



# Joint Unmanned Combat Air Systems

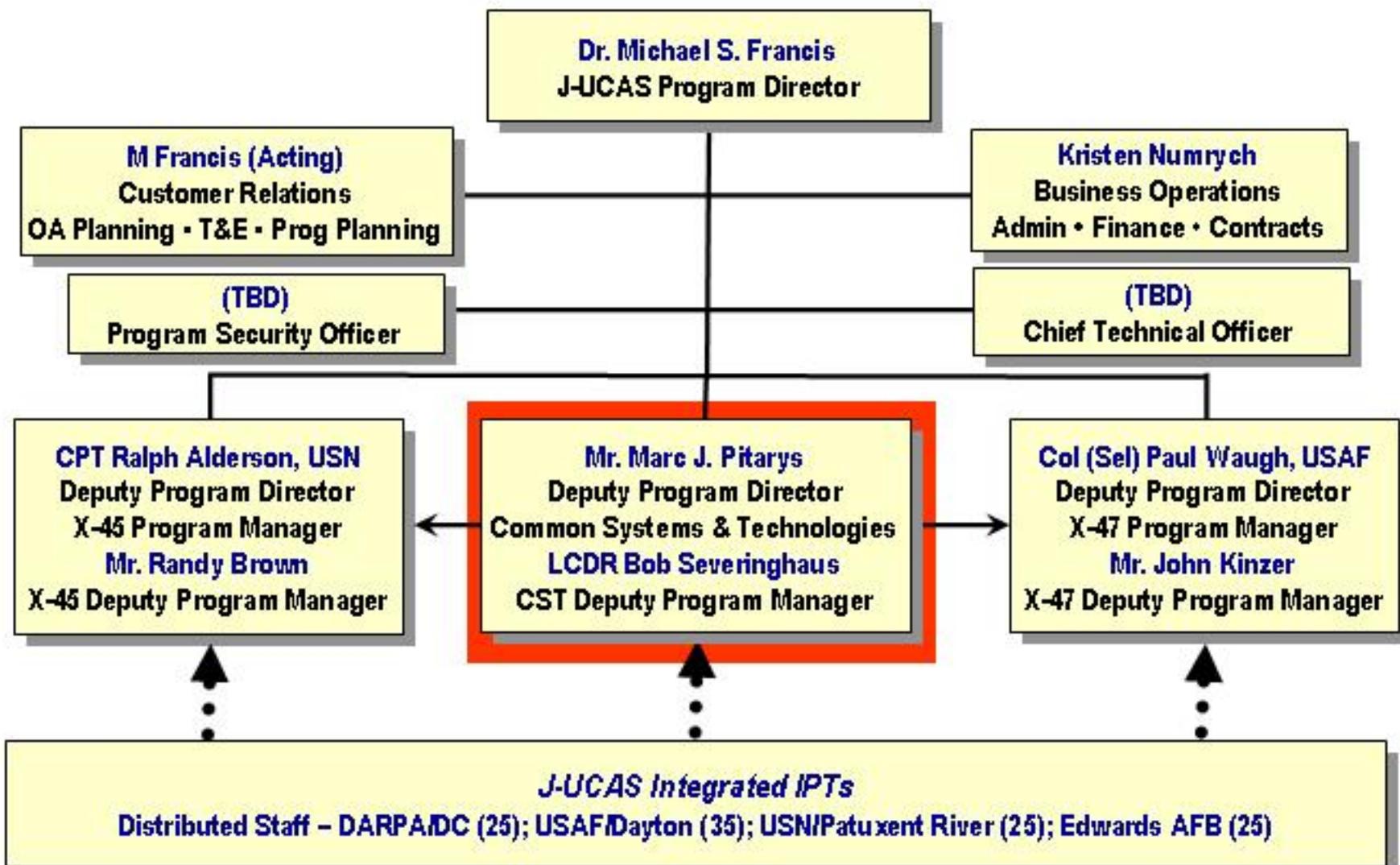
The background of the slide is a 3D rendered scene of a desert landscape with mountains and a body of water. Several unmanned aircraft are flying in the sky, connected by green lines to a satellite in orbit. The aircraft are casting shadows on the ground, and some are emitting red and white smoke trails. The text "Common Systems and Technologies Organization & Common Operating System Overview" is overlaid in the center in a large, bold, yellow font.

## Common Systems and Technologies Organization & Common Operating System Overview

Marc J. Pitarys  
Deputy Director, Common Systems and Technology  
20 APR 2004



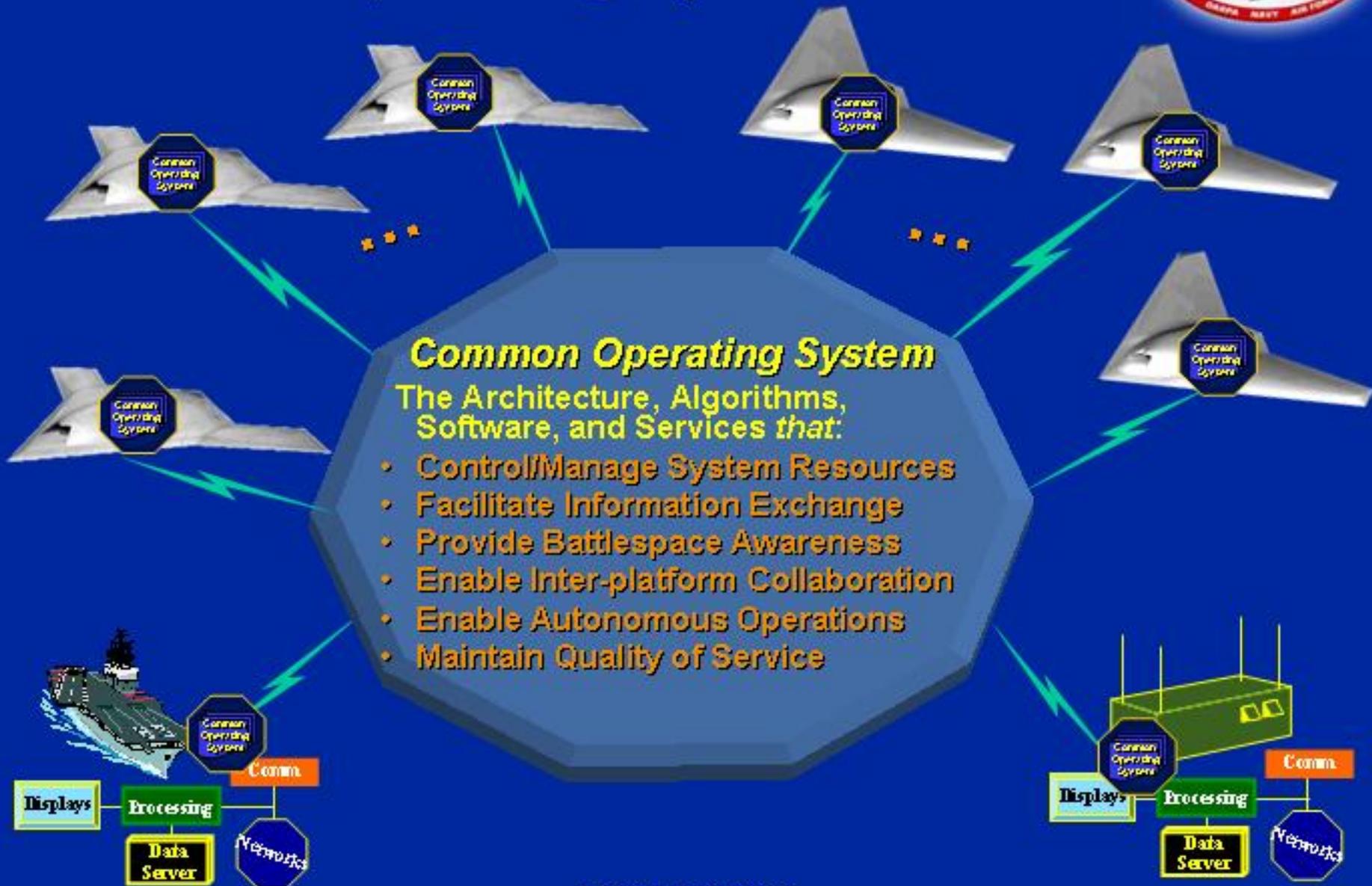
# J-UCAS Office Structure



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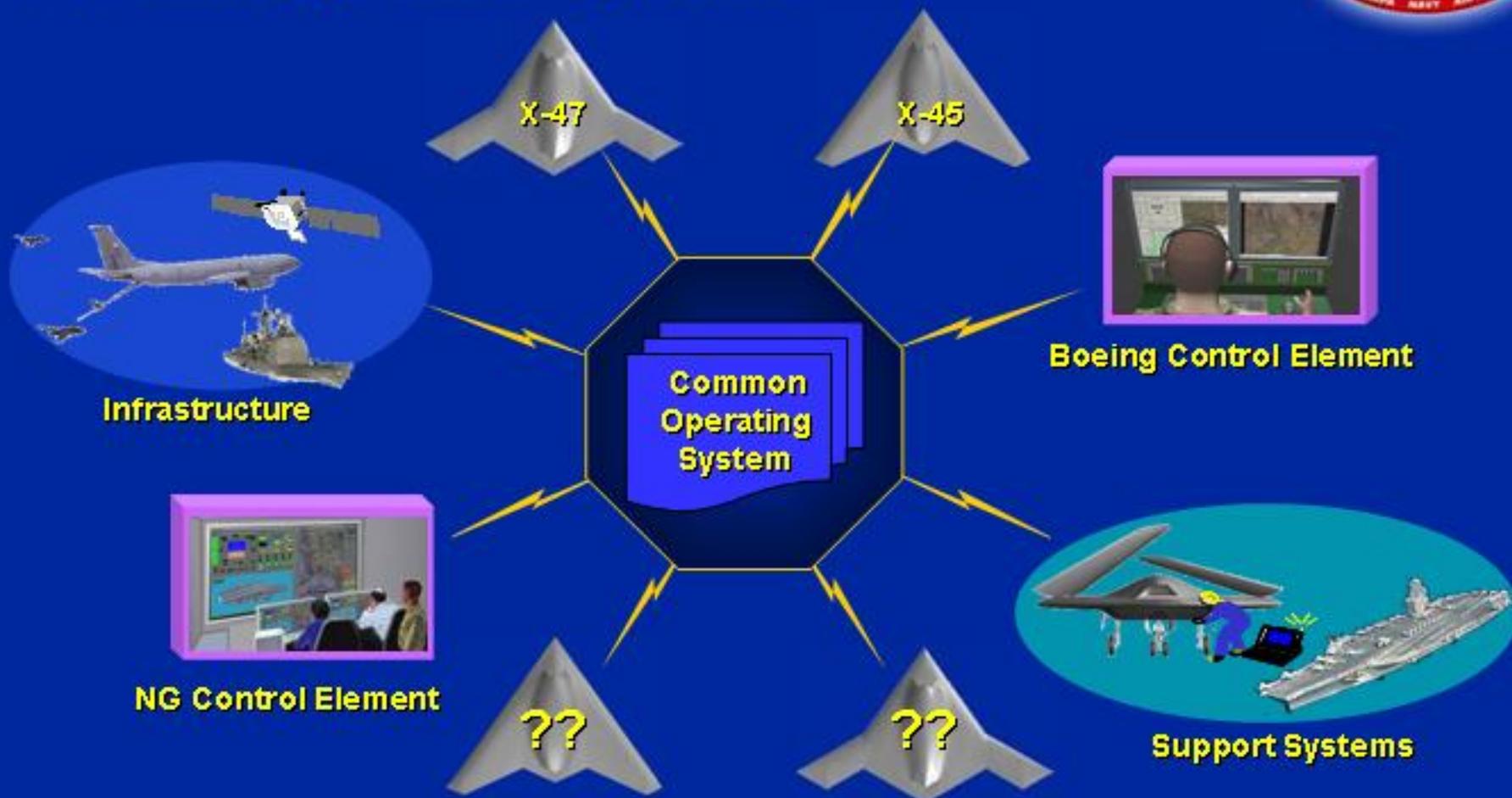
# Common Operating System



