TWO-WAY CBS-TO-DIS LINKAGE

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ABSTRACT

Distributed Interactive Simulation (DIS) protocols and standards are being used to enhance the fidelity of the military's family of training models and simulations. This paper will discuss a two-way interface between the Army's Corps Battle Simulation (CBS) and the Extended Air Defense Simulation (EADSIM) using DIS Protocol Data Units (PDUs). EADSIM is a high fidelity analytic model used by the Services. At the theater level, CBS is integrated with the other Services' models via the Aggregate Level Simulation Protocol (ALSP) to form the Joint Training Confederation (JTC). The basic approach was to develop the ability for EADSIM to play through the CBS model and thus enable both stand-alone CBS and JTC interactions, as the needs of the training audience dictate. The Prairie Warrior '96 exercise demonstrated the use of this concept to focus Army assets on the Theater Missile Defense (TMD) mission. The careful evaluation of the timing constraints required to have the two very different models interoperate was central to the development of the two-way interface since major changes to either of the two models would have been cost prohibitive.

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Greg Wenzel is a senior associate at Booz•Allen & Hamilton Inc. Greg has over eight years of modeling and simulation experience with C4I systems and is involved in the distributed simulation technologies of DIS, ALSP, and the Common Object Request Broker Architecture (CORBA) as applied to integrating live, constructive and virtual simulations. Greg recently completed the Booz•Allen and Hamilton Command and Control Systems Interface (C2SI) prototype for the National Air and Space Model (NASM) program. Greg also has extensive experience in the design of models and simulations used for acquisition and training applications. He has a B.S. in Computer Science from Clarion University of Pennsylvania and will complete his M.S. in Computer Science from the Johns Hopkins University in May 1997.

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INTRODUCTION

Many possible applications exist for linking older training models with more modern simulations and models. Distributed Interactive Simulation (DIS) protocols and standards are very useful for making this linkage. This paper describes a prime example of this. We linked the Army's base-level combat simulation with a high fidelity analytic simulation to achieve a level of realism that promotes realistic responses from the training audience.

This is the first two-way implementation using DIS Protocol Data Units (PDUs). Earlier work with the Corps Battle Simulation (CBS) includes a one-way interface that enabled situational awareness for Atlantic Resolve '94 [1] and the use of a one-way ModSAF, Eagle, CBS interface in the Corps Level Computer Generated Forces demonstration as part of the Joint Precision Strike Demonstration program.

The first two-way CBS-DIS interface was developed for Theater Missile Defense operations and used during Prairie Warrior (PW) 1996. It grew out of the realization that today's warfighters face the threat of ballistic missiles in a theater of operations and that the granularity of Theater Missile Defense (TMD) operations in CBS is too coarse for the proper exercise of battle drill.

THEATER MISSILE DEFENSE PRIORITY

The ultimate goal of using modeling and simulation for training is to provide a high fidelity simulation environment for senior commanders and their staffs. The training audience has placed the highest priority on TMD operations—the focus of this project. In order to meet the initial objective of ensuring a robust TMD capability for training, we provided a detailed portrayal of the Active Defense pillar of the Theater Missile Defense program. Active Defense is one of four TMD pillars and is concerned with launch notification of, and defense against, ballistic missiles fired against US forces. The Army's Corps Battle Simulation was originally designed as a force-on-force simulation, used for training commanders and staffs at the division level and above [2]. Making major modifications to CBS to provide detailed TMD functionality is too expensive, but we achieved operationally valid TMD play by making a small modification to enable CBS to interact with a more detailed portrayal of TMD. The Extended Air Defense Simulation (EADSIM) provided the degree of realism needed, and DIS protocol data units were used to provide the communications between the models.

DESIGN ISSUES

Many concerns arise when disparate models are made to interact. Thus, when we included high fidelity TMD play in CBS, we were forced to address three significant design issues: 1) timing differences, 2) aggregation/ disaggregation, and 3) a consistent view of the battlespace across models. In addition, we had to be concerned with the rapid development approach and the need for extensive testing with CBS to avoid possible corruption of its data base.

