Insertion of Embedded Infosphere Support Technologies Enabling Time Critical Target Prosecution

8th International

Command and Control Research and Technology Symposium
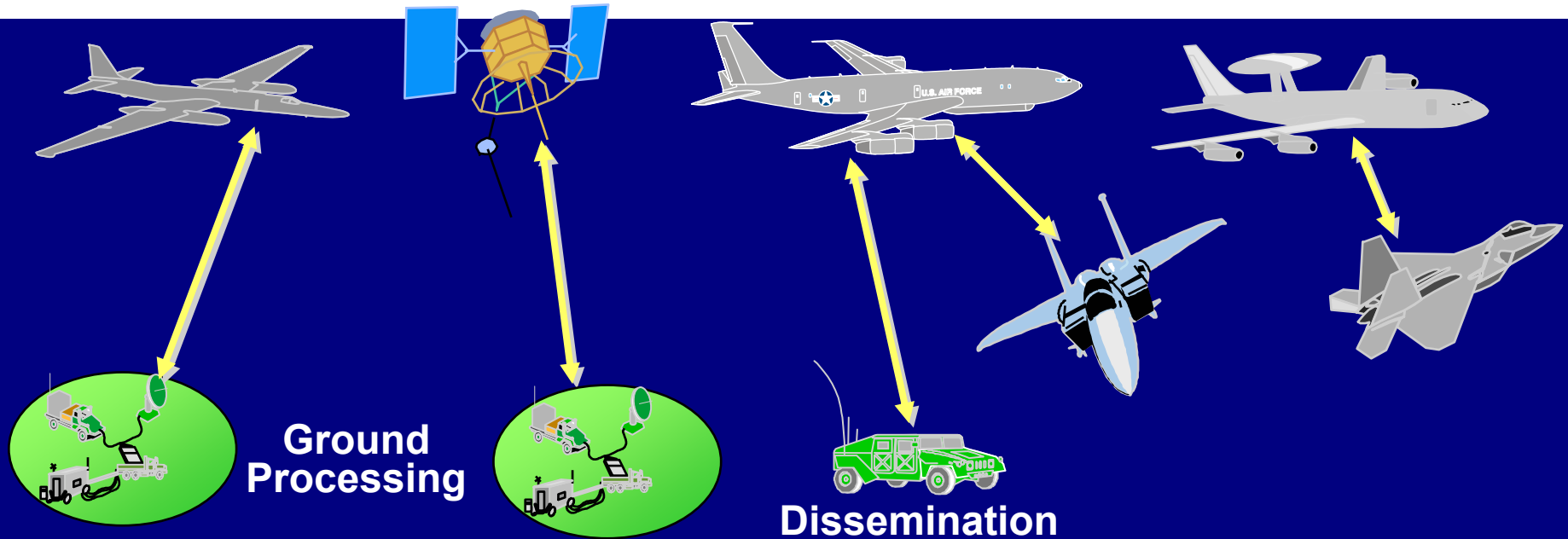
June 17-19, 2003
National Defense University
Washington

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Information Directorate
Air Force Research Laboratory

Today's Operational Picture

**Ground Processing**

Dissemination

- Individual stove-pipe systems (many consisting of legacy hardware and software)
- Little interoperability among systems
- Labor intensive collection and coordination
- Difficult to build recognized operational picture
- Scattered snapshots of the battlespace
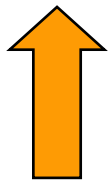- Non-standard C2 systems/centers