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# The Integrated System



- ***Intra- and inter-operable elements ... GIG-compliant network***
- ***Flexible autonomy and H-I-L operations ... Dictated by mission***
- ***Range-payload performance dictated by platform selection***

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# Common Operating System



## Rationale

- Ensures Common Architecture, Protocols, and Interfaces
- Decreases Complexity Of System-of-Systems Integration
- Assures Intra- and Inter-operability of J-UCAS Elements
- Enables Autonomous Collaborative Operations
- Decouples Air Vehicle & Other Hardware From System's Information Technology Component

## Impact

- Not dependent on single contractor
- Reduces cost of entry for new technologies
- More rapid fielding of capabilities
- Improves ability to upgrade/modify
- Enables inter-vehicle collaboration
- Enables information exchange with external entities (e.g. platforms, C2)
- Increases op tempo & network centric warfare capabilities
- Improves battle-space awareness
- Minimizes impact of platform changes on system development
- Provides mechanism for evolutionary system improvements

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# J-UCAS System Elements



## Operational Infrastructure

- Communications Relay
- Navigation
- Sustainment
- Transport



## Platform/Vehicle(s)

- Mission-Tailored Design
- Vehicle Management
- Vehicle Autonomous Functions

## Communications

- Secure Links/Network
- LOS or BLOS Ops



## Operating System

- System C2 & Interfaces
- Comms Management
- Mission Planning
- Autonomous Functions
- Health/Status
- Logical HSI ...

## Control Station(s)

- Physical HSI (Displays, I/O, ...)
- Launch/Recovery Control
- Vehicle-Payload Operations
- Human Crew



## Payload Systems

- Sensor(s)
- On-Board Processing
- Data Relay
- Weapons



## Direct Support

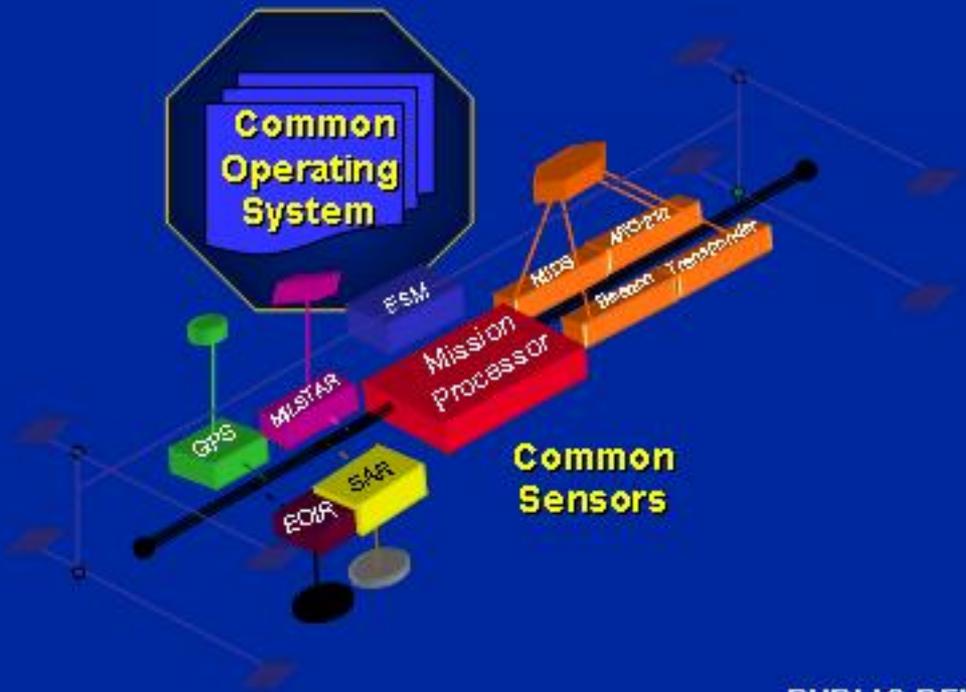
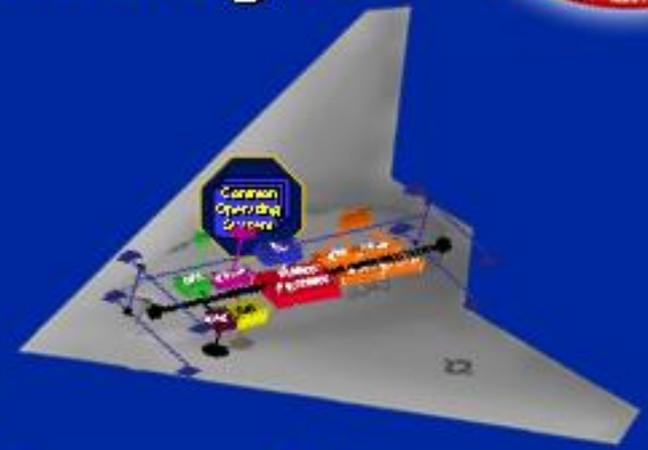
- Maintenance
- Logistics
- Launch/Recovery Infrastructure



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# Common Systems & Technologies



- **Common Operating System**
- **Communications capability**
- **Sensors**
- **Weapons**
- **Avionics hardware (e.g. processors)**

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# Common Systems & Technologies Responsibilities



- **Common Operating System**
- **System Architecture**
- **Interoperability**
- **Sensor, weapon and communication capabilities.**
- **Mission Ops/Control, Planning, & Intel**
- **Distributed Modeling and Simulation Capability**
- **Command and Control Definition**
- **Information Assurance**

**Common Systems and Technologies  
have an effect across multiple levels of the program**

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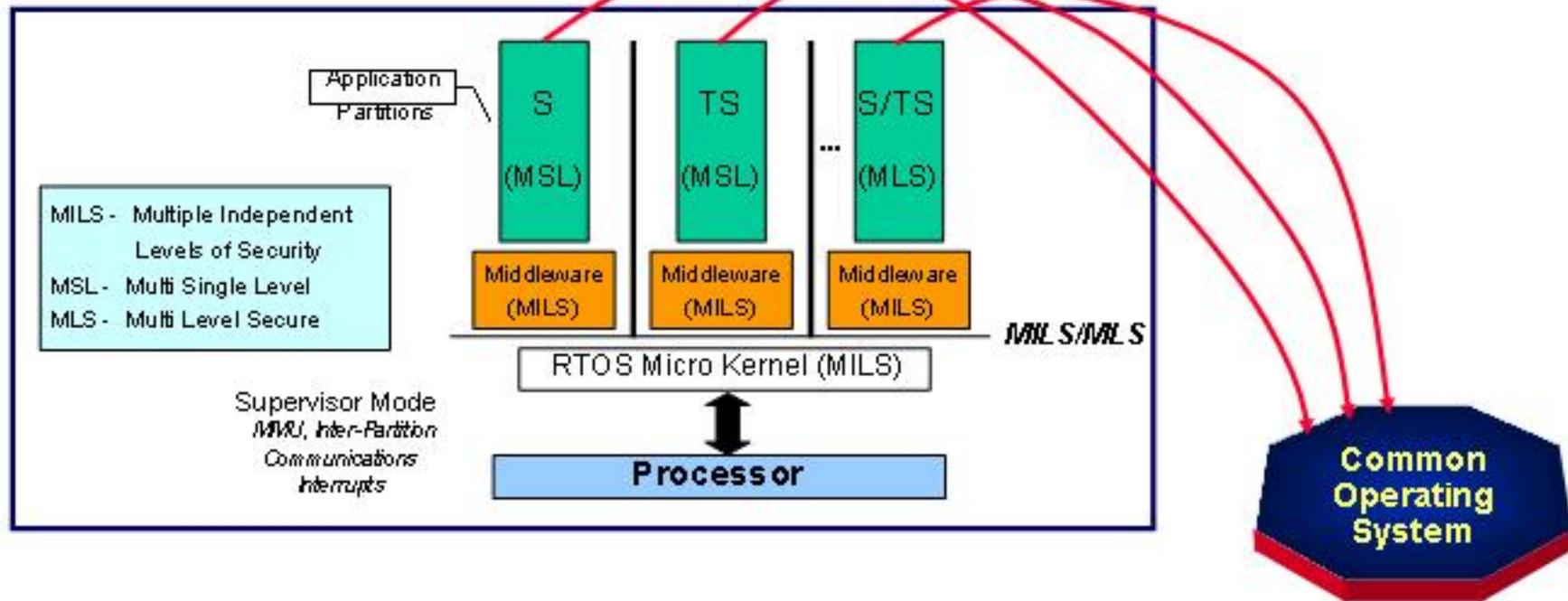
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# Information Assurance

- Common Operating System
- System Architecture
- Interoperability
- Sensor, weapon and communication capabilities.
- Mission Ops/Control, Planning, Intel
- Distributed Modeling and Simulation Capability
- Command and Control Definition
- **Information Assurance**

## Approach

- J-UCAS to work with commercial Real Time Operating System (RTOS) vendors, consortium, and NSA in providing one or more certified RTOS MILS Micro Kernels to support X-45 and X-47
- Work with commercial vendors, consortium, & NSA in providing a high assurance certified MILS middleware layer





# Common Systems and Technologies (CST) Mission Statement & Focus



## MISSION

- To develop a common operating system to facilitate the integration of systems (e.g., sensors, weapons, and communications) while minimizing the impact of platform constraints
- To develop a common system architecture to ensure intra and inter-operability of J-UCAS system elements
- To develop common hardware and software application components
- To develop common sensors

## Focus

- Reduce redundancies to minimize cost and resource expenditures
- Remove barriers of entry with regard to adopting new technology for J-UCAS
- Accelerate the introduction of a network centric war fighting capability

