

F22
LOCKHEED • BOEING
GENERAL DYNAMICS



ADVANCED TACTICAL FIGHTER

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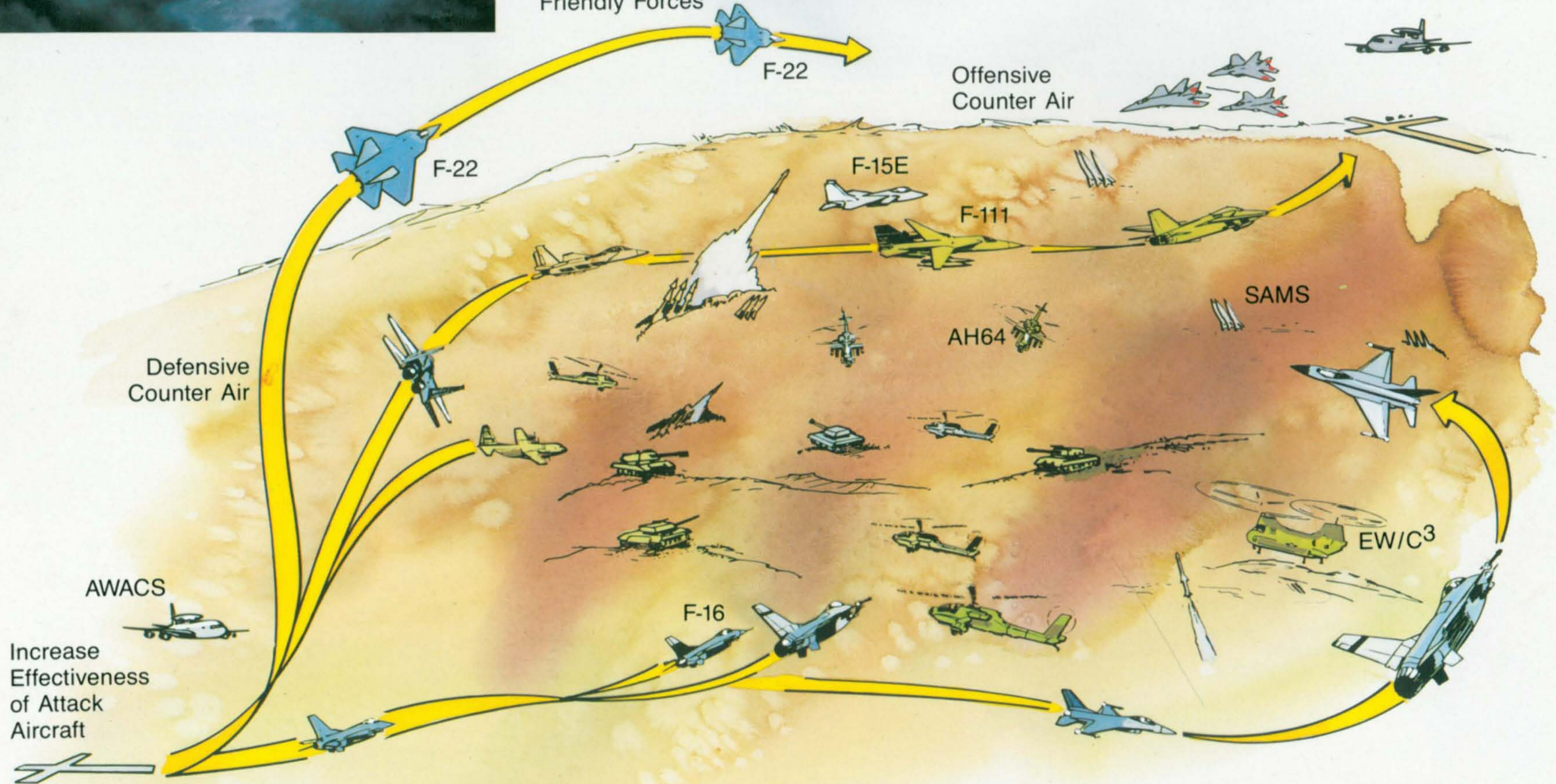
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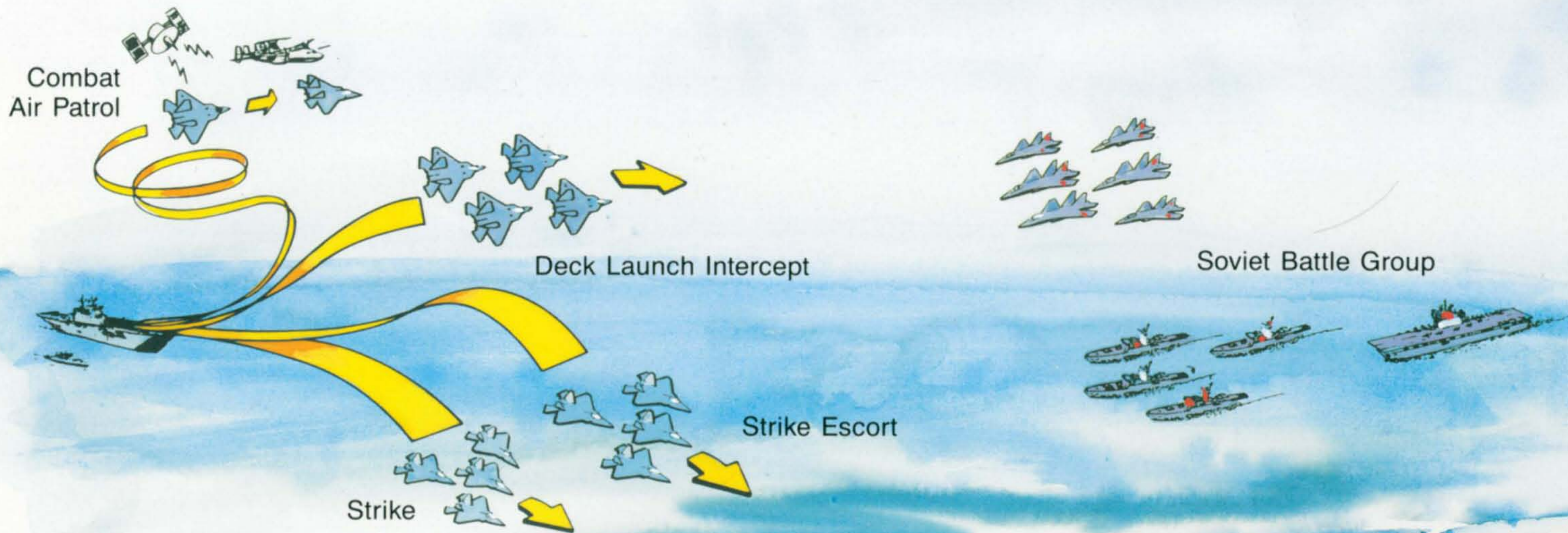
DOMINANCE OVER LAND

Sustained Operation Over Enemy Territory

Protection of Friendly Forces



DOMINANCE OVER SEA



MISSION

AIR SUPERIORITY



Air Superiority Fighter

The Soviets continue to develop their next generation fighter which is expected to outperform our current class of air superiority fighters.



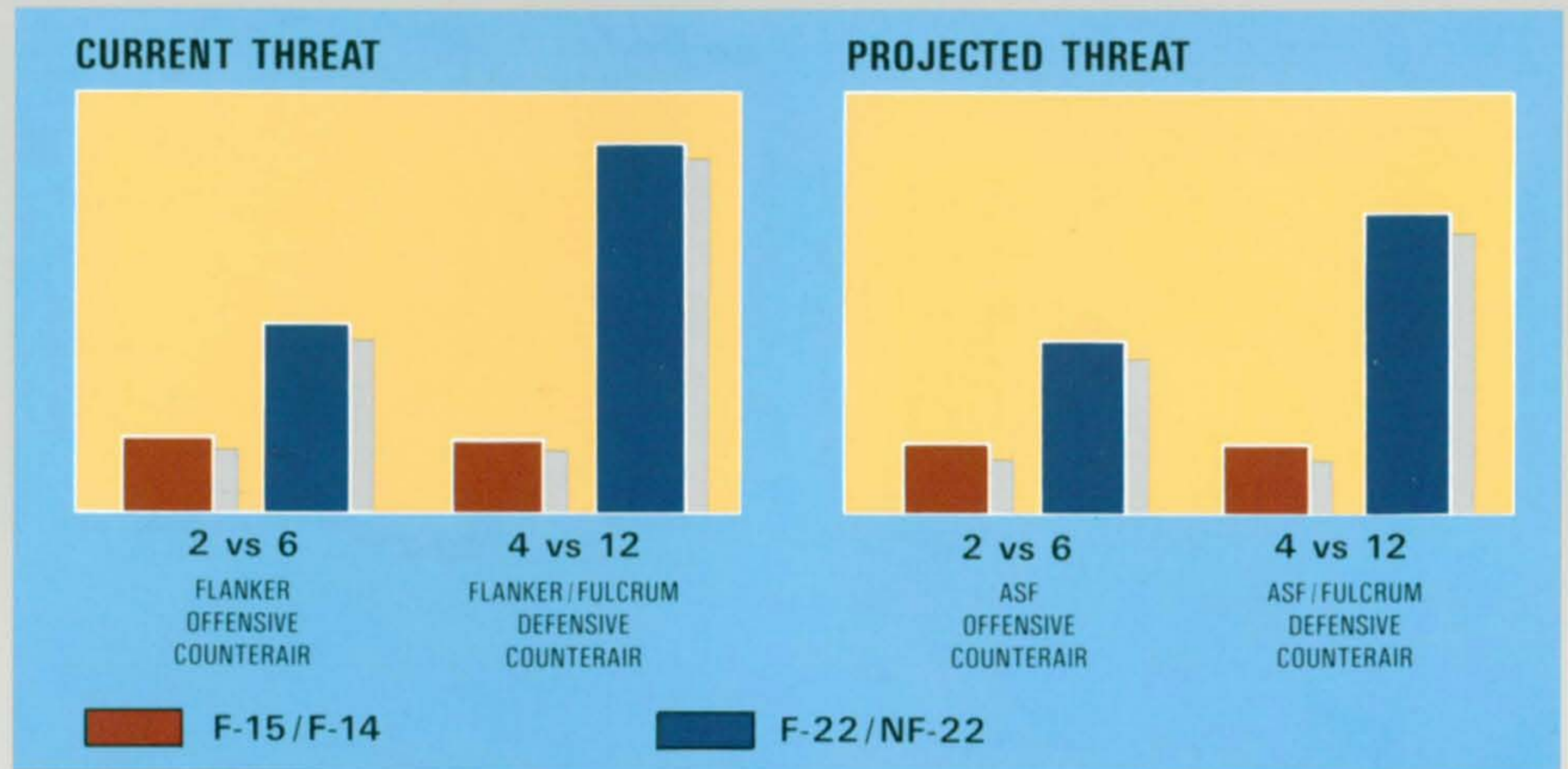
Mig-29

Sales of the Mig-29 continue to third world regions creating instability and an increased challenge to U.S. air power.