"Data Overloaded, Information Starved" -- SAB

The Way Ahead
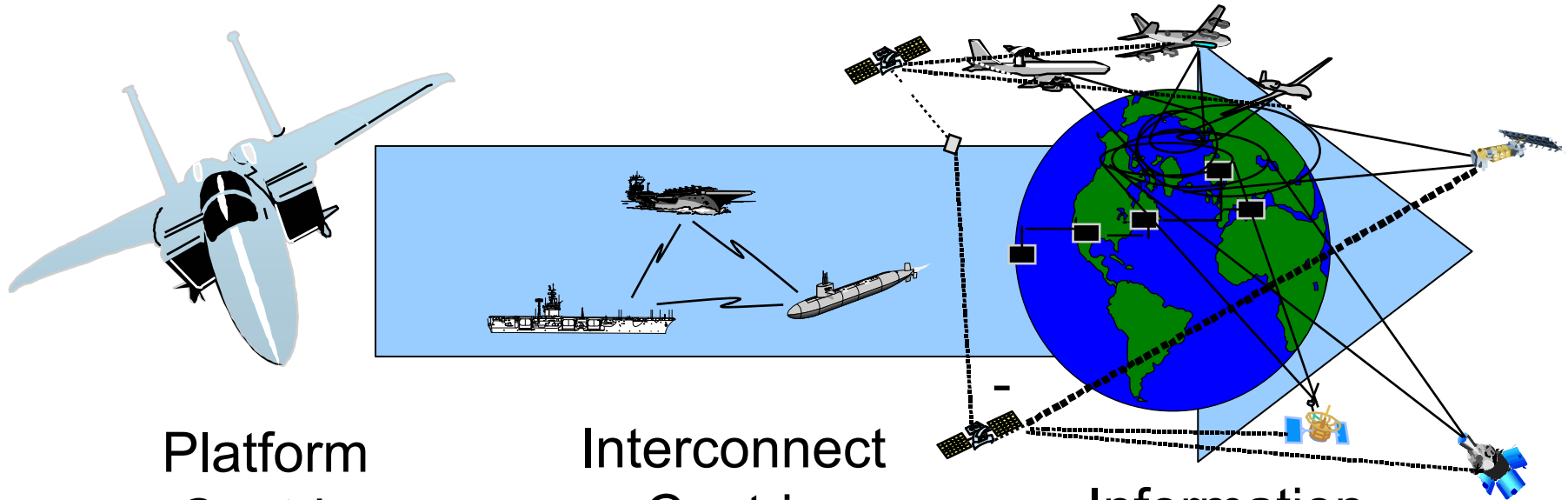
Platform Centric

Interconnect Centric

Information Centric

USAF still here

Some say we're here

We all want to be here

Future Operational Picture

Global Grid

Sensors

Weapon Systems

Processing & Exploitation Centers

C2 Centers

Aerospace Warriors

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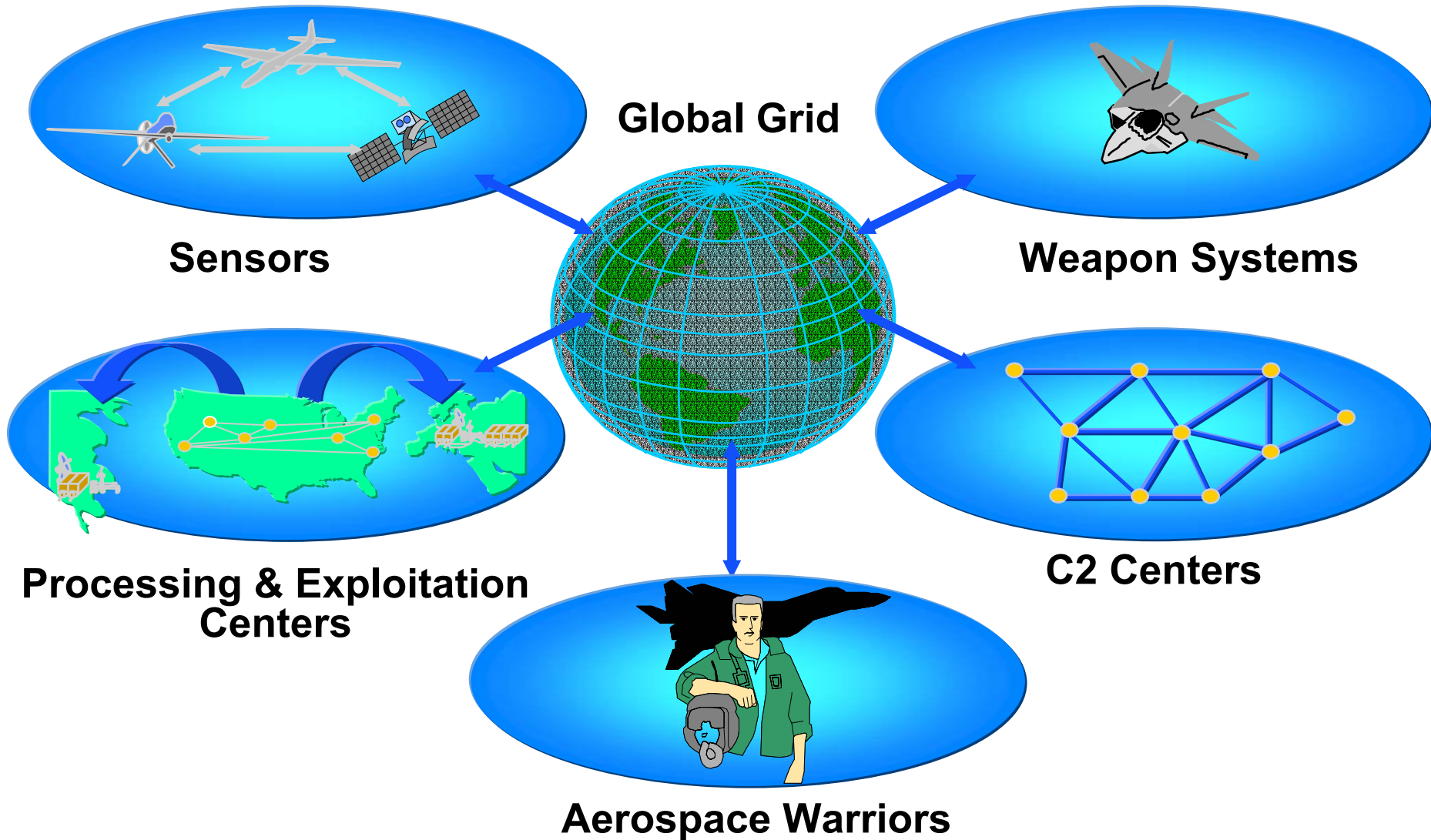
Benefits of an Infosphere based Information Exchange Infrastructure

- Improved sensor-to-shooter timeline.

- Reduced human involvement in the decision making process.

- Data is distributed more effectively because it is processed and shared.

- Connection dependencies between participants is eliminated.

Infosphere Terminology

- **advertise** - send a message to the infosphere describing the data to be published.

- **publish** - make data available for sharing.

- **subscribe** - make a request to the infosphere for future data.

- **query** - make a request for a one time transfer of historical data.

- **participant** - any application that sends or receives data.
  - fuselet - performs simple tasks on data objects. Ex., filtering, aggregation, transformation.
  - adapter/wrapper - adapts legacy data for use in the infosphere.
  - agent - solves a specific problem. Ex., SCUD Launch Detection Agent.

JBI Provides Information Exchange Infrastructure

- The Infosphere is a system of systems that integrates, aggregates, & distributes information to users at all echelons, from the operation and command centers and into the field.

- The Infosphere is built on four key technologies:

