DIS COMPATIBLE MISSION PLANNING FOR IMPROVED REHEARSAL & TRAINING EFFECTIVENESS

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Abstract:

Present day Unit Level mission planning systems, such as the Air Force Mission Support System (AFMSS), are used by pilots and wing commanders to plan safe and efficient aircraft missions in the tactical environment. DIS based simulation and training exercises are focused on high fidelity, realistic, man-in-the-loop tactical engagements. However, current simulation and training exercises do not employ the tactical concepts of operations related to mission planning. These exercises, without proper planning, do not provide the training required of our modern day force structure.

The incorporation of unit level mission planners into the DIS environment allows for improved mission rehearsal and training effectiveness. By using the fielded mission planner, pilots are provided with the tactical environment to allow them to practice approved concept of operations, further minimizing the differences between simulation based training and real world operations. The architecture presented in the paper supports the use of the unit level planner in conjunction with the existing exercise management protocol to establish an electronic link to flight simulators for coordinated exercise set-up, preview, and debrief. When used in this manner, mission planners allow for improved Measures of Effectiveness (MOEs) and After Action Review (AAR), such as the analysis of planned versus actual flown routes.

Sanders has been conducting research in the area of mission planning / simulation integration since 1991. The current implementation has coupled the AFMSS planning architecture with the DIS simulation protocol, allowing Computer Generated Force (CGF) aircraft to be flown by the mission planning computer. Additional research has involved the sharing of mission planning data such as route information utilizing DIS broadcast, client-server, and point-to-point communication models. These existing capabilities were demonstrated at I/ITSEC 94.

Based on our past experience, an additional suite of Protocol Data Units (PDUs) is proposed to handle mission planning data not currently supported by the existing DIS standard. A system architecture for integrating DIS based simulation and mission planning capabilities for unit to force level exercises is also presented.

Authors

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Eric Brett received a BS in Electrical Engineering from Rensselaer Polytechnic Institute in 1984, and an MS in Computer Science from Boston University in 1991. He has been involved in the design and development of several of Sanders' mission planning systems. He has led research efforts in mission preview systems and 3D graphics since 1993. Mr. Brett is currently the Principal Investigator of the Preview Systems and Simulation Independent Research and Development program, which is enhancing mission planning / simulation integration.

David Phelps received a BA in Mathematics from Hartwick College in 1979 and an MS in Computer Science from the University of Connecticut in 1982. He has over 12 years of experience in developing distributed software for simulation-based training systems. He was the Principal Investigator on an Independent Research and Development Program which integrated the Air Force Mission Support System with DIS-compatible networks. Mr. Phelps is currently Section Manager of Advance Projects for the Engineering and Technology Directorate of the Information Systems Division of Sanders.

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1. INTRODUCTION

The military has embraced DIS-based simulation exercises for a variety of purposes: to provide training, to verify strategy and tactics, and to evaluate concepts for systems under consideration. These exercises depend on degrees of "realism" to attain meaningful results. One of the main contributors to "realism" is the performance of individual platforms and systems on the simulated battlefield. Many simulators participating in DIS-based exercises provide high fidelity vehicle performance. However, the planning of exercises for these high fidelity systems still contains a large component of manual effort, including "back of the envelope" calculations and trial and error positioning of simulated entities in preparation for the exercise. Simulation Manager capabilities are now becoming available which incorporate capabilities to locate and define movement for simulated entities.

In order to best follow the "train as we fight" dictum, the exercise planning process should mirror, or better yet be, the process by which battles are planned in the field. Although currently fielded systems for battle planning are not yet fully integrated, and are for the most part not simulation oriented, sophisticated planning tools with attributes that lend themselves to the simulation world are becoming available.

Current automated air mission planning systems comprise sophisticated sets of modeling and visualization tools based on validated platform performance models. These systems can be used to help exercise planners define realistic exercises more quickly and with greater reliability than has been the case in the past. The use of DIS-compatible mission planning tools will decrease both the manpower and the cycle time necessary to plan exercises, thus reducing training costs, while increasing exercise planning flexibility and the reliability and realism of the resulting plans. Capabilities which are built into planning systems, such as route deconfliction, can greatly increase the degree of rigor in exercise planning. Validated route plans, provided via DIS, reduce the effort required to perform exercise preview, execution, and analysis by creating a common baseline to be shared among responsible entities involved in each of these functions.

The Information Systems Division of Sanders is investigating approaches and principles of using air mission planning systems, such as the Air Force Mission Support System (AFMSS), to provide high performance tools for planning DIS-based exercises. AFMSS is the Air Force's service-wide unit level mission planner. Its architecture supports several related mission planning systems, including the Special Operations Forces Planning and Rehearsal System (SOFPARS). Using such tools, it will also be possible to integrate mission planning skills and techniques into the tactical and team training objectives. In addition to the uses outlined in this paper, the large installed base of such planning systems (nearly 300 AFMSS already installed worldwide) provides a unique opportunity for distributed planning support of wide area exercises.