Timing Issues

The general approach for synchronizing models with different time management schemes is to throttle all models back to the slowest model. Some authors state that all models must operate at the same time scale [3]. As a general statement for addressing maximum interactions of the models, this is probably true. But in most cases, and in the case of CBS, this is impractical. Adding detailed TMD functionality to CBS is a case where only small vignettes covering a few minutes of game time are being examined within the context of much less granular time steps. Campaigns are fought over days and months; missile flight times are usually less than ten minutes. Also, the players involved in the TMD operations are a small number of the game's participants. It was anticipated that TMD play could be conducted within the CBS events or run concurrently with other events. The results at PW96 support this assumption.

Aggregation/Disaggregation

Aggregation/disaggregation is always difficult to accomplish in dynamically interactive games. It is especially difficult to manage maneuver units that enter and leave contact numerous times. In the case of TMD, only a small number of units are of interest—Theater Ballistic Missile (TBM) and Patriot Air Defense Artillery units—and these organizations move only once or twice in a game day. Basically, they are either moving or employed in a doctrinal configuration. This simplifies the aggregation/disaggregation functions. Since there is no formal Aggregate functionality in the DIS standards, we used a proposed approach of the Aggregate PDU [4]. We found that the Aggregate PDU format specified in Foss and Franceschini's paper [4] was sufficient for TMD play. The doctrinal templating of the Patriot units required generating entity state PDUs for each of the assets in an operational battery. The entity state information was then grouped into an Aggregate PDU and transmitted. The Extended Air Defense Simulation used the aggregate information to identify the operational battery command hierarchy.

Consistent View of the Battlespace

A consistent view of the battlespace is required so that all models participating in an exercise perceive the same information about the units of interest. For instance, models that deal only with icons of aggregate units should see the icons at the same geographic location. Further, models and sensors should see the equivalent entity-level laydowns across terrain representations. Perhaps the most important step in achieving this goal is either to use a common model to maintain the disaggregated representation of the units of interest or to use a standard templating function for the units. Aggregate-level models prefer the former; entity-level DIS models prefer the latter.

Data Base Consistency

The construction of the CBS-DIS interface took the above issues into account. In addition, it had to deal with the implications of the two-way interaction with CBS. There was concern that an automated write-back into CBS might cause data base inconsistency problems, especially in view of the short time to develop the interface. To properly address this concern, we limited the write-back operation to logistics update information since a supply update order already existed for the CBS Master Interface (MI). A test of this capability was scheduled for the conclusion of PW96; however, it was successfully demonstrated at the Joint Training Confederation (JTC) Confederation Test (CT) [5] only six weeks after development of the interface began. At PW96, the write-back capability was validated.

CBS-DIS CONNECTION

The Corps Battle Simulation serves as the base model in two principal training environments—in a stand-alone mode for the Army's Battle Command Training Program (BCTP) and as the base model for the Joint Training Confederation. The CBS-DIS interface was used in a JTC exercise (PW96) in May 1996 and will be used in Cascade Peak, a BCTP exercise for I Corps in Fort Lewis, WA, in November 1996. Figure 1 shows the logical configuration for BCTP exercises. A description of the JTC configuration will be covered later.

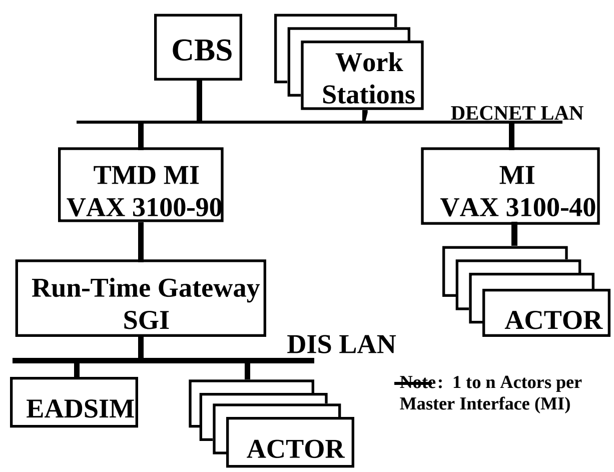

Figure 1. CBS Environment and Connection to DIS Models

Figure 1 depicts a logical view of the CBS environment and the DIS connection. When CBS is a member of the Joint Training Confederation, this arrangement is still valid, and all special models can still interface with CBS. The Master Interfaces provide a means for players and other models (Actors) to interact with CBS.

