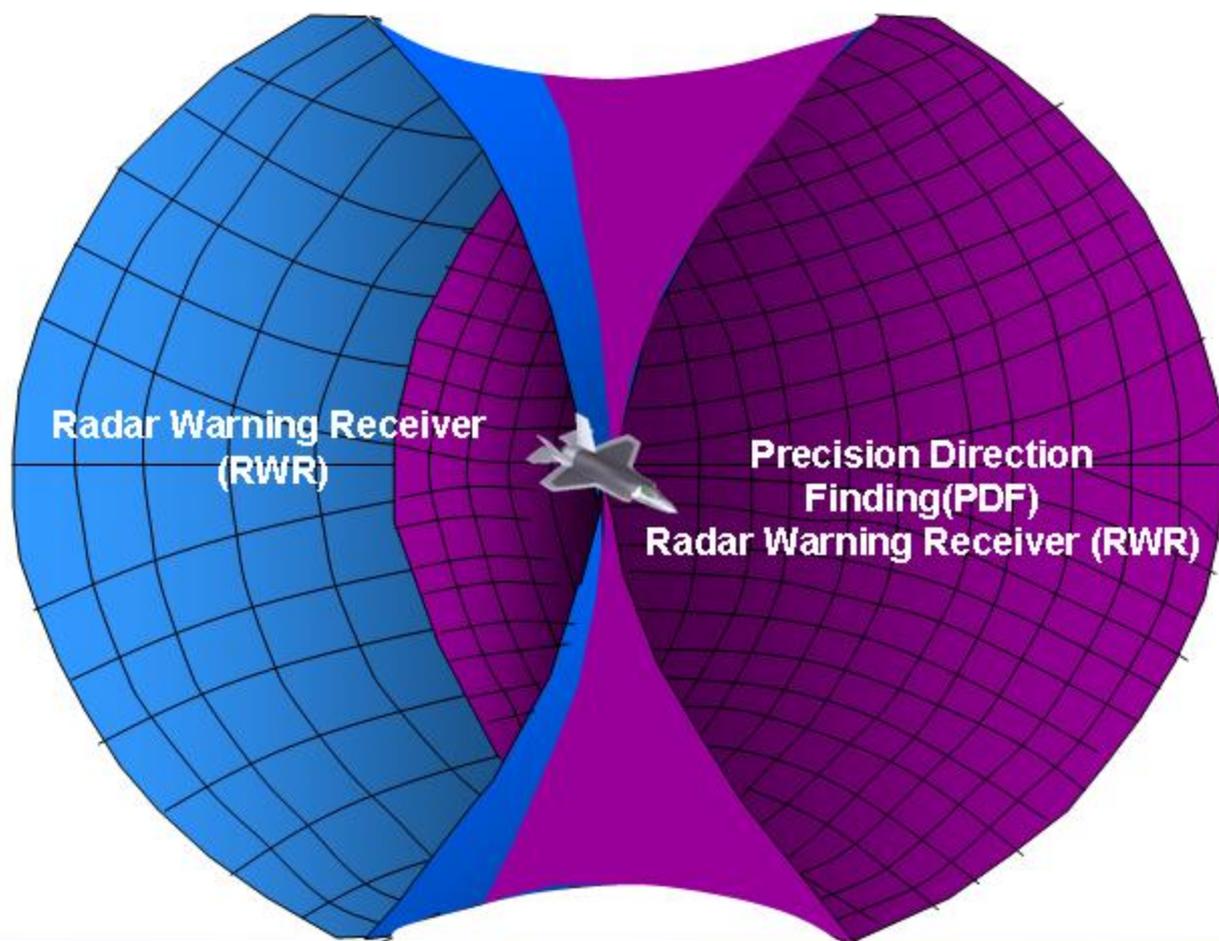


DAS Sensor





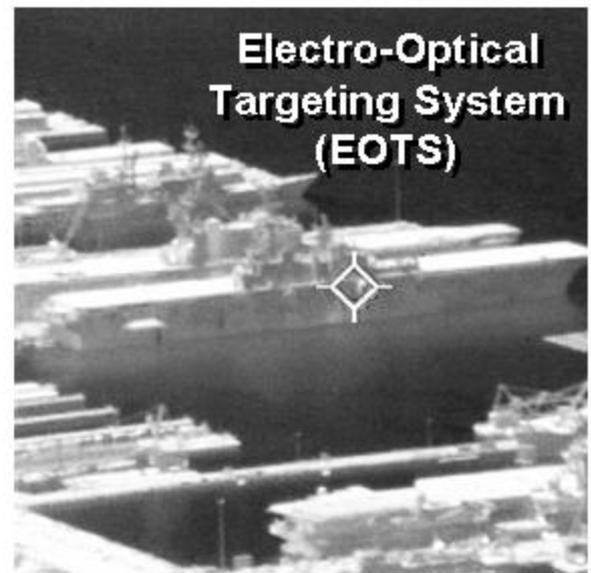
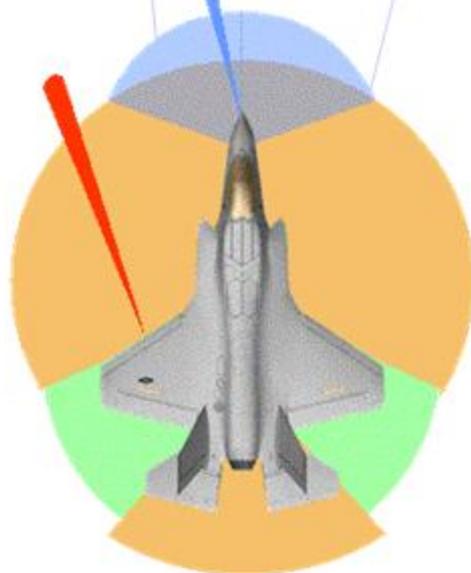
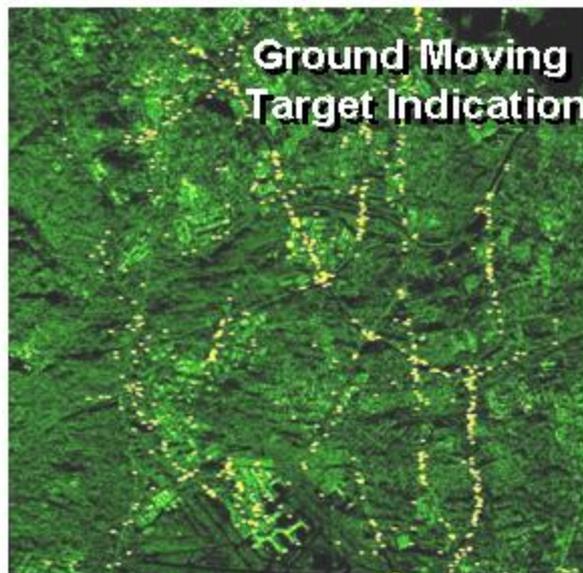
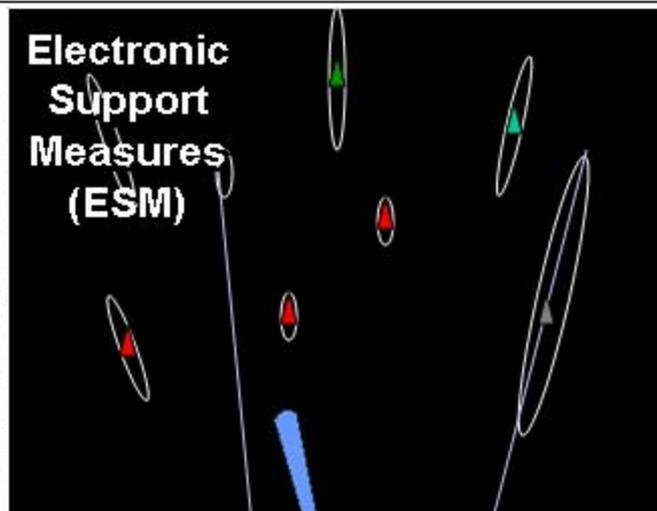
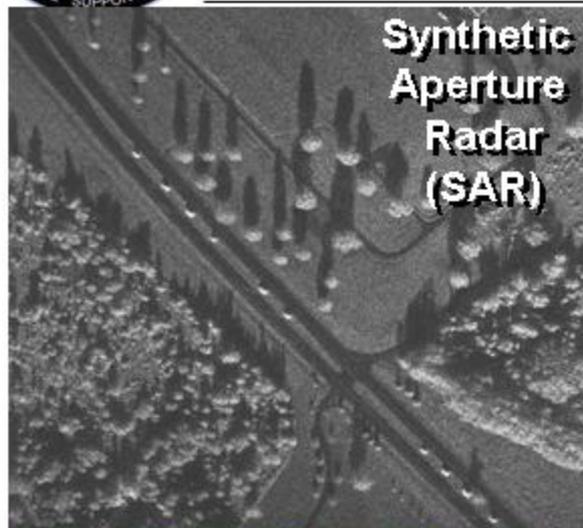
Electronic Support Measure (ESM)



ESM Capabilities Support Enhanced Passive SA, and
Suppression & Destruction of Enemy Air Defenses Capabilities



F-35 Multi-Spectral Fused Sensors





Pilot System Products