Current Air Superiority Fighters

When the F-22 enters the inventory, the current air superiority fighters will be over 25 years old.

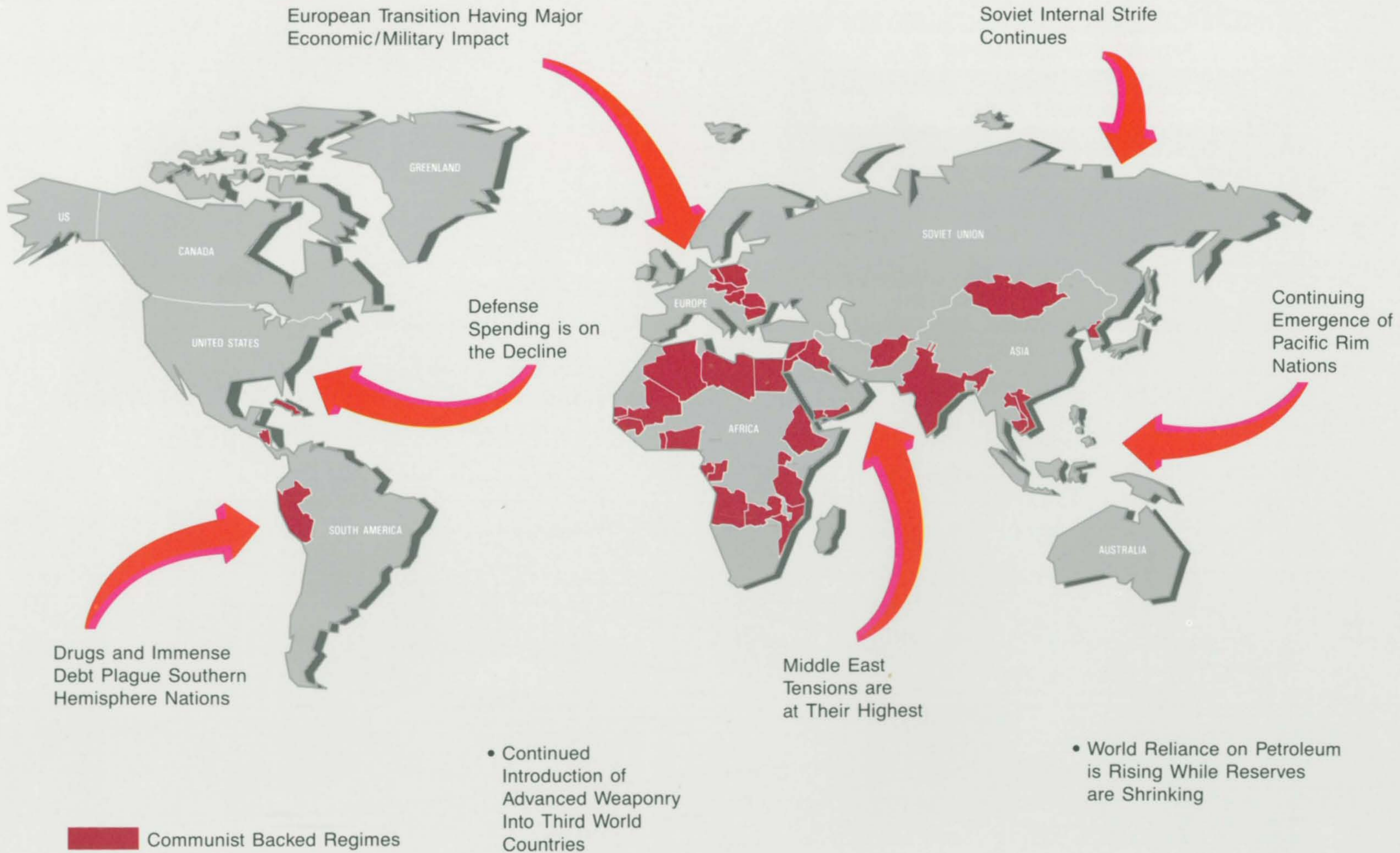


Effectiveness of F-22 Exchange Ratio

Designed in low observability, supercruise capability and advanced avionics provide the exchange ratios necessary in a reduced force structure.