The Run-Time Gateway (RTG) has its own dedicated TMD MI and provides the interface to the DIS world. The events of interest to the CBS-DIS interface are unit dispositions, TBM launches, and impact points. These events are captured by the TMD MI, sent to the RTG, and passed to the EADSIM via DIS protocol data units.

Corps Battle Simulation

In both the stand-alone mode and the JTC mode, CBS models threat surface-to-surface missile (*e.g.*, SCUD-C, FROG-3) units and air defense artillery units with ballistic missile engagement capability (*e.g.*, Patriot, CORPSAM) as aggregate units in a three kilometer hexagonal grid. The units can vary from individual asset, through Battery, to Battalion. All components that compose a unit are located in the lower left corner of the iconic representation on the CBS display.

When a TBM is launched in CBS, an alert notification indicating a launch occurred is sent to the training audience and an impact event is scheduled in the CBS model. In stand-alone mode, an internal CBS algorithm models the launch delays and engagement by Patriot, and if the TBM is destroyed, the impact event is deleted. There is no opportunity for dynamic interactivity with the training audience, but typical delays for operations are realistically modeled. For example, the order to launch a TBM from a Transportable Erector Launcher (TEL) usually takes about twelve minutes of game time to set up and launch. This is reflected in the time delay from order issue to order execution.

Master Interface

The Master Interface [6] is an application developed by the Jet Propulsion Laboratory (JPL) that allows special models to extract information from CBS. There are two approaches to provide information to the MI—reports and orders. Reports are sent to the MI, but generally do not change the CBS data base. The reports are queued and can have a significant time delay. The RTG implementation uses the second approach, the order, to ensure objects are updated in the data base and are immediately available. This approach allows the fastest update to the MI application.

Run-Time Gateway (RTG)

For the purpose of this paper, the application program that performs the translations between CBS and the DIS world is called the Run-Time Gateway. The use of the RTG to generate DIS PDUs not only allowed EADSIM to interact with CBS, it also allows for the addition of other DIS-compatible models and simulations as needed by the training audience. The concept and approach for designing the RTG can be extended to tactical communications through the use of Signal PDUs and/or serial communications directly with C4I systems, utilizing their native message formats. So the RTG architecture has applicability to a broader set of legacy models that can be extended to interact with many high fidelity models.

As mentioned earlier, CBS is the base model for ground combat [7]. Because CBS is message-based, an application program that manages information translations and state information is required for interoperability. To enable EADSIM to handle the Active Defense mission, several essential pieces of information had to be fetched from CBS, modified to provide entity-level detail, and translated into DIS PDUs. The principal concerns were disaggregation of unit icons and providing launch information. CBS contains an aggregate unit with a number of launchers, missiles, and radars. The RTG performs a quick evaluation of the icon's associated attributes and disaggregates the unit into an operational battery if the number of launchers and radars is equivalent to a typical Patriot unit. The template for the disaggregate function performed in the RTG is shown in Figure 2.

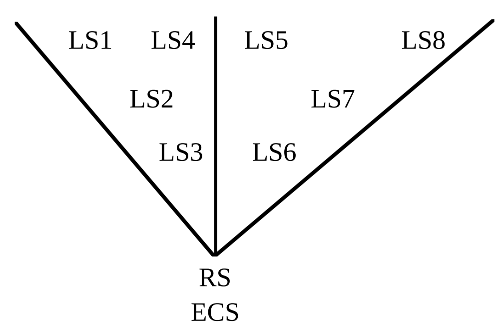

Figure 2. Typical Launcher Deployment Scheme for TBMs

The vertical center line in Figure 2 has an azimuth of zero. The left outer most limit of the Patriot Launcher is on a 320 degree azimuth from the radar. The azimuth of the rightmost launcher is at a 50 degree azimuth from the radar. The azimuths and distances for the Launcher Station (LS), Radar Set (RS), and the Engagement Control Station (ECS) are calculated each time an update on a unit of interest is received from

CBS. The number of missiles, radars, and launchers is evaluated before each calculation is performed to properly account for possible battle damage that may have occurred in CBS since the last update. The RTG determines what entities were damaged and this information is maintained in the object list until a unit is completely destroyed or merged with another unit.