In order to investigate this area, we have delineated phases and responsibilities of exercise planning / conduct and correlated them to the mission planning process. We have also defined an exercise planning architecture within which mission planning systems can be integrated to perform functions for the simulation community, as well as for their current primary users.

2. MISSION PLANNING

To correctly model or simulate a process, it is important to understand the structure and data flows of the the actual system to be simulated. The following discussion introduces the tactical mission planning process [1] of the United States Air Force from Theater Level through Unit Level (see Figure 2-1).

At the top of the command hierarchy is the Joint Task Force (JTF) Commander. The JTF Commander has overall authority of all land, sea, and air resources within the theater of operations. It is the JTF Commander's responsibility to determine the military objectives which must be accomplished to meet the objectives of the campaign. It is important to note that these military objectives will often change on a day to day basis, driven by the results of previous interactions between friendly and hostile forces. The JTF Commander works with his headquarters staff to determine a strategy which will accomplish the current goals.

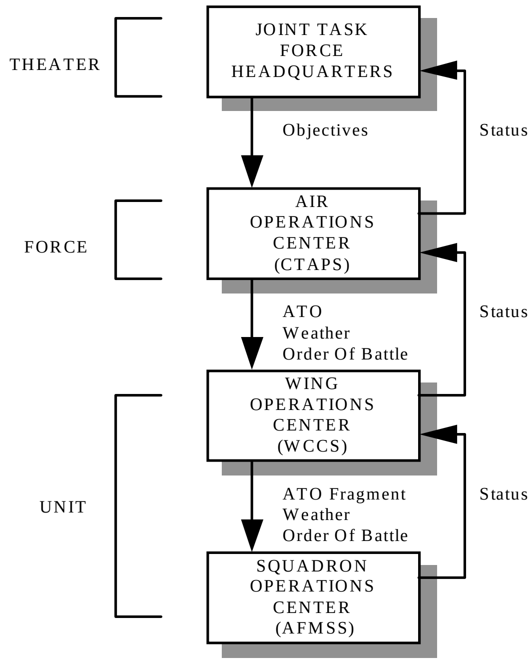


Figure 2-1. Mission Planning Hierarchy

One member of the JTF Commander's staff is the Joint Forces Air Component Commander (JFACC). The JFACC has control of all air resources (Air Force, Army, Navy and Marine) in the theater. At the JFACC's disposal is the Air Operations Center (AOC), which provides the capabilities to perform hostile force analysis and friendly force planning. The AOC determines the appropriate target list based on military objectives and available resources, as well as determining the allocation of aircraft and munitions to be used on each target. The AOC also attempts to deconflict the missions at a Theater level to minimize collisions/interference between the various aircraft. The system currently used to automate this process is the Contingency Tactical Air Control System Automated Planning System (CTAPS), to be replaced in the near future by the Theater Battle Management Core System (TBMCS).

The primary result of the AOC's planning is the Air Tasking Order (ATO). The ATO contains a day's orders for all air missions within the theater. For each mission, the ATO contains information such as:

- Target(s) to be attacked
- Number and type of aircraft for each target
- Airbase of mission origin
- Munitions to be used on each target
- Critical waypoints information (e.g. takeoff time, time on target, refueling points, etc.)
- Support forces (e.g. refueling and jamming)

At the Wing Operations Center, the information relevant to the particular Wing is broken out of the ATO into a Fragmentation Order. Based on this Fragmentation Order, the Wing determines if there are enough resources (aircraft, aircrew, munitions) to accomplish the specified missions. If the wing lacks the resources to perform any of the missions, this status is passed back to the AOC. The remaining missions are then passed to the Squadrons within the Wing. There are a variety of existing planning / command and control systems in use by various Wings. However, a standard system, such as the Wing Command and Control System (WCCS), will become the common planning platform in the future.

The Squadron Operations Center is responsible for planning individual aircraft routes based on the Fragmented ATO. The planning process attempts to maximize the probabilities of meeting the ATO objectives while minimizing the risk imposed by hostile threats. The planning is typically performed by the actual aircrews who analyze the ATO, Enemy Order of Battle, Terrain Elevation Data, Aircraft Performance Parameters, Maps and Imagery to determine a viable flight path to and from the target.

