# Defensive Planning for Combined Forces

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## *ABSTRACT*

*This paper is based on the experience gained by personnel of the Information Directorate of the US Air Force Research Laboratory's Rome, NY Research Site, during the development, validation, testing and fielding OF the Joint Defensive Planner (JDP) in the USAF Theater Battle Management Core Systems (TBMCS). JDP was used, for the past three years, in its successive developmental spirals, by the US/NE/GE Extended Air Defense Task Force during the Joint Project Optic Windmill (JPOW) exercises in NATO. JDP is currently being evaluated by personnel of the United Kingdom (UK) Joint Force Air Command HQ and the UK Air Warfare Centre for potential use in UK Systems. How this all came about is the essence of this paper that addresses many of the topics associated with this Symposium.*

## INTRODUCTION

This paper "Defensive Planning for Combined Forces" addresses the theme of this Symposium: "Commanders at all levels and types of military organizations require timely and accurate awareness of the situation in their respective areas of responsibility as well as prediction of likely intentions of participants".

Of equal, or greater, importance is that Commanders at all levels have a **consistent** situation awareness, although the level of detail may vary, depending upon position in the Chain of Command or organizational functions to be performed. The overall goal is to provide a single, joint software planning tool to assist Theater Air and Missile Defense (TAMD) staffs of the Combatant Commander (COCOM), Joint Force Commander (JFC), Area Air Defense Commander (AADC), Regional Air Defense Commander(s) (RADC), and Service Component Commanders to collaboratively develop the operational level joint TAMD plan to counter air and missile threats. This was an important JDP design goal that was met during development and fielding. Figure 1 illustrates the operational context of one TAMD planning tool being used at the strategic level (Joint Force Campaign Planning) and down to the operational level (Situation Monitoring and Plan Repair).

The resultant Area Air Defense Plan (AADP) documents the AADC's plan for integrating and coordinating joint air and missile defense. It details how TAMD operations will support the Joint Force Air Component Commander's (JFACC's) Joint Air Operations Plan and the JFC's Campaign Plan. This paper reflects on JDP Lessons Learned and incorporates them as general guidelines to describe a process to develop defensive planning tools for combined forces.

Joint TAMD planning includes campaign level deliberate and crisis action planning. Combatant commanders translate national and theater strategy into strategic and operational concepts through the development of

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theater campaign plans. Deliberate planning prepares for a potential contingency based upon the best available information and using forces and resources apportioned to the COCOM by the Services. Deliberate planning is conducted principally in peacetime to develop joint operation plans for contingencies identified in strategic planning documents. Crisis action planning is based on current events and conducted in time-sensitive situations and emergencies using assigned, attached, and allocated forces and resources. Crisis action planning follows procedures that parallel deliberate planning, but are more flexible and responsive to changing events. The planning tools should be adaptable to various configurations (i.e., in garrison, aboard ship, in exercises, and in deployments).

This paper addresses several of the topics of interest of this Symposium. The seven following sections relate these topics to defensive planning.

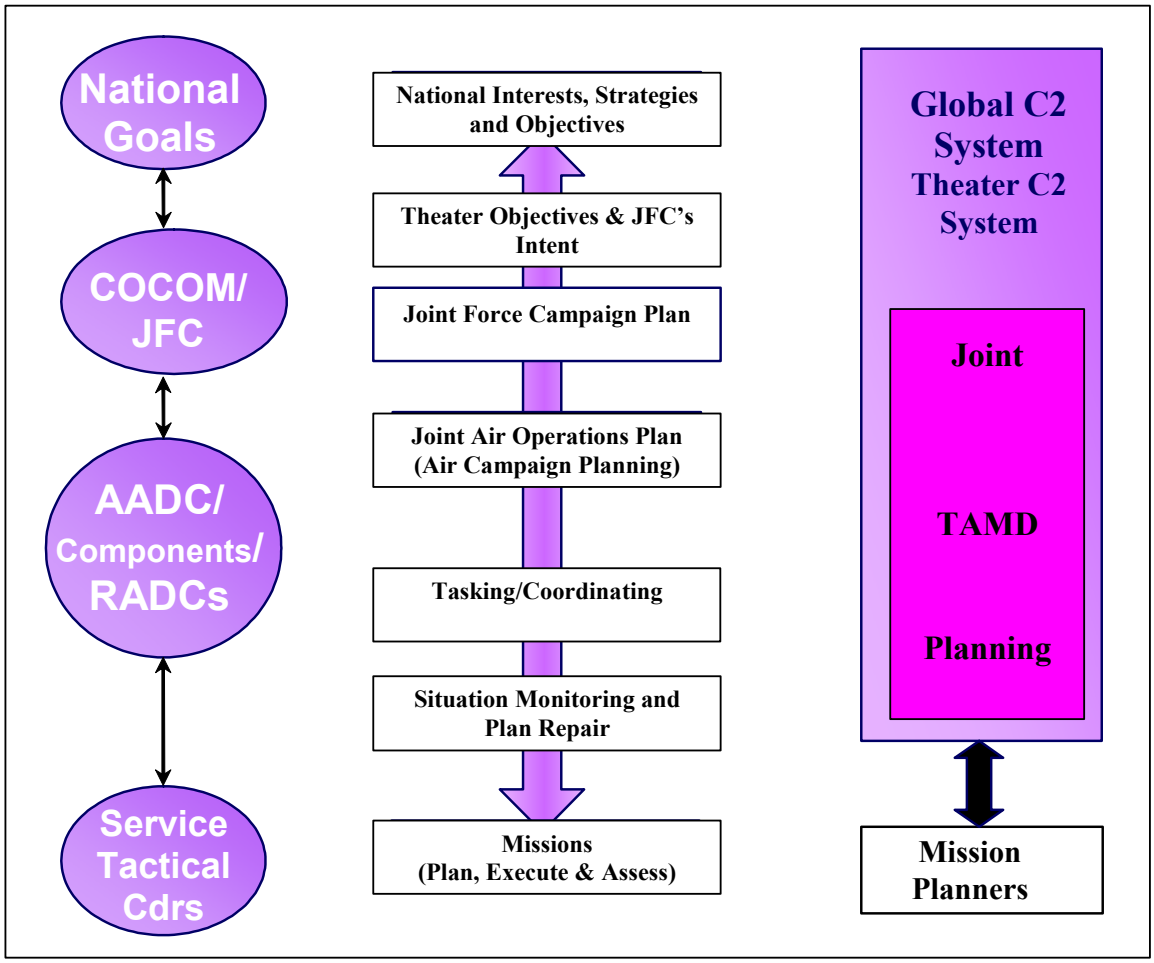


**Figure 1: TAMD Operational Context.**

## 1.0 MILITARY REQUIREMENTS FOR DATA INTERPRETATION AND INFORMATION FUSION

General military requirements are to create an Area Air Defense Plan for the entire theater of operations for the entire campaign which may consist of many phases. Defensive planning and operations are critical in the

early phases of a campaign as offensive capability builds up. New and complex non-military information aspects such as national, alliance and coalition political and economic objectives and strategies must be translated into military objectives (Effects Based Operations) and strategies that finally result in military tasks. These military tasks must be traced back to the original stated objectives and strategies and must be consistent with the Rules Of Engagement (ROE) and legal aspects of the operation. The objectives and strategy statements must be electronically captured at the highest Command level and must be made available at all Command levels as more detailed and responsive planning ensues. The defensive planning tool should capture these objectives and use them as criteria during plan development while also allowing the commanders at lower echelons to refine the guidance from higher echelons.

In terms of planning tool development, the general requirements described above must be decomposed into more detailed, or derived, functional design requirements to the level that trained and skilled planners and other defensive operators need to perform their jobs. These requirements are generally referred to as "Workstation Requirements". This is accomplished by forming a Joint User Group (JUG) of defensive operational expert users from as many services, agencies, and organizations as possible. The JUG guides the development process, evaluates sequential prototypes from both technical and operational viewpoints, and approves the final product. This process assures the final product meets operational objectives. The Group also makes informed judgements involving cost and time constraints against technical and functional performance. Figure 2 represents this process. The process of rapid evolutionary prototype (i.e. spiral development) demonstrations is conducted with a large group of user representatives. This is the preferred way of verifying very early, and continuously through the development cycle, that the planning tool is performing the required functions, that the correct data is available, and is fused into information the user needs to see. At this point the visualization aspects should be derived.