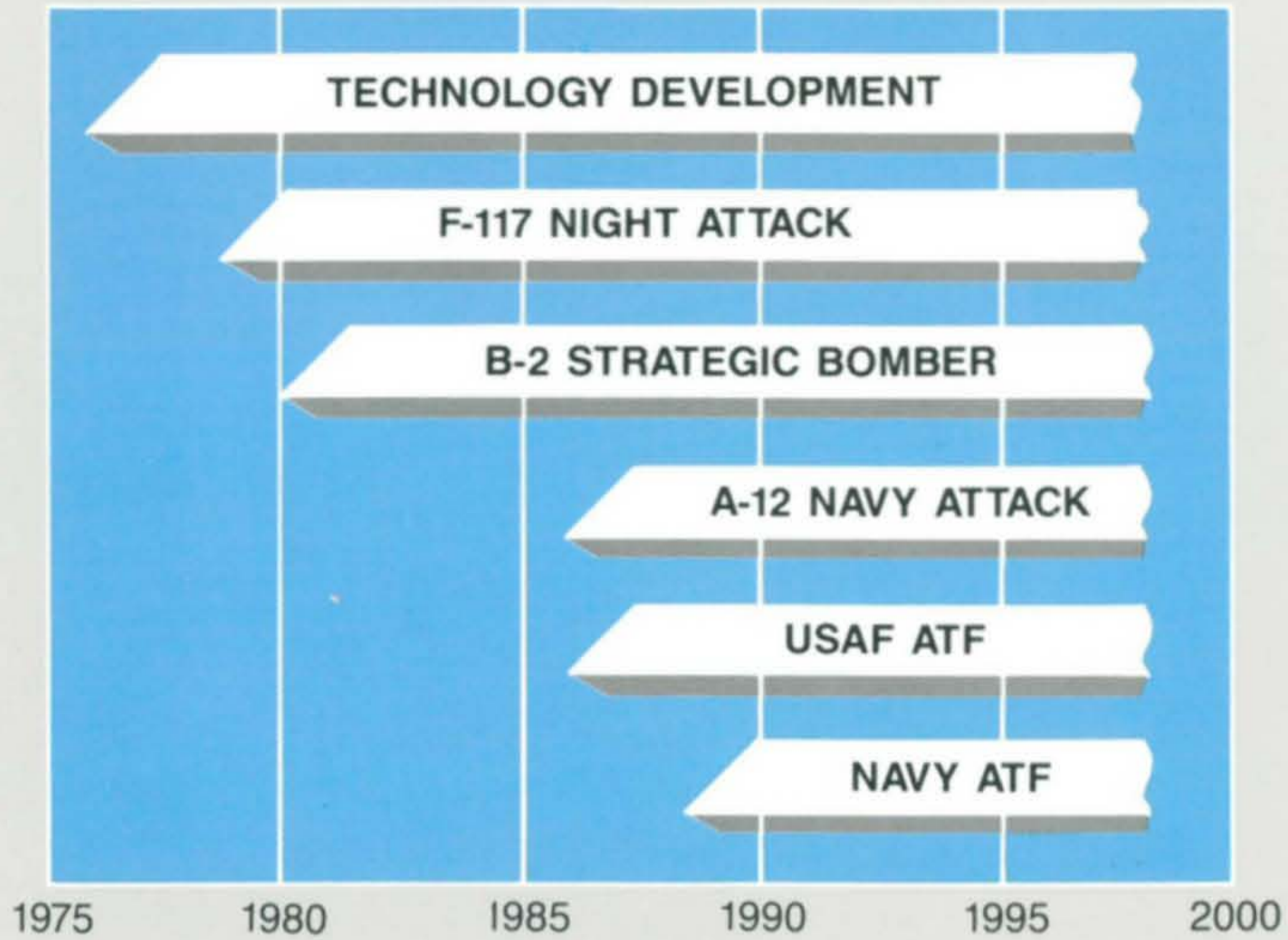
WORLDWIDE INSTABILITY CONTINUES



REQUIREMENT

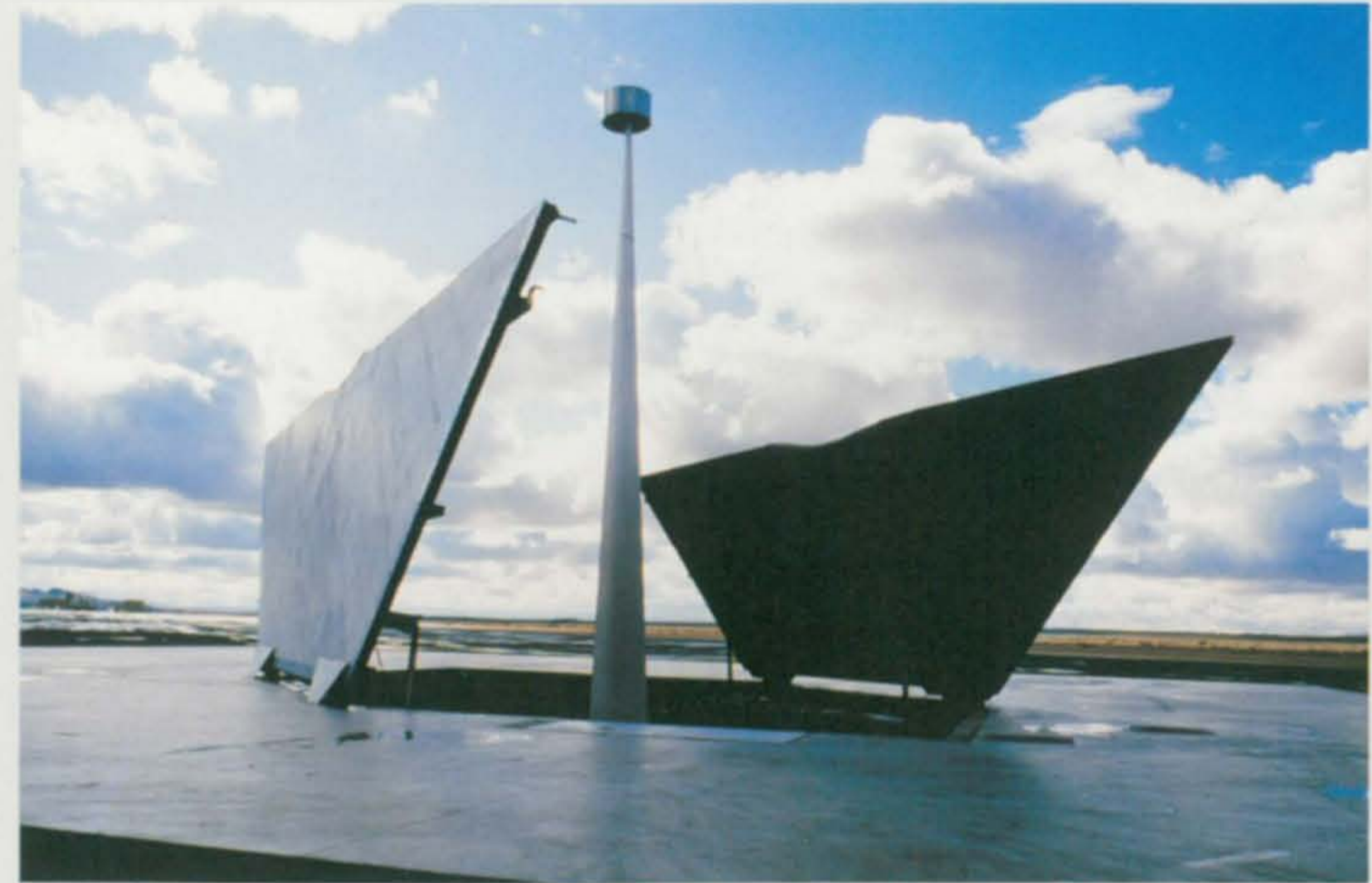
THREAT DRIVEN

LOW RADAR CROSS SECTION IS A MAJOR OFFENSIVE ADVANTAGE



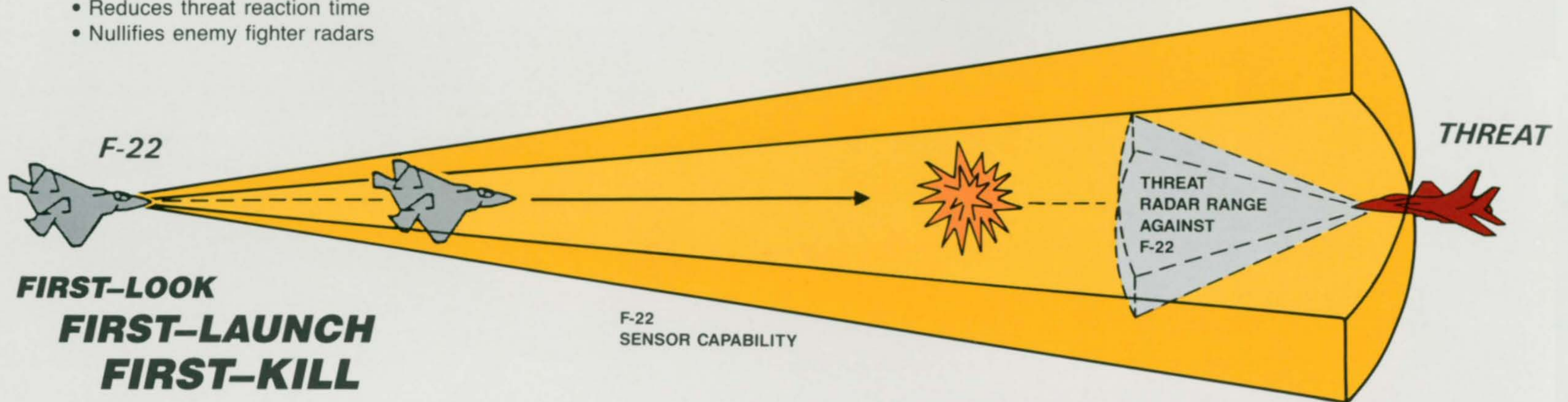
Very Low Observable Technology Development

- Essential to survivability and increased combat capability
- Reduces threat reaction time
- Nullifies enemy fighter radars



Radar Cross Section Design Verification

- Lockheed/USAF testing complete
- Designed signature goals achieved
- All FSD design apertures/movable flight surfaces/engine sections measured