To assist in the planning process, the aircrews utilize AFMSS, the standard unit level mission planning system deployed within the Air Force. This computer based system provides automated planning tools to assist the aircrew in determining the most effective route to accomplish the specified mission. The system performs basic flight planning calculations, such as navigation, flight time and fuel burn, and flight performance restrictions. In addition, the system optimizes threat penetration capabilities by taking into account enemy radar and missile capabilities, radar cross sections of the aircraft, and terrain masking opportunities. The system provides indications to the aircrew of when, where, and by whom the aircraft will be threatened along the planned route.

Output of the system may be in the form of Combat Mission Folders (CMFs) which are comprised of hardcopy forms and annotated maps that the pilot can bring into the cockpit, or electronic Data Transfer Devices (DTDs) which download information directly into the aircraft flight computers.

3. SIMULATION PLANNING EXPERIENCE

Under a variety of programs, attempts have been made to insert portions of mission planning into simulations. Several activities with which the authors have been affiliated are highlighted below.

3.1 Sanders Mission Preview System

Through an internally funded program, Sanders developed a mechanism to insert unit level route planning into the simulation realm. The intent of this effort was to provide a 3D graphical display capability that would depict aircraft flights planned on the AFMSS system. The primary link to the simulation network is accomplished through a Computer Generated Force (CGF) module (see Figure 3-1).

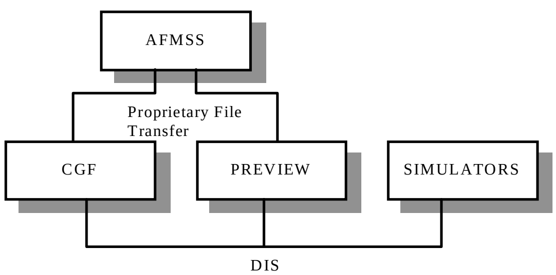


Figure 3-1. Mission Preview Architecture

The CGF extracts aircraft route data from the unit level planner database, then "flies" one or more of these routes and transmits aircraft locations in DIS format. The static route data is also supplied directly to the Preview System (a "Stealth") through a proprietary file transfer. The Preview System is then capable of inserting a graphic overlay of the planned route(s) in the simulated view, as well as inserting 3D vehicle models based on the DIS traffic. This “highways in the sky” capability allows a Preview System operator to visually verify if manned simulators executing the routes remain on or near the AFMSS-generated mission plan through the course of a simulation run. Using the local CGF capability, AFMSS can also be used as a situation monitor (plan view display) during the exercise, while continuing mission planning of additional aircraft routes.

This program focused on providing a preview capability to a specific mission planning system. One problem with the result is that route data is not transferred via the DIS protocol. Because of this, no other simulators or stealths in the DIS exercise have access to the route information. Also, Simulation Management PDUs were not used, as the CGF executed locally and controlled all aircraft that were defined for the mission plan.

3.2 Lockheed SiMan Demonstration

As a demonstrable capability for the 1994 I/ITSEC conference, several companies within the Lockheed Martin Corporation coordinated their DIS efforts to develop and integrate a mechanism to provide flight plans to a cockpit simulator based on real mission planning data. Components included a Simulation Manager (SiMan) supplied by Lockheed Martin Missiles and Space Company, along with CGFs simulating TEL/SCUD, Ground Based Radar and Interceptor, and SAM entities. Sanders supplied a DIS capable AFMSS system, and Lockheed Martin Tactical Aircraft Systems contributed a DIS capable F-16 cockpit simulator (see Figure 3-2).

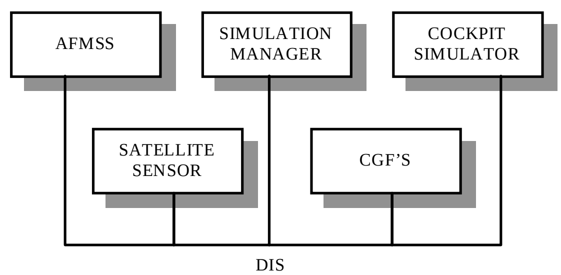


Figure 3-2. SiMan Demo Architecture

In this architecture, the SiMan requests that a route be planned, AFMSS plans and returns it to the SiMan, and the SiMan forwards it to the cockpit simulator where it is available for use by the pilot. The architecture uses two prototype PDUs to determine the simulation resources available during the exercise. In the implementation, the SiMan first issued an "All Call" PDU which was broadcast over the DIS network to query for resources. Each simulator responded with a "Register" PDU to declare its existence and capabilities. Message PDUs were used to pass the route information not supported by the standard set of PDUs.

While concentrating on the initial uses of real mission planning data, this demonstration did not address the entire problem of utilizing mission planning systems. It used Message PDUs to pass data, rather than formally identifying prototype PDUs for the specific purpose. Route information was broken into multiple Message PDUs and broadcast over the DIS network. There was no assurance that the systems receiving this data received all of the data components.