Building a DIS interface to CBS allows DIS-compatible models to serve as adjunct models for many possible training events across the training spectrum from single service to joint operations. It was this design feature that enabled high fidelity TMD play with the Joint Training Confederation during PW96.

Extended Air Defense Simulation (EADSIM)

The Extended Air Defense Simulation [8] is an analytic simulation that can be used for Air Defense Analysis. The model is used by all services and fielded at more that 200 sites. For the TMD application, it can model TELs and missiles at the entity level, apply appropriate radar coverage algorithms, use doctrinal engagement methods, assess the effectiveness of the engagement and provide a logistics count of munitions expended. EADSIM has been modified to use DIS PDUs for communications with other high fidelity models. Via Signal PDUs, it can also generate tactical messages to stimulate warfighters at their go-to-war workstations.

JTC-CBS-DIS INTERACTIONS

In the Joint Training Confederation environment, CBS controls the movement and supply of TMD assets, but TBM launches and Patriot engagements are done in the Air Warfare Simulation (AWSIM) [9]. A 1996 JTC modification allows TBMs launched in AWSIM to be ghosted in CBS so that this information can be fed into the high fidelity DIS environment. A logical depiction of the physical architecture between JTC and the DIS environment is shown in Figure 3.

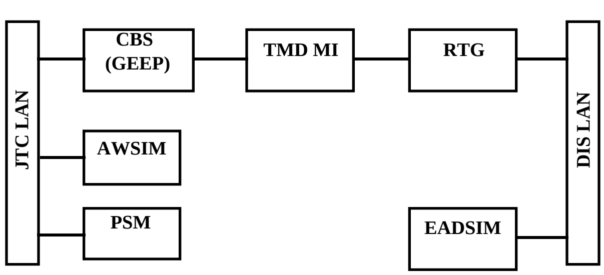

Figure 3. Joint Training Confederation and DIS Connection

The JTC has eight principal models, but the models of interest to this paper are AWSIM, CBS, and the Portable Space Model (PSM). The JTC models interact via a common message based protocol called the Aggregate Level Simulation Protocol (ALSP).

In the JTC configuration, AWSIM controls the launch of TBMs and the engagement of these missiles with Patriot missiles. When a TBM is launched, information is passed to the other member models via ALSP. The PSM receives this information and then runs a sensor model and forwards information about the launch to other models and players via real-world communications message formats.

CBS receives the launch information via ALSP from AWSIM. The information from AWSIM is ghosted in CBS and instantiated as an object in the CBS Game Engagement Events Processor (GEEP) data base and made available to the Master Interface as an object update order. The RTG translates this information into a DIS Create Entity Simulation Management PDU and sends this information to EADSIM. EADSIM processes the information by launching a TBM and performing the fly-out.

JTC Timing Issues

Traditional game timing in a JTC or BCTP exercise is in terms of hours and/or days. Commands are input into the simulations and results are shown much later. With the analytic models such as EADSIM, execution timing is on the order of seconds to minutes. Rapid results are returned to the analyst so that parameter changes can occur and rerun of the simulation can be performed.

Linking the JTC through CBS to EADSIM required solving some timing issues. The updates in the JTC are on a one-minute cycle [10], and some entities will not be updated if they are not involved in events during that cycle. Since the DIS nominal transmission rate of once every five seconds for stationary units is required [11], the RTG handles this functionality by maintaining a persistent object list for all TMD entities in CBS.

The RTG will send out Entity State PDUs at a minimum of once every five seconds for all the objects in the list. When the RTG receives a new update for a TBM, it will not place this entity in the object list of the RTG but will create a simulation management

PDU, Create Entity, telling EADSIM to create a TBM of a certain type at a particular launcher location and to perform fly-out of the missile.