- Information exchange
  - **Publish/Subscribe/Query**

- Transforming data to knowledge
  - **Fuselets**

- Distributed collaboration
  - **Shared, updateable knowledge objects**

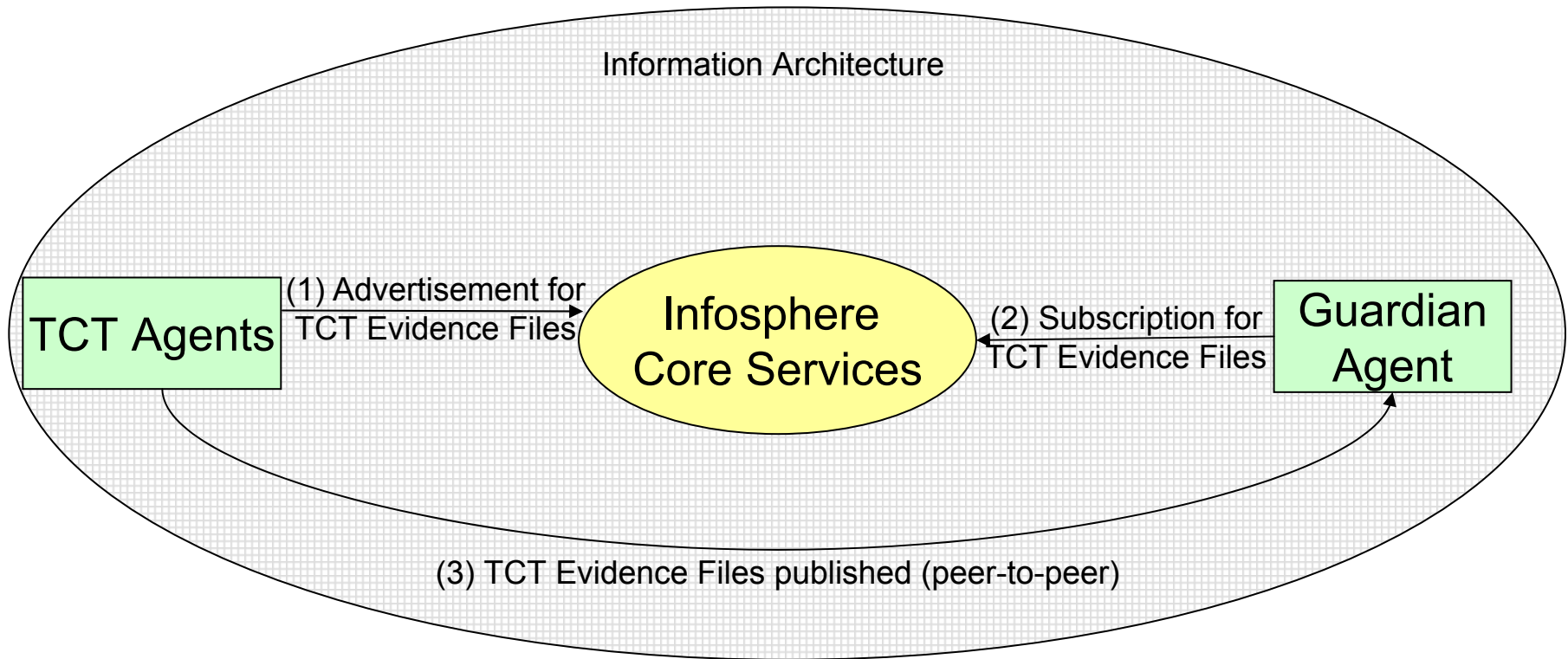- Force/Unit interfaces
  - **Templates**

    Operational capability

    Information inputs

    Information requirements

JBI Core Services Architecture

Information Architecture

TCT Agents

(1) Advertisement for
TCT Evidence Files

Infosphere
Core Services

(2) Subscription for
TCT Evidence Files

Guardian
Agent
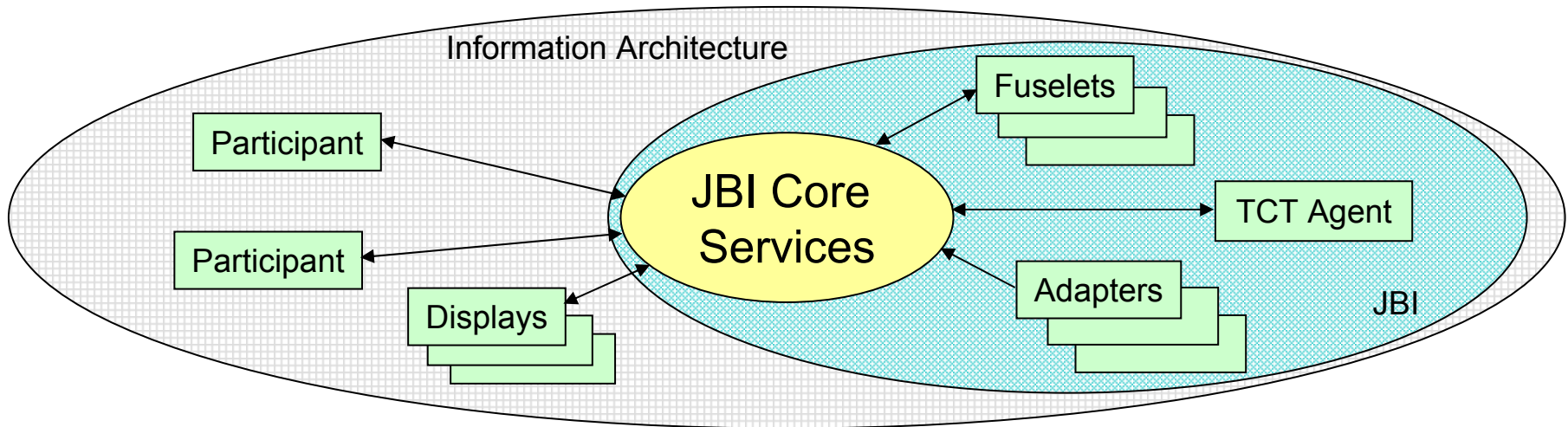
(3) TCT Evidence Files published (peer-to-peer)