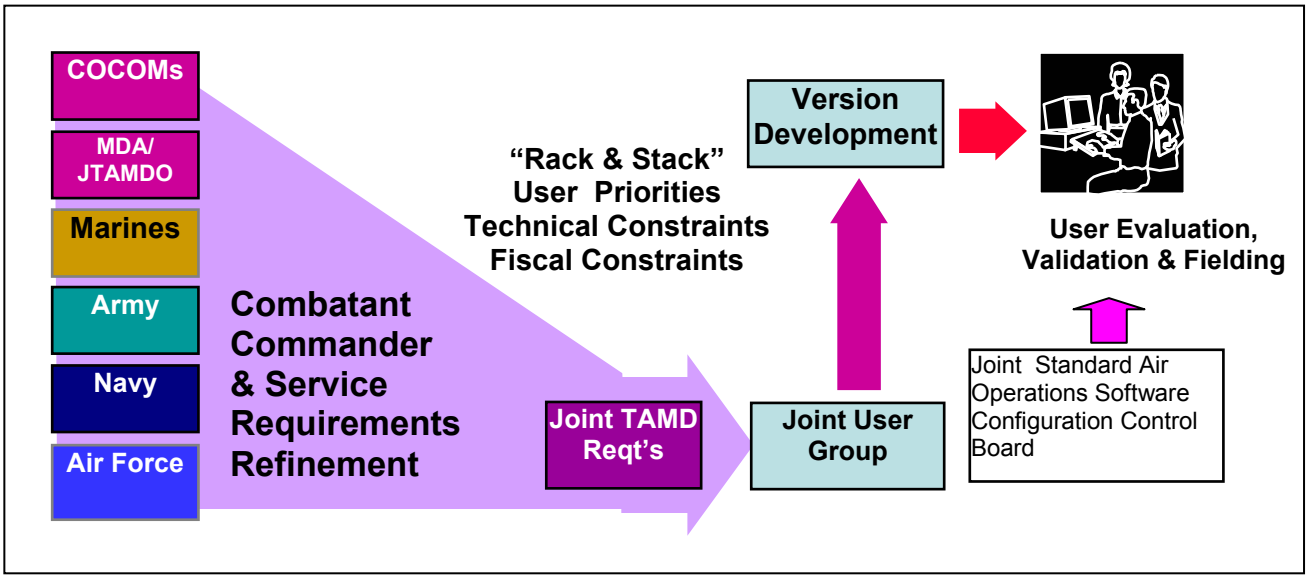


**Figure 2: Joint Users Group (JUG).**

Figure 3 illustrates another important aspect of defensive planning. A campaign may consist of many phases from pre-deployment until forces return to garrison. Also, the phases may begin as Operations Other Than War (OOTW) and could conceivably escalate to a combat situation, possibly asymmetric, perhaps with more

defensive than offensive operations, and then revert to peace keeping. The AADP must serve the purpose through all phases of the campaign. Figure 3 shows a five phase campaign. Defensive designs must be prepared for each phase consistent with the situation during that phase. More than one defense design may be needed during each phase, dependent upon the changing threat, situation assessment, political and military objectives and other factors. Note that a defense design may overlap many 24 hour Air Tasking Order (ATO) days. There may also be more than one defense design in effect during a single ATO day. Aircraft that fly Combat Air Patrol (CAP), or are associated with other defensive missions, must be tasked as part of the ATO and must adhere to the Airspace Control Plan (ACP).

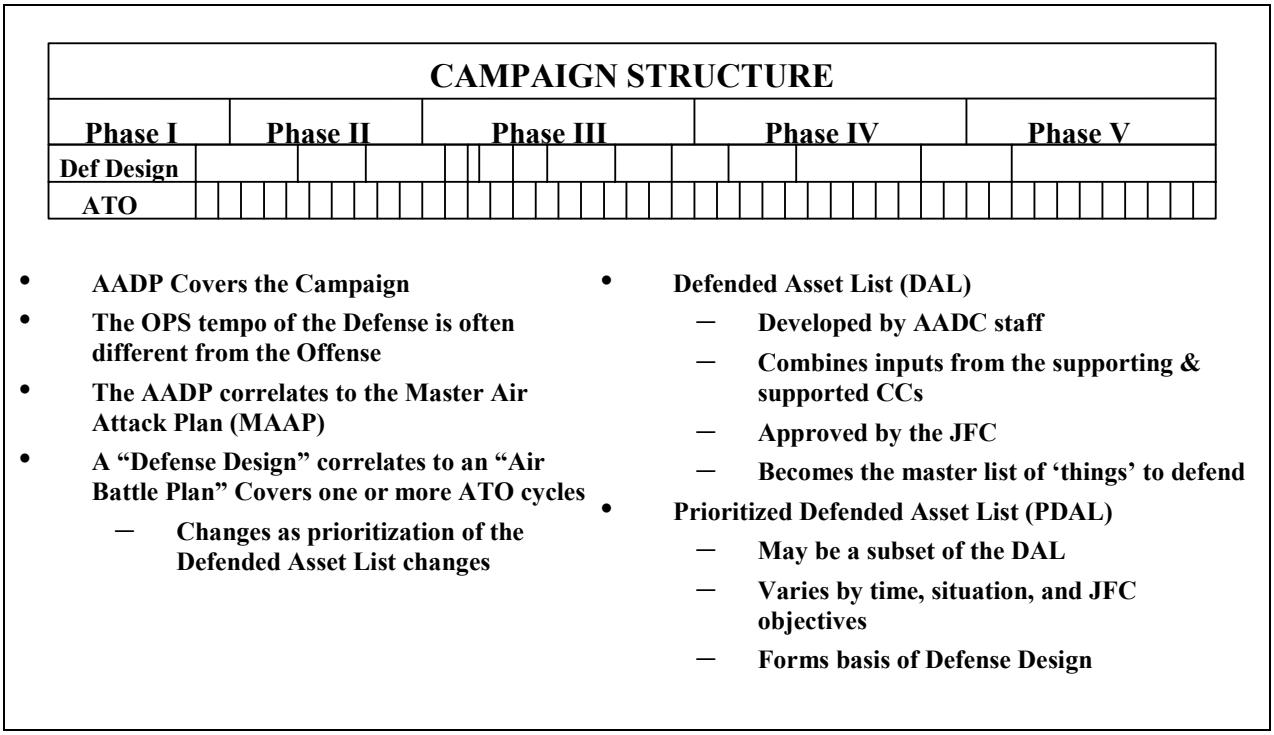


**Figure 3: Defensive Planning within the Campaign Structure.**

## 2.0 CONCEPTS OF MILITARY DATA AND INFORMATION FUSION

Military data on both friendly and adversary forces is required. Data input should be automated as much as possible. Not all data is available in easily accessible data bases. Therefore, this requires that simple user friendly Graphical User Interface (GUI) capabilities be incorporated that allow operators to set up or edit cases of interest. Representations of friendly resources, Command Control (C2), surveillance and shooters, are critical to conducting "what if" scenarios. Threat locations and potential avenues of approach, or courses of action, need to be quickly entered. Lists of defended assets need to be nominated and ranked in priority order with respect to criticality, vulnerability and recoverability with respect to a specific threat weapon system (see Figure 4). Finally, the map based graphical representations need to be easily understood by defensive planning commanders and staffs. The system must be adaptable to a variety of situations including Operations Other Than War, Peace Keeping, combat or in instances of Counter Terrorism.

The term "Information Fusion" in this paper is not used in the familiar intelligence context of bringing together reports from disparate sensors, or other information sources, and "fusing" into a single coherent interpretation. Rather, fusion means bringing together Friendly Order Of Battle and Enemy Order Of Battle data elements, capabilities of friendly and enemy air and missile systems, both surveillance and weapons, and Geographic Information Systems (GIS), in such a way that several candidate defense designs can be planned and evaluated against a variety of threat Courses Of Action (COA). The planning tool operator is supported in a software architecture by a collection of Wizards, Text and Data Editors, graphical display products including Power Point, Hyper Text Markup Language (HTML) and others. This collection of capabilities is designed and configured to support the operational user who always has the capability to interact with, and override, the computer operation, as part of the planning capability.