3.3 COMPASS

The Common Operational Mission Planning and Support Strategy (COMPASS) program, sponsored by the Defense Modeling and Simulation Office, provides a mechanism for allowing legacy unit level mission planning systems to share data and conduct collaborative planning. Under direction from SAIC as the Prime Contractor, Sanders has updated AFMSS and SOFPARS (a variant of AFMSS used by the Special Operations Forces) to communicate with the Navy's Tactical Automated Mission Planning System (TAMPS) and the Defense Nuclear Agency's Contingency Adaptive Planning System (CAPS) via the COMPASS architecture.

The architecture of COMPASS is client/server based (see Figure 3-3). Transferred data includes display

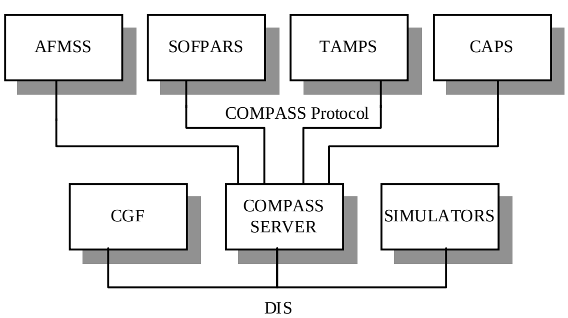


Figure 3-3. COMPASS Architecture

information such as annotations, weapon effects, and aircraft routes. COMPASS is also capable of providing 2D previews of multiple aircraft routes shared by the clients, and translating DIS traffic into display information so that the COMPASS clients can act as Plan View Displays.

The DIS interface in the COMPASS architecture is listen only. Entity data created by other DIS simulators can be received and translated into display data for the COMPASS capable systems, but the COMPASS servers will not generate DIS data for any additional planning data shared by the COMPASS clients. All other COMPASS overlay and route data used for collaborative planning is transferred in a non-DIS compliant manner, and is therefore unavailable to non-COMPASS systems.

3.4 Lessons Learned

Each of the above activities has focused on a subset of the planning process as it relates to simulation, not the system as a whole. None of these architectures has looked at the problem from a force level to cockpit process taking into account data flows required between the systems while serving in a simulation role. Based on our experiences, we have begun to look at the larger scope of the relationship of mission planning systems to the simulation world in general and to simulation-based training in particular.

4. PROPOSED ARCHITECTURE FOR EXERCISE PLANNING

We propose an overall architecture for incorporating mission planning capabilities into the development of simulation exercises. In order to do that, we have mapped the real world tactical planning process and systems onto the process of planning exercises. Many of these exercise planning steps are currently not automated.

4.1 Planning and Execution Phases

We have identified five phases of exercise development and execution (see Figure 4-1). These phases, labeled T0 through T4, may be internally iterative. They generically cover the exercise development process from concept development through planning, execution, and after action review.

These phases directly correlate to the activities of battle planning and conduct that occur in the field which are described in Section 2 of this paper. Phase T0 (Political Situation Definition) generally correlates to the development of objectives and establishment of the theater level military situation by the JTF Commander. Phase T1 (Exercise Definition) comprises Force Level Planning by the Air Op-