Specific Example of Publish/Subscribe Services

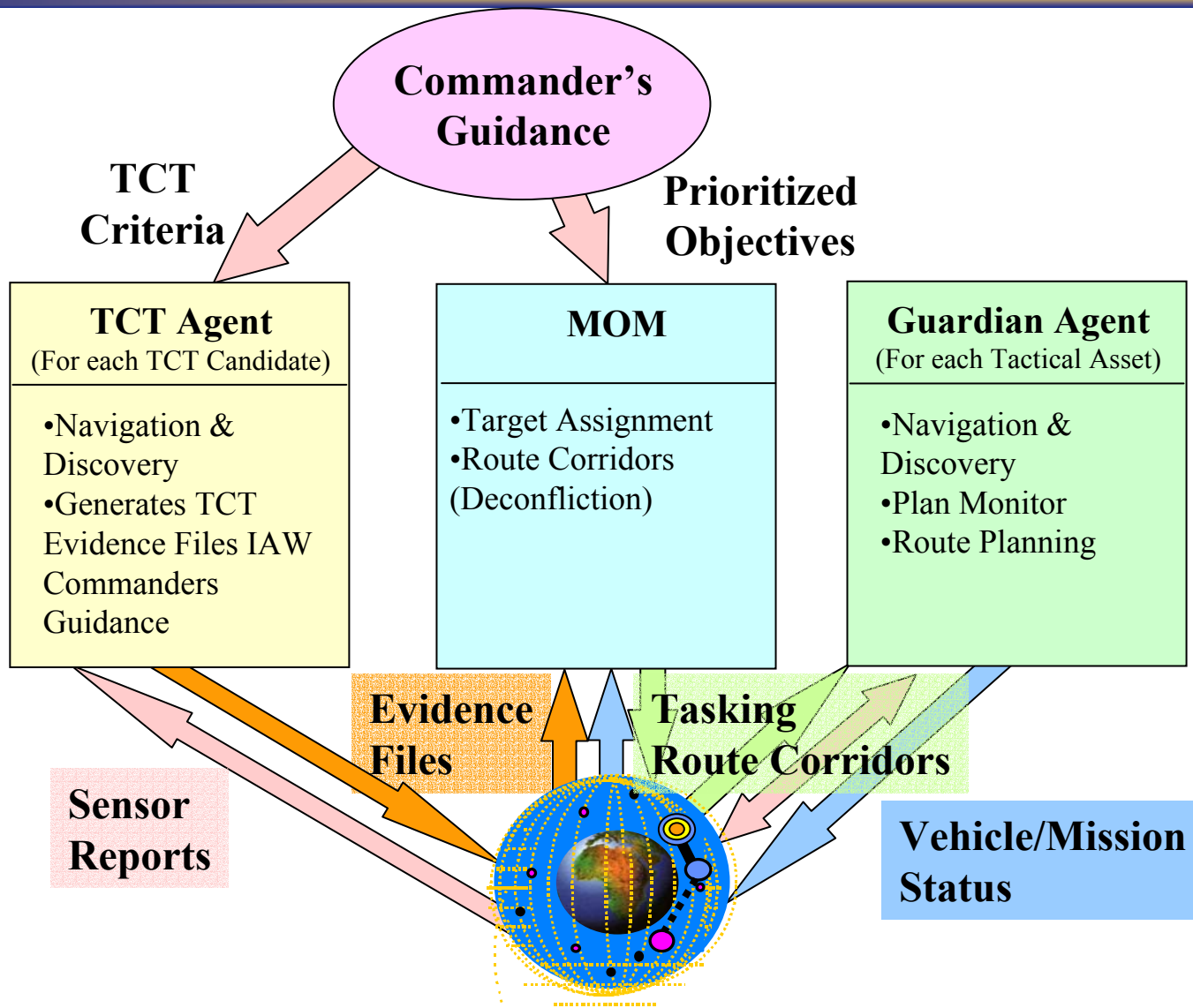# JBI Library

- In addition to the set of Core Services, JBI offers a Library of Domain Specific Applications that currently includes:
  - Adapters to enable legacy Time Critical Target (TCT) data sources to interface with JBI Core Services.
  - Fuselets to convert track, intel and imagery data from different sources into a common format.
  - Agents to track possible TCTs and publish Evidence files.

IEIST "High-Level" TCT Demo Architecture

Commander's Guidance

TCT Criteria

Prioritized Objectives

TCT Agent
(For each TCT Candidate)

- Navigation & Discovery
- Generates TCT Evidence Files IAW Commanders Guidance

MOM

- Target Assignment
- Route Corridors (Deconfliction)

Guardian Agent
(For each Tactical Asset)

- Navigation & Discovery
- Plan Monitor
- Route Planning

Evidence Files

Tasking Route Corridors

Sensor Reports

Vehicle/Mission Status

IEIST TCT Demo Architecture

| SOURCES | JBI | IEIST | F-15 SIM |

- C4Isim — Tracks & ELINT → CORBA → Wrapper
- Commander's Guidance → Wrapper
- IPB → A2IPB Wrapper
- Images → Broadsword Wrapper

JBI Broker

TCT Agents → Target Folder

Guardian Agent → Target Folder → CORBA

Desktop F-15 Simulator

Collaboration Client Browser

OSA Tracks

Engagement Cmd: (Wpn/Tgt Pairing)

MOM ← Strike Assets DB

= existing
= St Louis dev item
= Seattle dev item

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What is a SoftwareAgent?

- An autonomous software element

- Deployed in a publish/subscribe environment
  to solve a specific problem

- Is data oriented, rather than process oriented

- Subscribes to all data objects necessary to
  solve a problem, and publishes a data object
  which is the solution to the problem.