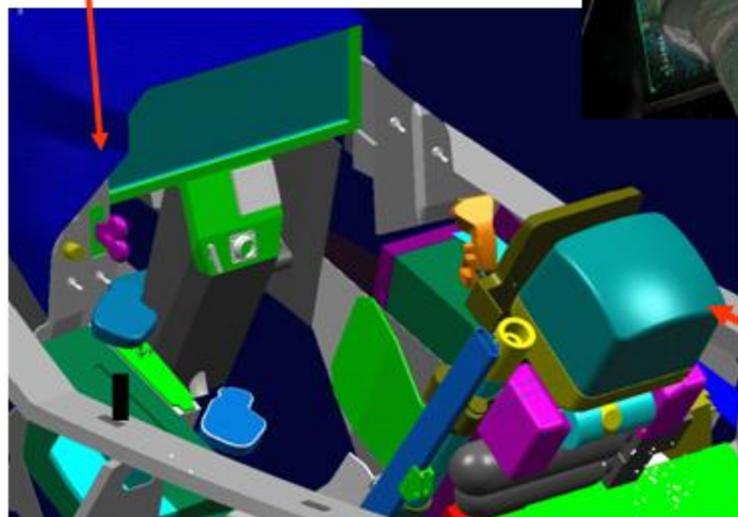
MFD and Display Management Computers (Kaiser)



Helmet-Mounted Display

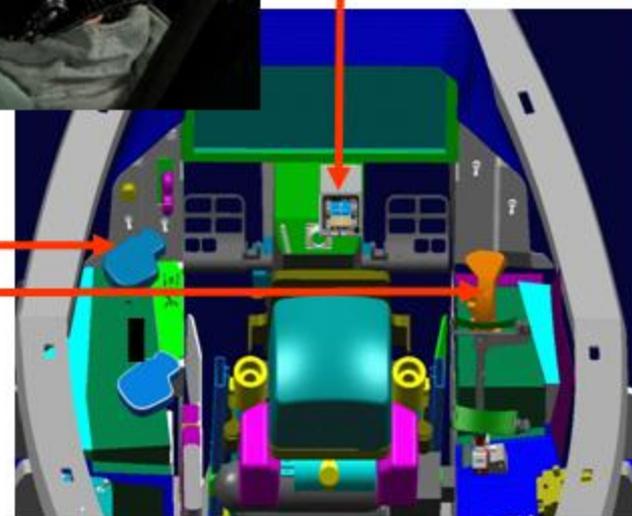


Standby Flight Display (SFD)



Throttle and Side Stick (HOTAS)

Mk.16 Seat (Martin Baker)





Non-Technical Data

CTOL & CV Weapons Carriage Requirements



Store Fully Certified During SDD

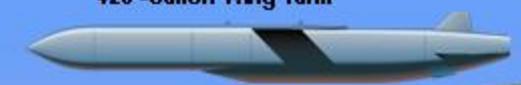
EXTERNAL WEAPONS

INTERNAL

EXTERNAL WEAPONS



426-Gallon Wing Tank



Stormshadow



GBU-38 JDAM 500-lb (MK-82 Warhead)