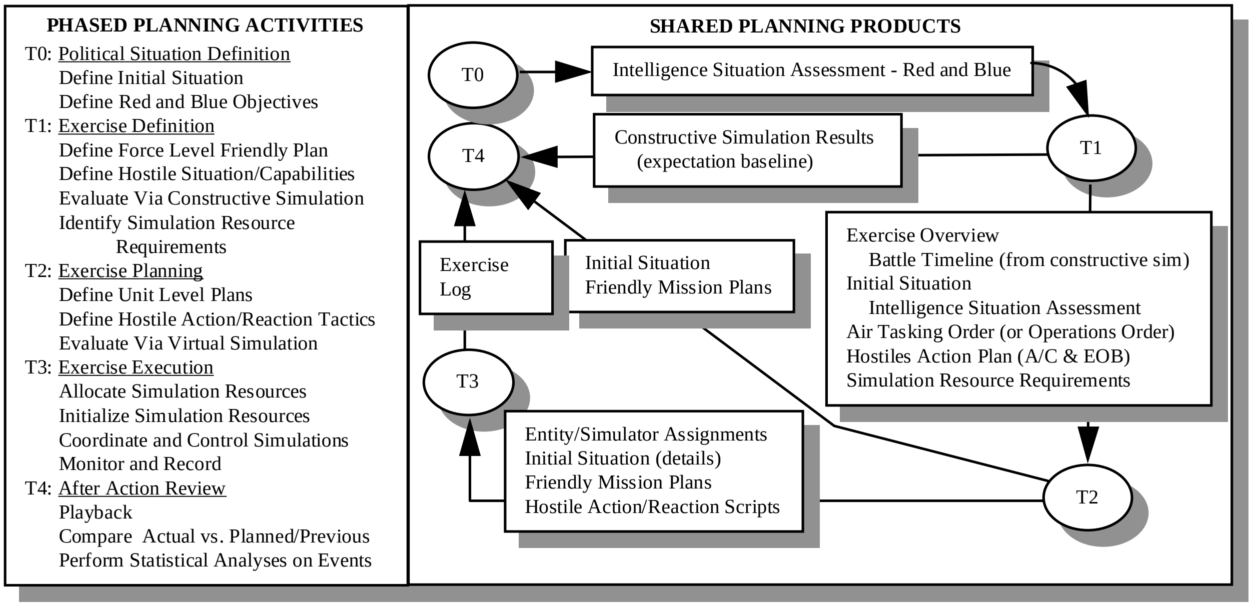


Figure 4-1. Phases of Exercise Conduct

erations Center. Phase T2 (Exercise Planning) represents Unit Level Mission Planning by Wing and Squadron Operations Centers. Phase T3 (Exercise Execution) correlates with Mission Conduct activities. And finally, Phase T4 (After Action Review) corresponds with Mission Debrief.

Data interfaces between the phases consist of mission planning products with additional simulation control information, such as resource requirements and resource allocations. In our approach, it is not necessary to have control interfaces between the phases, except to the extent that certain data is required as an entry condition to the phase.

Our architecture for use of mission planning in simulation exercises is defined using the following set of guidelines:

- achieve high-fidelity and flexibility through use of fielded planning systems
- planning systems are not dedicated simulation resources
- exercise execution may not be temporally contiguous to planning

These guidelines assert that tactical assets may be used on a part time basis to provide high fidelity plans. These plans may be stored, preferably in an exercise library which frees up the mission planning asset for later use in simulation exercises. The plans may also be retained in the planning system. Furthermore, these exercise planning activities can be accomplished without modifying the planning functions of the fielded systems. To support realism, planning activities conducted during these phases should utilize functions of fielded planning systems to the greatest extent practical, subject to the availability of tactical assets.

4.2 Simulation Components

The infrastructure required to support Exercise Planning includes standard DIS components, as well as tactical mission planning assets (see Figure 4-2).

The SiMan is the only resource which is presumed by our approach to be persistently available throughout the phases. It provides the coordination for everything from the Exercise Definition Phase through After Action Review. It may contain, or be integrated with, monitor, logging, and debrief facilities.

The Force Level Planner (FLP) allocates conceptual resources to conceptual objectives. It also defines the overall simulation resources that will be required to support the plan, similar to real battle planning. The constructive simulation can be optionally used both to preview/evaluate the force level plan and to provide expected battle results for use in exercise debrief and review.