- Is usually rule-based

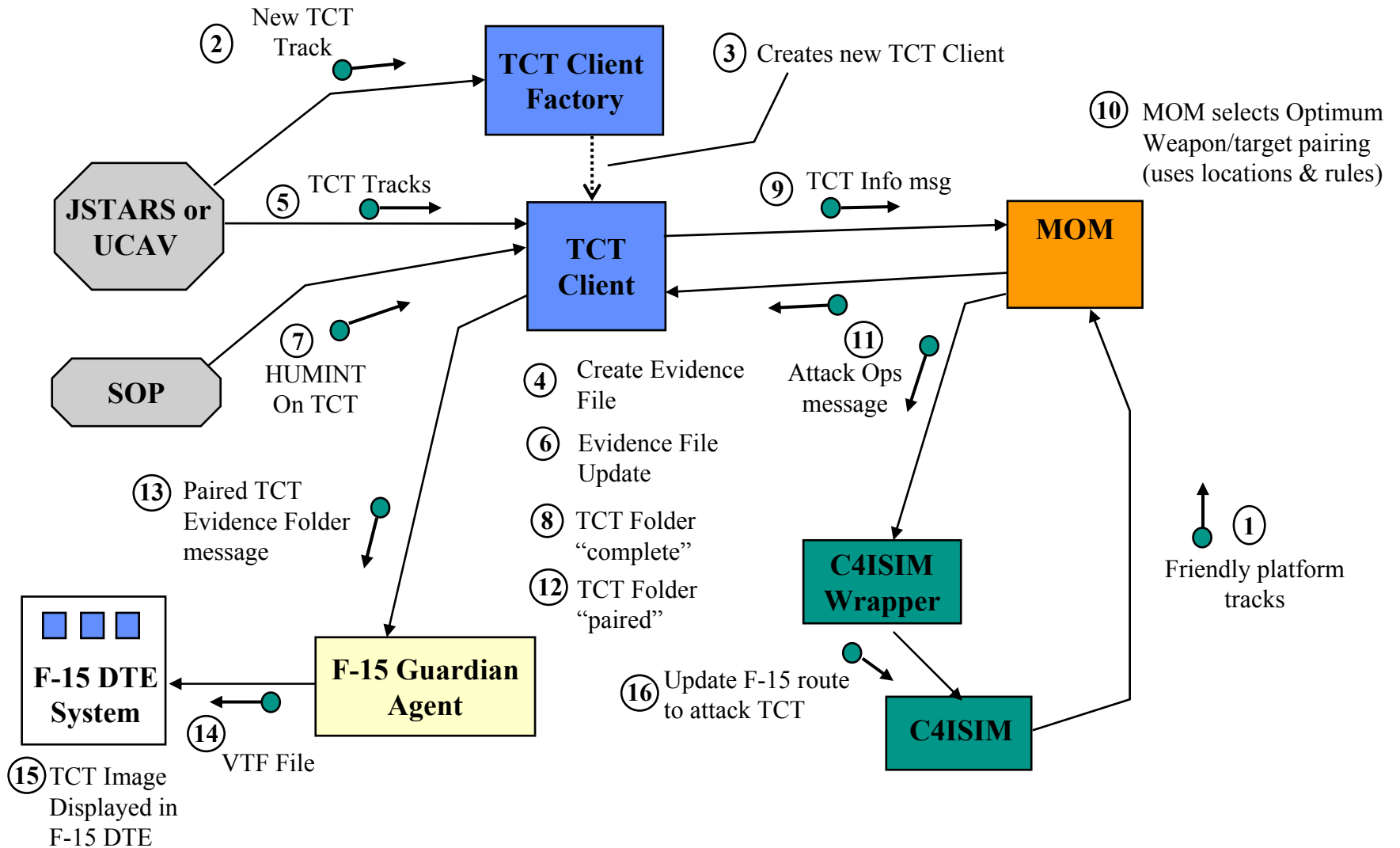- Performs no user interfacing

F-15 Agents Provide Information Management
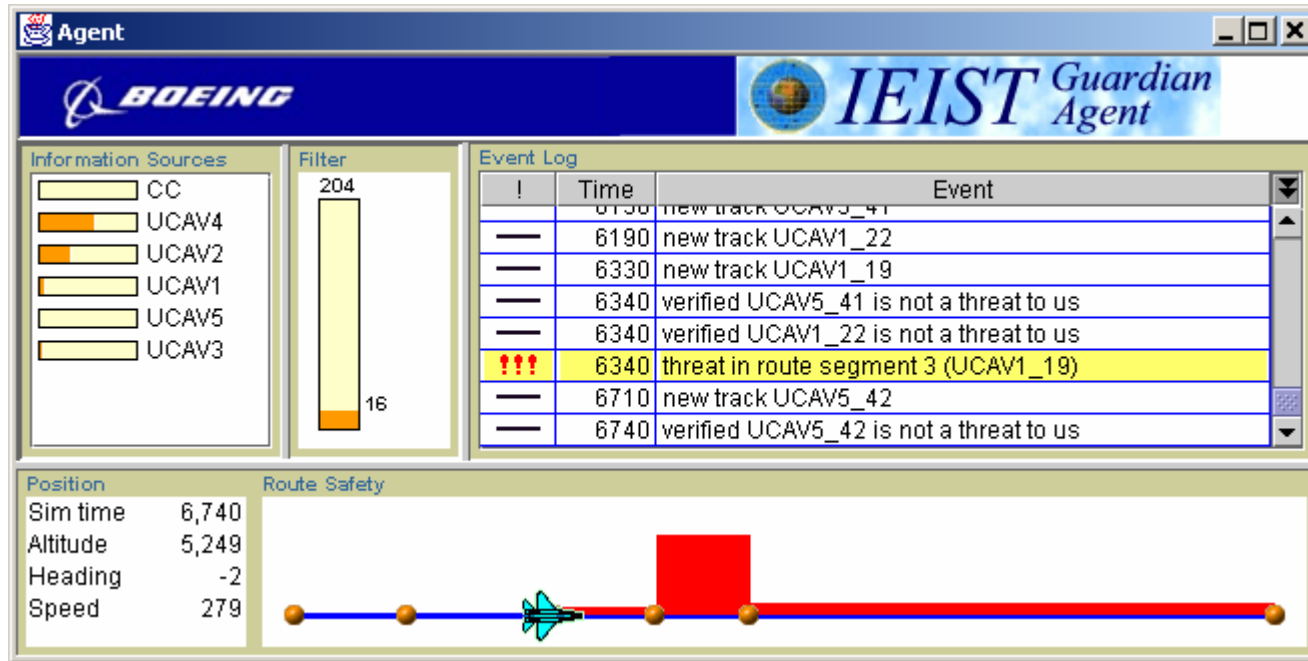
- F-15 Guardian Agent monitors for threats along route
- Guardian Agent displays route threat status information
- It tracks status data from information sources

TCT Kill Cycle For F-15s

- ② New TCT Track
- ③ Creates new TCT Client
- ⑩ MOM selects Optimum Weapon/target pairing (uses locations & rules)

TCT Client Factory

JSTARS or UCAV

- ⑤ TCT Tracks
- ⑨ TCT Info msg

TCT Client

MOM

SOP

- ⑦ HUMINT On TCT
- ④ Create Evidence File
- ⑪ Attack Ops message

- ⑥ Evidence File Update

- ⑬ Paired TCT Evidence Folder message
- ⑧ TCT Folder "complete"
- ⑫ TCT Folder "paired"