## 3.0 APPLICATION EXAMPLES AND DEMONSTRATORS OF DATA AND INFORMATION FUSION

One of the early defensive planning tasks is to prepare the Defended Asset List (DAL) which includes all the entities that need to be defended in the Joint Operations Area during the campaign. In the terminology of this paper, "assets" are the entities to be defended and "resources" are the entities that are used to defend the assets. The next step is to rank order or prioritize the assets, for a specific period of time, in terms of criticality, vulnerability, and recoverability. A simple example is given in Figure 4. Values in the range 0.0 to 1.0 are applied to each factor based on the capabilities of the threat weapon system. The values are then weighted. For this example the weights applied are in the ratio 3:2:1. The result of this activity is the prioritized DAL (PDAL).

| Asset | Criticality Weight - 3 | Vulnerability Weight - 2 | Recoverability Weight - 1 | Ranking | Priority |
|---|---|---|---|---|---|
| Airbase | 0.9 | 0.9 | 0.6 | 0.85 | 1 |
| C2 HQ | 0.9 | 0.7 | 0.9 | 0.83 | 2 |
| City | 0.6 | 0.9 | 0.9 | 0.75 | 3 |
| Port | 0.6 | 0.9 | 0.8 | 0.73 | 4 |
| Cultural Center | 0.9 | 0.1 | 0.4 | 0.55 | 5 |
| Logistics Site | 0.5 | 0.5 | 0.1 | 0.43 | 6 |
| Civilian Airport | 0.4 | 0.3 | 0.1 | 0.32 | 7 |

**Figure 4: PDAL Results from Analyzing Criticality, Vulnerability, and Recoverability.**

Note that the "cultural center" is given a very high criticality rating of 0.9, but is only number 5 on the PDAL. It may be of great value to the local population for historical, religious, or political reasons, but may have little military value. Or it may just not be a viable target for enemy strike capability, at least in the current operational phase, and therefore has a very low vulnerability rating.

## 4.0 THREAT IMPACT/ASSESSMENT

The air and missile threat can be defined through Intelligence Preparation of the Battlespace (IPB) or the more advanced Predictive Battlespace Awareness (PBA). In actual system use, qualified air and missile defense planners will have the final say in refining the threat activity and possible Enemy Courses of Action. The planning tool software should be configured to retrieve (import) and display detailed enemy order of battle data from intelligence databases. The Import Wizard function allows the operator to view and import data without having to enter the data manually.

## 5.0 SITUATION AWARENESS, SITUATION ASSESSMENT

Situation awareness will be determined by a combination of data availability, information availability, and geographic mapping systems overlayed with both friendly and enemy status. Critical to defensive planning is enemy launch points, for both air and missiles threats, possible avenues of approach, trajectories, assets to be defended, and resources available to defend these assets. The planning tool software should be configured to retrieve (import) and display detailed friendly order of battle data from air operations databases, using the Import Wizard, as above.

Situation assessment depends upon the fusion of critical performance of all available sensors in the area, based on their location, including land, sea and airborne sensors. This information should be used to display overlapping surveillance coverage patterns as affected by terrain elevation obstructions. For defense laydown planning the position of mobile or relocatable sensors should be evaluated in a series of "what if" scenarios. Even more important is the fusion of critical performance of all available land, sea, and airborne shooters in the area, based on their location and capabilities to engage the incoming threat. The objective is a defense design that best utilizes limited defensive resources tasked to counter projected enemy courses of action against rank ordered strategic and operational friendly assets.

## 6.0 REPRESENTATION OF MILITARY KNOWLEDGE

Military knowledge in this context is represented in the final products. The AADP is the most important. It includes the DAL and PDALs. PDALs is plural since there may be many PDAL instances as the campaign progresses and the situation evolves. There may be many Defense Designs for the same reasons. The AADP is part of the overall Theater Operations Plan (OPLAN), or could be tailored to specific contingency operations. It is extensible to different phases of the campaign and could be modified for various time periods within each phase, as the situation changes. The AADP is a force level plan which is distributed to the tactical level operators for detailed planning and implementation. Actual implementation, as in precise location of fixed and mobile surveillance and shooter resources, is the responsibility of the respective Service tactical commanders. However these locations need to be fed back to the Force Level for plan updates. Likewise aircraft orbits and ship patterns need to be fed back to keep the AADP as current as possible.

Military knowledge and situation awareness is also represented by the graphics in Figures 5, 6, and 7.

Many of the topics described above are illustrated in Figure 5, which represents an entirely made up scenario. The capabilities assigned to the sensors and shooters are not based on actual capabilities but are meant to show some of the graphics capabilities in a scenario that is not very realistic. It shows aspects of what a defense design might look like. Enemy Air Avenues of Approach (AAoA) are shown in triple red lines. A potential Missile Threat Origin (MTO) is located and the large red circle indicates the range of missiles

launched from this site. Note that several of the assets on the PDAL (Figure 4) are currently in threat of enemy activity while some are not. An airborne warning and control system aircraft is positioned in an orbit for surveillance of both enemy AAoAs. A combat Air Patrol (CAP) fighter is positioned to protect both the AWACS aircraft, C2 HQ and Airbase 3, through Fighter Engagement Zones (FEZ) 2 and 3. Likewise CAP 1 is protecting Air Base 1. The pie shaped "wedges" from the CAP aircraft indicate typical acquisition radar range and kinetic range of their weapons. The shields near the assets indicate they are being protected. Similarly a Navy ship is protecting the port. Friendly Surface to Air Missile (SAM) sites 2 and 3 are located to protect the City and the C2 site. The C2 site is partially obscured by the words SAM 3 in Figure 5.

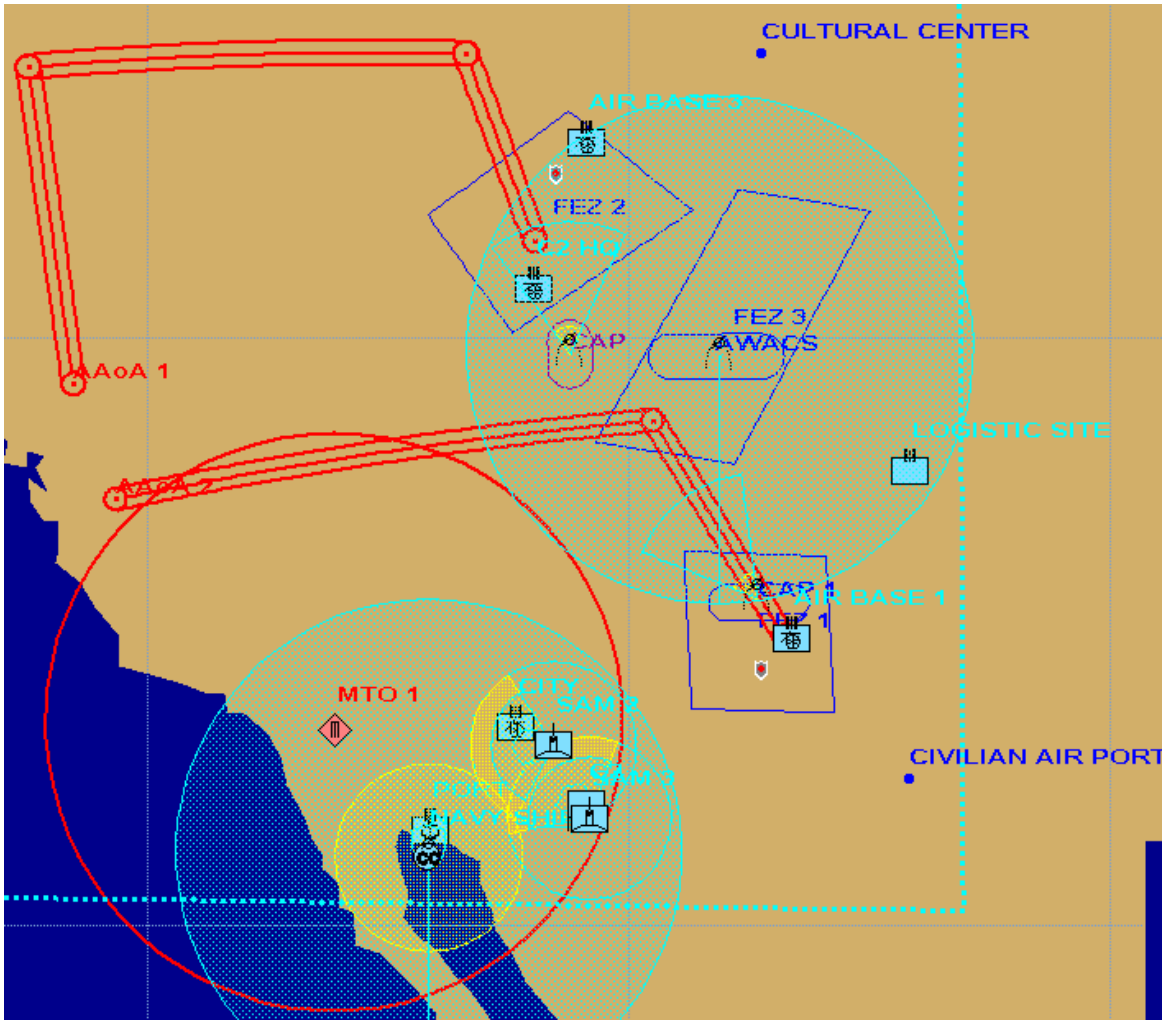


**Figure 5: Map Based Planning.**

Figures 6 and 7 show sensor coverage to detect enemy aircraft that might use the AAoAs indicated by the red lines. Both ingress and egress routes are shown. Here altitude, radar cross section, and terrain effects are parameters included in the calculation. These calculations can be included on the map display of Figure 5 to complete the Defense Design. This feature is not shown. Several Defense Designs may be developed and evaluated through the application of appropriate Measures of Effectiveness and Measures of Performance.