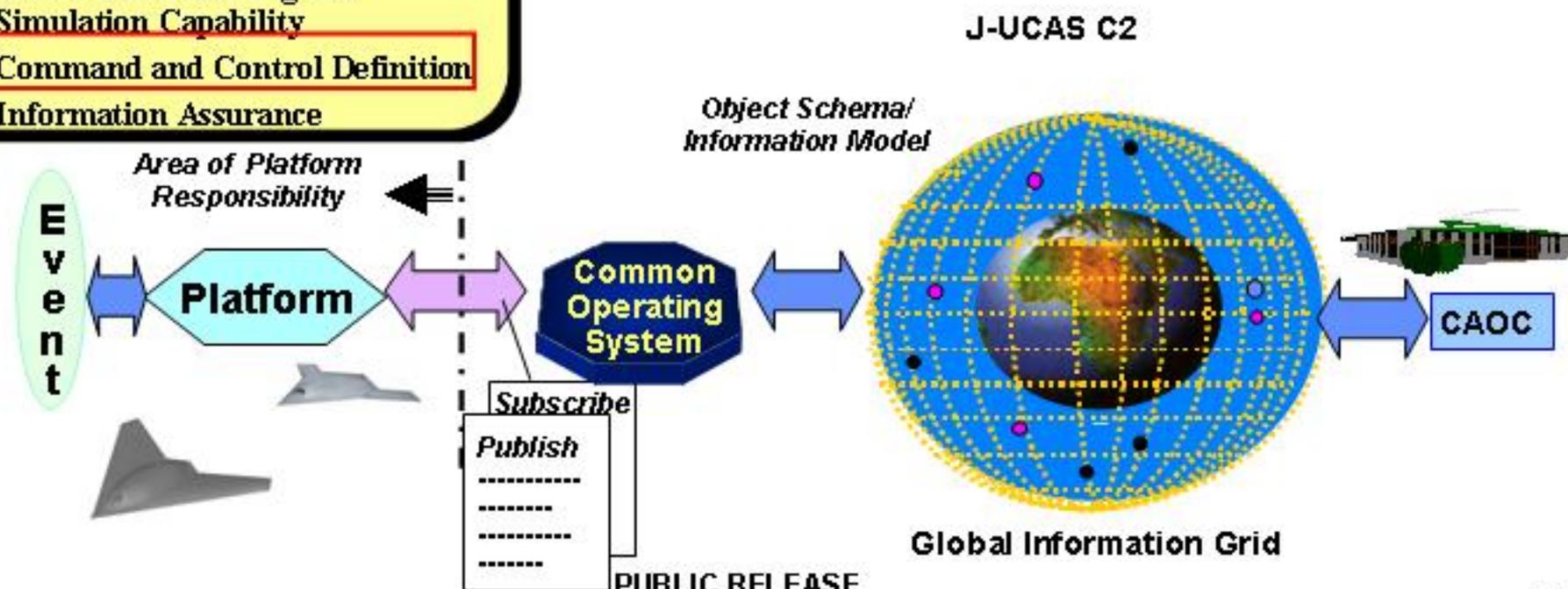
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# Command and Control

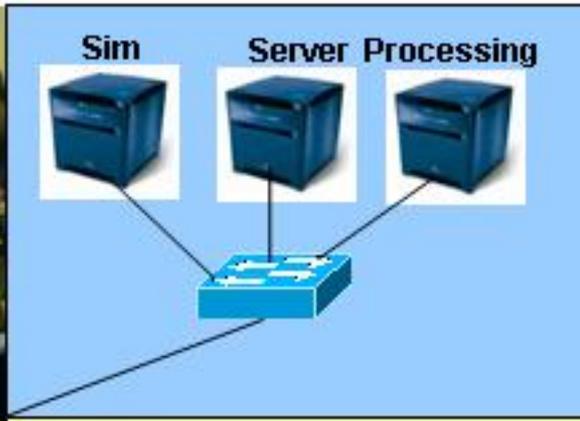
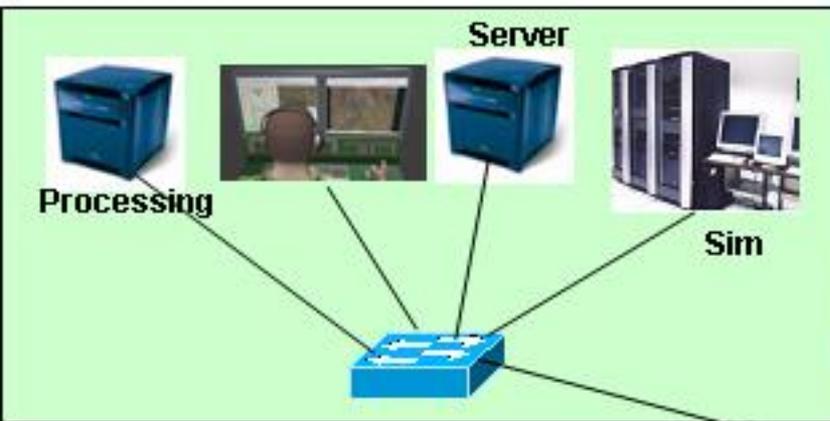
- Common Operating System
- System Architecture
- Interoperability
- Sensor, weapon and communication capabilities.
- Mission Ops/Control, Planning, Intel
- Distributed Modeling and Simulation Capability
- **Command and Control Definition**
- Information Assurance

- ### J-UCAS Command and Control (C2)
- Information Exchange through "Publish and Subscribe"
  - Transforms Data into Information, then Knowledge
  - Distributed Collaboration Operations



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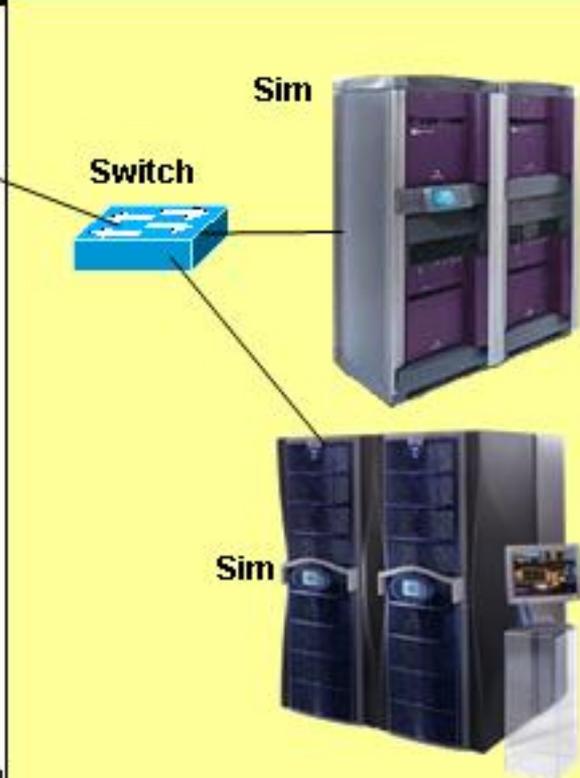
# Distributed Modeling and Simulation



- Common Operating System
- System Architecture
- Interoperability
- Sensor, weapon and communication capabilities.
- Mission Ops/Control, Planning, Intel
- **Distributed Modeling and Simulation Capability**
- Command and Control Definition
- Information Assurance

**Distributed Modeling & Simulation Capability with multiple levels of fidelity**

- Support integration of common system components,
- Demonstrate interoperability,
- Conduct joint exercises



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# Mission Planning and Intel Support

## Joint Mission Planning System (JMPS) Current Plans

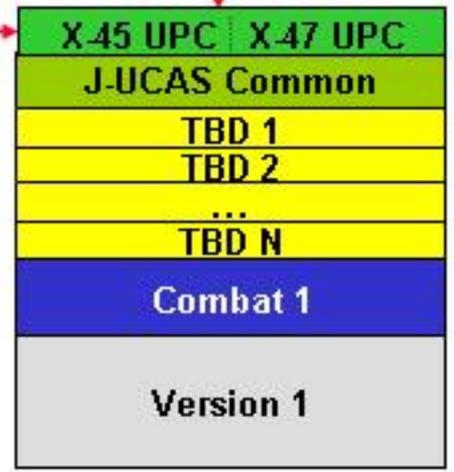
- Common Operating System
- System Architecture
- Interoperability
- Sensor, weapon and communication capabilities.
- **Mission Ops/Control, Planning, Intel**
- Distributed Modeling and Simulation Capability
- Command and Control Definition
- Information Assurance