F-22

STEALTHY

SUPERIOR ACCELERATION CAPABILITY

F-14D

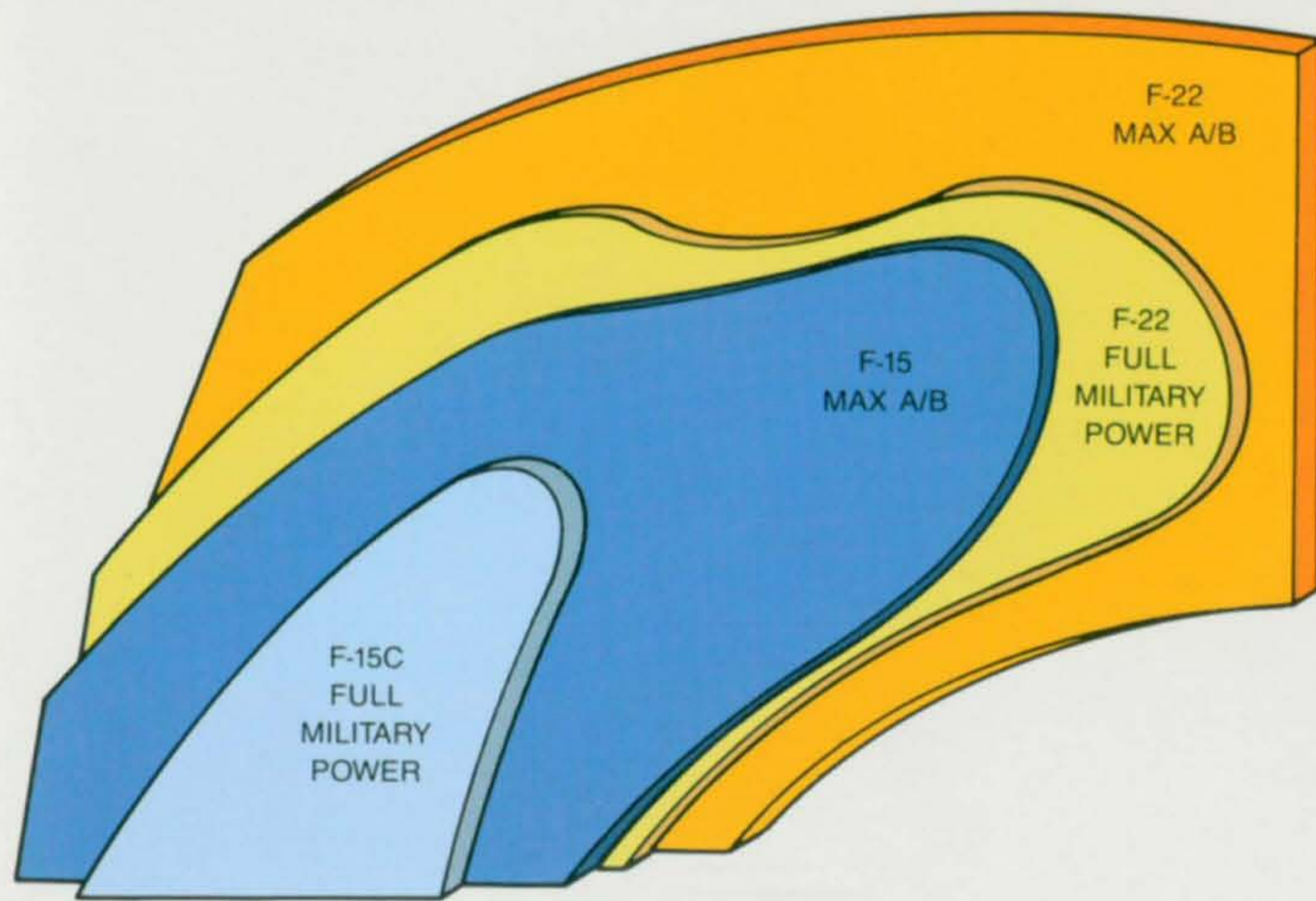
F-15C

SU-27

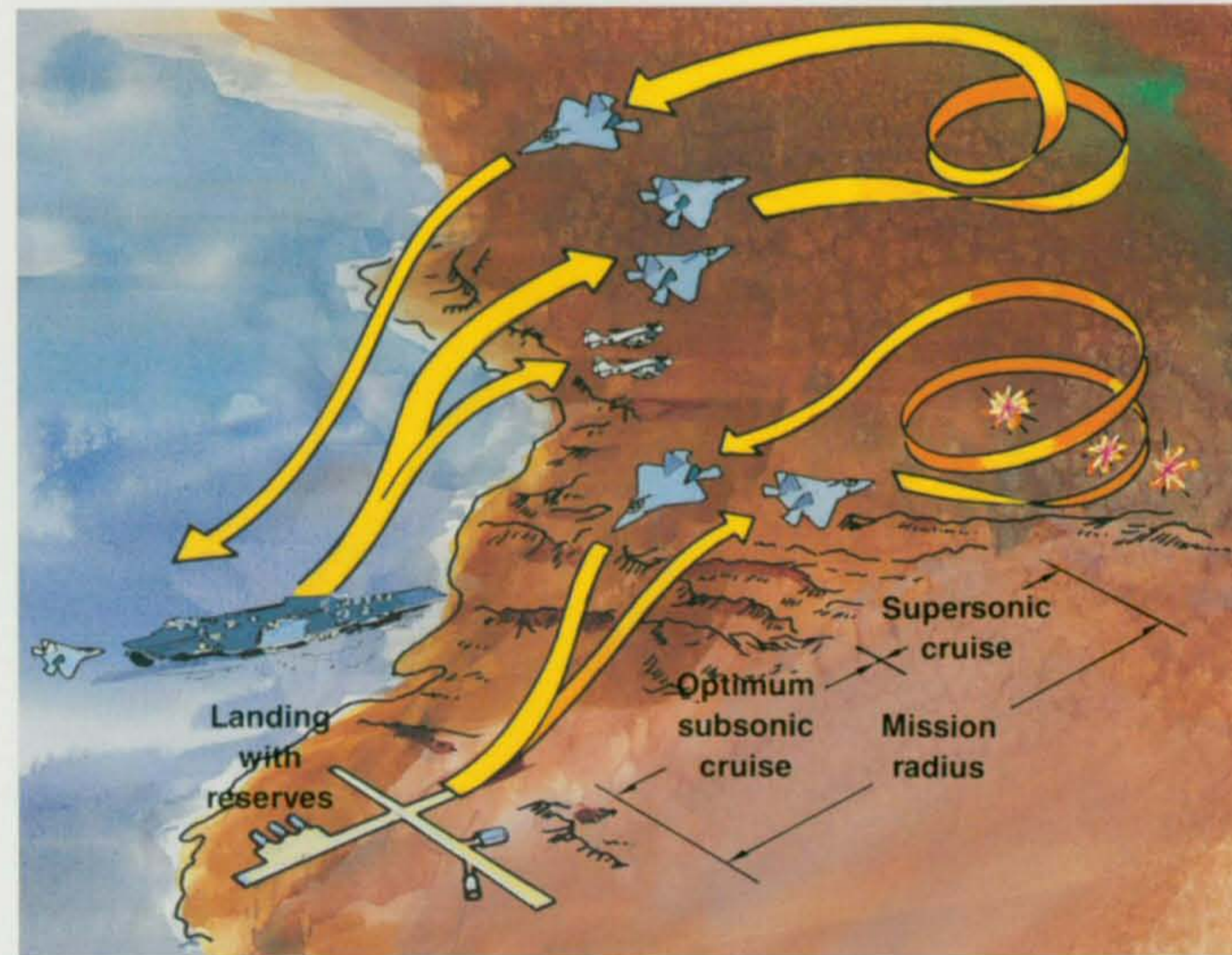
F-22



IMPROVED AERIAL COMBAT PERFORMANCE



INCREASED COMBAT RANGE



25% Increase Over the F-15C, 35% Increase Over the F-14D, Both of Which Lack the Ability to Cruise at Supersonic Speed Without Using Fuel-Consuming Afterburner (Supercruise).

PERFORMANCE

AERODYNAMICS

DESIGN

OPTIMIZED FOR LOW OBSERVABILITY AND AGILITY

**LOW OBSERVABLE INLETS
AND NOZZLES**

HIGH INTERNAL FUEL CAPACITY

BLENDED WING/BODY

- Structurally efficient

ADVANCED COCKPIT

THRUST VECTORING

- Unlimited maneuverability

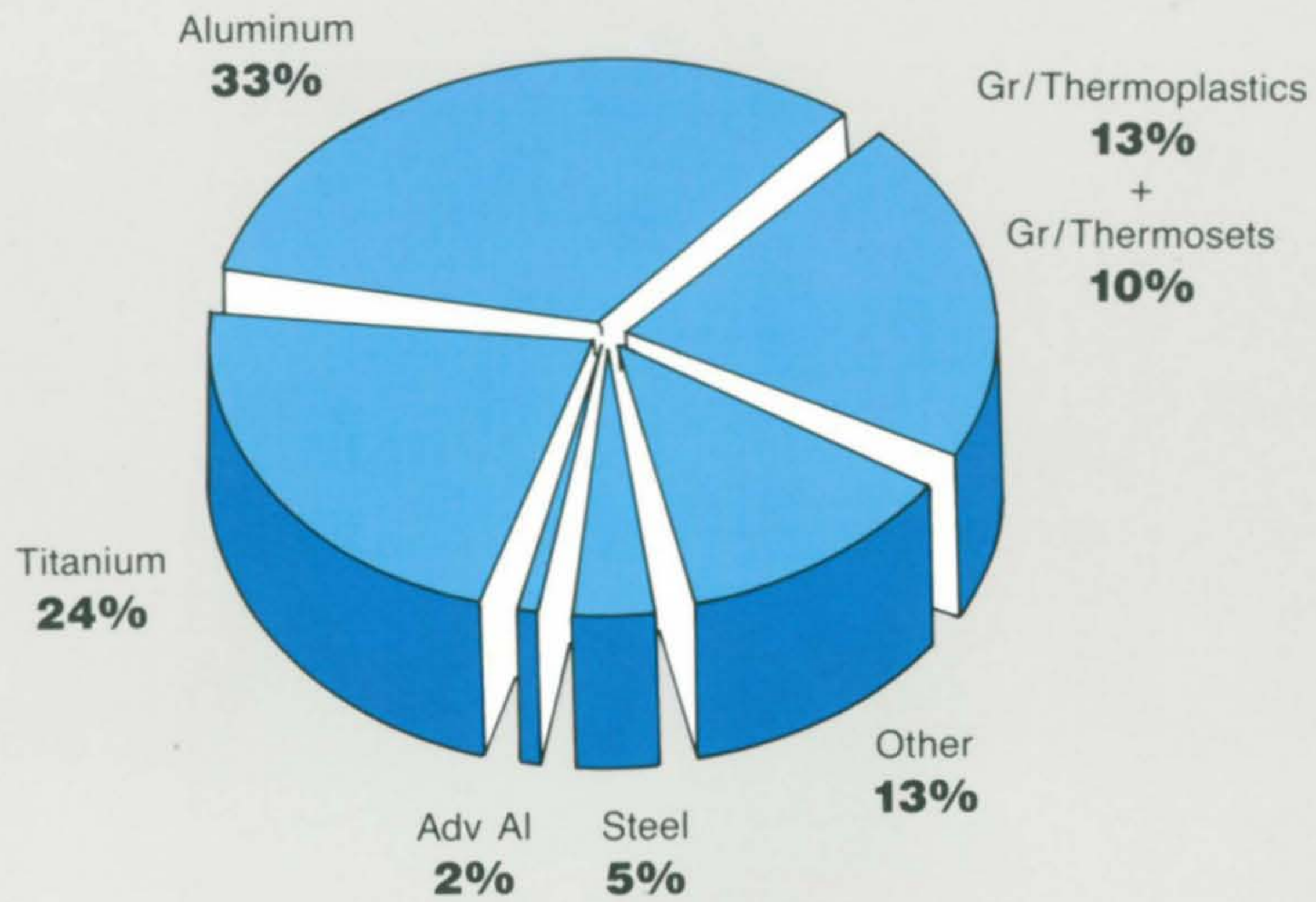
INTERNAL WEAPONS CARRIAGE

SUPERCruise CAPABILITY



F22

BALANCED



PROTOTYPE MATERIAL USAGE



SINGLE PIECE THERMOPLASTIC WING SKINS

- Lightweight
- Field repairable
- Advanced thermoset mid body skin



BATTLE DAMAGED COMPOSITES EASY TO REPAIR

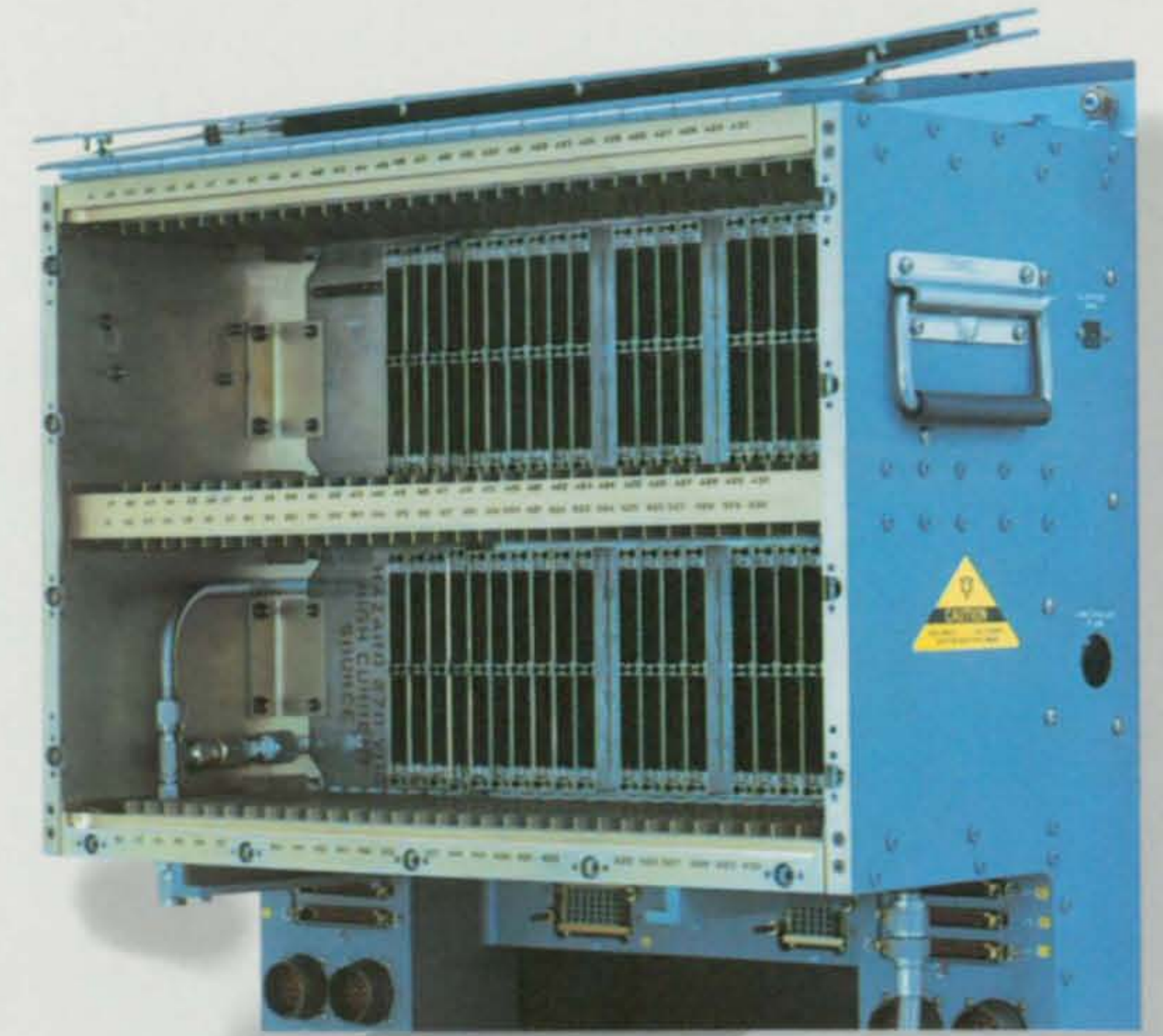


DURABLE

MATERIALS

32-BIT PROCESSOR

- Pave pillar architecture (fault tolerant)
- VHSIC common modules
- Sem-E packaging
- Liquid cooling
- ADA based software