The Defense Design selected is included in the Area Air Defense Plan for each phase of the campaign. Non-selected Defense Designs can be archived and reused as alternatives in the future.

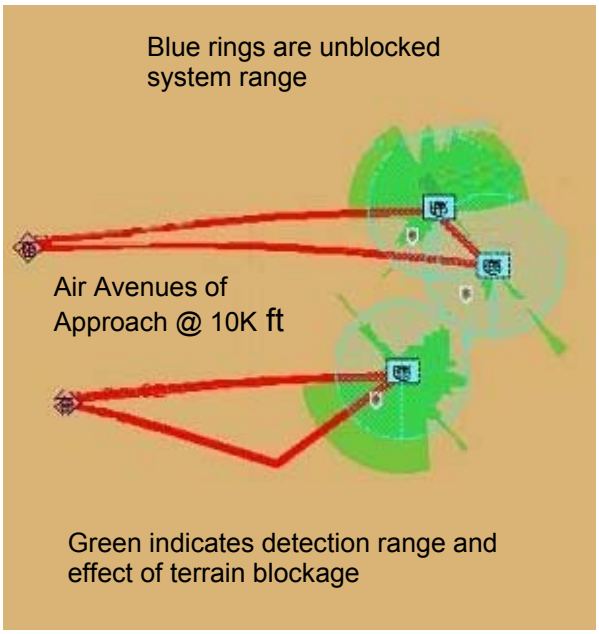


Figure 6: Terrain Considerations at Low Altitude.

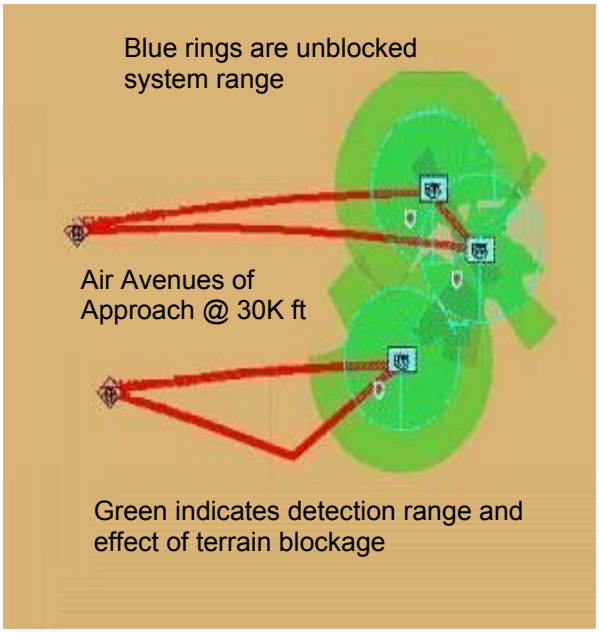


Figure 7: Terrain Considerations at High Altitude.

## 7.0 ARCHITECTURE OF FUSION SYSTEMS

Having considered all the above, the operational, system, and technical architecture of the planning tool should be robust, and fully implemented. The architecture is represented in Figure 10. The selection, integration and maturation of the technologies as the planning tool evolves provides the requisite functionality. Consideration is given to data, data bases, relational and/or object oriented data base management systems, information/knowledge bases and management, displays, programming languages, distributed collaboration, interactive collaboration, local or wide area collaboration, effects of narrow band communications connectivity between collaborating sites, security, geospatial information systems, and other technologies. One other architecture consideration is the use of Commercial Off-The-Shelf (COTS) products. This consideration must be tempered by the cost of licenses and the length of time the COTS product will be supported by the vendor. The COTS license for the JDP client server architecture allows up to five clients to create five different defense designs at the same time, or all five could be collaboratively working on the same design. The collaborative nature of the tool allows one operator to make a change from his/her client. The change is propagated through the server and stored in the data base, and immediately distributed to all clients on the network. Commanders at all levels can not only see the same consistent view, they can help create it.

A critical part of the architecture's flexibility is the use of smart static table (SST) representations of C2, surveillance and shooter capabilities. The use of SSTs versus detailed models and simulations provides faster analysis times and greater latitude in system representation. The SSTs are accessed and the results are available in a timely manner. Also using SSTs ensures that each operator using same data will always get the same consistent result which is not always the case with a Monte Carlo simulation approach.

Other features include compatibility with Microsoft Office products. Graphical and text information is readily imported into Power Point to create briefings. The AADP is produced as an HTML document for distribution or web portrayal. Text can easily be formatted or adapted for transmission during staff coordination or for a presentation. Text can be cut and pasted from the planning tool to several Microsoft Office products. Figure 8 is the content of the AADP and Figure 9 shows an example of a somewhat expanded AADP pasted in a word document.

**Area Air Defense Plan**

**Copy No.**
**Issuing Headquarters**
**Place of Issue**
**Date/Time Group of Signature**

**JOINT AIR DEFENSE PLAN:**
**REFERENCES:**
**COMMAND RELATIONSHIPS:**
**1. Situation:**
a. Guidance.
b. Adversary Forces.
c. Friendly Forces.
d. Non-Allied Forces.
e. Rules of Engagement
**2. Mission**
**3. Air Defense Operations**
a. Operational Concept
b. Coordinating Instructions
**4. Logistics**
**5. Command, Control, and Communications.**

Figure 8: ADP Content Figure.

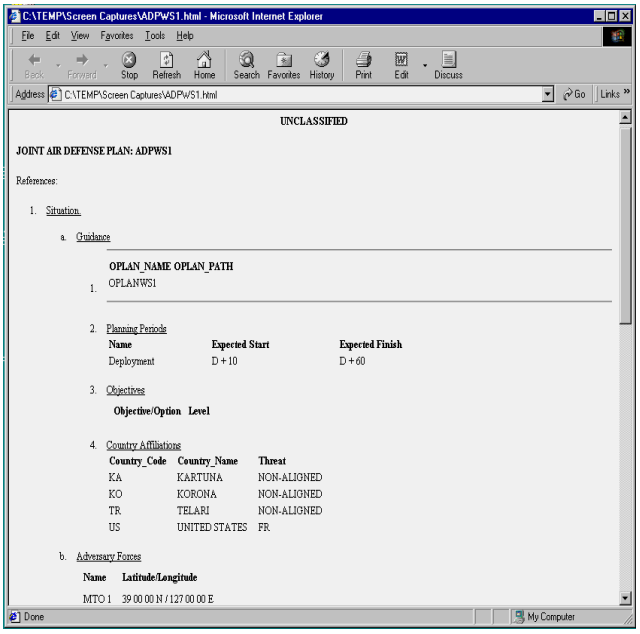


Figure 9: AADP Pasted in Word Document.