AGM-159 JASSM



MXU-648/CNU-88 Baggage Pod



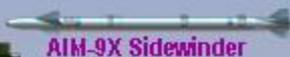
AGM-154A/C JSOW Glide Bomb



AIM-120B/C AMRAAM



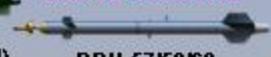
GBU-31 JDAM 2,000-lb (MK-84 Warhead)



AIM-9X Sidewinder



GBU-32 JDAM 1,000-lb (MK-83/BLU-110 Warhead)



BDU-57/58/60 Laser-Guided Training Round



GBU-31 JDAM 2,000-lb (BLU-109 Warhead)



Missionized Gun



Brimstone/Joint Common Missile

MK-76/MK-58/BDU-48



GBU-32 JDAM 1,000-lb (MK-83/BLU-110 Warhead)



GBU-12 Paveway II 500-lb LGB (MK-82 Warhead)



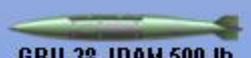
GBU-31 JDAM 2,000-lb (MK-84 Warhead)



AGM-154A/C JSOW Glide Bomb



CBU-103M05 WCMD



GBU-38 JDAM 500-lb (MK-82 Warhead)



Brimstone/Joint Common Missile



GBU-31 JDAM 2,000-lb (BLU-109 Warhead)



AIM-120C AMRAAM



AIM-132 ASRAAM

Weapons Currently Under Development



UK 500# PGB



Phase I SDB



GBU-10 Paveway II 2,000-lb LGB (MK-84 Warhead)



GBU-24A/B Paveway III 2,000-lb LGB (MK-84 / BLU-109 Warhead)



GBU-16 Paveway II 1,000-lb LGB (MK-83 Warhead)



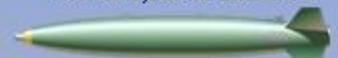
MK-83 BLU-110 LDGP 1,000-lb LDGP



MK-83 BSU-85 HDGP



MK-84 2,000-lb LD/HDGP



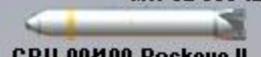
MK-84 BSU-50 Ballute 2,000-lb HDGP



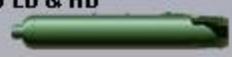
GBU-12 Paveway II 500-lb LGB (MK-82 Warhead)