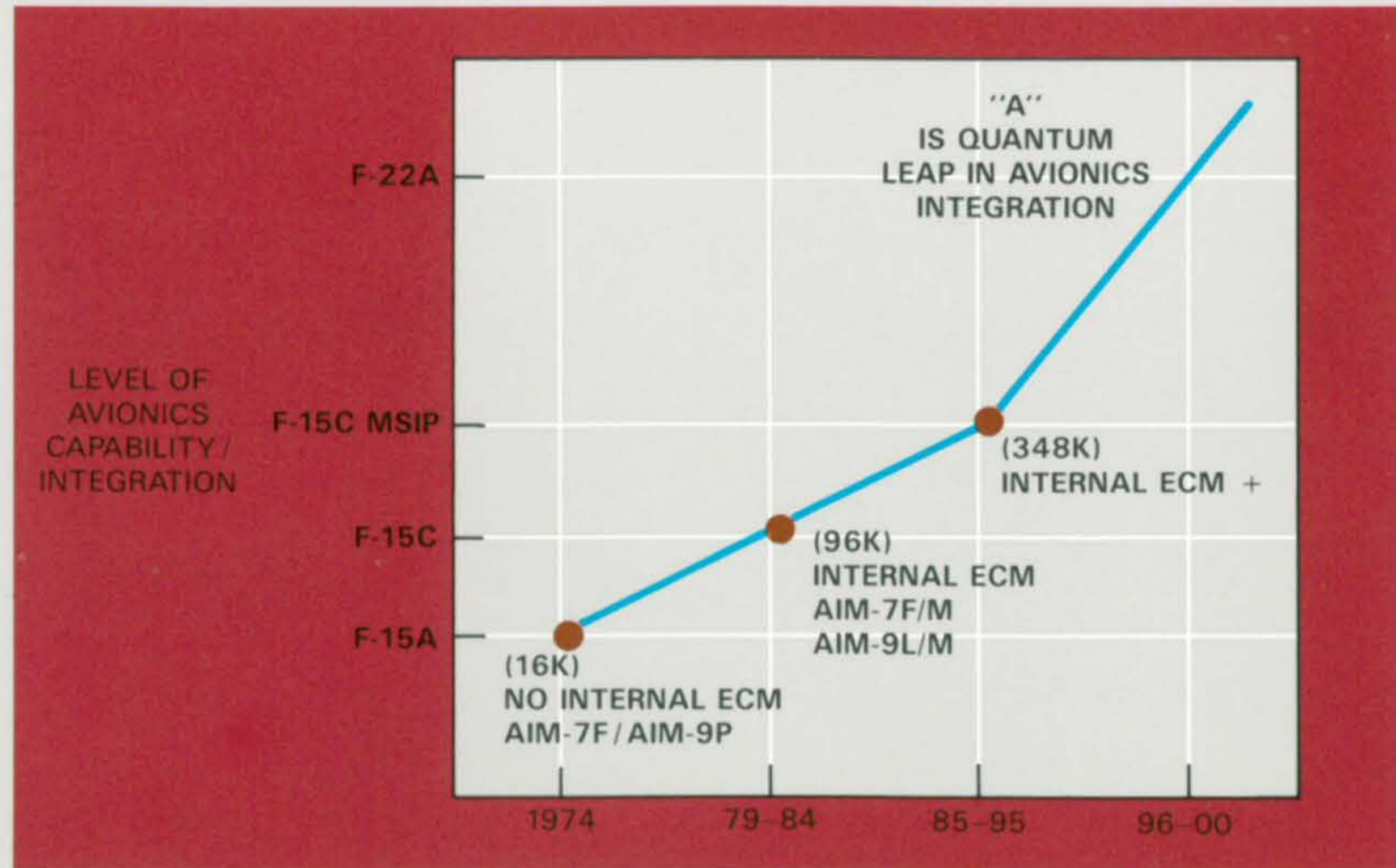


ICNIA TECHNOLOGY

- Intra-Flight data link
- Integrated Comm/Nav
- IFF

ACTIVE ARRAY RADAR

- Multimode
- Wide field of view
- High reliability



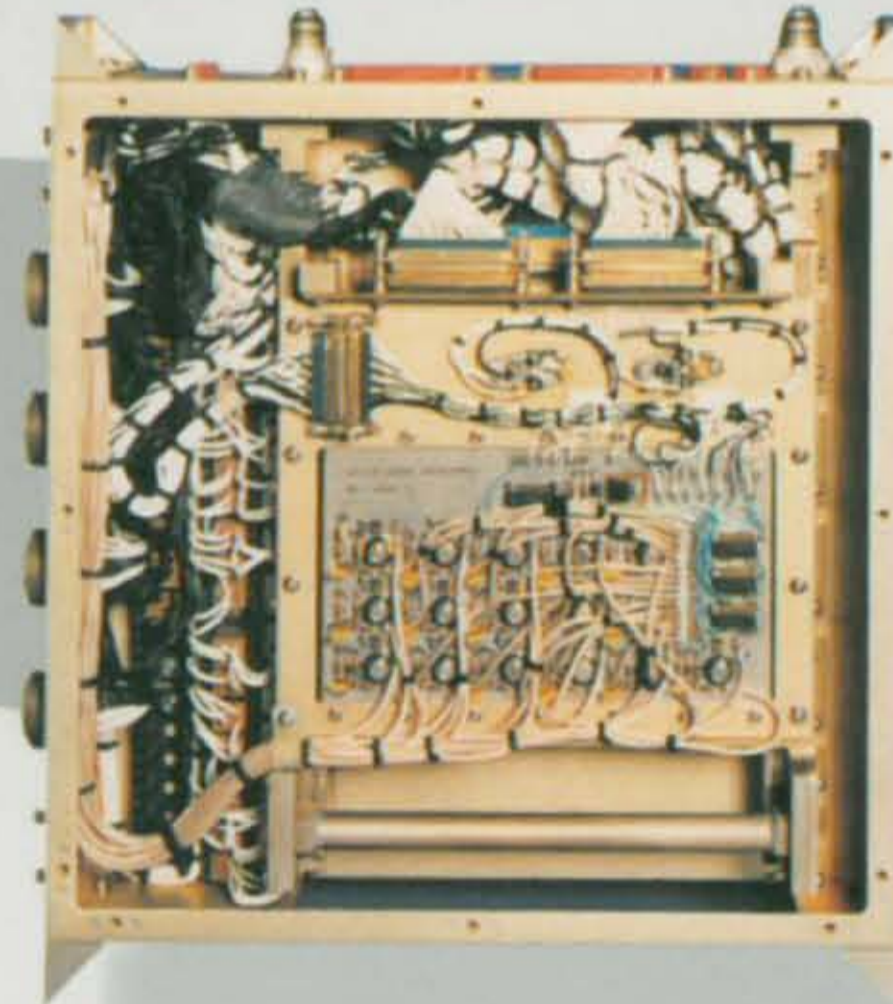
Avionics Evolution

AVIONICS

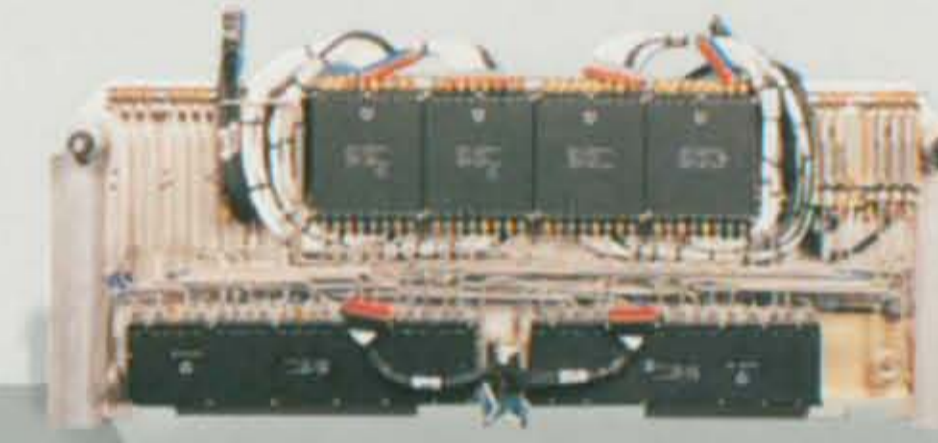
FOTR Replacement CCA



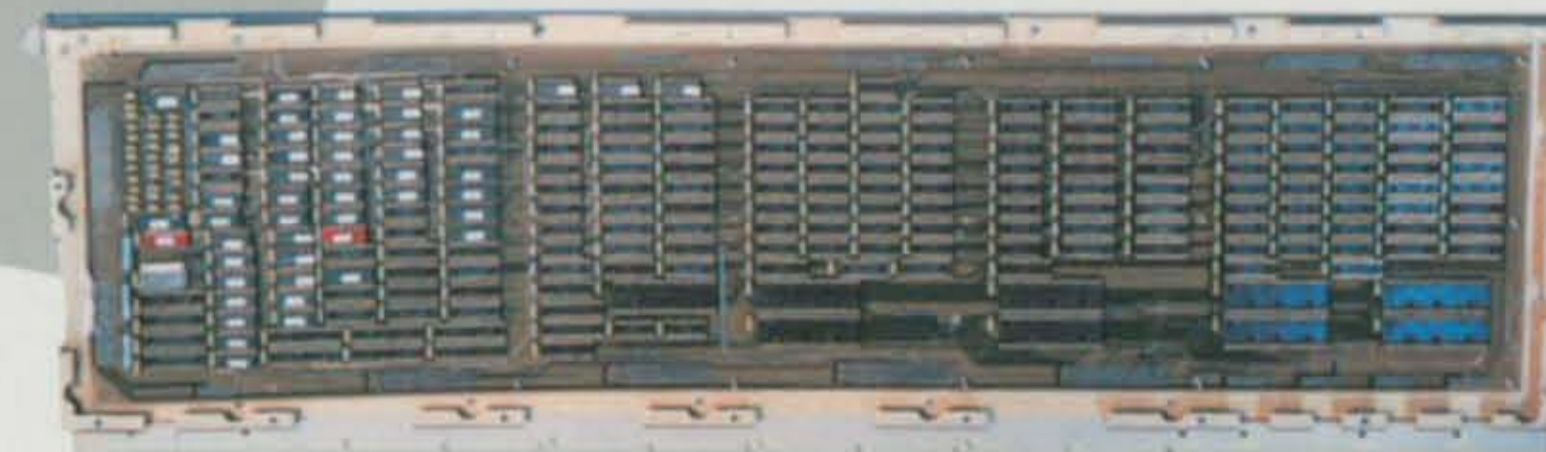
ARRAY Interface Assembly



Azimuth Electronics



Azimuth Controller Assembly



INEWS TECHNOLOGY

- Accurate emitter location/ID
- Threat warning/assessment
- Integrated countermeasures