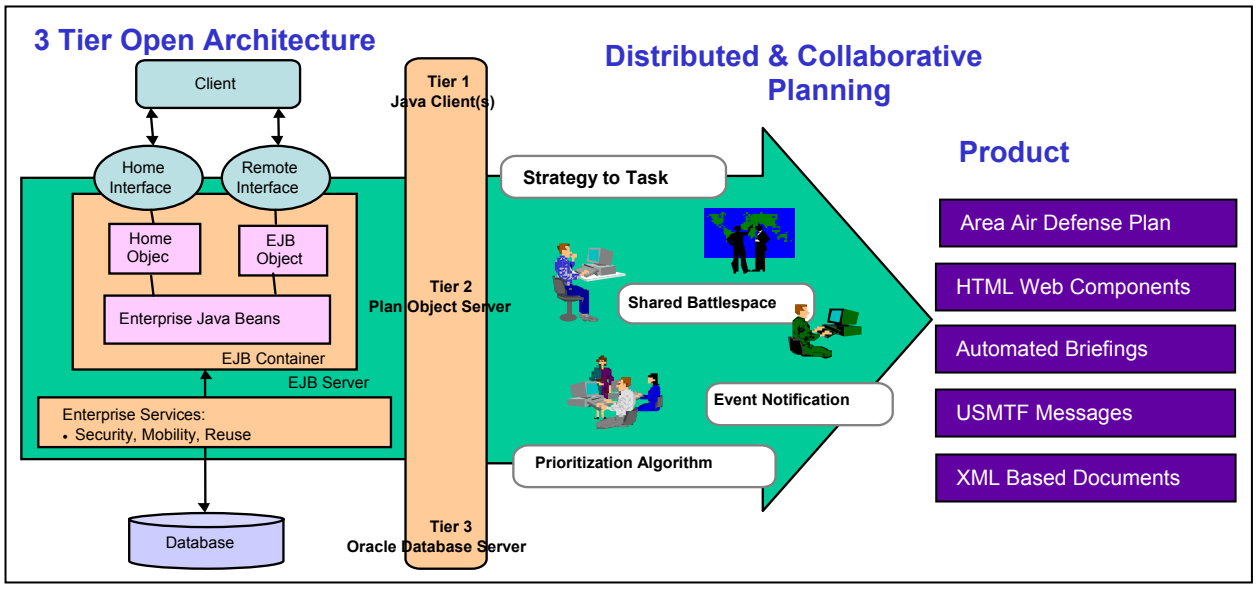


Figure 10: Technical Architecture of Fusion System.

## 8.0 SUMMARY

The stated intent of this paper entitled "Defensive Planning for Combined Forces" was to addresses the theme of this Symposium: "Commanders at all levels and types of military organizations require timely accurate awareness of the situation in their respective areas of responsibility as well as prediction of likely intentions of the participants". To accomplish this goal the paper addressed the topics of interest to this symposium with lessons learned from an exhaustive, comprehensive and successful development and fielding of JDP. Figure 11 combines in pictorial form the essentials of the defensive planning process beginning with Global/Theater objectives and ending with task specific outputs.

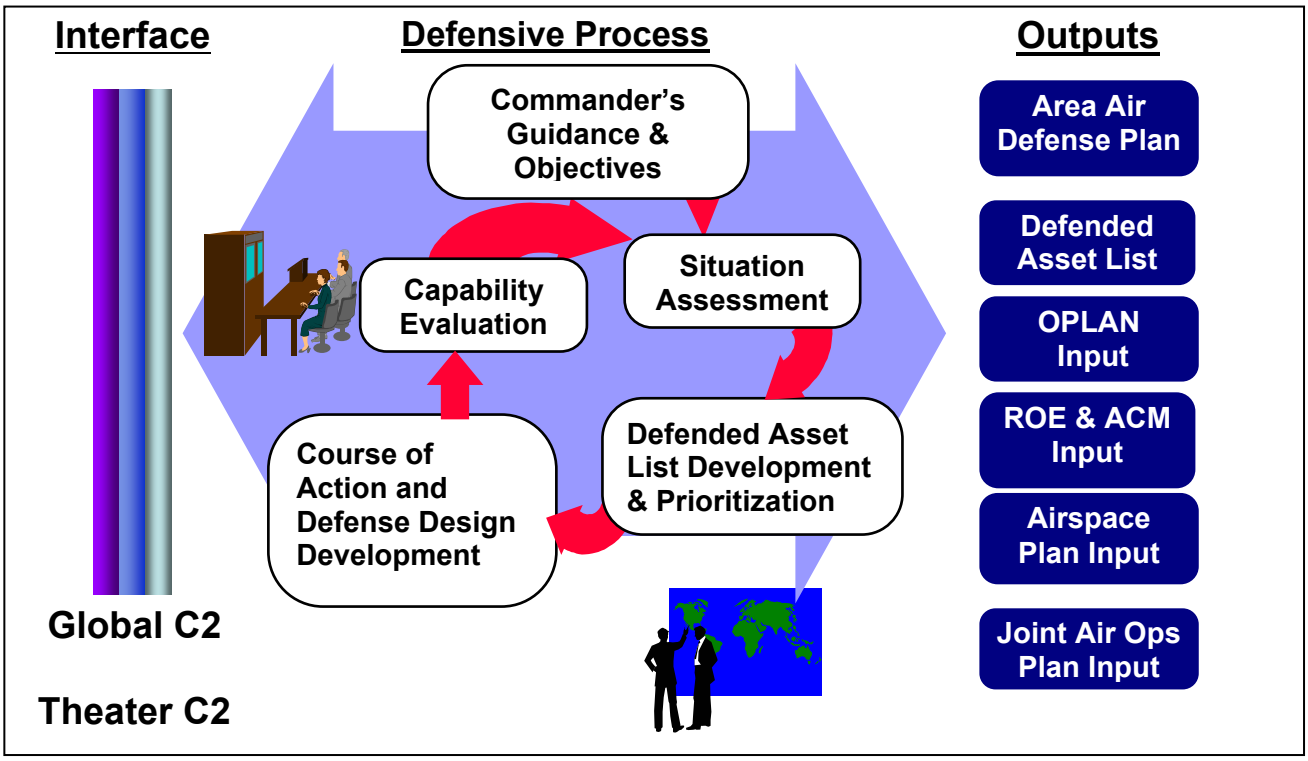


**Figure 11: TAMD Operations Planning.**

## 9.0 CONCLUSION

The Joint Defensive Planner planning tool was developed to provide the capability to satisfy stated US Joint Service defensive planning requirements using the process described above. This goal was met with JDP being fielded as an integral part of the Theater Battle Management Core System. A stand alone laptop version has also been used in exercises and real world operations.

The open architecture and the technologies incorporated represent capabilities that we believe could be somewhat easily extended to Combined Force and even coalition operations. Of particular importance is the capability of the smart static table representations to allow instances of C2, surveillance and shooter resources to be input by system and/or data base administrators. A worldwide terrain data base is included. The client server architecture is amenable to collaboration with allied or coalition partners. The AADP created in the planning tool can be cut and pasted into a variety of formats for other users.

NATO RESEARCH & TEHNOLOGY ORGANISATION
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SYMPOSIUM ON
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# Defensive Planning for Combined Forces