32 Common Capabilities

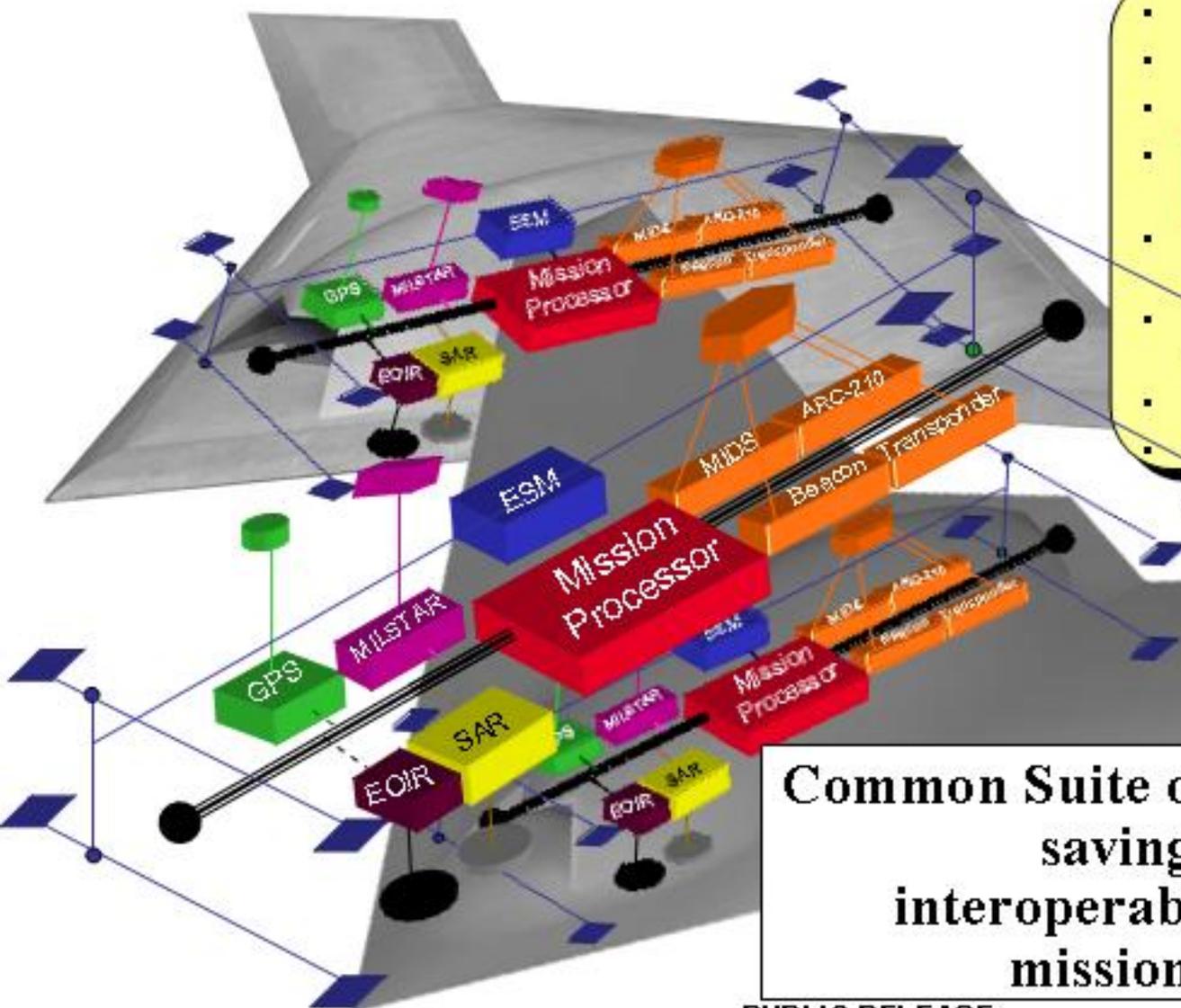


Develop components common to the J-UCAS domain



UPC:  
Unique Planning Component

# Common Sensors and Communications



- Common Operating System
- System Architecture
- Interoperability
- **Sensor, weapon and communication capabilities.**
- Mission Ops/Control, Planning, Intel
- Distributed Modeling and Simulation Capability
- Command and Control Definition
- Information Assurance

**Common Suite of sensors offers cost savings, enhanced interoperability and improves mission effectiveness**

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# Intra- and Inter-operability (I2-Operability)

- Common Operating System
- System Architecture
- **Interoperability**
- Sensor, weapon and communication capabilities.
- Mission Ops/Control, Planning, Intel
- Distributed Modeling and Simulation Capability
- Command and Control Definition
- Information Assurance

## Joint Interoperability Directives & Instructions

**DoDD 4630.5**

IT and NSS interoperability and supportability is essential.

**DoDD 5105.19**

CISA shall ensure end-to-end interoperability.

**CJCSI 6212.01B**

All NSS and IT, regardless of ACAT, must be tested and ... certified by JTC.

**DoD 4630.5000**

Interoperability is the ability to provide and accept data, information, material, and services ... and ... include both the technical exchange of information and the end-to-end operational effectiveness of that exchange, as required for mission accomplishment.

**DoDI 4630.8**

All systems must be tested for interoperability before fielding ... and certified by JTC ... throughout a system's life.

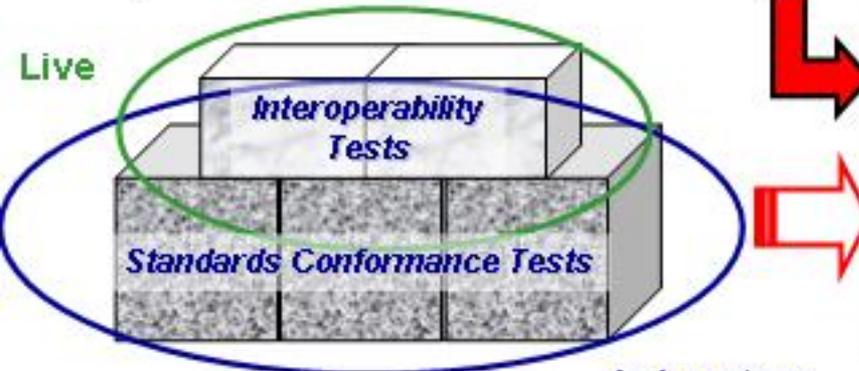
**CJCSI 3170.01C**

Mandates Interoperability KPP for CDD, CPD and CRD

**DoD 5000 series**

For IT systems, including NSS, ... JTC shall provide system interoperability test certification memoranda ... throughout the system life-cycle and regardless of ACAT.

### J-UCAS Interoperability Certification



**• Standards Conformance**  
Standards conformance is the ability to adhere to rules contained in the applicable standards.

**• Joint Interoperability**  
Ensures that system effectively exchanges information with joint participants in both environments.

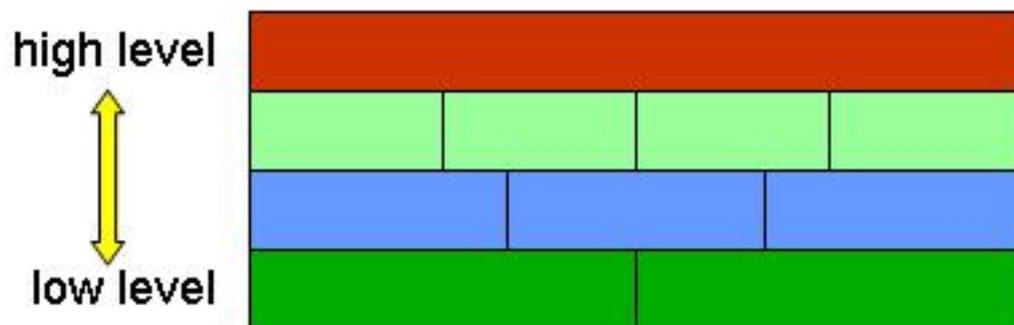
*Note: Standards provide a necessary building block for ensuring interoperability, but are not sufficient to ensure that systems are interoperable in a joint environment.*

Building Block Approach

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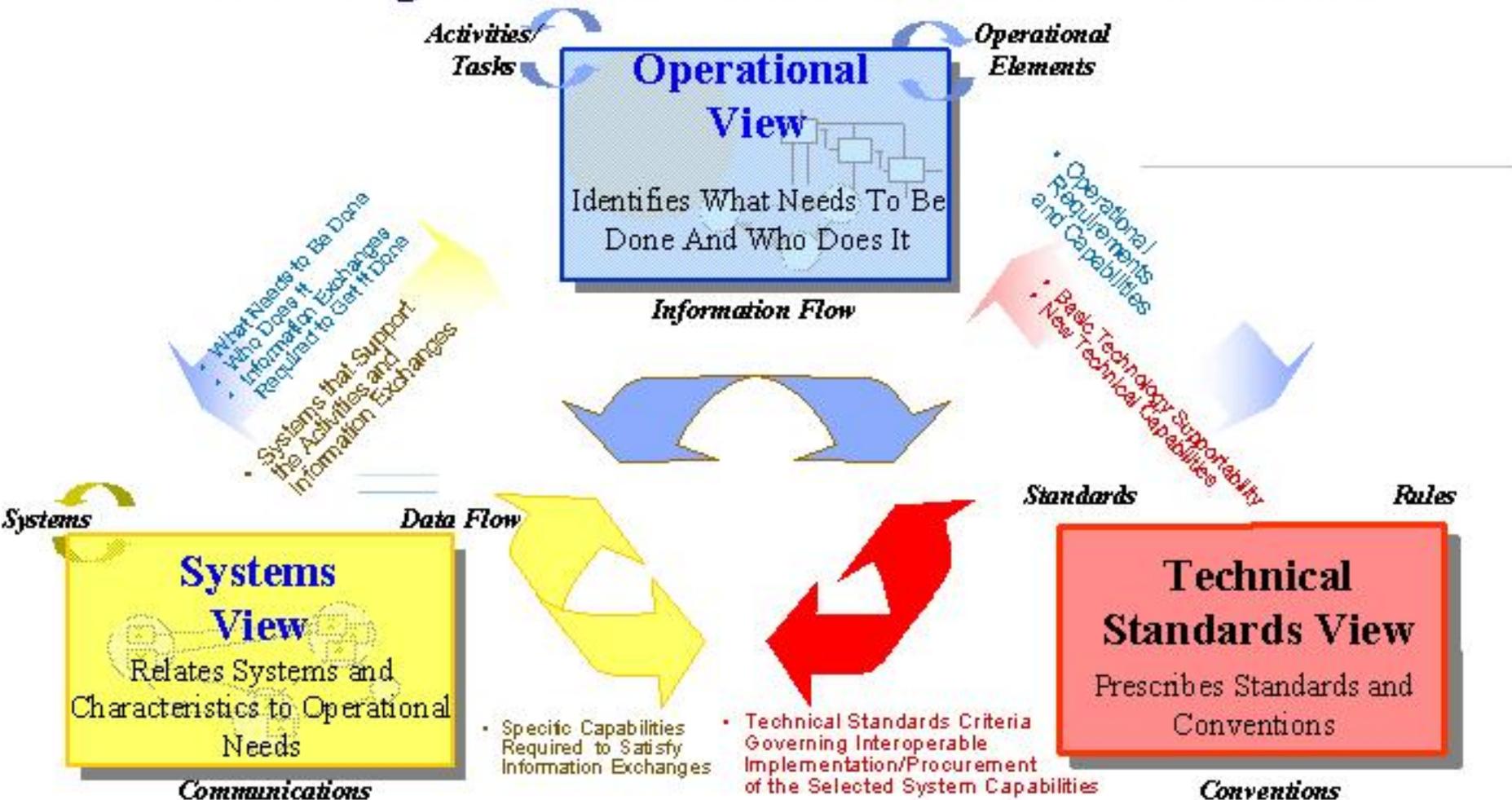
# Service Based Architecture

- Architecture composed of software layers
- Software layers composed of software services
- Software services provide open, loosely coupled service interface



Service interfaces encapsulate the service isolating users & other services from the detailed operations inside.

## An Integrated Architecture with Three Views



# System Architecture

- Common Operating System
- **System Architecture**
- Interoperability
- Sensor, weapon and communication capabilities.
- Mission Ops/Control, Planning, Intel
- Distributed Modeling and Simulation Capability
- Command and Control Definition
- Information Assurance

## Architecture Defines the Fundamental **Structure** and **Relationships** of the J-UCAS:

- How J-UCAS Is Partitioned and Where the Interfaces Occur
- How The J-UCAS Components Interact with Each Other and the Outside World
- What Universal Rules the J-UCAS and Its Parts Must Comply With (Priorities, Operating Modes, Standards, Safety, etc.)