INTEGRATED

Reliability

(Mean Time Between Maintenance Hours)
DOUBLE THAT OF CURRENT FIGHTERS

Maintainability

(Maintenance Man Hours per Flight Hour)
ONE-THIRD THAT OF CURRENT FIGHTERS

Supportability

Sortie Generation (Sortie per Aircraft per Day)
ONE AND ONE-HALF TIMES CURRENT FIGHTERS

Auxiliary Power Unit allows austere field operations with minimal support

On-board oxygen and inert gas generating system deletes requirement for current ground support equipment and reduce turn-around time

Ground level access to systems, weapons, and servicing points ≈ provides major reduction in unique ground support equipment requirement



F22



Very high speed
integrated circuits

Fault tolerant avionics allow continued sortie
generation with minimal impact on system capability

REDUCED AIRLIFT REQUIREMENT

- F-22 requires two-thirds less airlift necessary to deploy a 24 aircraft F-15 squadron
- Releases U.S. capability to airlift other military assets into combat areas
- Allows overall quicker response time to world crisis

Liquid cooled core avionics (sized for growth)
provide four times the reliability of the current
F-15 avionics system

On-board centrally integrated diagnostics
increase fault isolation capability tenfold



Modular Electronics

- 1/40th the size with 6 times the processing power of current fighter system
- Deletes requirement for avionics intermediate shop

SELF SUFFICIENCY

DESIGNED TO MEET THE NAVY MISSION



FORWARD, MID AND AFT FUSELAGE MODS

- Full length keelson to support carrier landing stress
- Increased internal fuel capacity

CATAPULT LAUNCH AND RECOVERY SYSTEMS

- Materials suitable for marine environment
- Deck level avionics access

NEW WING

- Increased aspect ratio planform
- High lift flaps
- Reduced spot factor

ADDED WEAPONS CAPABILITY

- Sparrow
- Advanced Air-to-Air Missile (AAAM)
- Harpoon
- High speed Anti-Radiation Missile (HARM)
- Advanced Interdiction Weapon System (AIWS)

F22 CARRIER SUITABLE

AIR FORCE AND NAVY COMMONALITY IS MORE THAN SKIN DEEP

AVIONICS/ARMAMENT – 80% COMMON

- Common integrated processors
- Common modules
- Radar modules
- Apertures
- INEWS
- Comm/Nav/ID
- Software
- Cockpit controls and displays
- AIM-120/AIM-9/gun

AIRCRAFT SUBSYSTEMS – 80% COMMON

- Materials
- Hydraulics/fuel
- On-Board Oxygen Generation System
- On-Board Inert Gas Generation System
- Observables
- Environmental Control System
- Engines and nozzles
- Vehicle management system
- Auxiliary Power Unit

	NEW STAND ALONE NAVY FIGHTER PROGRAM	CURRENT NATF PROGRAM	COST SAVINGS
Development _____	\$8.7B	\$5.1B	\$3.6B
Production _____	32.6	30.4	2.2
Support _____	27.6	22.4	5.2
TOTAL _____	\$68.9B	\$57.9B	\$11.0B

Navy F-22 Program Cost Savings (FY 85 \$)



NAVY F-22

COMMONALITY



AVIONICS FLYING LAB

- Replication of ground lab in a Boeing 757 to demonstrate F-22 integrated avionics and software in dynamic flight conditions

AVIONICS GROUND PROTOTYPE LAB

- Demonstrated sensor performance in a static environment using integrated prototype hardware and software

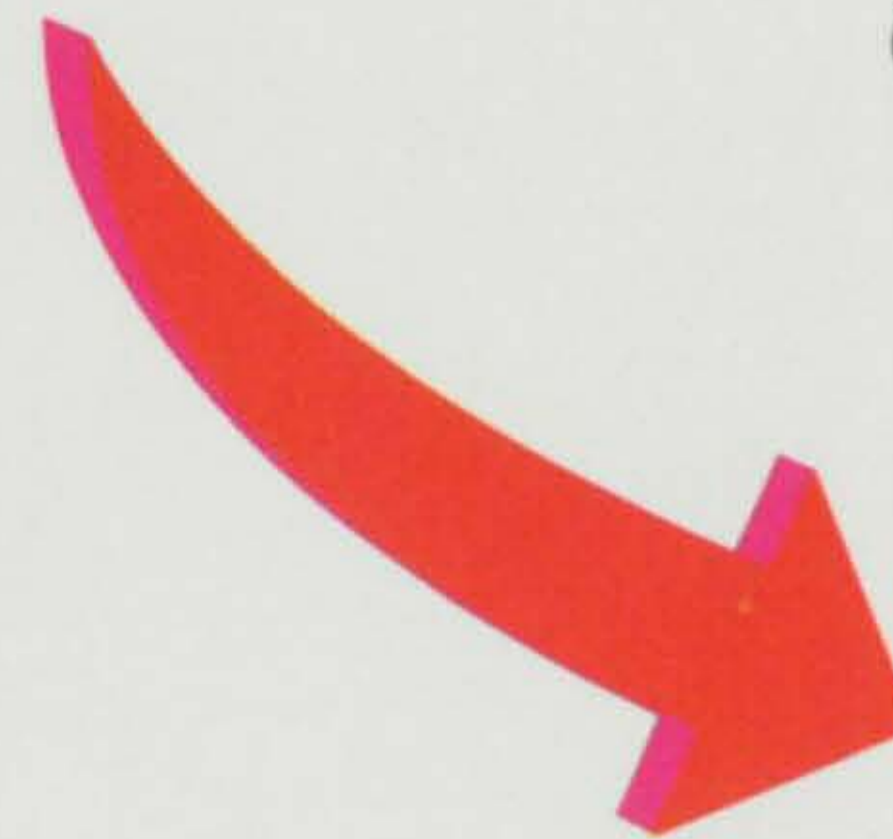


- Pilot Controlled Automated Sensor Management, Weapons/Stores Management

- Automated Aircraft Subsystem Monitoring (Engines, Fuel, Hydraulics, etc.)

- Extra-Wide Heads Up Display (HUD)

- Provisions for Helmet Mounted Display Capability (Growth)



F-22 CONCEPTUAL COCKPIT

- A roadmap to development of a revolutionary fighter cockpit that allows the pilot to dedicate his focus on tactics and weapons employment to maximize weapon system effectiveness



YF-22A

- Introduction of advanced avionics capability into the prototype aircraft



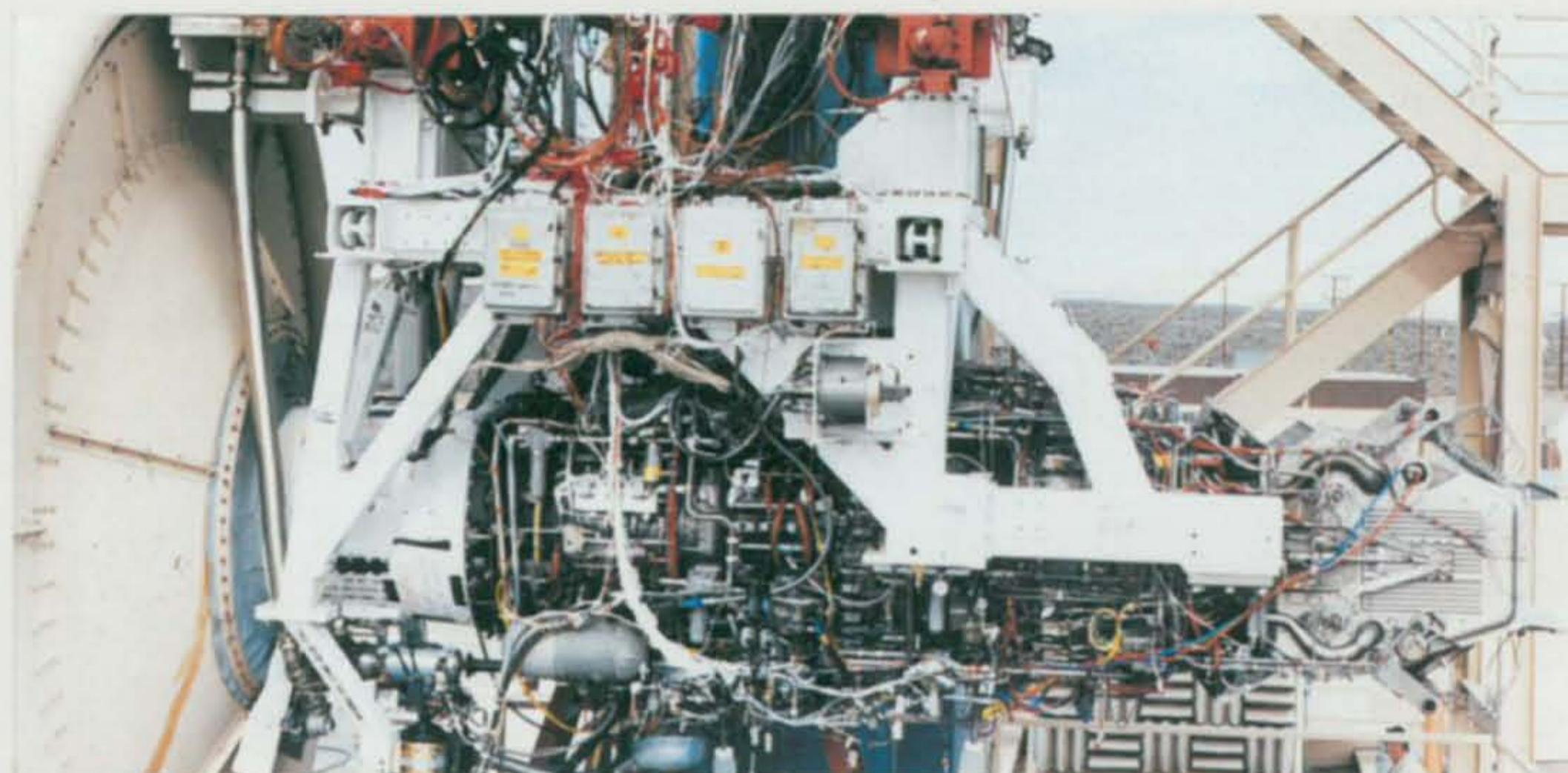
WEAPONS SYSTEM SIMULATION CENTER

- High fidelity manned simulation to evaluate F-22 system effectiveness, cockpit controls and display and pilot interface