The JTC uses the "slowest model" methodology of timing management. If any simulation is overloaded by processing requirements and falls off of the current game clock time, it will notify the confederation, and the confederation will slow down to the slowest simulation's time. This timing can be as slow as sixty percent of real-time as was seen during Prairie Warrior. This is a hot issue since minimizing timing latencies is important for the TMD time critical events.

The answer to the problem is to exploit "looseness" to achieve the training objectives of the TMD players. The "looseness" approach used in the RTG is to take a one-way feed of the time-critical event information such as a TBM launch and immediately pass this from the JTC network via the TMD MI order to the RTG. Once this information is sent to the RTG, the timing latency is in milliseconds since the RTG immediately sends out a DIS PDU with this information. Once this information is on the DIS network, the real-time simulation of EADSIM processes the PDU and sends out the critical message to other interested participants. It should be noted that even though the game has slowed to a rate slower than real-time, the launch information will be sent from EADSIM properly synchronized with the game time.

The additional functionality provided by the RTG is to allow information on the outcome of engagements of TBM and Patriot fly-outs to be placed back into CBS. When EADSIM performs a Patriot fly-out to intercept the TBM, an accounting is performed by the RTG on the number of Patriots required to engage the TBM. This information, upon completion of the fly-out of the Patriots or intercept of the TBM is sent back to CBS via the Master Interface as a Supply Update Order. This message reduces the number of missiles in the corresponding Patriot unit in CBS, so that CBS will use the high fidelity information of EADSIM as a logistics arbitrator. This also maintains consistency between the TMD environments in CBS and EADSIM.

INTEGRATION TESTING

Integration testing occurred during the JTC Confederation Test in March 1996 and again in stand-alone mode during the TMD Tactical Operations Center (TOC) validation test in April 1996. During CT, aggregation/disaggregation tested flawlessly and the launch data was successfully passed through CBS through the RTG to EADSIM without any difficulty. However, after successfully sending the launch information through the same route, the training audience voiced concern that the route may introduce too much time delay for the launch data to be tactically useful.

The standard set by the user community was two minutes from launch initiation to receipt by the tactical user. Since there was no tactical user at CT, the time from launch to receipt by EADSIM was used. Several tests under varying loads were conducted. For routine loads, launches of up to 97 TBMs at a time were handled in less than thirty seconds; well under the maximum time criteria. However, during a launch of 144 TBMs, the launch messages were received in two volleys. The first volley of 97 was received in thirty seconds, followed by a second volley of 47 TBMs three minutes later. The delay was observed between the AWSIM launches and receipt of the launch data at the TMD MI. Therefore, the delay is associated with the JTC and not the DIS translations. A possible cause may be the way the message mailboxes are set up in CBS, but the specific cause was undetermined. Given the current JTC configuration, this provided an upper bound on the number of concurrent launches that could be handled. Fortunately, the user community does not expect and cannot handle anything approaching this limit. Additionally, the coordination necessary for the simultaneous launch of 144 missiles in the same theater makes this scenario highly improbable. After CT, the two-way feed of the logistics data from EADSIM to CBS was tested. The mechanism for feedback was the Supply Update Order. This was tested without error in the CBS stand-alone mode.

The TMD Tactical Operations Center validation test (VT) in Huntsville, AL provided a tactical environment with operational users to look at launch data. The TMDTOC is a real-world, state-of-the-art, digital TOC operated by a highly trained cadre of soldiers. During the VT, CBS ran in a stand-alone mode. Again, aggregation/disaggregation worked as expected. In addition, all launches were received from CBS through the TMD MI, through the RTG and EADSIM and into the TMDTOC in under thirty seconds. This test established the TMDTOC configuration for PW96.

PRAIRIE WARRIOR 1996 (PW96)

Prairie Warrior 1996 was an Army-sponsored, large-scale, computer-assisted exercise that provided a training environment for 21st Century leaders and an analytic environment for conducting Advanced

Warfighting Experiments. A modified configuration of the Joint Training Confederation provided the simulation environment. This confederation of models was composed of several member models and many special models. The member models of interest to this paper are AWSIM, CBS, and PSM. During PW96, EADSIM was considered a special model, and the Army's TMDTOC interacted with the JTC's participants. The logical arrangement of these models is shown in Figure 4.