### Common Operating System

- Attack Management
- Sensor Management
- Weapon Management
- System and Mission Contingency Management
- Fusion
- Interfaces to the Global Information Grid
- Inter/Intra-operability
- Situation Awareness
- Networking
- Route Planning
- Battle Damage Assessment
- Battle Management Decision Aids



X-47

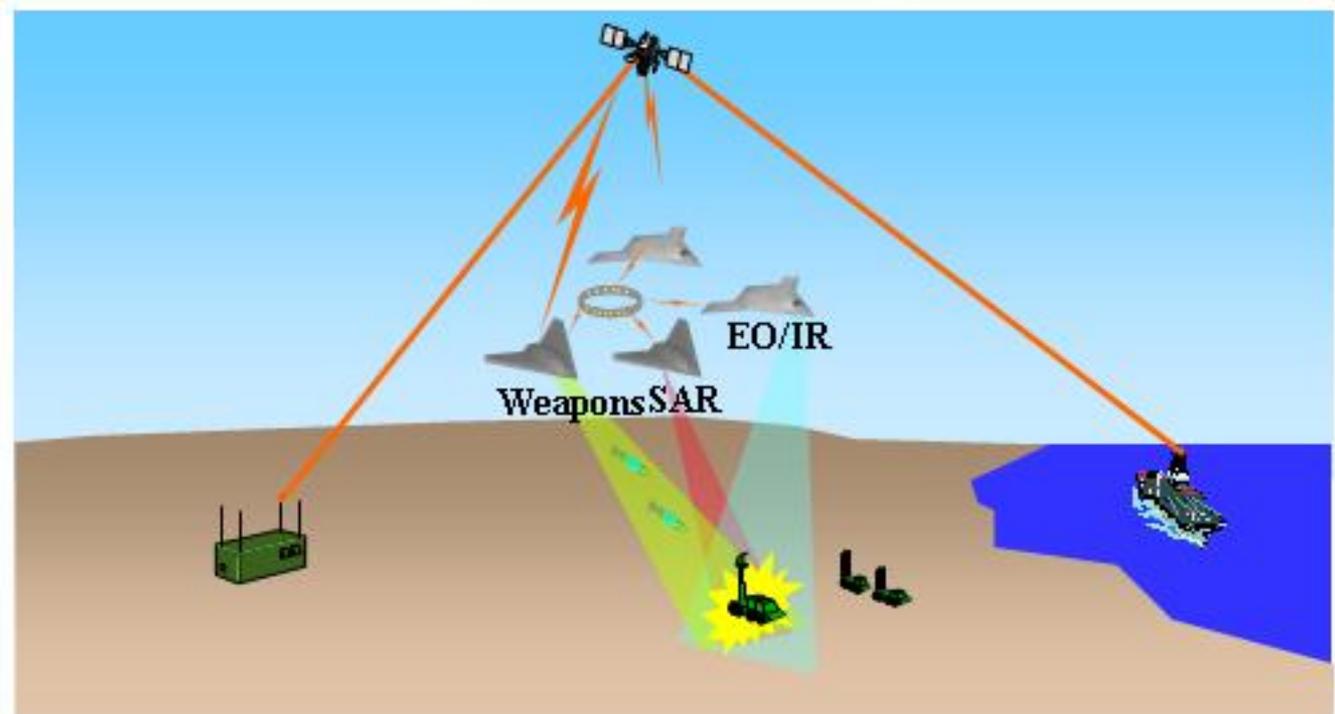


X-45



### Mission Control

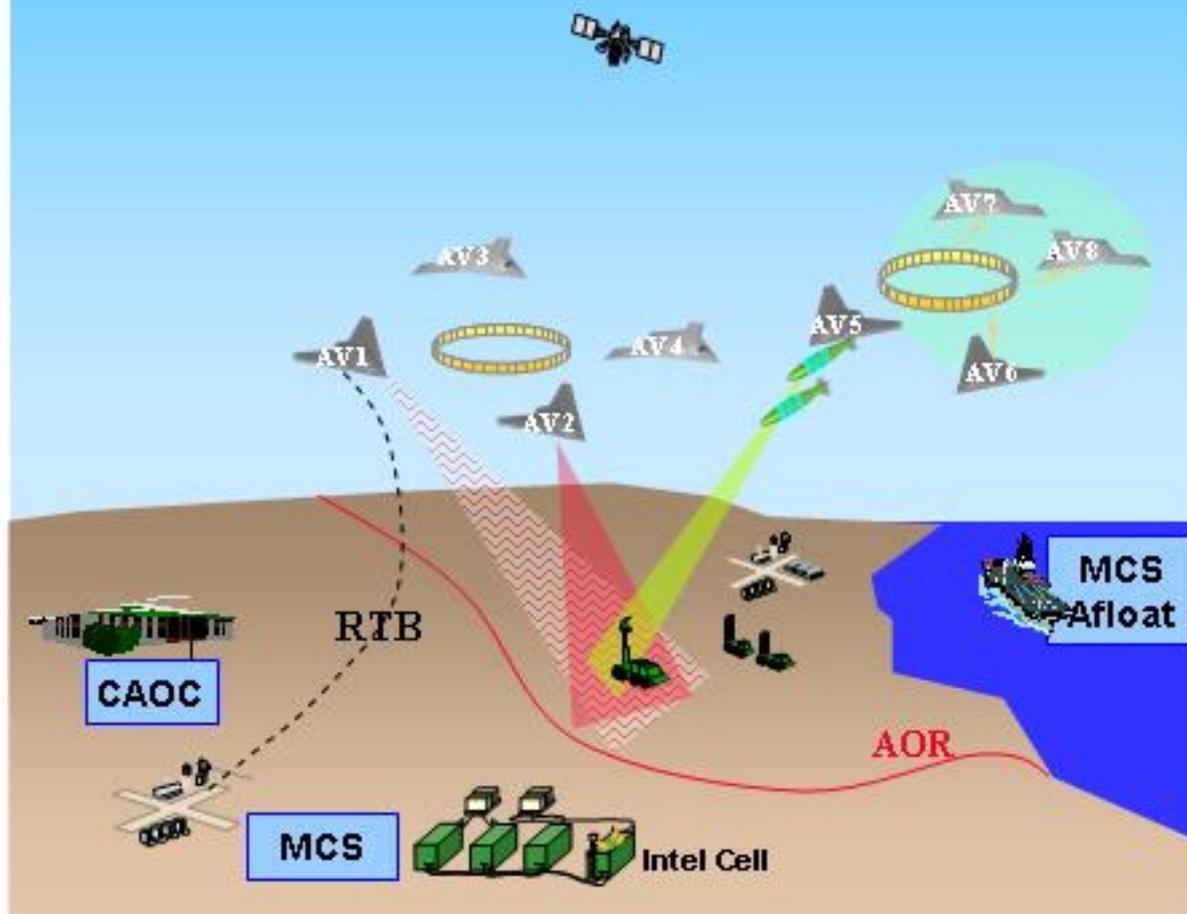
- Operator Displays
- Communications
- Processing



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# Contingency Management with Common Operating System

## Contingency Management Scenarios

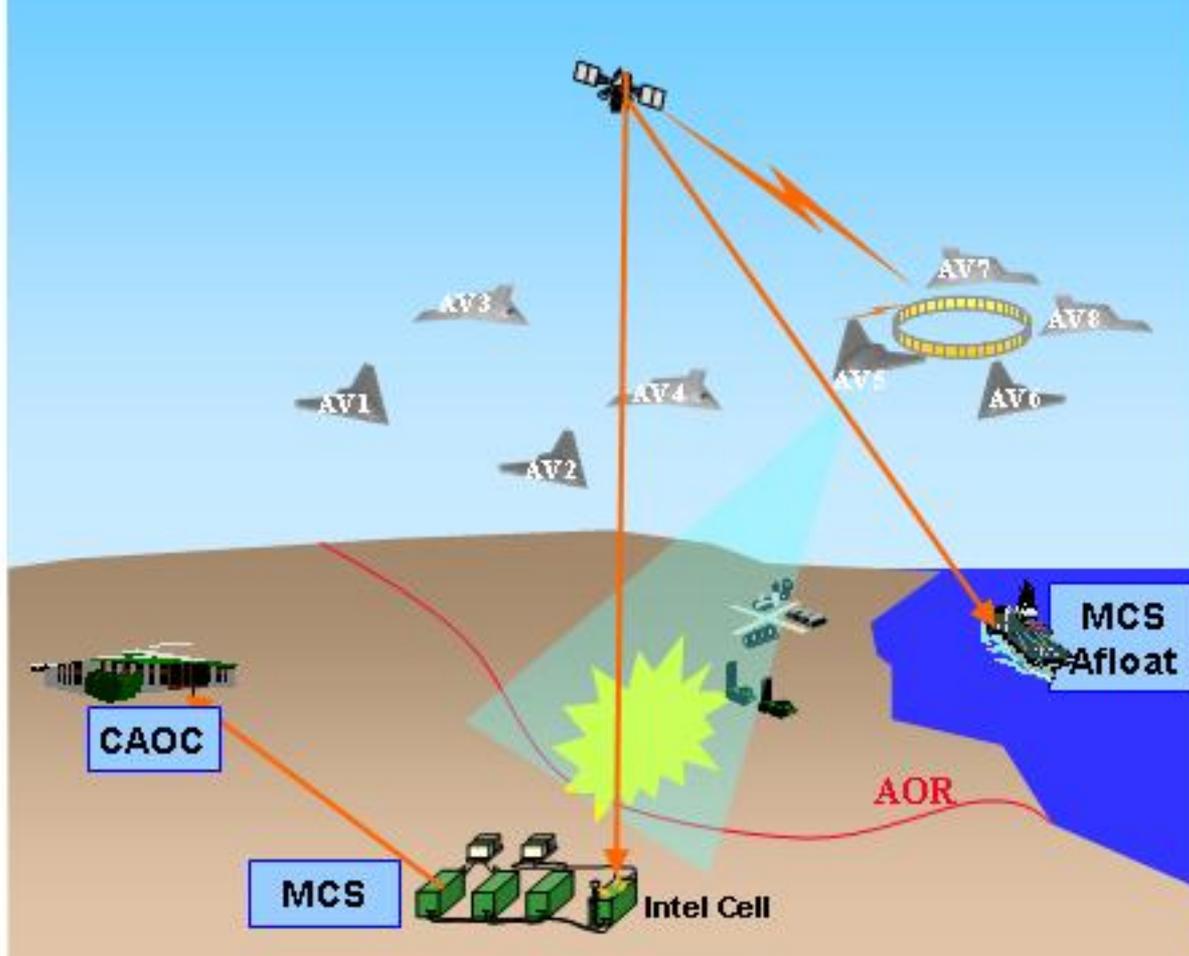


<b>Sensors</b>			
ESM	SAR	EO/IR	
AV6, AV7, AV8		AV2	
<b>Comm</b>			
Intra Vehicle Data Link	SAT COM	LAN	
AV6, AV7, AV8			
<b>Weapons</b>			
J-DAM 2k	J-DAM 1k	J-DAM 500	Small Diameter Bomb
AV5			
VMS	<b>Vehicle Contingency</b>		
AV1 Low on Fuel: Return to Base Unable to complete SAR			
Common Operating System	<b>System Contingency</b>		
Reconfigure remaining sensors Commence SAR imagery from AV2			
AV5 ESM Failure: Unable to detect threats Locate threats with AV6, AV7, AV8 Attack with AV5			