MK-82 500-lb LD & HD



CBU-99M00 Rockeye II Cluster Munition



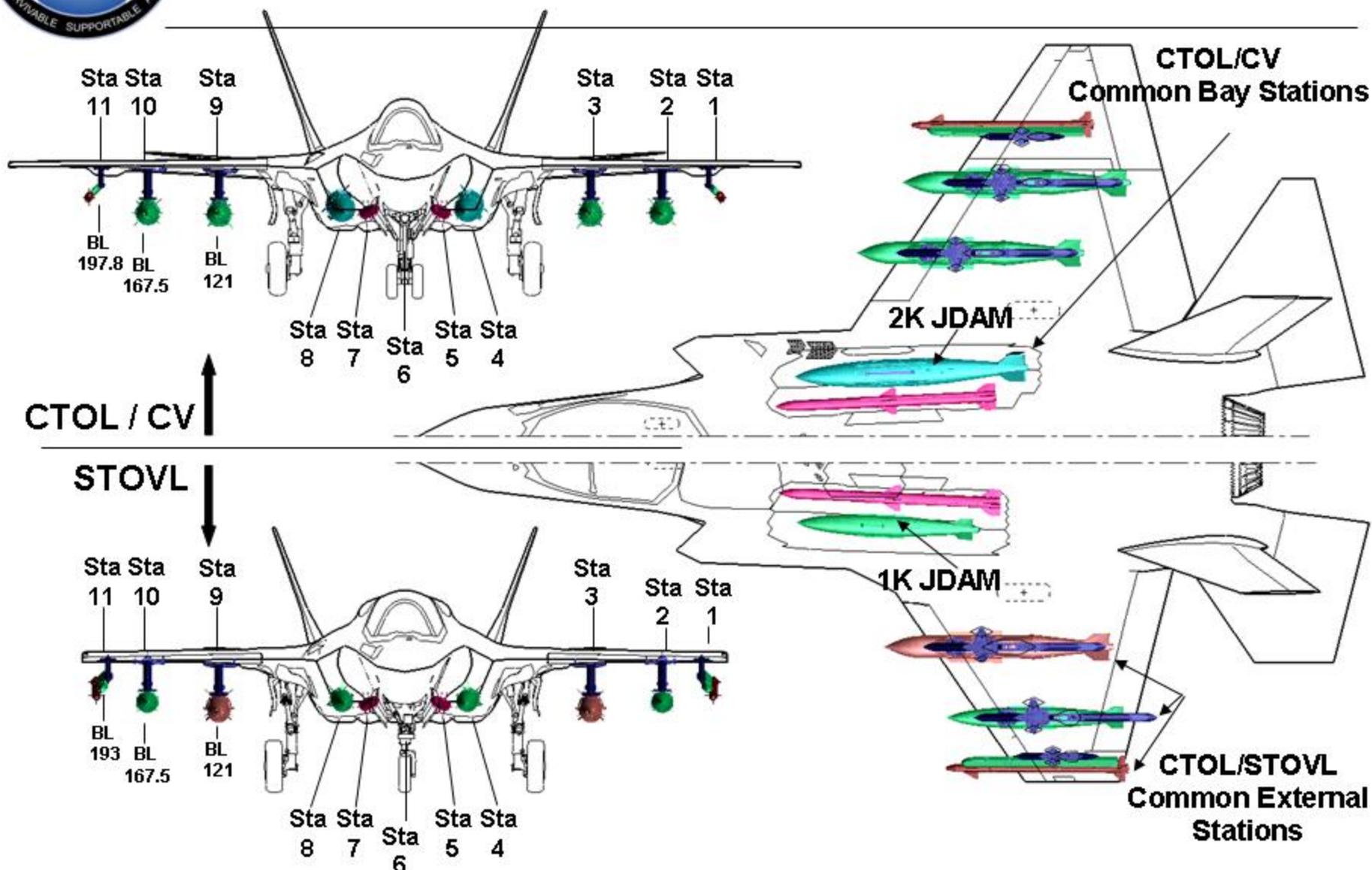
CBU-103M05 WCMD



AIM-132 ASRAAM

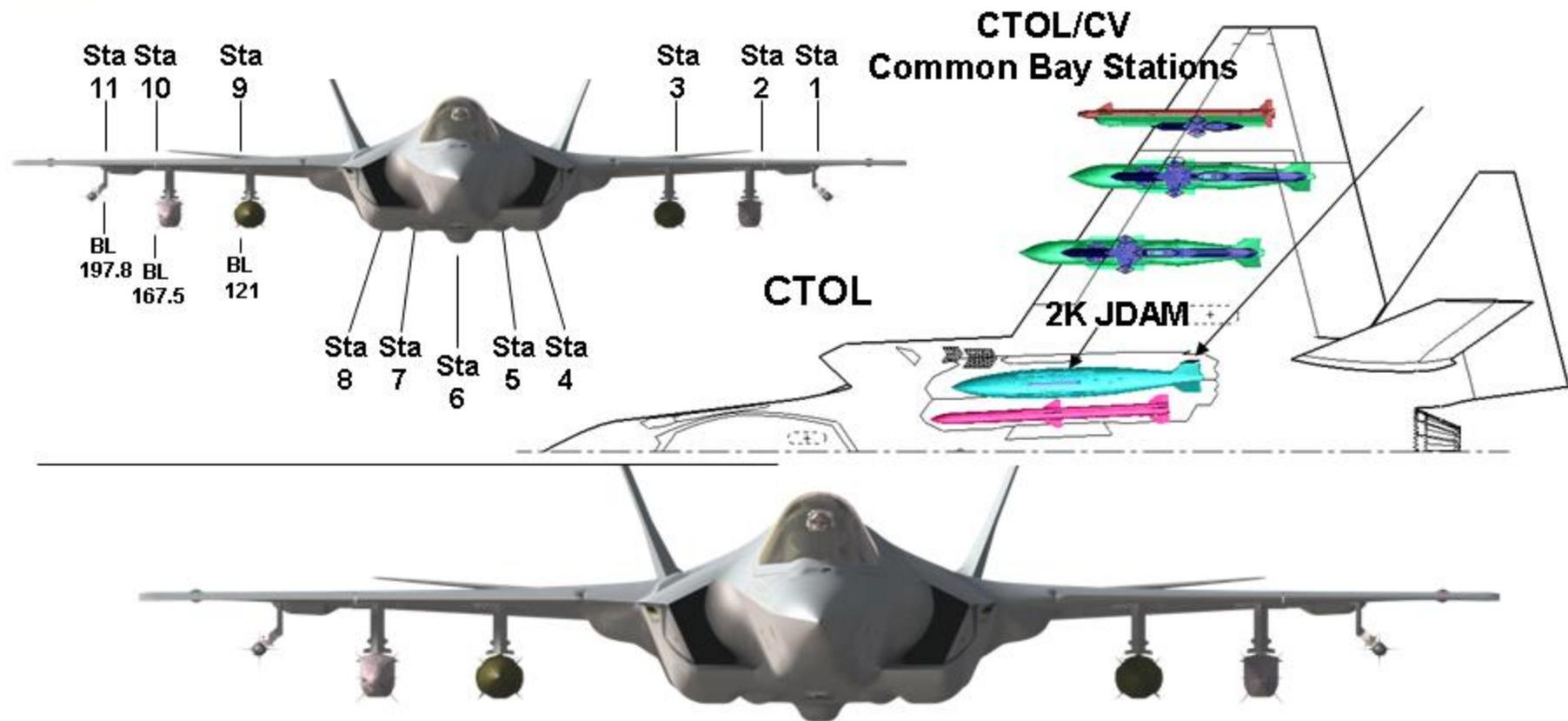


Weapons Carriage Arrangement





CTOL 240-4 Weapons Carriage Arrangement



Station	11	10	9	8	7	6	5	4	3	2	1
Store	A/A	A/A, A/S	A/A, A/S	A/A, A/S	A/A	Gun	A/A	A/A, A/S	A/A, A/S	A/A, A/S	A/A
Capacity C	300	2,500	5,000	2,500	350	1,000	350	2,500	5,000	2,500	300



Non-Technical Data

STOVL Weapons Carriage Requirements



Store Fully Certified During SDD

EXTERNAL WEAPONS

INTERNAL

EXTERNAL WEAPONS

- 426 -Gallon Wing Tank
- Stormshadow
- AGM-159 JASSM
- MXU-648/CNU-88 Baggage Pod
- AGM-154A/C JSOW Glide Bomb
- AIM-120B/C AMRAAM
- GBU-31 JDAM 2,000-lb (MK-84 Warhead)
- AIM-9X Sidewinder
- GBU-32 JDAM 1,000-lb (MK-83/BLU-110 Warhead)
- BDU-57/58/60 Laser-Guided Training Round
- GBU-31 JDAM 2,000-lb (BLU-109 Warhead)
- Missionized Gun
- Brimstone/Joint Common Missile
- MK-76/MK-58/BDU-48

- GBU-32 JDAM 1,000-lb (MK-83/BLU-110 Warhead)
- GBU-12 Paveway II 500-lb LGB (MK-82 Warhead)
- CBU-103M05 WCMD
- GBU-38 JDAM 500-lb (MK-82 Warhead)
- Brimstone/Joint Common Missile
- AIM-120C AMRAAM
- AIM-132 ASRAAM
- UK 500# PGB
- Phase I SDB