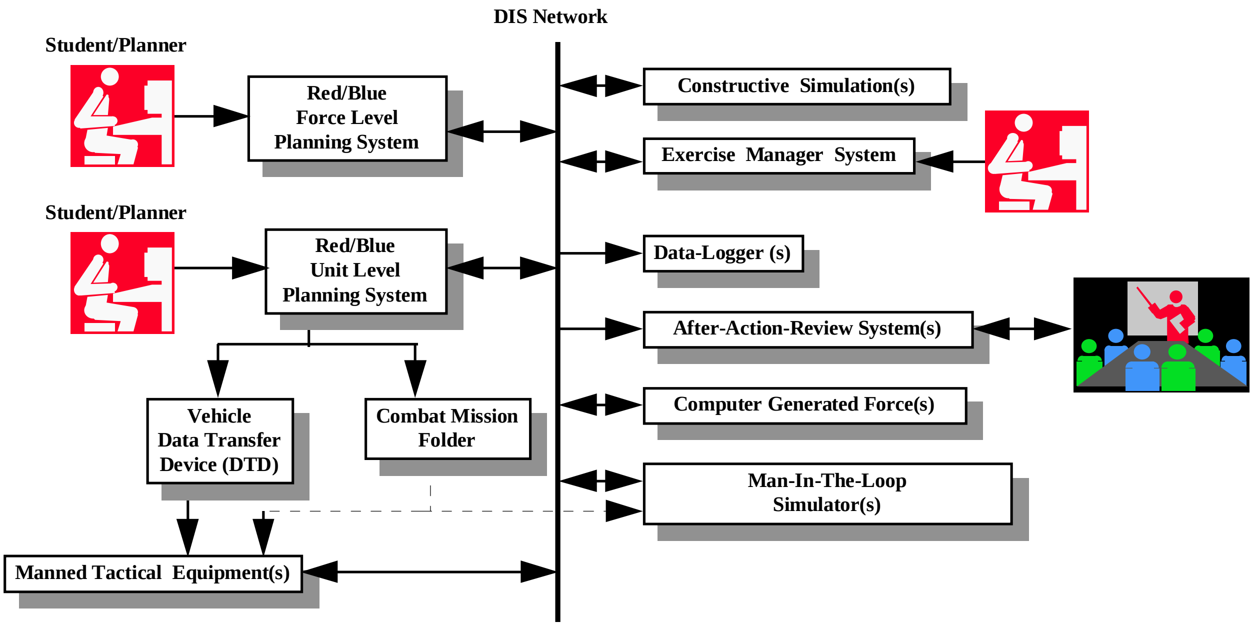


Figure 4-2. Simulation Components

The Unit Level Planner (ULP) accepts an assignment from the SiMan to provide a detailed plan which fulfills one or more parts of the Force Level Plan. One ULP may play multiple planning roles for an exercise, or conversely, a distributed set of ULPs may pose as a single planning facility. In addition to the DIS-based interfaces outlined in the the following sections, the ULP may load DTDs, and/or print hardcopy mission folders for trainees who will participate in the exercise.

The Computer Generated Force (CGF) may be optionally used to preview/evaluate the detailed plan developed via the ULP. This preview/evaluation does not require man in the loop simulators.

Man in the Loop (MITL) Simulators are normally used to execute the training exercise. To make best use of the planning data, the MITL simulators should be capable of accepting either a DTD (or functional equivalent, such as floppy disk) or DIS PDUs containing the data. Hardcopy CMFs could also be produced by the planner for the simulators.

Live platforms which are to be included in the simulation can either use hardcopy mission folders or accept mission plans directly from the mission planner in their standard format, such as on a DTD produced by the mission planner. This brings a new, and essential, level of integration to the use of live platforms in a simulated exercise.

4.3 Proposed PDUs

Our architecture makes use of existing DIS PDUs to transmit data between simulation and planning assets, and identifies four new PDUs required to fully automate the exercise planning / execution process.

The new PDUs introduced are the “All Call”, “Register, “Tasking Order”, and “Mission Plan”. To initiate the planning process, the All Call PDU is sent by the SiMan to query the network for assets available for planning the exercise. The Register PDU is a response from the planning asset identifying the type of asset and its capabilities. The Force Level Plan is communicated using a Tasking Order PDU, which includes battle information in an aggregated level, such as for a wing or squadron. Unit Level Planning data is communicated using the Mission Plan PDU, which comprises individual platform route information and associated data.

4.4 Component Interfaces

The interfaces between the various systems that make up the DIS infrastructure, including the new interfaces associated with the integration of fielded planning systems, are illustrated in Figures 4-3 through 4-8. The architecture is discussed in the context of the planning and execution phases outlined in section 4.1.

Political Situation Definition(T0): We are not addressing the automation of T0 activities in this paper, except to the extent that T0 must produce a general description of a scenario of activities, a set of objectives and an initial situation in the form of Order of Battle data.

Exercise Definition and Planning (T1 & T2): Phases T1 and T2, as shown previously in Figure 4-1, comprise the definition and planning of the exercise. In Exercise Definition (T1), the SiMan and FLP interoperate to produce an exercise definition in the form of a Force Level Plan. In Exercise Planning (T2), the SiMan and ULP interoperate to define squadron missions, in the form of individual aircraft routes. The proposed architectural interfaces of the Force Level (for T1) and Unit Level Planner (for T2) are similar. In general, the SiMan queries planners for capabilities and the planners respond. The SiMan allocates planning responsibilities, and planners then conduct planning activities. When the requested plan is complete, the planner notifies the SiMan and either stores or forwards the plan to the SiMan. The SiMan may concurrently carry out other responsibilities while planning is in process.

We will illustrate the ULP / SiMan interface for the Exercise Planning (T2) phase (see Figure 4-3), and