- ① Friendly platform tracks

C4ISIM Wrapper

F-15 DTE System

F-15 Guardian Agent

- ⑯ Update F-15 route to attack TCT

C4ISIM

- ⑭ VTF File
- ⑮ TCT Image Displayed in F-15 DTE

The Scenario

- Kosovo based scenario

- Two F-15s flying search and destroy missions
    - DTE's for each F-15

- Two pairs of UCAVs flying search and destroy missions

- One UCAV flying mission to destroy pre-defined target

- A total of five TCTs appear during scenario run
    - SCUD-style Transporter/Erector Launcher (TEL)
    - Armor
    - Three SAM's

- All TCTs confirmed by Special Operation Personnel (HUMINT)

The Scenario (Cont.)
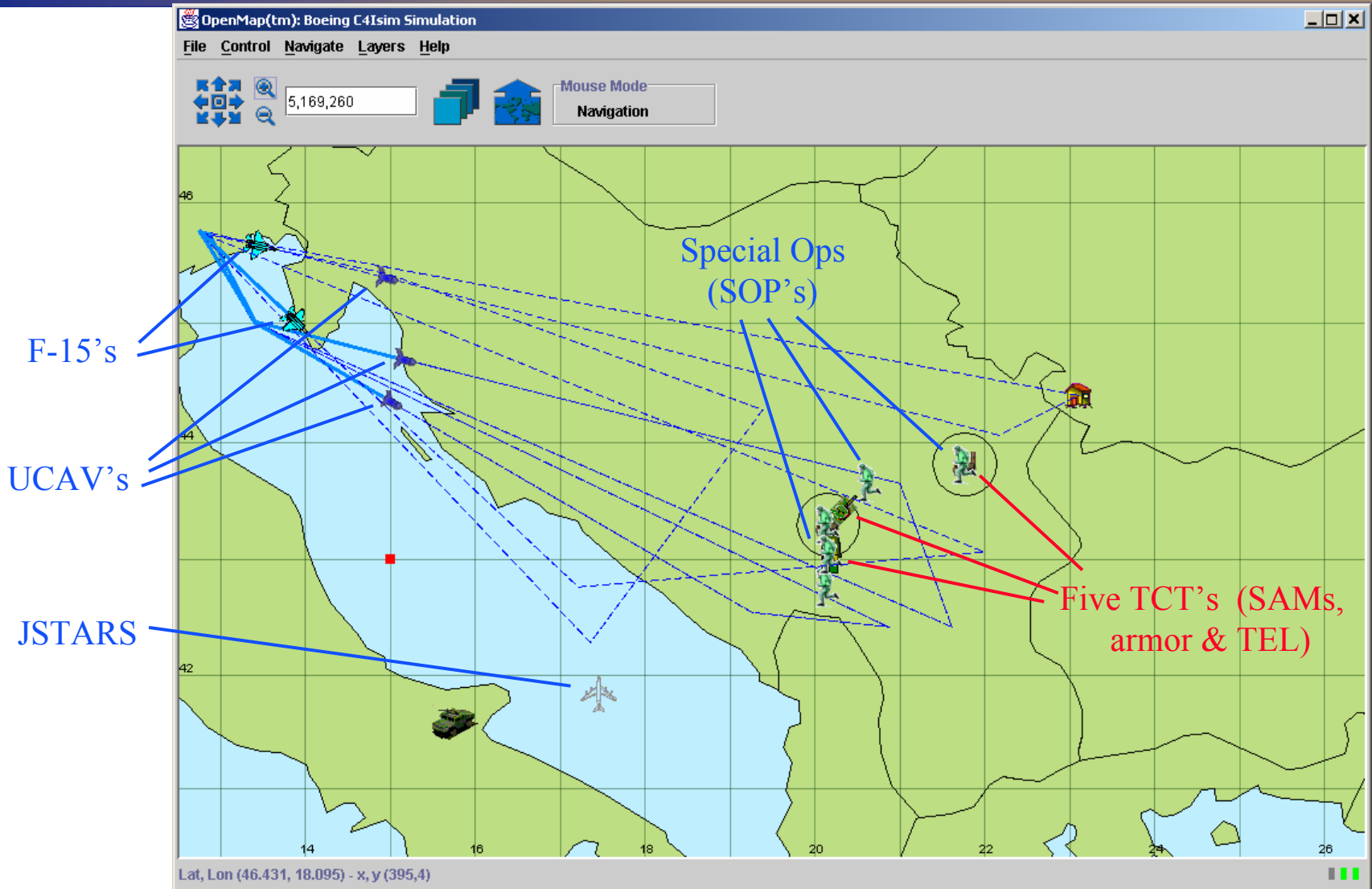
TCT Agent
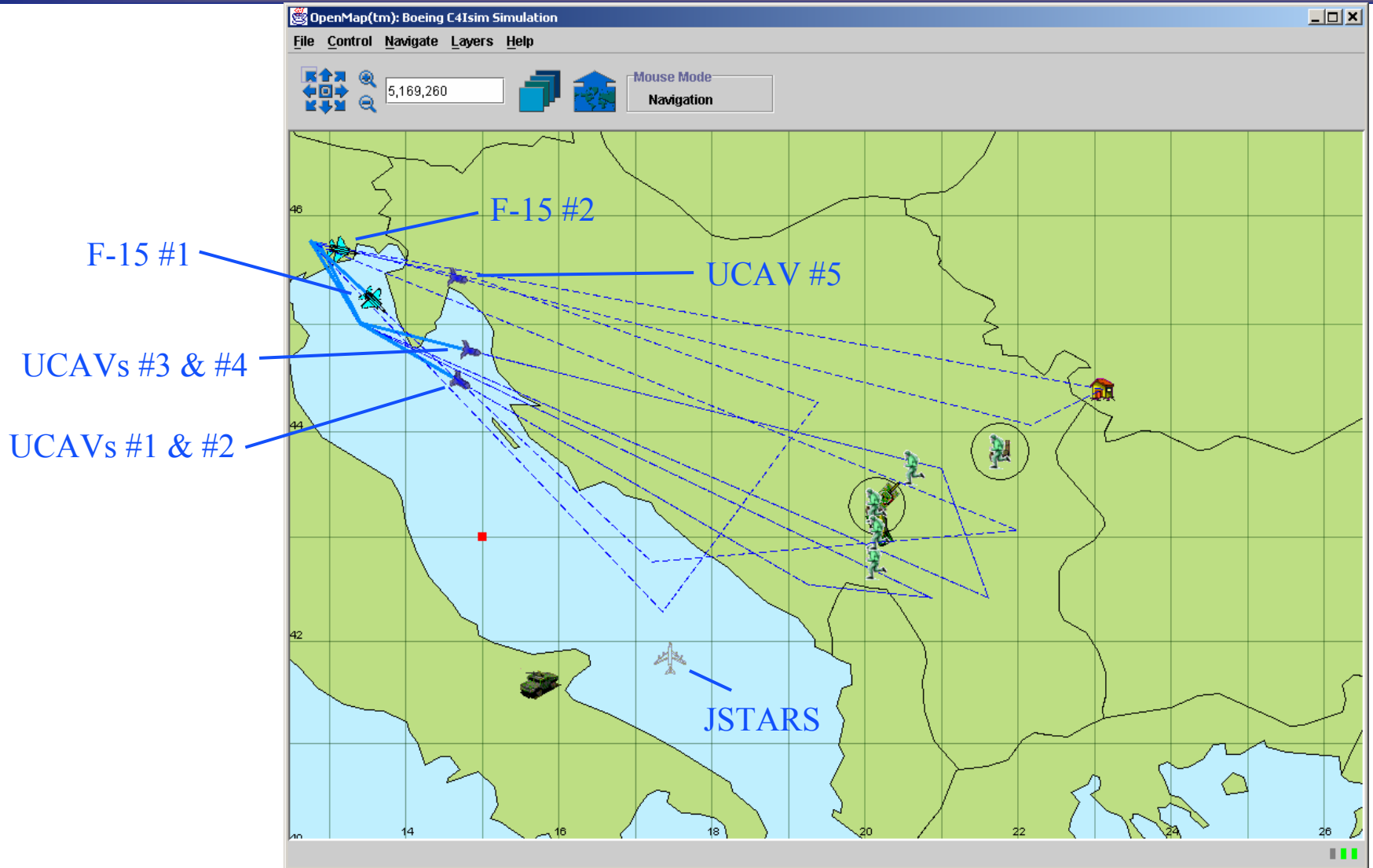
Scenario @ 1:00 Hrs.
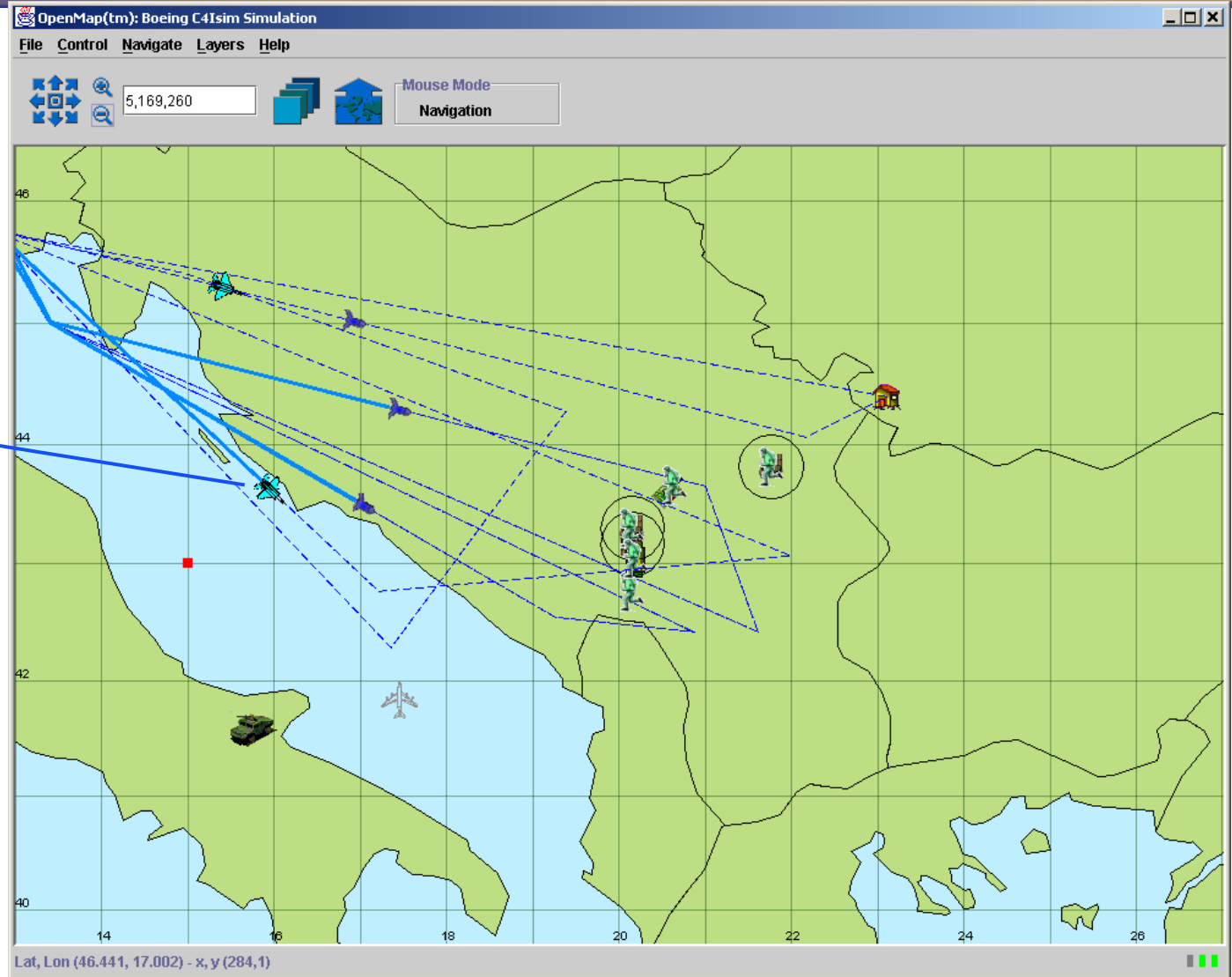
F-15 #1 assigned TEL
(TEL on current route)