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## 8. Battle Damage Assessment



**Common Operating System**

**Sensors**

ESM	SAR	EO/IR
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AV5

**Comm**

Intra Vehicle Data Link	SAT COM	LAN
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AV5

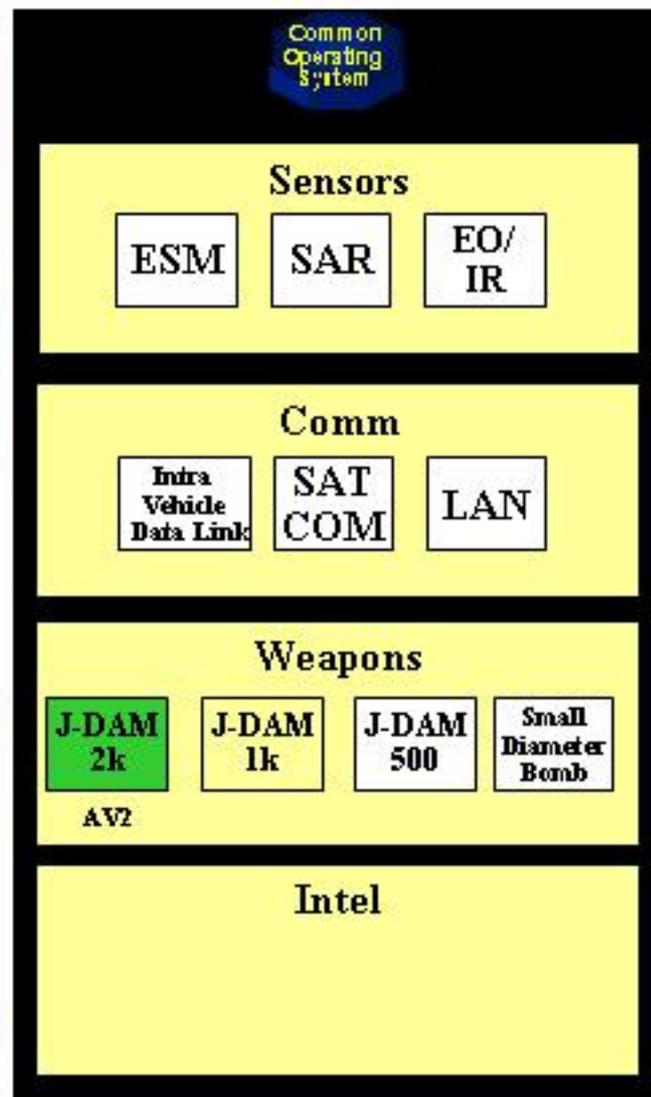
**Weapons**

J-DAM 2k	J-DAM 1k	J-DAM 500	Small Diameter Bomb
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**Intel**

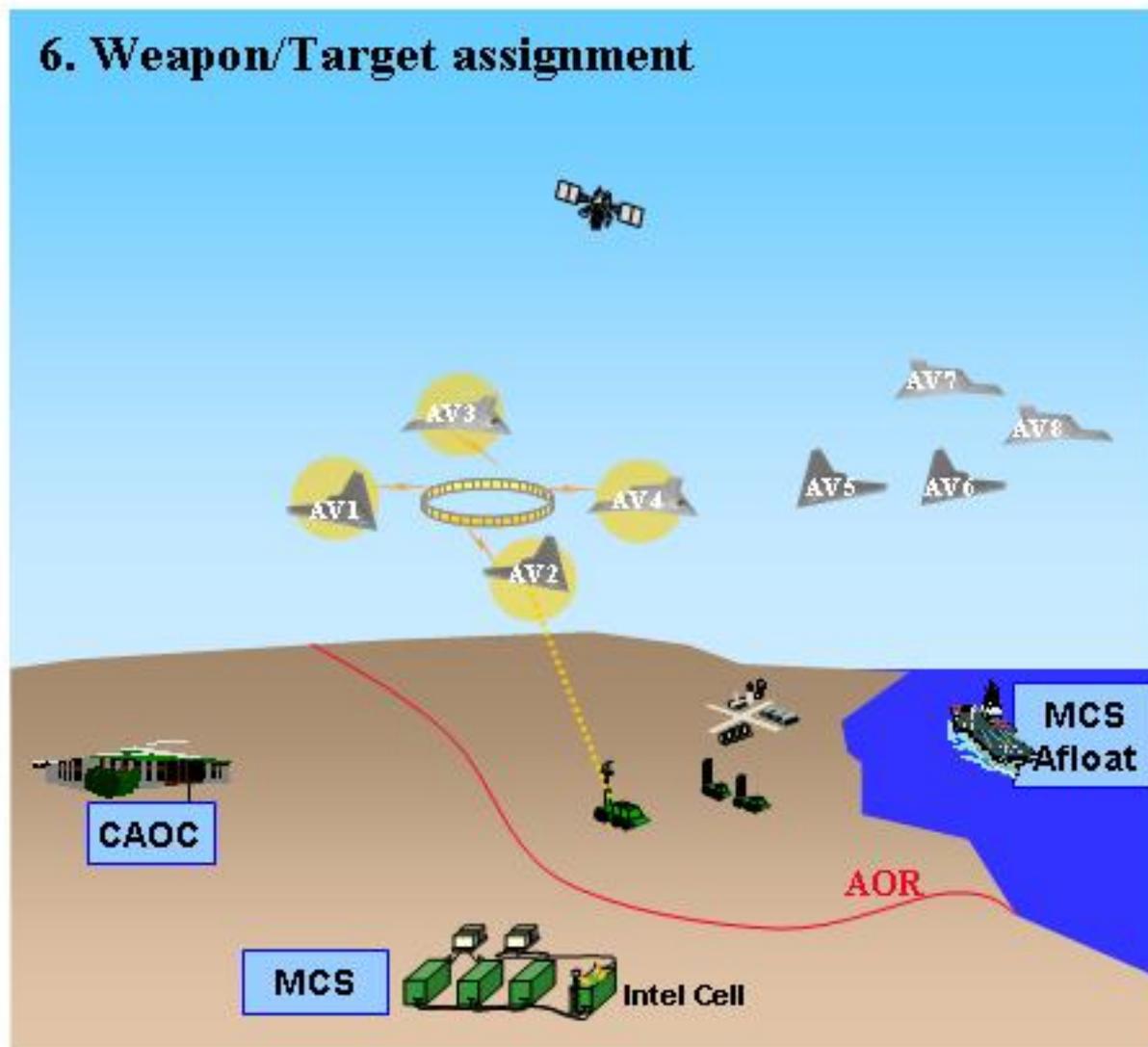
AV5 completed EO/IR maneuver for battle damage assessment (BDA)

## 7. Weapons release



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## 6. Weapon/Target assignment



**Common Operating System**

**Sensors**

ESM	SAR	EO/IR
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**Comm**

Intra Vehicle Data Link AV1 AV2 AV3 AV4	SAT COM	LAN
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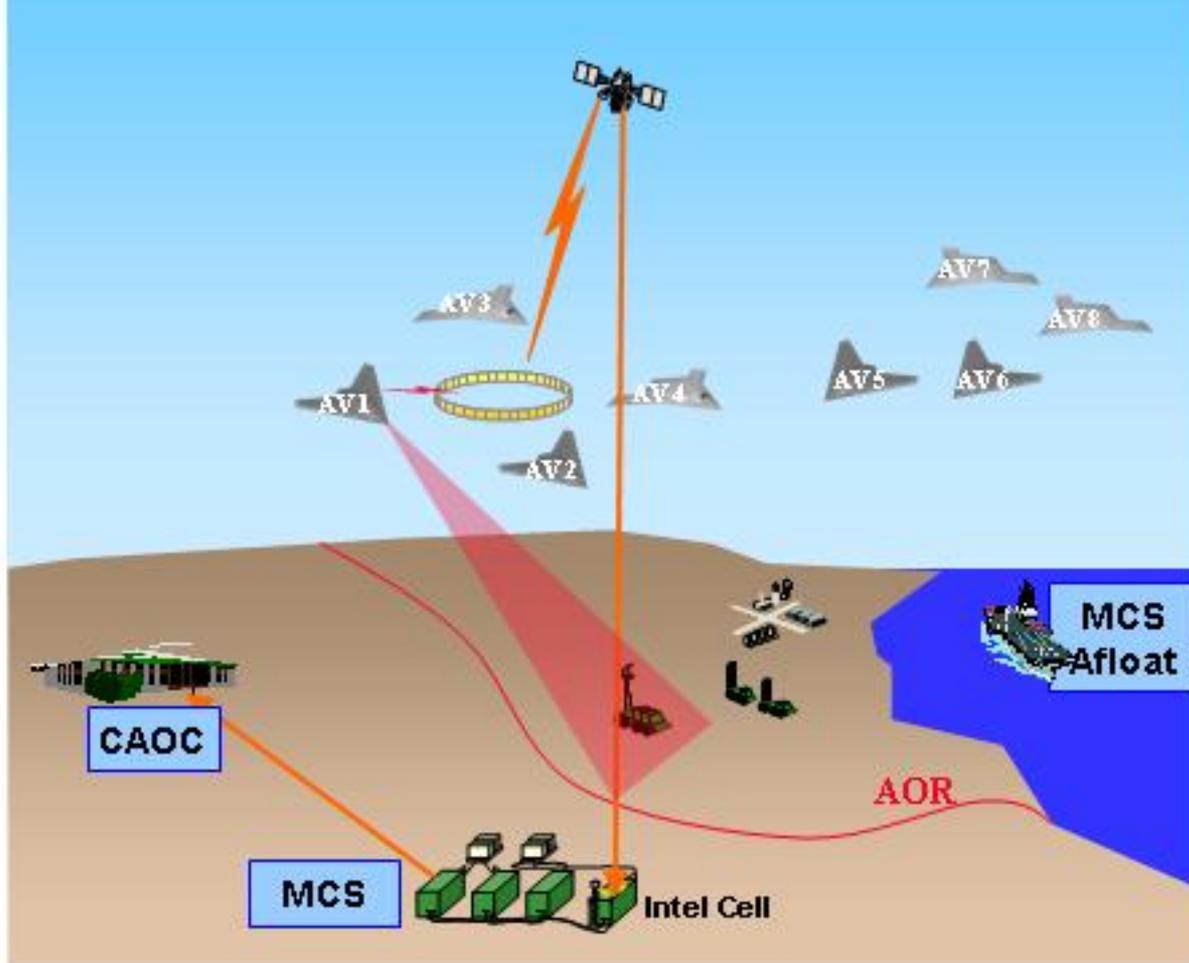
**Weapons**

J-DAM 2k	J-DAM 1k	J-DAM 500	Small Diameter Bomb
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**Intel**