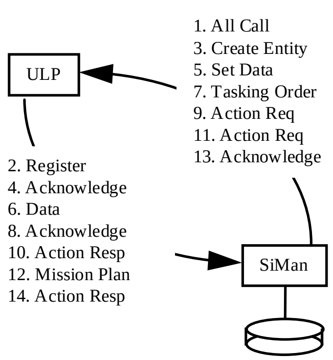


Figure 4-3. T2 Planning Activities

identify the differences for the Exercise Definition (T1) phase. The SiMan issues an All Call (1) to identify planning assets available on the net. The ULP responds with a Register (2) stating "I am a Unit Level Planner, and am capable of planning missions for F-16, F-117, and F-22". The SiMan then assigns an entity ID to the ULP by sending a Create Entity PDU (3), which is accepted by the ULP by sending an Acknowledge PDU (4). The SiMan then assigns the ULP to a conceptual role as defined in the FLP using the Set Data PDU (5), such as - "ULP, you are the planner responsible for the F-16 missions being flown out of Eglin AFB". The ULP accepts this responsibility and responds by sending a Data PDU (6). The SiMan then sends the Force Level Plan to the ULP using the Tasking Order PDU (7), and the ULP responds with an Acknowledge PDU (8). An Action Request PDU (9) is then issued requesting that the ULP perform detailed planning. The ULP responds with an Action Response PDU (10) indicating that planning is in progress, and then again when planning is complete. When planning is complete, the SiMan can request that the plan be sent by issuing another Action Request PDU (11). In response, the Unit Level Plan is sent using the Mission Plan PDU (12). To verify the plan's receipt, the SiMan sends an Acknowledge PDU (13). The planner then sends an Action Response PDU (14), which indicates completion of the Action Request (from step 11).

Phase T1 differs from the description above only in that: 1) it assumes only Order of Battle / situation input, rather than an existing plan, and 2) it generates a force level, rather than unit level, plan. To illustrate T1, Figure 4-3 would not include steps 7 and 8 and would replace ULP with FLP.

Exercise Preview (for T1 and T2): We have also sub-divided T1 and T2 to suggest that preview capabilities could locally support the planning process via simulation. Again, we use the T2 phase as our example, but the architecture is basically the

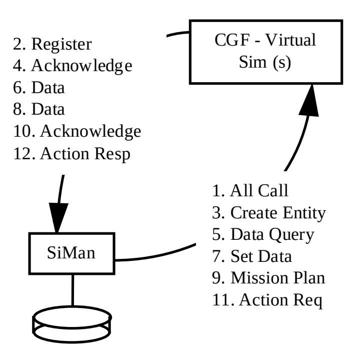


Figure 4-4. T2 Preview Activities

same for T1. Here, a Unit Level Plan can be previewed by using a virtual simulation CGF (see Figure 4-4). To review a Force Level Plan in the Exercise Definition phase (T1), the CGF is replaced by a constructive simulation and the Mission Plan PDU would be a Tasking Order PDU. This Tasking Order PDU can be used by Constructive simulations to preview the exercise and formulate the expected results of the training exercise prior to its execution (in the following phases). The availability of force/unit plans allows the SiMan to preview and do "what if" analyses before the time and money is spent to perform the manned training / simulation exercise in the next phase. However, we consider the preview function to be an optional step in the exercise development process. An alternative processing sequence, also supported by the architecture, changes the final four steps of Figure 4-3 (see Figure 4-5). The options

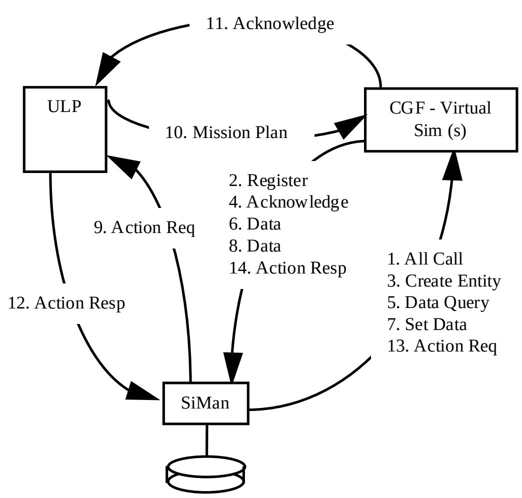


Figure 4-5. T2 Preview Activities Alternative

supported allow for either centralized storage of the plans by the SiMan, or for distributed storage at the mission planners, with direct interface to the CGF. We leave these as implementation options, depending on the expected availability of planning resources (dedicated, vice shared).

Exercise Execution (T3): The entry criteria for the Exercise Execution (T3) phase are that all of the mission plans have been produced and simulation resource requirements have been defined. In the case