- GBU-10 Paveway II 2,000-lb LGB (MK-84 Warhead)
- GBU-24A/B Paveway III 2,000-lb LGB (MK-84 / BLU-109 Warhead)
- GBU-16 Paveway II 1,000-lb LGB (MK-83 Warhead)
- MK-83 BLU-110 LDGP 1,000-lb LDGP
- MK-83 BSU-85 HDGP
- MK-84 2,000-lb LD/HDGP
- MK-84 BSU-50 Ballute 2,000-lb HDGP
- GBU-12 Paveway II 500-lb LGB (MK-82 Warhead)
- MK-82 500-lb LD & HD
- CBU-99M00 Rockeye II Cluster Munition
- CBU-103M05 WCMD
- AIM-132 ASRAAM

Weapons Currently Under Development



Mission Area Coverage JSF and Legacy

Lack of Penetrator Weapon

Lack of Stand-Off DEAD Weapon

Lack of Stand-Off Anti-Ship Weapon

External Carriage

Aircraft	Funded	CAS		Interdiction Fixed		Interdiction Moving		Strategic Attack		Tactical SEAD/DEAD		Strategic SEAD/DEAD		ASUW		Fighter Sweep OCA		DCA		DCA - CMD	
		Leth	Surv	Leth	Surv	Leth	Surv	Leth	Surv	Leth	Surv	Leth	Surv	Leth	Surv	Leth	Surv	Leth	Surv	Leth	Surv
Block III (End of SDD)																					
F-35 CTOL	Yes					EO		2K				SDB		GBU		4AAM		6AAM		IRST	NA
F-35 STOVL	Yes					EO		1K & Fuel				Wep	Wep	GBU		4AAM FUEL		6AAM		IRST	NA
F-35 CV	Yes					EO		2K				JSOW		GBU		4AAM		6AAM		IRST	NA
Block IV Weapons (SDB, JSOW-C P31)																					
F-35 CTOL	No					EO		2K								4AAM		6AAM		IRST	NA
F-35 STOVL	No					EO		1K & Fuel				SDB & Fuel		JSOW-C		4AAM FUEL		6AAM		IRST	NA
F-35 CV	No					EO		2K				JSOW		JSOW-C		4AAM		6AAM		IRST	NA
AV-8B	Yes					EO								SLAM							NA
F/A-18	Yes					EO								SLAM							NA
F-16 w/HTS	Yes					EO								SLAM							NA

- Significant Capability/ Little Operational Risk
- Good Capability/Low Operational Risk
- Good Capability/Minor Operational Risk
- Some Capability/Moderate Operational Risk
- Little Capability/High Operational Risk

- AAM--Air-to-Air Missile
- 2K--2000lb JDAMs (Mk-84, BLU-109)
- 1K--1000lb JDAM (Mk-83)
- EO--Electro-Optical

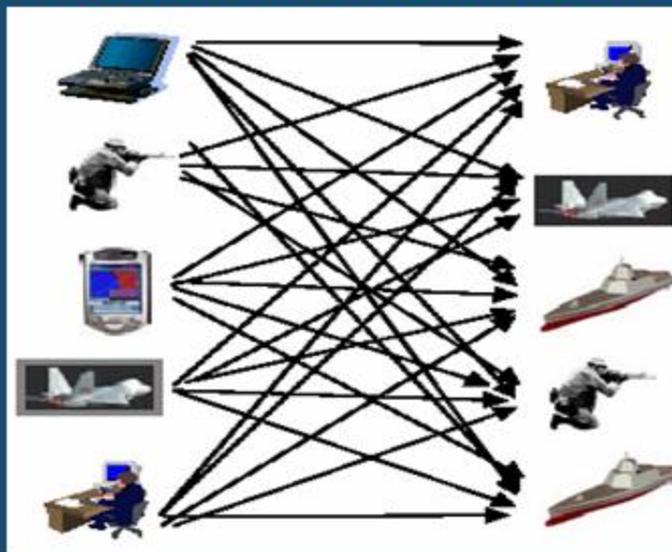
Lack of Stealth

Lack of Advanced Sensors & Multi Spectral Detections & Sensor Fusion



JSF In Middle of Warfighting Transformation

Present Environment



One-to-One Exchanges

- Interoperability Defined by Information Exchange Requirements (IERs)
- Strategy – Satisfy via Standards To Be Compatible With 2010 Architecture Defined via This Approach
- Measured by a Interoperability KPP

Net-Centric Environment

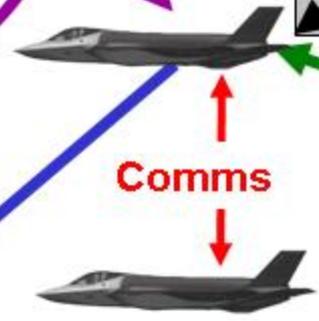
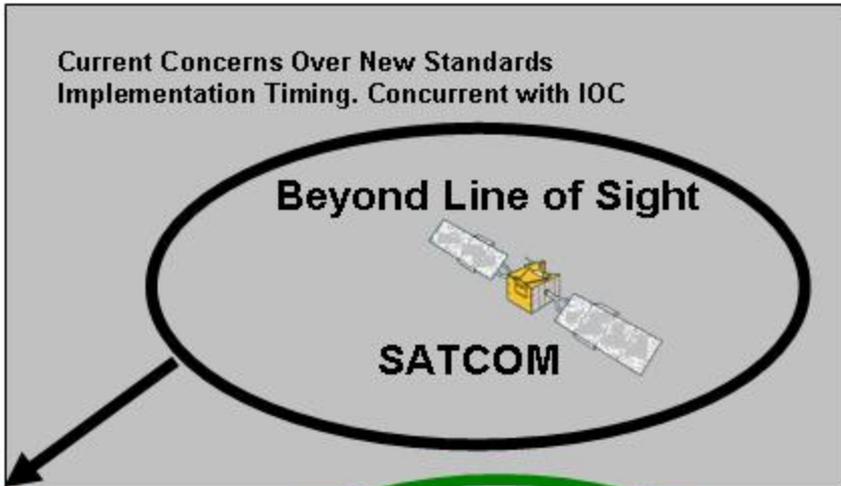