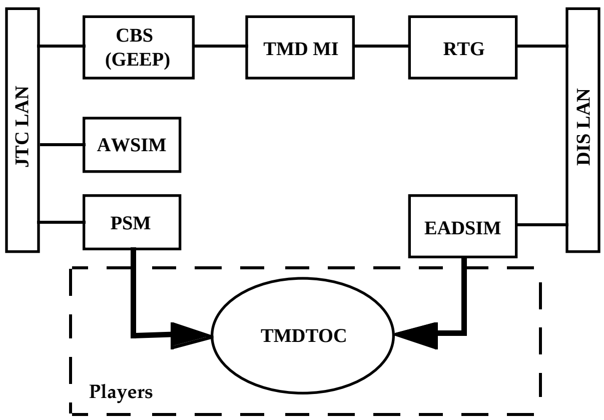

Figure 4. Prairie Warrior Configuration

PW96 provided the opportunity to evaluate the performance of the RTG in an operational context. However, because of its operational nature, gathering data became a challenge. The critical functions to be evaluated were :

- Was there a consistent mapping of units and entities of interest between CBS and EADSIM?
- Was the launch information timely?
- Was it possible to provide logistics updates to CBS?

Consistent Mapping

A consistent mapping of units was verified through observation. While the number of units in the CBS data base was large, the number of assets of interest to the TMD community was only a small number of the total. For PW96, this meant keeping a consistent view of just US Air Defense Artillery (ADA) battalions and opposing force transportable erector launchers. ADA assets are deployed as batteries, so each battalion decomposed and deployed as batteries in the CBS data base. The RTG had to handle the mapping of the batteries to individual fire units. As the exercise unfolded, the ADA assets were periodically moved and experienced attrition and reorganization. The RTG had to manage this mapping as well. By visually noting the ADA deployment on a CBS workstation, we easily verified the ADA mapping. In addition, the absence of unanticipated messages in the error handling routines provided further assurance that the proper picture of the battlespace was being maintained.

Timely Launch Information

Verification of launch information was the biggest challenge. There is no common clock in the JTC, and it is normal to see a difference between the wall clock and the game time. So several methods were employed to verify that timely launch information was being received by the TMDTOC from AWSIM, the controlling actor that initiated the launch. In the JTC mode, the PSM simulates the capability of the Defense Support Program and provides the Confederation-approved method of providing tactically formatted launch notification to players. To verify that the CBS-DIS methodology was capable of providing a timely, independent route for the same information, the time difference between two routes to a common receiver was measured. The TMDTOC was used as the collection point for the information. In the JTC, AWSIM launches the TBMs. This information is broadcast using the ALSP. The PSM and CBS receive this information at the same time. The PSM processes this information, adds a delay to simulate the real world systems processing, and sends the launch information via a serial feed directly to the TMDTOC. The broadcast information received by CBS from AWSIM must be entered into its data base and then sent through the TMD MI and on to the RTG. The RTG translates this information into a DIS Create Entity Simulation Management PDU and sends this information to EADSIM. EADSIM processes the information and does two things. It uses this information to provide a high fidelity fly-out and engagement of the TBM by Patriot missiles, and it formats the launch information into a pseudo tactical message wrapped in a Signal PDU (SPDU). This information is sent into the TMDTOC where it is formatted into a tactical message and forwarded via serial feed on to a common workstation, usually the Air Defense System Integrator (ADSI), which performs the function of accepting multiple tactical message formats. The ADSI forwards this information to the appropriate displays. The PSM message was sent directly to the ADSI, so it served as the common point for evaluating time delay issues.