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# INTRODUCTION

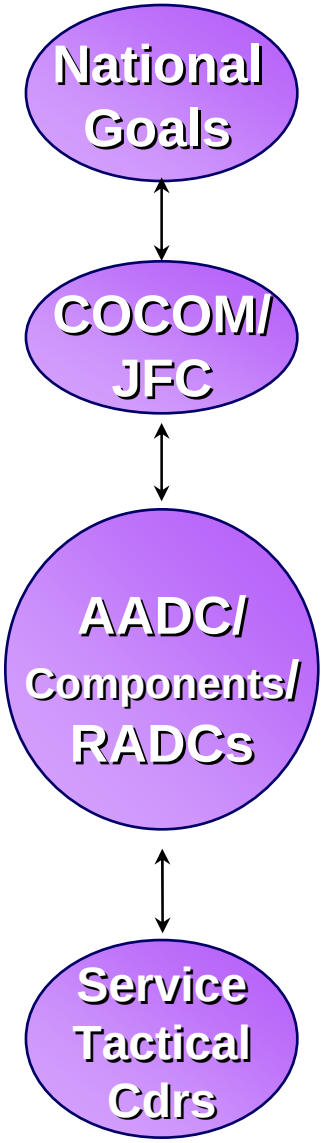
## SYMPOSIUM THEME

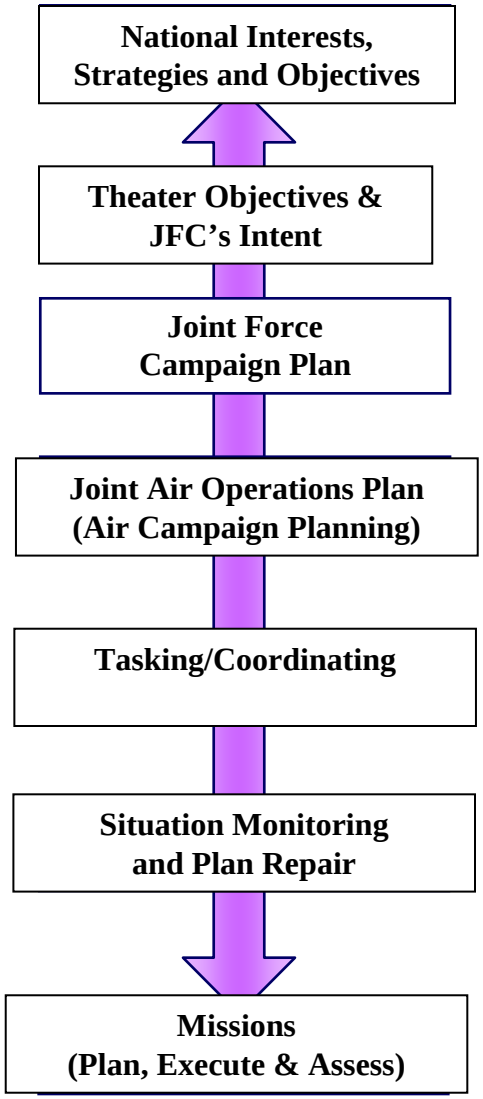
Commanders at all levels and types of military organizations require timely and accurate **consistent** awareness of the situation in their respective areas of responsibility as well as prediction of likely intentions of participants

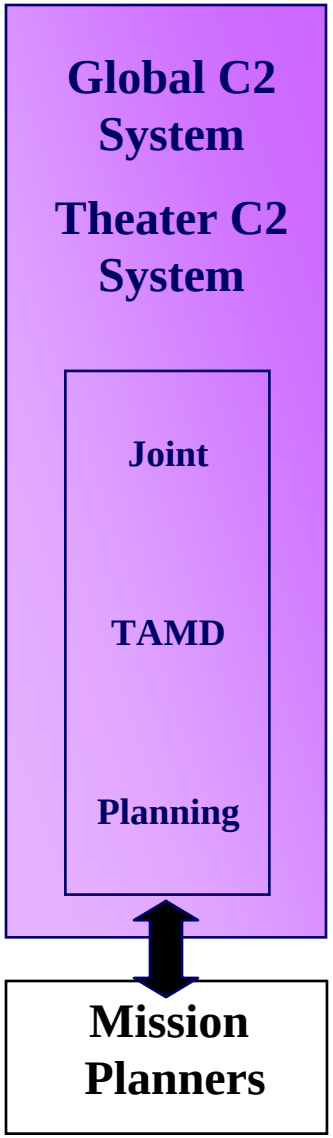
## TOPICS OF INTEREST

- Military Requirements for data interpretation and information fusion
- Concepts of military data and information fusion
- Application examples & demonstration of data & information fusion
- Threat impact/assessment
- Situation awareness, situation assessment
- Representation of military knowledge
- Architecture of fusion systems