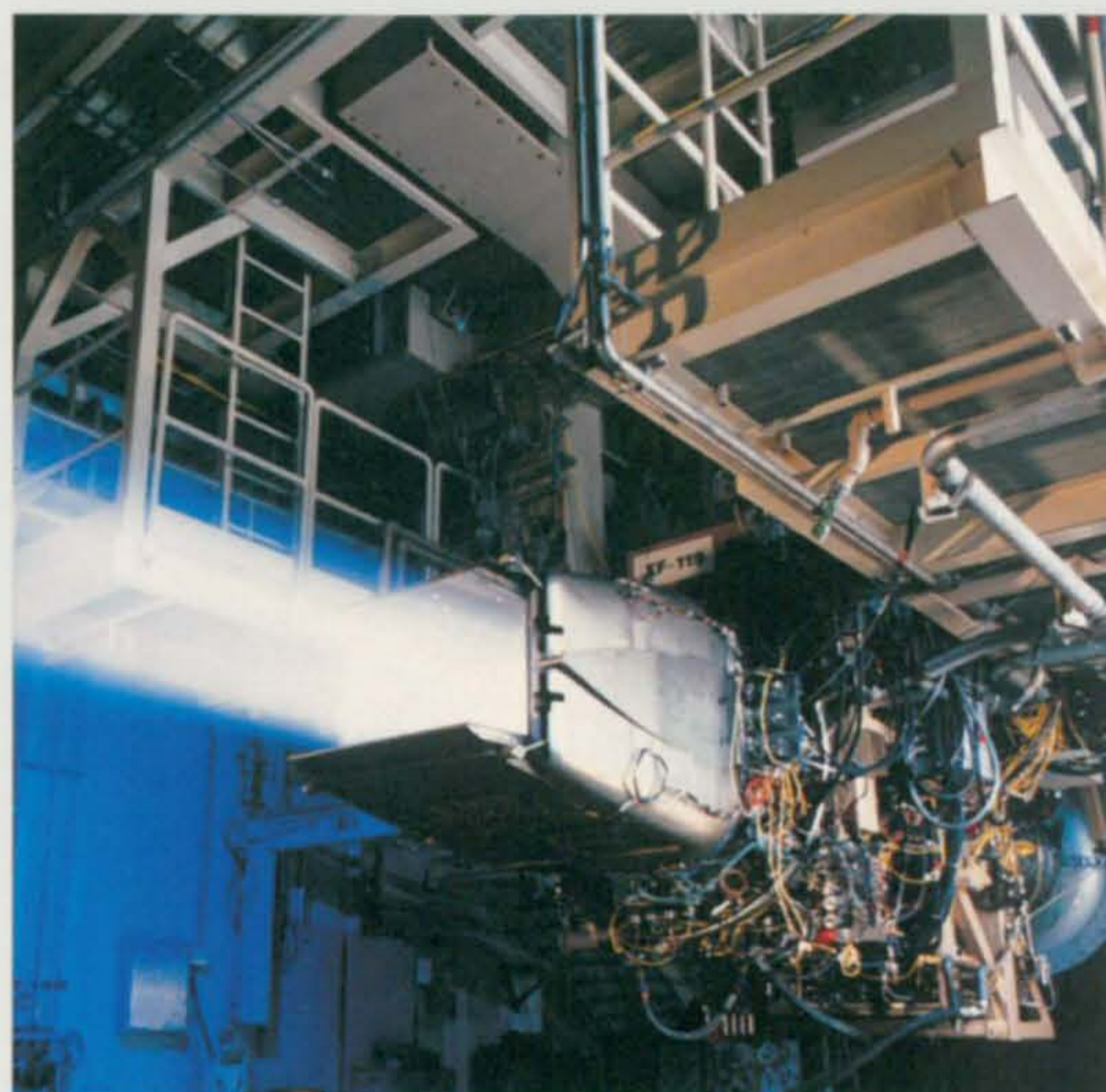


- High Resolution Liquid Crystal Displays
- Pictorial Formats
- Integrated Sensor Data
- Weapons System Control Through Hands On Throttle And Stick (HOTAS) Capability

COCKPIT EVOLUTION



**GENERAL ELECTRIC
YF-120 ENGINE**



**PRATT WHITNEY
YF-119 ENGINE**



**WIND TUNNEL TESTING CONFIRMS DESIGN
PERFORMANCE – OVER 24000 HOURS TO DATE**

- Maximum speed
- Inlet design
- Spin resistant
- Weapon Separation

ADVANCED TACTICAL FIGHTER ENGINE DEVELOPMENT

- Thrust vectoring nozzles
- Low observable inlets/nozzles
- 35,000 lb class engine thrust
- 40% fewer parts/60% fewer tools



AGILITY

- Maneuverability
- High angle of attack
- Flying qualities



WEAPON LAUNCH

- AMRAAM (AIM-120)
- Sidewinder (AIM-9)

PERFORMANCE

- Supercruise
- Maximum speed
- Turning performance



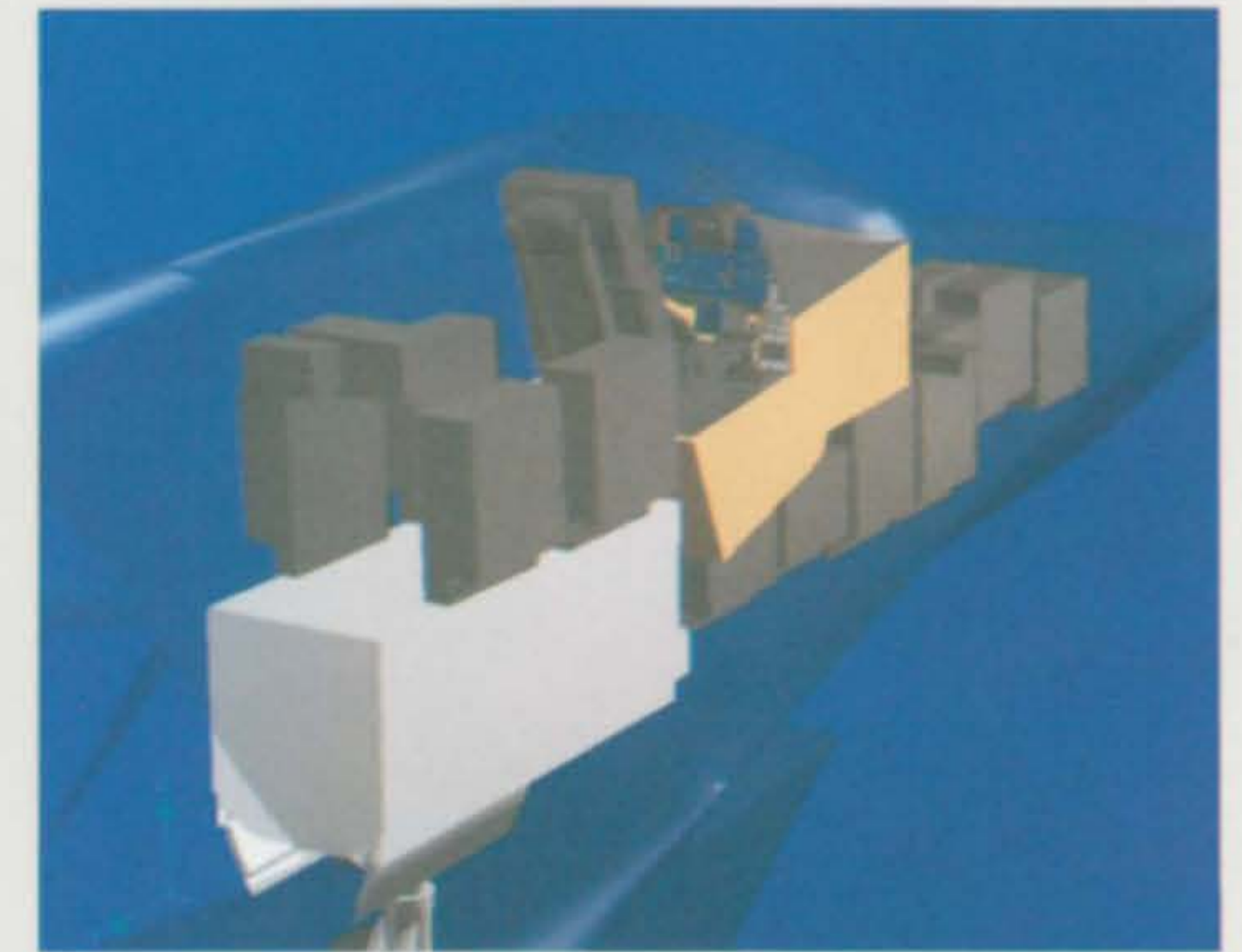
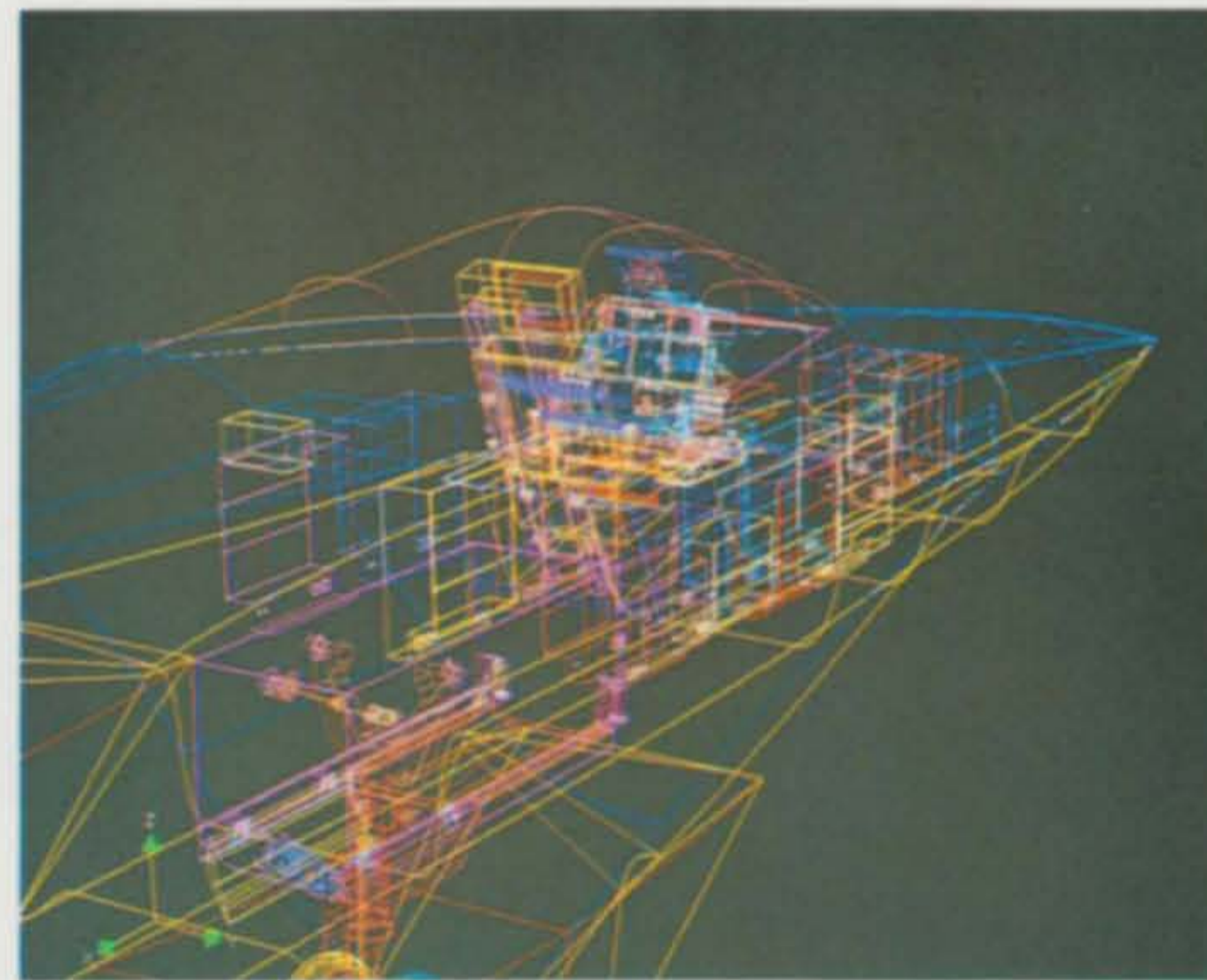
FLIGHT DEMO