During PW96, the TMDTOC conducted several data collection efforts. The TOC is not instrumented to automatically log and analyze incoming messages, so the data collection was done by soldiers the old fashioned way—by clipboard and watch. The path from the PSM simulated the transit time and message formats expected in actual operations. It was also the most direct path. The path through CBS, RTG, and EADSIM was longer and needed additional data massaging before reaching the TOC. Three test events were conducted to measure the time difference. The first was used to establish the procedures and identify bottlenecks between the RTG hand-off and arrival at the TOC. A time delay of seven minutes was observed. This required some analysis of intervening routers and models. The bottlenecks were identified and corrective actions taken. The next test event observed a minimum delay of three seconds and a maximum delay of 45 seconds. The final test event was even better with a maximum observed delay of less than thirty seconds. The results were consistent with the testing done during the CT and the VT. This was well within the established threshold. Also, the user-perceived time difference was insensitive to the number of launches occurring within a given time interval.

Logistics Updates

The aggregation and disaggregation technique and the handling of the launch information using DIS PDUs during PW96 met the users' expectations. Because of the rules regarding two-way interaction of models with the JTC, the logistics feed from EADSIM through the RTG was evaluated immediately after the end of the exercise. The National Simulation Center sponsored testing of the two-way link with CBS in the JTC and in stand-alone mode. A series of experiments provided increasing numbers of TBM launches and subsequent engagements by Patriots in EADSIM. We observed no error or latency in either confederation or stand-alone configuration. The logistics update information was translated from DIS PDUs to CBS Supply Update Orders, and the CBS log files were examined to verify the success of the operation.

PW96 Summary

PW96 provided a tremendous opportunity to gather observations about the RTG. The network loads that one could expect during a major exercise, combined with the significant TMD play, made this a great opportunity to test the RTG under heavy loads. During the eight-day exercise, the JTC recorded more than 2000 TBM launches, averaging 250 per 12-hr day. Of course, this number is a tremendous exaggeration of the number of TBMs that could be employed. But it was useful for the practice of battle drill for the TMD training audience.

From an operational perspective, the goal was to see that launch information got to the users in a timely manner. Having the TMDTOC at PW96 was beneficial in verifying the usefulness of the RTG approach. When the Portable Space Model participates in the JTC, it can send the launch information to all interested players, including the TMDTOC. Unfortunately, there are only a few JTC exercises conducted annually. In addition, the preponderance of the training events are not JTC based, and a mechanism must be provided for development tests and validation tests of real-world systems like the TMDTOC. By using CBS as the window into launch information, the TMDTOC can be routinely stimulated regardless of the JTC exercise schedule and participation by the PSM.

FUTURE WORK

This project provided stimulation for the Active Defense mission—one of TMD's four pillars. This first stage provided CBS the functionality for doctrinal templating of TMD assets, timely alert notification, and ground-to-air engagements of surface-to-surface missiles. In the next stages, Attack Operations and additional Battle Management and C4I (BM/C4I) functionality will add increased realism to the training environment.

Attack Operations will need to address new battlefield systems. In particular, Attack Helicopters and the Advanced Tactical Missile System (ATACMS) will be added to the DIS environment. Timing issues associated with incorporating these systems is currently being assessed. The Battle Management functions will mean real-world command and control communications formats and channels must be stimulated and simulated. The primary mechanisms in the DIS realm for BM/C4I are the Transmitter, Signal, and Simulation Management PDUs. Experiments with these PDUs are already underway.

Finally, all current and future work is being tracked with emerging standards and protocols. For example, transitioning DIS functionality to the Defense Modeling and Simulation Office-sponsored High Level Architecture (HLA) and using its Run-Time Infrastructure (RTI) for interacting between legacy models and DIS-based simulations are being evaluated by many organizations. The largest uncertainties are timing and latency. Not enough analysis has been done to properly assess these issues, especially with regard to addressing heterogeneous model connectivity.

SUMMARY AND CONCLUSIONS

Current military forces have immediate training needs. Providing adjunct capabilities that interact with legacy models via Distributed Interactive Simulation Protocol Data Units offers an affordable solution. Careful analysis of training needs, selection of appropriate DIS-compliant models to provide the added stimulation, and well-structured interfaces can provide those capabilities. This paper discussed one example of how to provide a dynamically interactive environment for today's warfighters by integrating EADSIM with the Army's base model via a DIS interface. Lessons learned from this project should be used in better defining new model requirements.

ACKNOWLEDGMENTS

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