One-to-Many Exchanges

- “Publish and Subscribe” Networks
- Strategy – Develop JSF Air System With Sufficient Flexibility To Adapt To Changing Environment
- Managed Networks – Key Interface Profiles (KIP) and Enterprise Services
- Measured by a Net-Ready KPP



Envisioned Voice and Datalinks Interoperability



Over 120 Information Exchange Requirements to Ensure Interoperability
Across US and Coalition Forces



What F-35 Means To the Enemy





Agenda

- Program Overview
- Upcoming Milestones & Major Accomplishments
- F-35 Performance & Capabilities
- Logistics System



JSF Autonomic Logistics System

Highly Supportable Aircraft

- ✓ Smart / Reliable Design
- ✓ Prognostics and Health Management
- ✓ Remove and Replace (R/R) Maintenance
- ✓ On Condition Maintenance

Training System

- ✓ Integrated Training
- ✓ Embedded Pilot Training
- ✓ On Demand Maintenance Training
- ✓ Air Vehicle Software Reuse



Support System

- ✓ Sustaining Engineering
 - ✓ 24/7 Help Desk
- ✓ Electronic Joint-Service Tech Data
- ✓ Intelligent Maintenance Management
- ✓ Global Supply Chain Insight
- ✓ Support Equipment Management

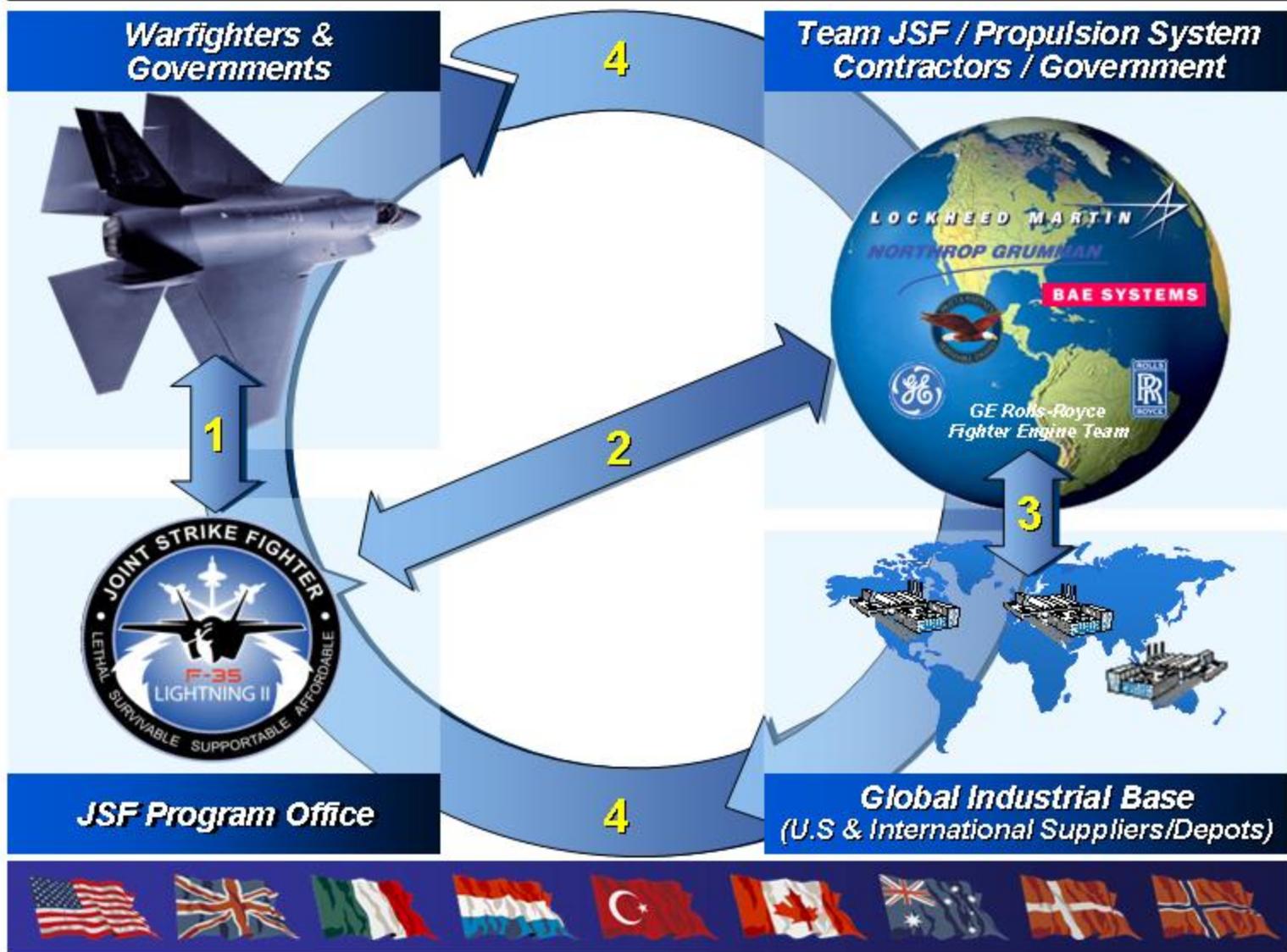
Autonomic Logistics Information System

- ✓ Distributed Information System
- ✓ Enterprise Resource Solution
- ✓ Secure
- ✓ Scalable
- ✓ Deployable