PERFORMANCE

COMPUTER INTEGRATED ENGINEERING AND MANUFACTURING (CIEM)

100% COMPUTER AIDED DESIGN/ MANUFACTURING

- Three dimensional, secure electronic data links to team design engineers
- Minimal engineering changes achieved
- Allows high quality prototype assembly





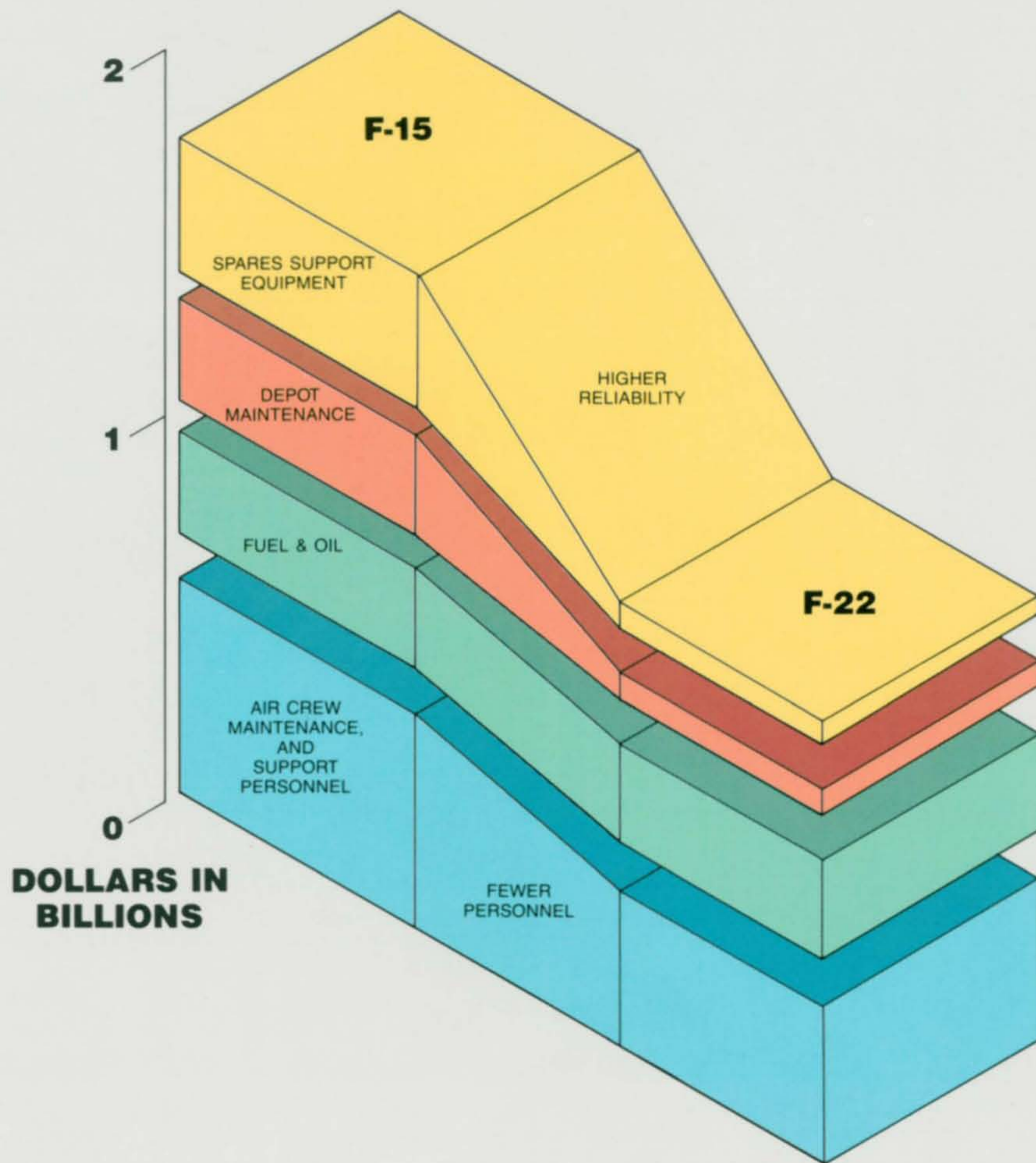
RESOURCES

**LOCKHEED • BOEING
GENERAL DYNAMICS**

UNMATCHED

COST

**TWENTY YEAR OPERATIONS AND SUPPORT COST COMPARISON
24 AIRCRAFT SQUADRON (FY 1985 \$)**



**20-YEAR SAVINGS
PER SQUADRON = 33%**

F-22

AFFORDABLE

LEADERS IN THE WORLD OF TACTICAL AVIATION

LOCKHEED



F-117A World's first operational stealth fighter

BOEING



E-3A Free world's airborne command and control platform

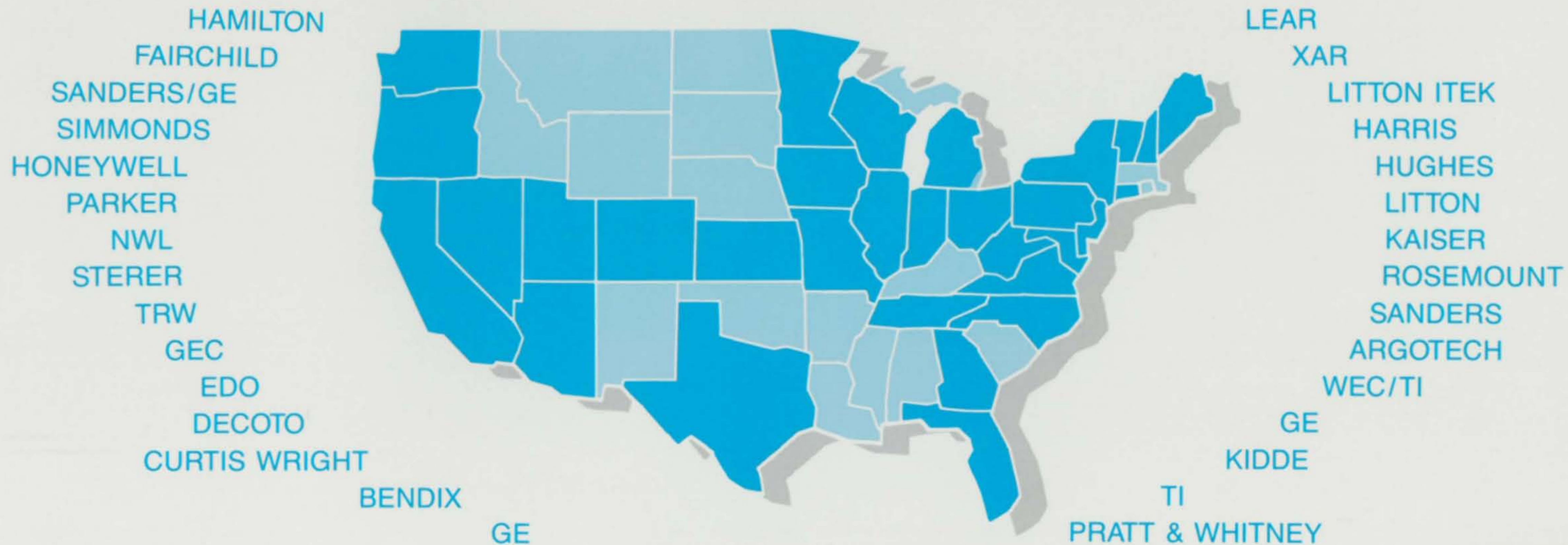
GENERAL DYNAMICS



F-16 Top line multi-role fighter active in 16 world-wide air forces

PRIMARY F-22 SUBCONTRACTORS

- Lockheed is the F-22 prime contractor with Boeing and General Dynamics as team members
- The F-22 Dem/Val team has been supported by major industrial participants, and thousands of men and women working at over 650 subcontractor locations in 32 states



EXPERIENCED

F-22 TEAM

“The Soviet fighter threat has reached essential technological parity with us. We must not allow them, or anyone else, to dominate in the future.”

DICK CHENEY
Secretary of Defense
May 14, 1990