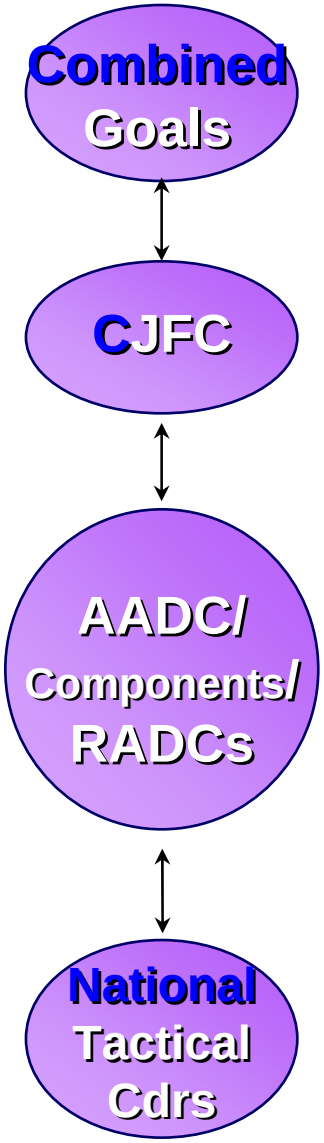
# TAMD Operational Context

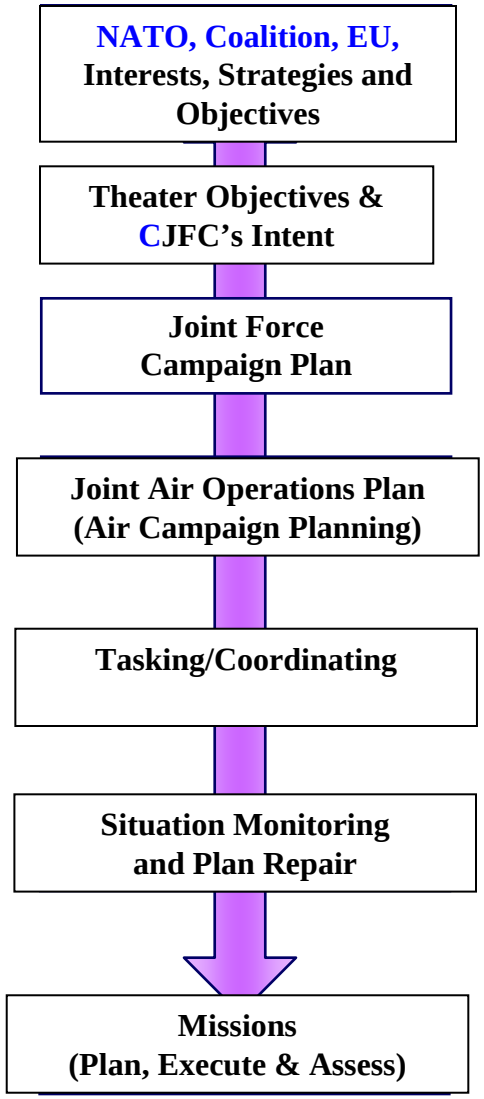


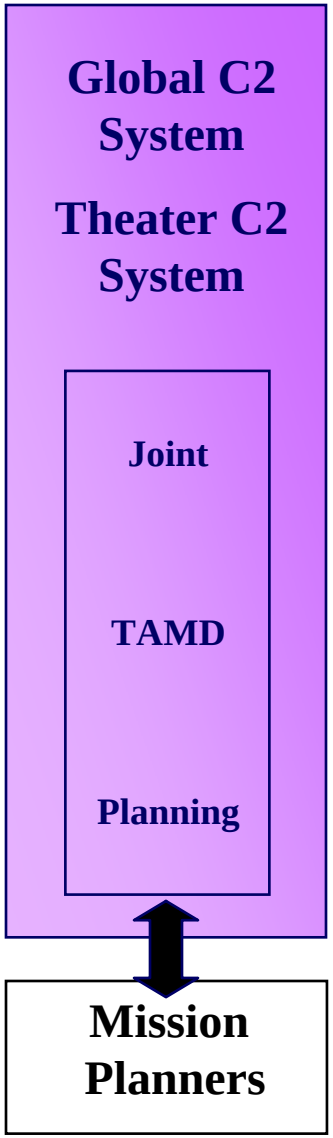



# TAMD Operational Context Combined (or Coalition) Forces

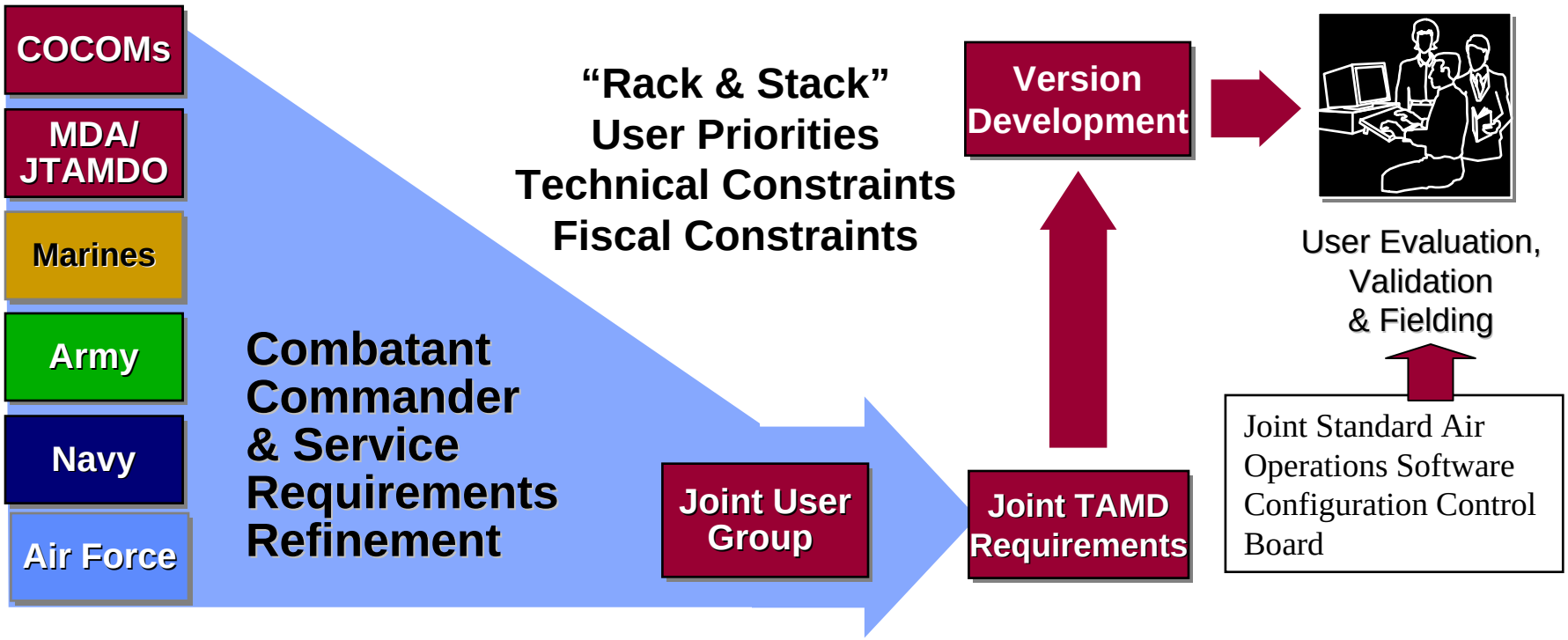


# Joint Users Group (JUG)

**Formed at program start—Identifies each Service or Organization requirements**
**Works together to agree on and specify "Joint" requirements**
**Evaluates sequential prototypes for specification compliance**
**Determines when military usefulness is achieved and is ready to field**




COCOM—Combatant Commanders
MDA---Missile Defense Agency
JTAMDO ---Joint Theater Air Missile Defense Organization

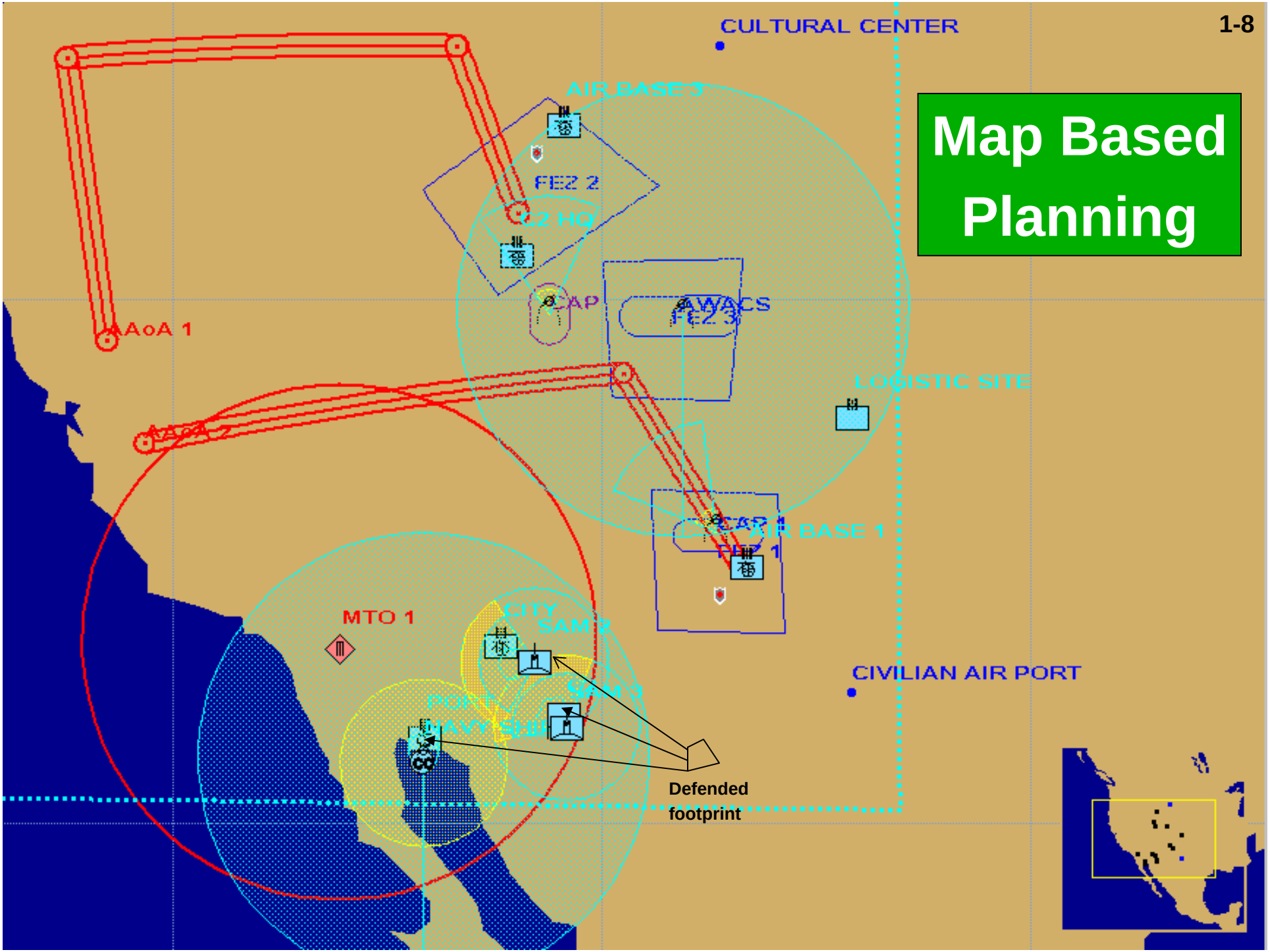
# Defense Planning within the Campaign Structure

| CAMPAIGN STRUCTURE | | | | | |
|---|---|---|---|---|---|
| **Phase I** | **Phase II** | **Phase III** | **Phase IV** | **Phase V** | |
| **Def Design** | | | | | |
| **ATOs** | | | | | |

- AADP Covers the Campaign
- The OPS tempo of the Defense is often different from the Offense
- The AADP correlates to the Master Air Attack Plan (MAAP)
- A "Defense Design" correlates to an offensive" Air Battle Plan"
  - Covers one or more ATO cycles
  - Changes as prioritization of the Defended Asset List changes
- Defended Asset List (DAL)
  - Developed by AADC staff
  - Combines inputs from the supporting & supported CCs
  - Approved by the JFC
  - Becomes the master list of 'things' to defend
- Prioritized Defended Asset List (PDAL)
  - May be a subset of the DAL
  - Varies by time, situation, and JFC objectives
  - Forms basis of Defense Design

# Prioritized Defended Asset List (PDAL) results from analyzing CVR

| Asset | C<br>Criticality<br>Weight - 3 | V<br>Vulnerabiliy<br>Weight - 2 | R<br>Recoverabiliy<br>Weight - 1 | Ranking | Priority |
|---|---|---|---|---|---|
| Airbases | 0.9 | 0.9 | 0.6 | 0.85 | 1 |
| C2 Hq | 0.9 | 0.7 | 0.9 | 0.83 | 2 |
| City | 0.6 | 0.9 | 0.9 | 0.75 | 3 |
| Port | 0.6 | 0.9 | 0.8 | 0.73 | 4 |
| Cultural Center | 0.9 | 0.1 | 0.4 | 0.55 | 5 |
| Logistics Site | 0.5 | 0.5 | 0.1 | 0.43 | 6 |
| Civilian Airport | 0.4 | 0.3 | 0.1 | 0.32 | 7 |



