... information for the Defense modeling and simulation community ...

DMSO NEWS

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INSIDE ...

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Agent Based Modeling

Marines' 'Project Albert' focuses on non-traditional modeling tools

By Lt. Col. Eileen Bjorkman, U.S. Air Force
DMSO Associate Director for Transformation
and Dr. Phil Barry
DMSO (MITRE Corporation)

[Lt. Col. Bjorkman and Dr. Barry participated in the 4th International Project Albert Workshop held August 6-9 in Cairns, Queensland, Australia.]

Project Albert is an initiative of the U.S. Marine Corps Combat Development Command (MCCDC), which uses a series of new models and tools, multidisciplinary teams, and the scientific method, to explore questions of interest to military planners.

Project Albert attempts to address three key areas that traditional modeling and simulation techniques often cannot capture satisfactorily:

- *Non-linear Behavior*. This includes situations where a small change in the model baseline (and the real world) creates a disproportionate response. Areas of non-linear behavior may be equated to opportunities and weaknesses within a military operation.
- *Co-evolving Landscapes*. The battlefield is fluid and dynamic as each commander adjusts his plan to the changing circumstances of the battle. Co-evolving landscapes attempt to account for the "I think he thinks" game in the modeling and simulation process.
- *Intangibles*. Intangible factors such as morale, discipline, and training can have an enormous, but traditionally unaccounted for, outcome on battles. Project Albert attempts to use personality-based models to investigate these issues.

Project Albert also uses two data management concepts to assist in identifying areas of interest by allowing users to investigate a large data space in order to identify situations where data relationships become non-linear or pro-

See PROJECT ALBERT, p. 8

Executive Forum for M&S set for June 17-19 in Norfolk, Va.

The Defense Modeling and Simulation Office (DMSO) will host the 11th annual *Executive Forum for Modeling and Simulation*, June 17-19, in Norfolk, Va.

The forum, formerly the DMSO Industry Days, is the Defense Department's premier event for federal government, senior Department of Defense (DoD), industry and academic executives, strategic planners, program managers and senior technical managers to gain insight into the Department's modeling and simulation (M&S) policies, plans, programs and emerging initiatives. The forum also provides the DoD with the opportunity to obtain feedback and insight into the views and plans of key warfighters, decision-makers and technology leaders in Congress, the DoD, industry and academia.

The Executive Forum on M&S is sponsored by the DMSO with the support of the National Training Systems Association (NTSA).

Watch the NTSA Web site at *www.trainingsystems.org/events/index.cfm* for an agenda, online registration, hotel information and more as the event — NTSA Event #21E0 — draws near.

- For program/agenda information contact Larry Alexander, conference project lead, at (703) 824-3404, Fax (703) 998-0667, or e-mail *lalexander@dmso.mil*.
- For conference registration information contact Kerry Davidson at NTSA at (703) 247-9471, Fax (703) 243-1659, or e-mail *kdavidson@ndia.org*.

Director's Corner

By Captain Michael G. Lilienthal, MSC, US Navy

Events of '9/11' strengthen our sense of urgency

The events of September 11 continue to loom large over our daily lives and focus the business of the nation. The emotional effects of the terrorist acts that day; the ensuing U.S. military operations in Afghanistan; the efforts to contain the spread of anthrax and anticipate and prepare for other bio and heretofore unimaginable scenarios; and the daunting task of expeditiously upgrading air travel security have rippled across our nation rekindling a single-minded patriotic will to bear the adversity and carry on. Whether we lost family or friends in the World Trade Center or the Pentagon, or have only witnessed the saga unfolding on TV, it has touched and changed us all.

On September 7, Colonel Crain had a retirement ceremony at the DMSO, the weekend was pleasant and the issues mundane. The day before "9/11" was part of getting my "sea legs" as the new director. I will never forget 9/11, watching the smoke rising from the Pentagon from our offices here at the DMSO. A shadowy, unconventional foe has brought the battle to us here in America and put our communities, our homes, and our families in harm's way. The plane that struck the Pentagon passed over my wife at home, less than a mile from the crash.

> ***"Since September, the DMSO staff and I have been executing a plan for course correction that I think takes into account the good advice I received from the senior advisors of our community, and provides a responsive, adaptable, focused organization for supporting our customers. Some programs will continue to execute as planned before 9/11."***

The President has declared that we are now at war. Every federal agency with a responsibility for public safety is working diligently to plug the gaps that allow terrorists to operate undetected and unhampered among us here and around the world. Ironically, the Saturday after the attack, I received by snail mail my certificate of appreciation celebrating the end of the Cold War. I believe that it will be a long time, if ever, before I receive a certificate celebrating the end of the terrorist war.