Threat	Weapon	Vehicle
SA-10	2K J-DAM	AV2

## 5. SAR image pushed to MCS & Intel Units



**Common Operating System**

**Sensors**

ESM	<b>SAR</b>	EO/IR
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AVI

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**Comm**

Intra Vehicle Data Link	SAT COM	LAN
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AVI

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**Weapons**

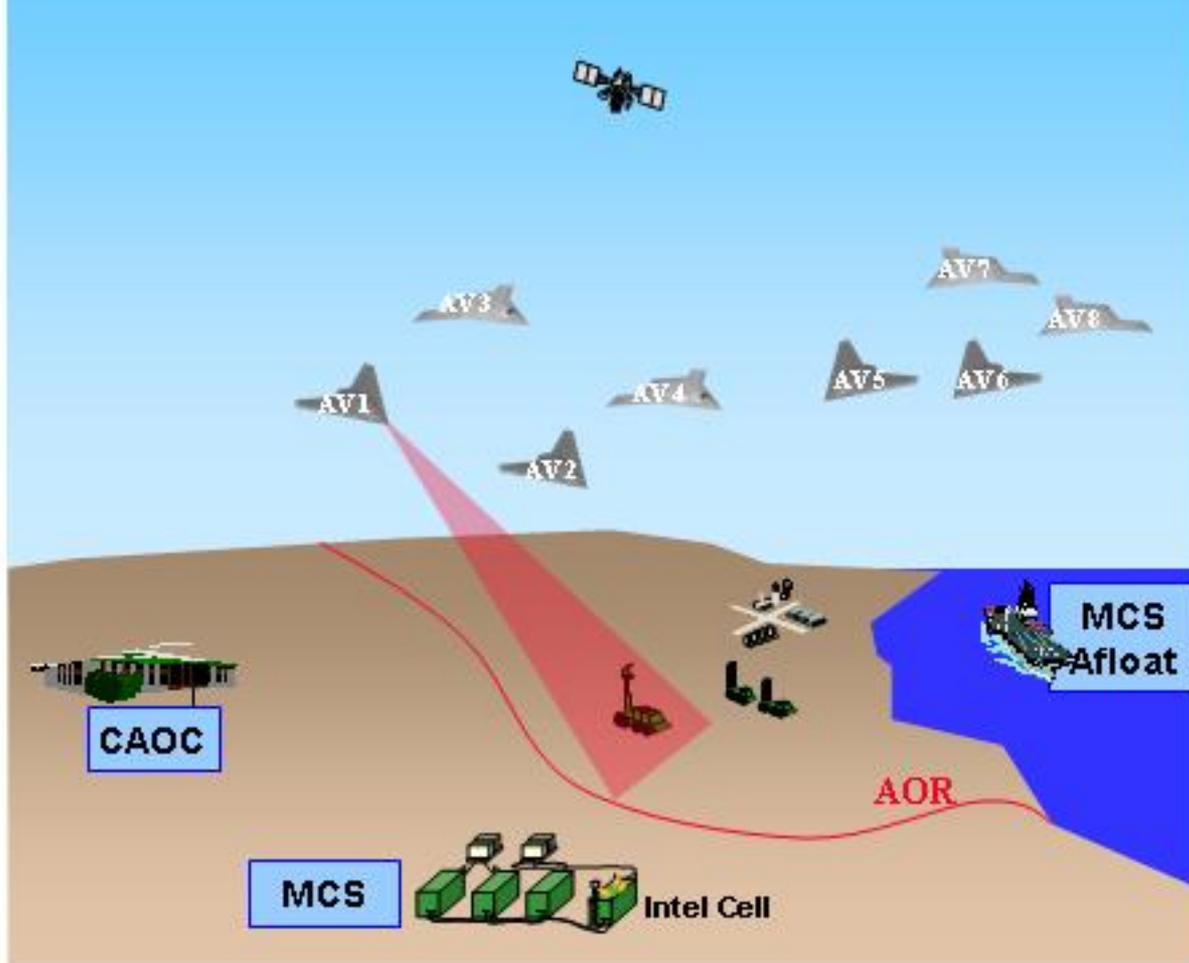
J-DAM 2k	J-DAM 1k	J-DAM 500	Small Diameter Bomb
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**Intel**

SAR image sent to MCS and copied to CAOC server

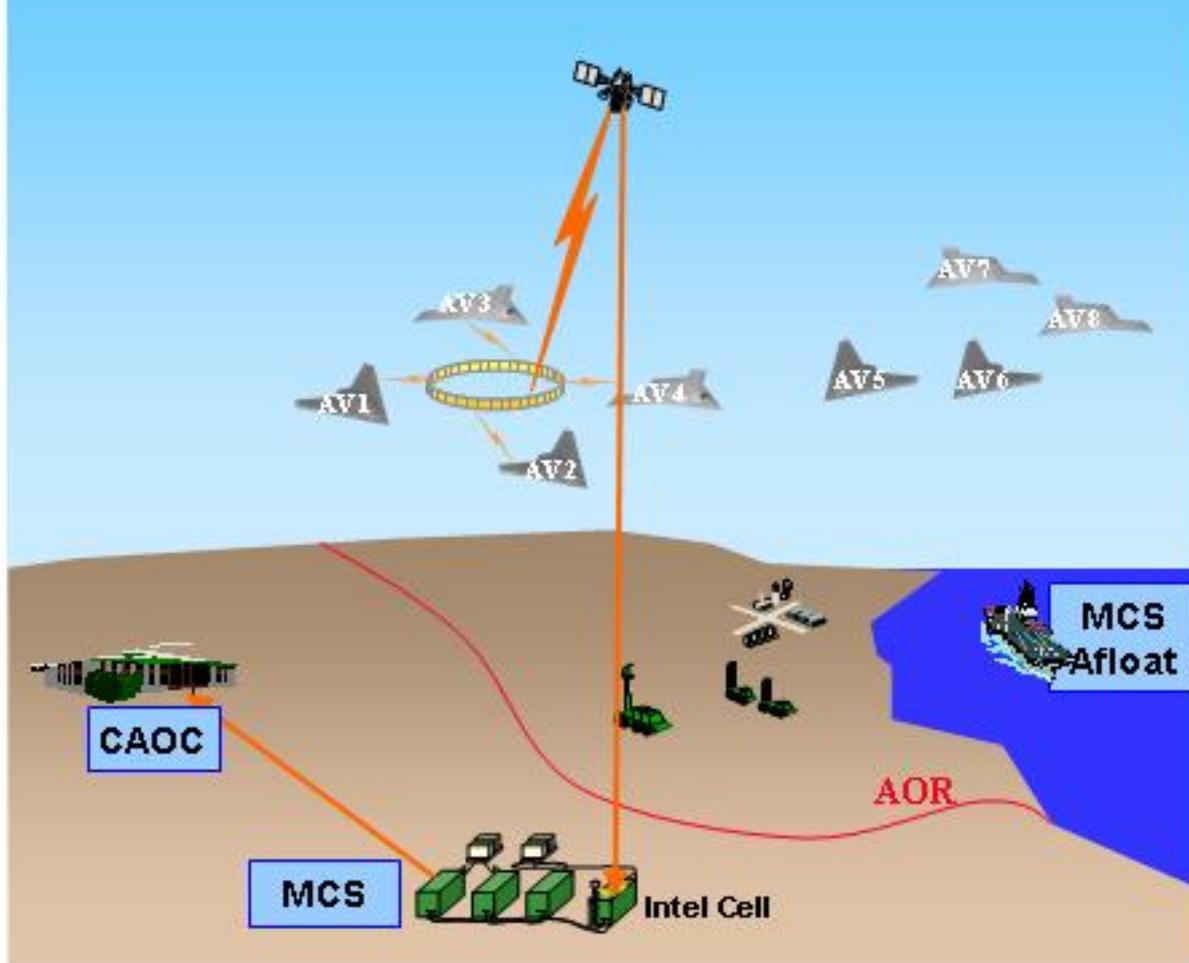
## 4. Air vehicle performs SAR maneuver



**Common Operating System**

<b>Sensors</b>			
ESM	<b>SAR</b>	EO/IR	
AVI			
<b>Comm</b>			
Intra Vehicle Data Link	SAT COM	LAN	
<b>Weapons</b>			
J-DAM 2k	J-DAM 1k	J-DAM 500	Small Diameter Bomb
<b>Intel</b>			
Capture SAR script selected			