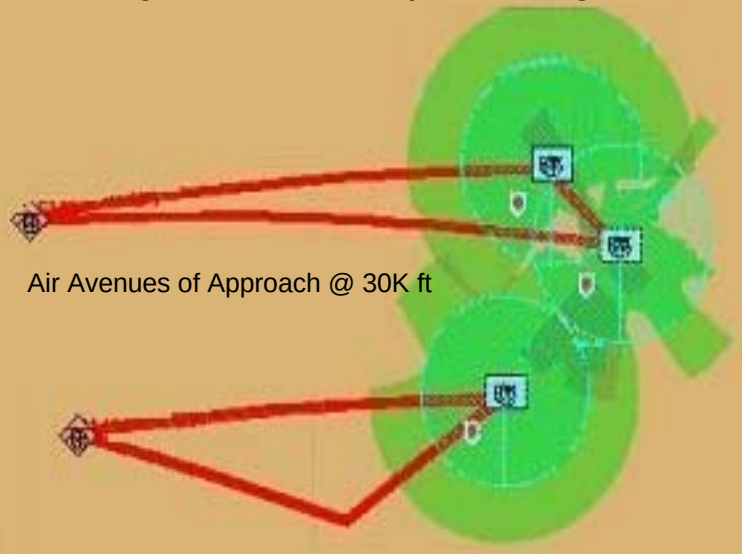

# Map Based Planning

# Terrain Considerations

Blue rings are nominal system ranges


Green indicates detection range and effect of terrain blockage

Blue rings are nominal system ranges




Green indicates detection range and effect of terrain blockage

# AADP Content, Pasted in Word Document

## Area Air Defense Plan

**Copy No.**
**Issuing Headquarters**
**Place of Issue**
**Date/Time Group of Signature**

**JOINT AIR DEFENSE PLAN:**
**REFERENCES:**
**COMMAND RELATIONSHIPS:**

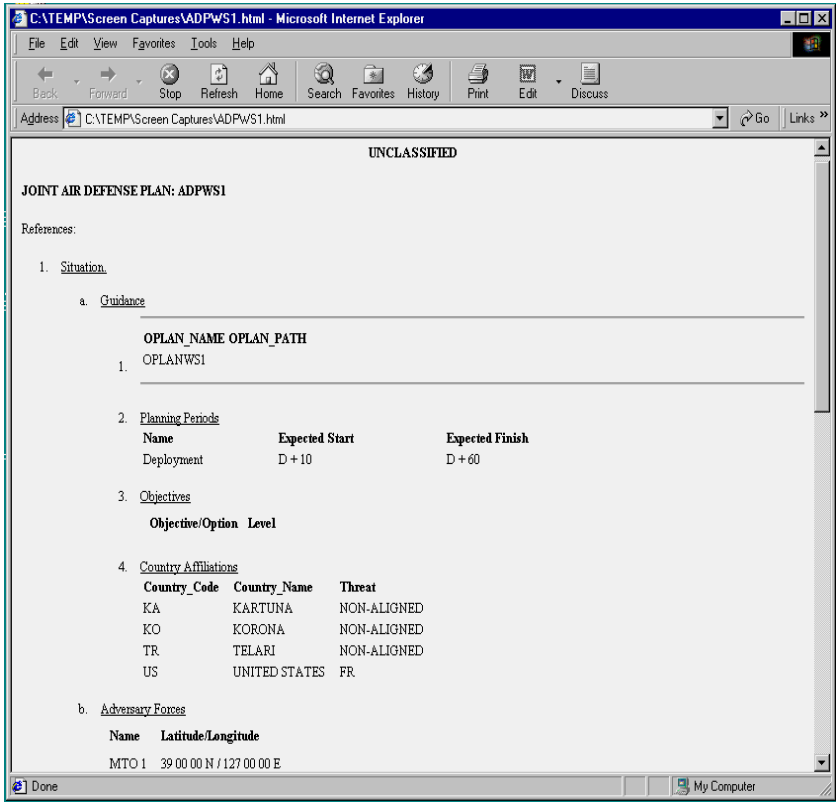
**1. Situation:**
- a. Guidance.
- b. Adversary Forces.
- c. Friendly Forces.
- d. Non-Allied Forces.
- e. Rules of Engagement

**2. Mission**

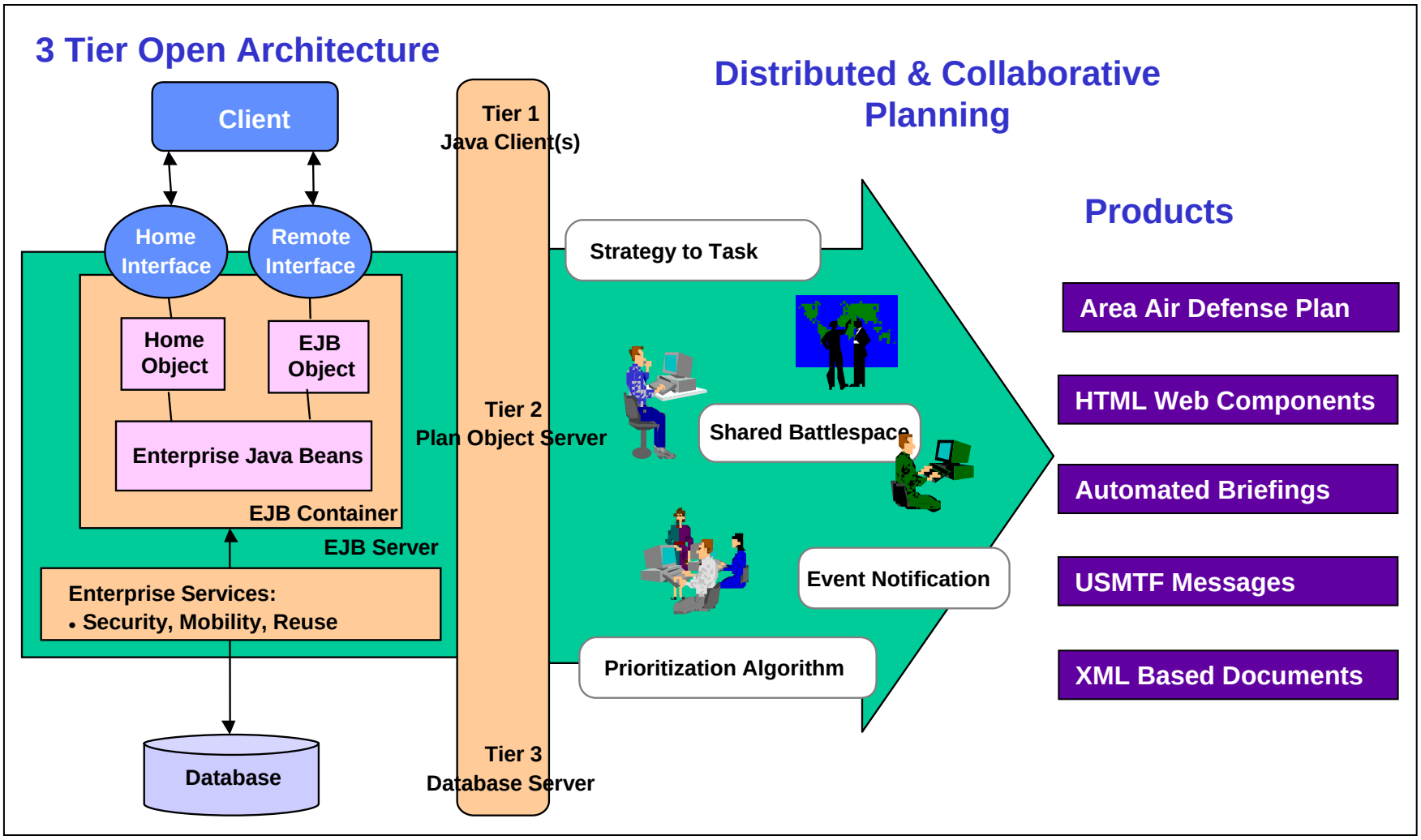
**3. Air Defense Operations**
- a. Operational Concept
- b. Coordinating Instructions

**4. Logistics**

**5. Command, Control, and Communications.**

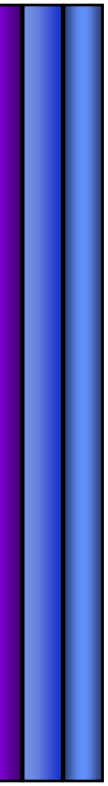


# Technical Architecture of Fusion System



# TAMD Operations Planning

## erfaces



Global C2

heater C2

## Defensive Process


## Outputs

- Area Air Defense Plan
- Defended Asset List
- OPLAN Input
- ROE & ACM Input
- Airspace Cont Plan Input
- Joint Air Ops Plan Input