Autonomic Logistics Provides Order Of Magnitude O&S Savings

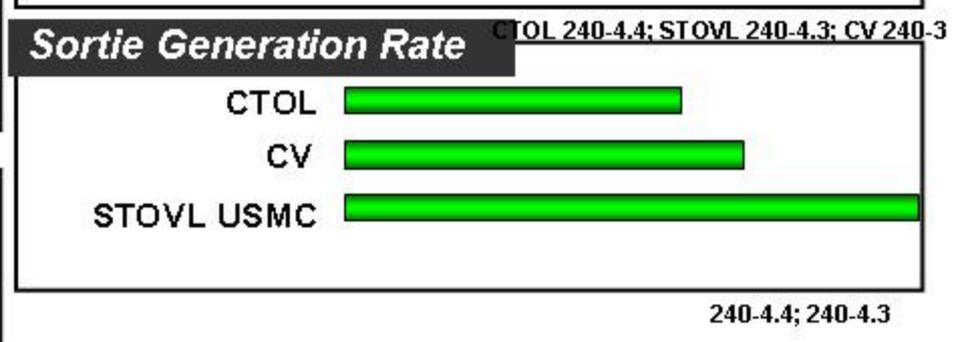
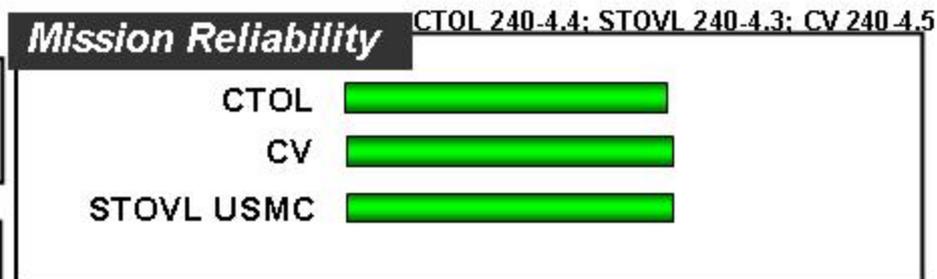
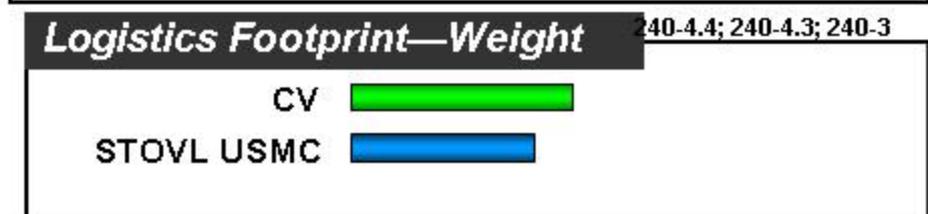
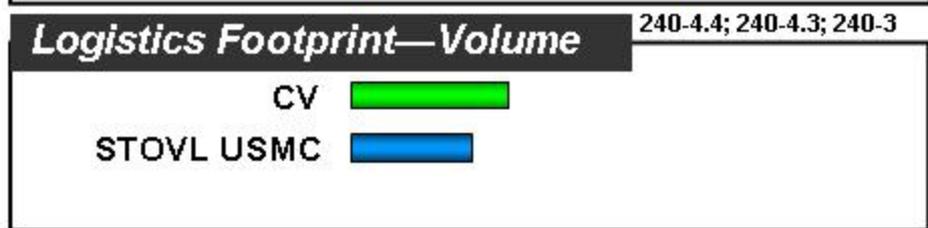
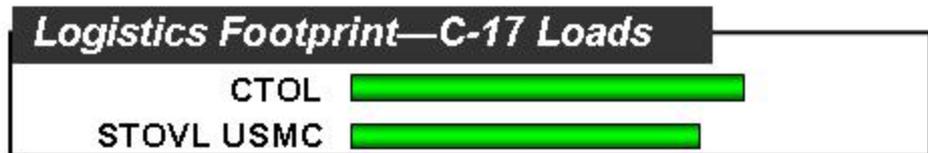


Global Sustainment Strategy





Key Performance Parameter Status Supportability Attributes



- CTOL 240-4.4; STOVL 240-4.3; CV 240-4.2 unless noted
- Contract Engine Deck
- Projected IOC Weight Empty based on WSR 132 CE + 3% Growth
- Data as of 2-7-06

Threshold Requirement CE Performance

- Exceeds ORD Objective
- Meets Rqmt/Exceeds Tripwire
- Meets Rqmt/In Tripwire Band
- Does Not Meet Requirement

F-35 has three supportability KPPs, the combination of which improve deployability and inherently help reduce Operating and Support (O&S) costs.



Pilot Program for Performance-Based Logistics

TRADITIONAL LOGISTICS PROCESS

Contractor Paid for Breakage

- Airplane Flies – Airplane Breaks
- Maintainer Finds Problem
- Maintainer Replaces Failed Part
- Airplane Flies
- Failed Part Sent for Repair
- Failed Part Repaired (Without Reliability Improvements) and Returned to Supply
- Contractor is Paid for Repair



JSF LOGISTICS PROCESS

Contractor Paid for Usage

- Contractor Paid to Support XX Flight Hours
- Airplane Flies
- Airplane Notifies Maintenance a Part Will Fail in XX Hours
- Maintainer Decides When to Replace
- Maintainer Replaces Part
- Airplane Flies
- Part Sent for Repair
- Contractor Repairs Part With Improved Reliability Modifications (at His Cost) and Improved Part is Returned to Supply

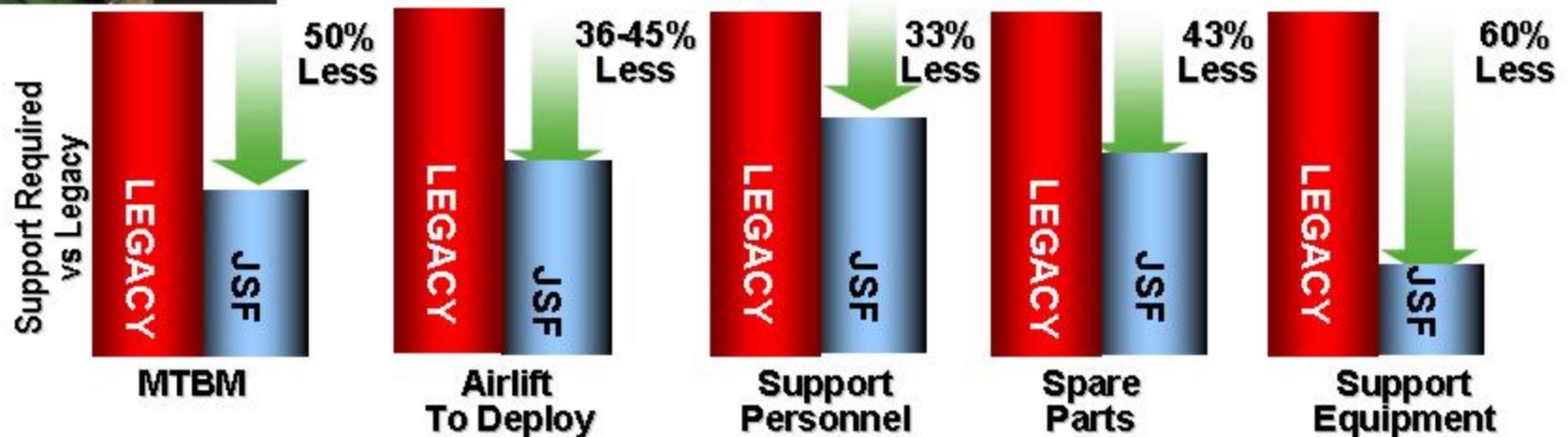
Contractor Aligned With Warfighter to Improve Availability and Reduce Cost