Agent — IEIST Guardian Agent (BOEING)

Information Sources
- CC
- UCAV4
- UCAV2
- UCAV3
- UCAV1
- UCAV5

Filter

Event Log

!	Time	Event
	20	subscribed to sensor reports from UCAV2
—	30	subscribed to sensor reports from UCAV3
—	30	subscribed to sensor reports from UCAV1
—	240	subscribed to sensor reports from UCAV5
—	4770	evaluating UCAV4_1 (possible threat)
!!!	4960	threat in route segment 2 (UCAV4_1)
!!	4960	UCAV4_1 targeted for attack
!!!	4980	alert crew of attack plan for UCAV4_1

Position
Sim time	5,180
Altitude	5,245
Heading	85
Speed	279

Route Safety

Mouse Mode
Navigation

F-15 #1 GA warns of threat

UCAVs #3 & #4 Heading to SAM 02

UCAVs #1 & #2 will soon be assigned to attack SAM 01

SAM 02 radiating

TEL heading west

SAM 01 radiating

Lat, Lon (44.753, 20.763) - x, y (560,17)

20

Scenario @ Time 1:45 Hrs.


Agent — IEIST Guardian Agent (Boeing)

Information Sources:
- CC
- UCAV4
- UCAV2
- UCAV3
- UCAV1
- UCAV5

Filter: 21 / 8

Event Log:

!	Time	Event
	3200	evaluating UCAV2_1 (possible threat)
‼	5380	updating mission plan
‼‼	5400	threat in route segment 3 (UCAV2_1)
‼	5400	UCAV2_1 targeted for attack
‼‼	5420	alert crew of attack plan for UCAV2_1
—	5540	new track UCAV5_39
‼‼	5550	threat in route segment 3 (UCAV5_39)
—	6150	new track UCAV5_41

Position:
- Sim time: 6,300
- Altitude: 5,249
- Heading: 90
- Speed: 279

Route Safety

Mouse Mode: Navigation

Lat, Lon (44.586, 21.153) - x, y (627,64)
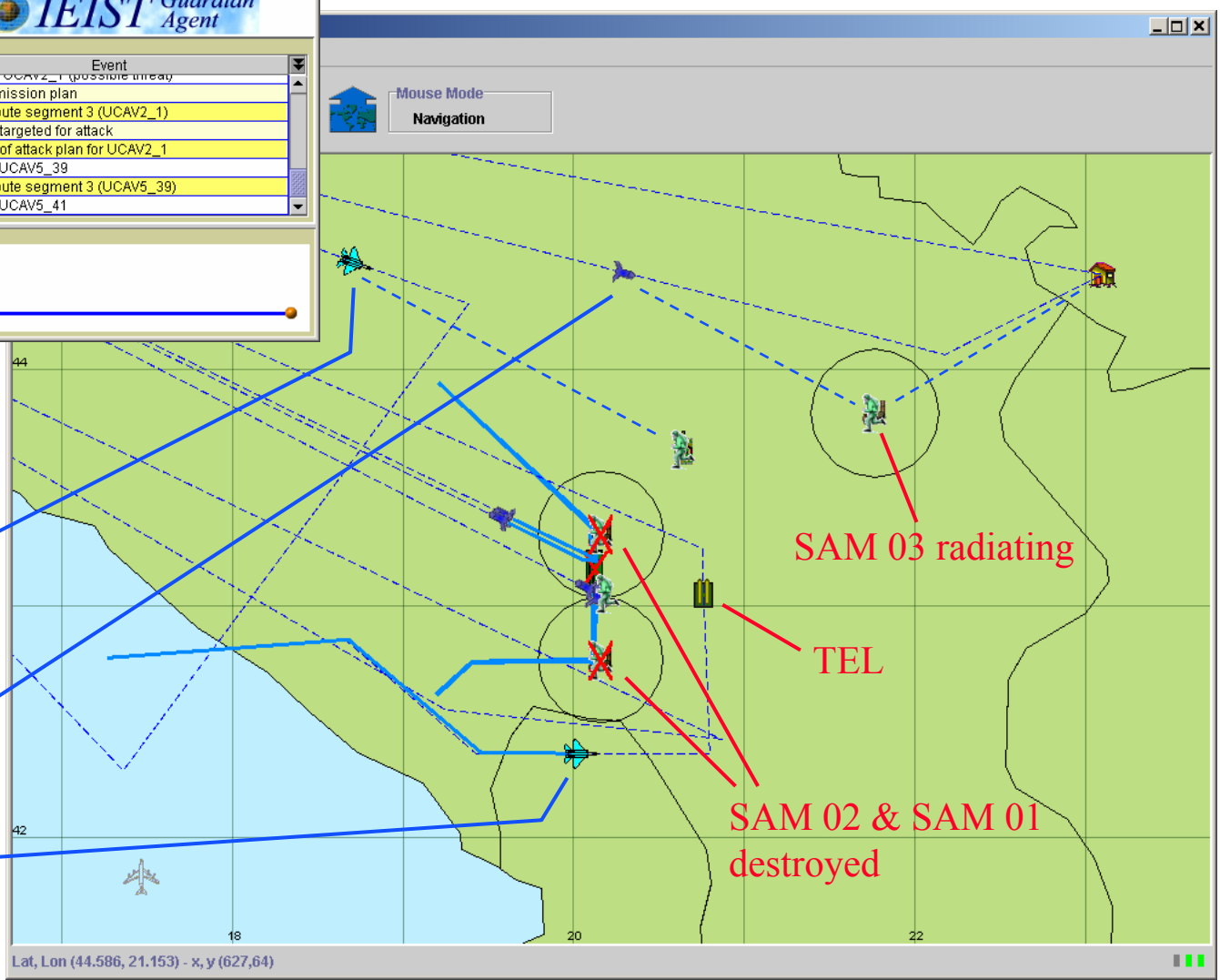
F-15 #1 GA shows no threat (UCAVs destroyed SAMs)

F-15 #2 will attack armor

UCAV #5 will re-route to SAM 03

F-15 #1 re-routed around threat

SAM 03 radiating

TEL

SAM 02 & SAM 01 destroyed