## 3. Threat data pushed to MCS & Intel Units



**Common Operating System**

**Sensors**

- ESM
- SAR
- EO/IR

**Comm**

- Intra Vehicle Data Link
- SAT COM
- LAN

AV1 AV2  
AV3 AV4

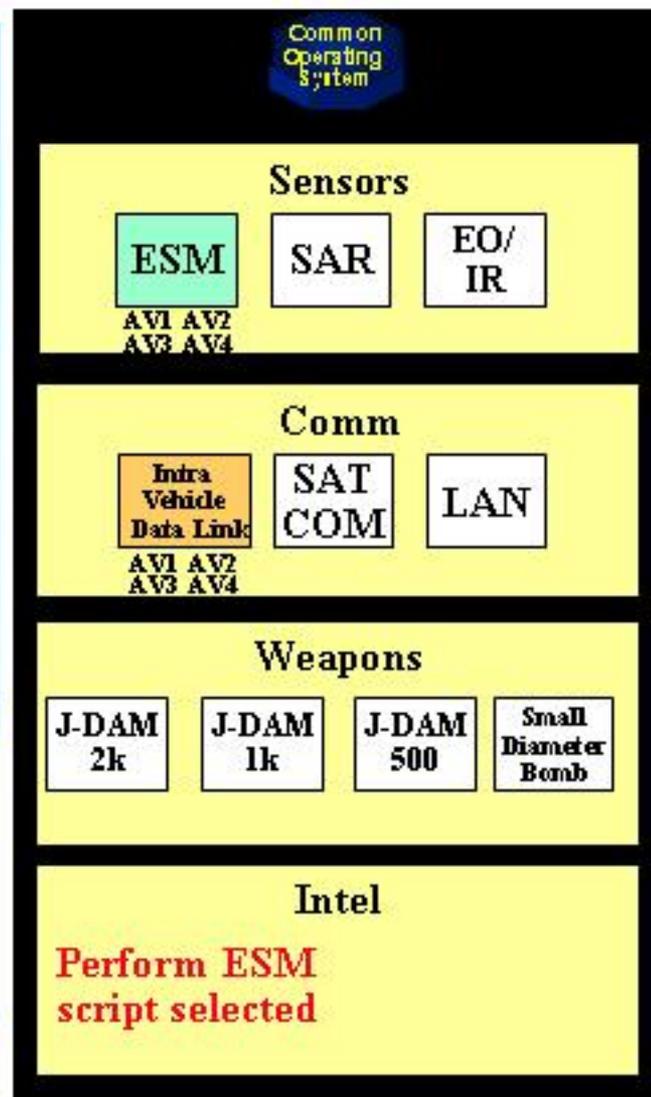
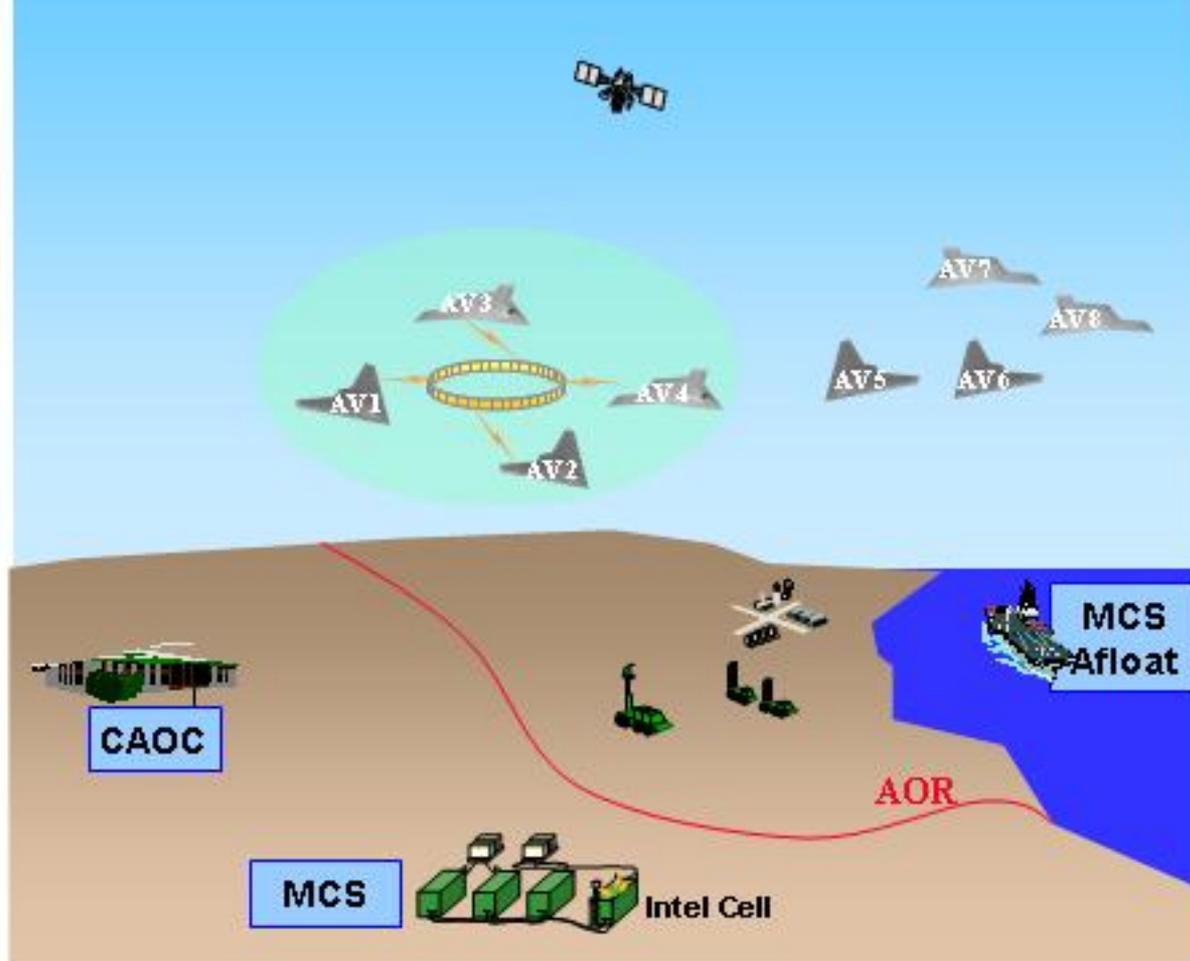
**Weapons**

- J-DAM 2k
- J-DAM 1k
- J-DAM 500
- Small Diameter Bomb

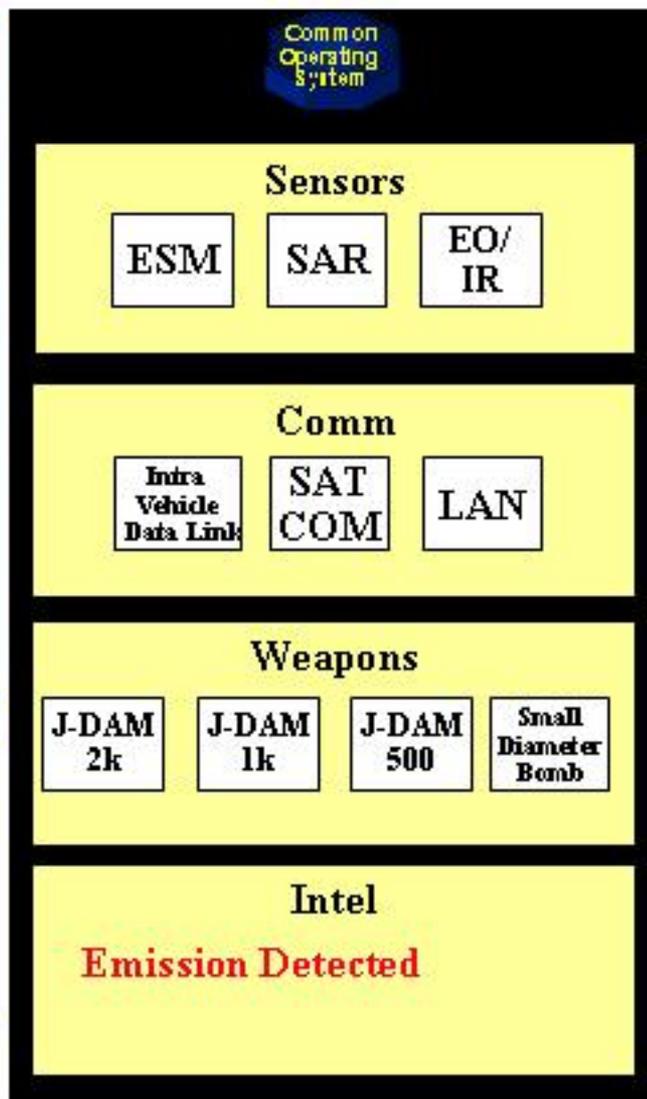
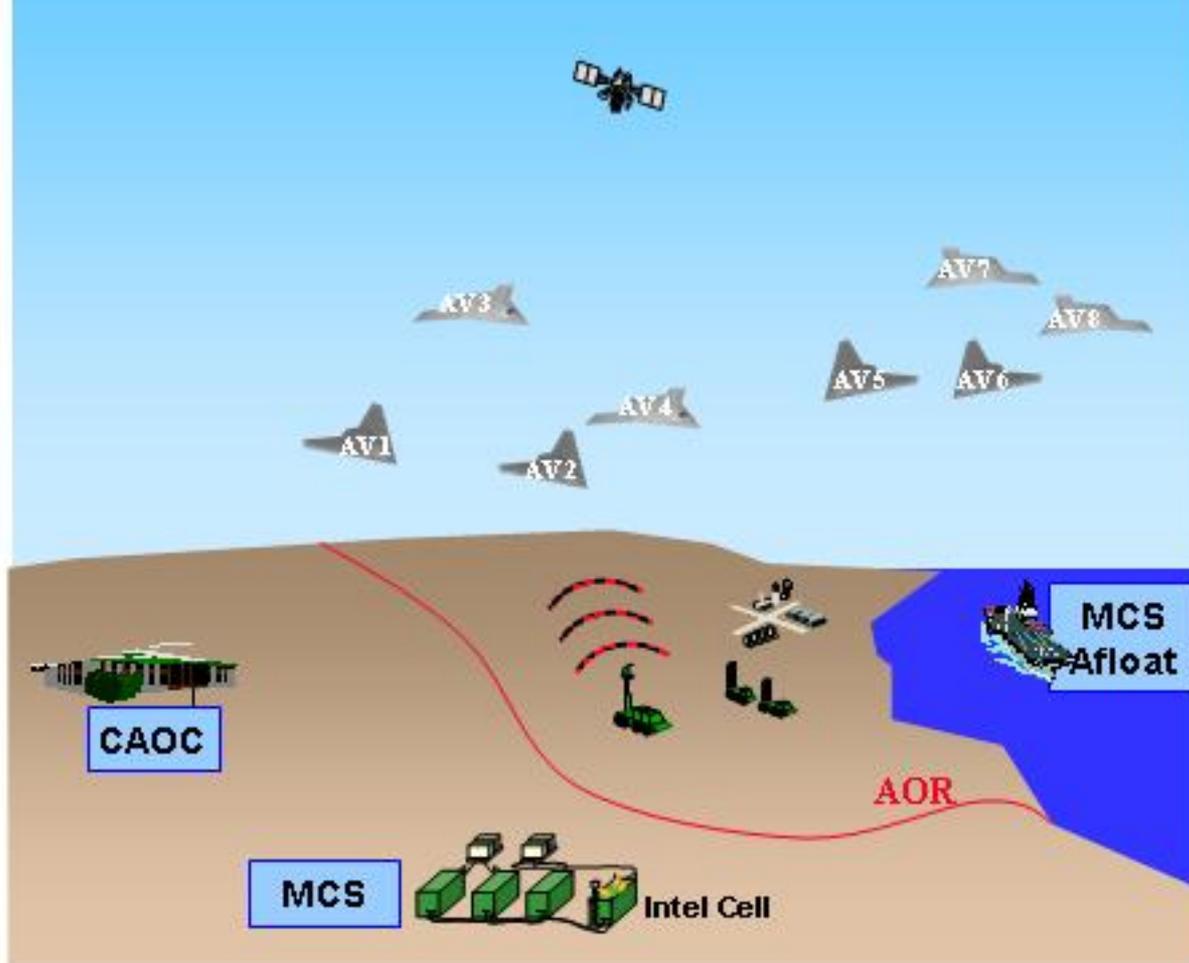
**Intel**

Link 16 track detection received

## 2. ESM locates and IDs the threat



## 1. Threat begins emitting radar signal



***Common Operating System  
Vignettes***

**SEAD Mission  
Contingency Management**

# Common Operating System Functionality



## Information Management

- Publish/Subscribe
- Fusion

## Battle Management

- Common Relevant Operational Picture
- Integrated Fire Control

## Critical GIG Interfaces

- MILSTAR
- Link 16
- SIFRNET
- TCDL
- JWICS

## Human System Integration

- Display Management
- Decision Aids
- Situation Awareness

## Resource Management

- Sensors
- Payloads
- Attack
- Power

## Contingency Management

- System
- Mission

## Network Management

- Quality of Service
- Bandwidth Allocation
- Link Control

## Planning

- Mission Planning
- Collection Planning
- Dynamic Re-planning

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