F35 Reliability, Maintainability & Supportability Approach Advantages over Legacy AC



Support



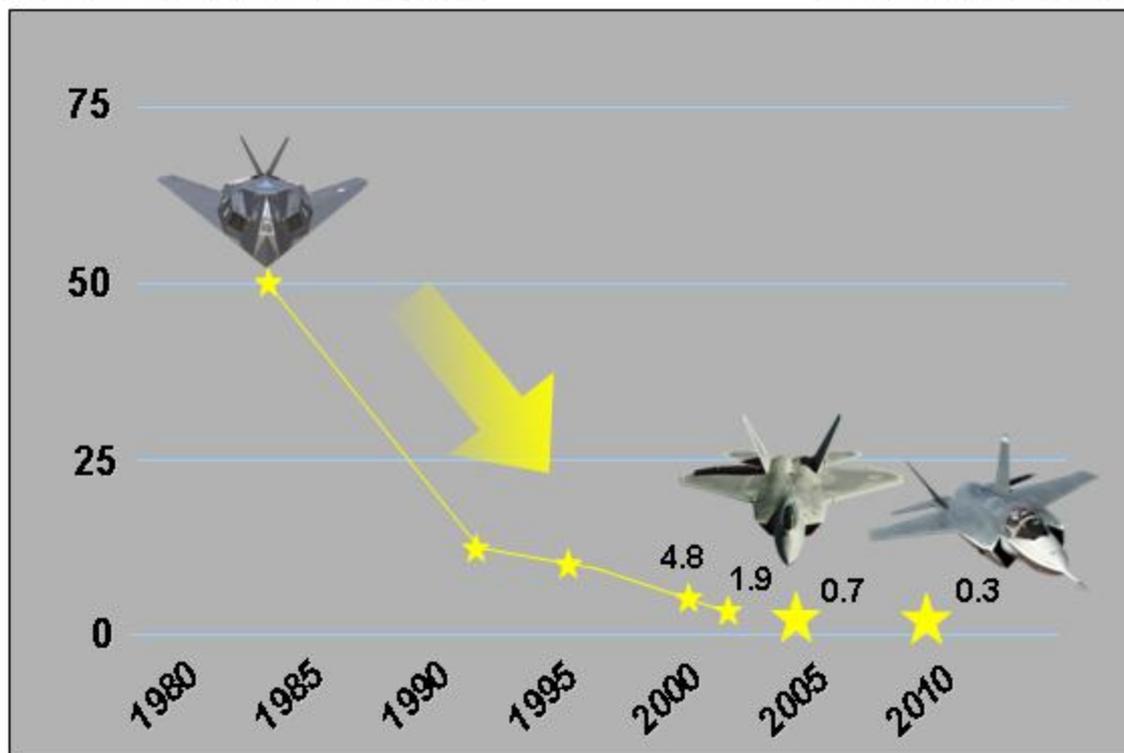
F-35 provides significant improvements in overall supportability vs legacy AC.



5th Generation Stealth Is Affordable

Maintenance Man-Hours

Maintenance Actions



99% of total F-35 maintenance actions require No LO restoration.



Affordability

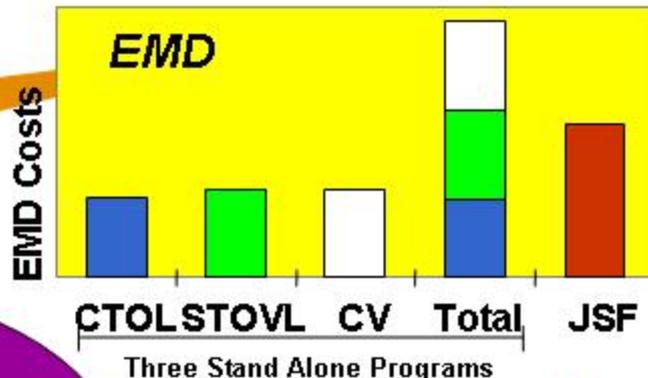
Total Ownership Cost Reduction

Production

Airframe 70-90% Common or Cousin Parts

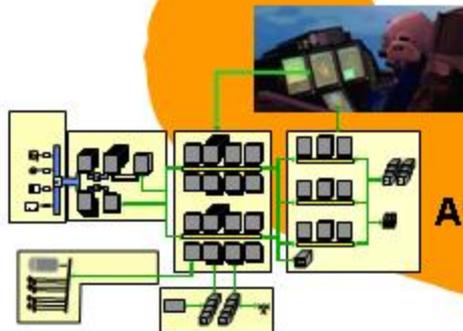


Common Core Propulsion System



Commonality Key to Affordable URF

Reduced Total Ownership Costs



Avionics System ~100% COMMON

Joint Training & Support

Operations & Support





Summary

- **The F-35 Lightning II Provides the US Warfighter, our Coalition Partners, and the Combatant Commanders with a Highly Deployable 5th Generation Multi-Role Strike Fighter Force that is:**
 - Lethal
 - Survivable
 - Supportable
 - Interoperable

... And do it Affordably

FEAR 5

THE REVOLUTION BEGINS