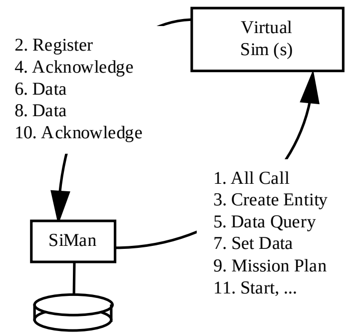
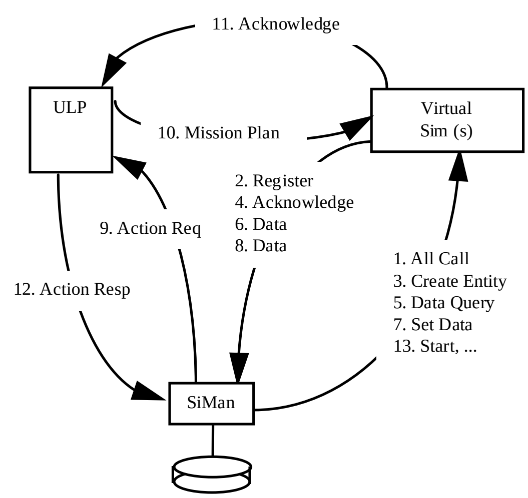


Figure 4-6. T3 Activities

where the SiMan has stored all of the plans, it can then forward them to the corresponding virtual simulator using the Mission Plan PDU (see Figure 4-6). As can be seen, the mission planner is not necessarily required for this phase.

An alternative processing sequence incorporates the ULP in this exercise initialization process (see Figure 4-7). Here the ULP is tasked to disseminate mission plans directly to the associated simulation resource.

The advantage of the alternative implementation is that the ULP can provide additional services such as printing of hardcopy CMFs or production of DTDs.



Note: The electronic transfer performed by steps 10 and 11 can be replaced by printing of the mission folder or production of the DTD.

Figure 4-7. T3 Activities Alternative

These products could be used to supply mission plans to simulations which are not configured for electronic transfer via PDUs, and are essential for the integration of live components such as an actual F-16 that will fly in the exercise.

After Action Review (T4): Mission planning related data may be used for a number of purposes during AAR (see Figure 4-8). The Force Level Plan

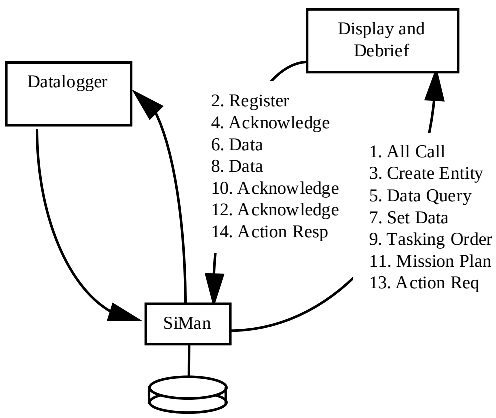


Figure 4-8. T4 Activities

(prioritized objectives) and the results of constructive simulation (expected results) can be compared against the PDU data log. The statistics generated from the data log can be used to measure overall effectiveness of the action. For example, did Blue forces destroy as many high priority targets as the simulation predicted? Did they do it as quickly? Also, the unit level plans (methods and tactics) can be compared against the PDU log to determine how closely the trainees were able to follow their planned routes. For example, were aircraft engaged by SAM sites because they deviated from planned routes?

Although constructive simulations are currently not integral functions of Force Level mission planning, we note that results from such simulations could be of great value in an After Action Review package.

5. CONCLUSIONS

We have identified an approach to using existing mission planning processes and fielded systems to facilitate the planning of realistic scenarios in DIS-based simulation exercises. We have done this within the context of existing Simulation Control PDUs, but believe it is necessary to add new PDUs specific to this application.

As mission planners are integrated across command levels, and begin to interoperate across the services, the capability to seamlessly conduct both battle planning and training exercise planning will grow. This will provide opportunities to enhance the flexibility and effectiveness of training throughout the force. This enhancement will come through the use of validated automated planning tools that already speed the planning process and provide “what-if” analysis tools on the battlefield. By using tools familiar to the aircrews, we can realize additional training effectiveness for the overall battle planning and execution process. The Air Force is integrating and standardizing interfaces among its mission planning systems from Force Level down through Unit Level. As these efforts progress, we can examine details of bringing these specific systems into the simulation world.

To validate the major concepts of this architecture, our work will continue on the development of a demonstrable testbed consisting of Simulation Manager and Mission Planning Systems communicating via the protocols presented. We will use this to verify that the architecture is valid and will identify any deficiencies or inconsistencies in the approach that require refinement. Specific areas that we plan to examine include: a) fully define the content of the PDUs introduced in this paper, b) continue integration of local simulation capabilities with mission planners to allow for preview of exercises, c) integrate, via the architecture presented, AFMSS with a number of Simulation Manager products which are currently under development, d) incorporate components of force level mission planning into the architecture, and e) develop approaches to integrate simulation-based preview results with After Action Review.

REFERENCES

1. Thomson, Duncan: Task 37 Mission Planning and Force Mangement Functions and Systems; Mitre Corporation, for US Air Force Electronic Systems Command