I had already begun, as the DMSO Deputy Director in the two months prior to my assumption of the directorship, to seek out the thoughts and advice of numerous senior leaders, both inside and outside of the DoD, on how the DMSO could best serve our modeling and simulation customers and what the high-priority things are that need to be done first.

The DMSO had already been working on how to provide M&S support to the warfighter for operations other than war (OOTW), which at least put us in the ballpark for participating in the dialogue concerned with implementing non-traditional missions and threats. However, our efforts were just not geared to envision a terrorist attack like we all witnessed on 9/11.

See DIRECTOR'S CORNER, p. 3

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Commentary

Standards are useful, but they don't solve 'Groundhog Day' problem

By Mark Phillips
Senior Research Scientist
Virginia Modeling Analysis and Simulation Center (VMASC)
Old Dominion University

We never seem to learn from the past, hence we are doomed to repeat it, like in the movie "Groundhog Day."

A good start for breaking the cycle is the development of an architecture or framework. Standards are useful tools in building a supportive and stable framework – they're the foundation for the architecture – but don't solve the problem. The fact that we can rapidly pull together a federation of different simulations – which becomes a whole new simulation – is a testament to the ability of those who worked together to create standards, but we're still looking six feet in front of us. It's the year 2001, and we're not as far from the mark as we could be, and the reason is not technical, but political and cultural for the most part. The real question isn't "how do we pull together a simulation on short notice," but rather, "why are we?"

Having spent a few years in the modeling and simulation arena, I have often had a strange sense of dejavu. Well I'm 15,000 km (not sure of the miles) from home in Australia, five years on and still feeling like I have been here before. Hmmm.

It all started in September when as usual I opened my mouth at the wrong time and suddenly found myself as the lead integration engineer for the "Joint Battlespace Environment (JBE) for IITSEC 2001" demonstration, a U.S. Joint Forces Command initiative. At the instant the task was given to me, I had a strange sense of dread and excitement all at once. The task was to bring together a number of simulations (HLA and DIS) and C4I systems (not to mention more than 30 engineers) into one system for the purpose of demonstrating the vision to the Interservice and Industry Training, Simulation and Education Conference (IITSEC) audience in November. The task was also a prelude to the further development of the concept as a warfighting, experimentation, analysis and acquisition tool. I had six weeks – of which five days were my critical testing days (OUCH!).

As I stared out of my window, I couldn't help but notice that a family of groundhogs had made their home behind our simulation laboratory. One sat up and looked me in the eye, almost mocking me … perhaps he knew what I was in for. If you have seen the movie "Groundhog Day," then you know what I am alluding to – being doomed to repeat history until you **"get it right.**"

Being a shy and introverted person, I was suited to the task completely and until recently thought that "SEI" stood for "Software Engineering Institute." Well, it really stands for "Social Engineering Insight." How exactly do

See GROUNDHOG DAY, p. 5

Director's Corner

Continued from p. 2

Since September, the DMSO staff and I have been executing a plan for course correction that I think takes into account the good advice I received from the senior advisors of our community, and provides a responsive, adaptable, focused organization for supporting our customers. Some programs will continue to execute as planned before 9/11. However, others will be reoriented to support the updated direction, e.g. DMSO will provide Runtime Infrastructure-Next Generation (RTI-NG) and interface specification development support for the Joint Simulation System (JSIMS) program and Joint Experimentation.

I've gotten approved a set of principles to guide DMSO in the near term as we focus our efforts. We will accelerate our focus on Joint needs and the DMSO's role as a catalyst for the M&S community. We will base our technologies and methodologies on where we are going, not where we have been. The events of 9/11 only strengthen our sense of urgency for the advancement and transition of M&S for the use of the warfighter.

While we're on the subject of warfighters, I'd like to welcome aboard several new additions to the DMSO staff. The first is **Army Colonel Ken Pieper**, who joined the DMSO as Deputy Director in September. Ken came to us from the Wargaming and Simulation Center at the National Defense University where he was a Senior Military Fellow. A 1979 graduate of the United States Military Academy, he was commissioned in the Field Artillery and has served in command and staff positions in tactical units from the battery through corps level in the U.S. and Europe. An Operations Research Systems Analyst, he graduated from the United States Naval Postgraduate School in 1989 with a Master of Science in Operations Analysis. He is also a Joint Specialty officer serving his third Joint tour of duty.

Three of our new staff members arrived in October – **Dr. John Tyler**, **Mike Rugienius** and **Shirley Ginwright**. John, who is shepherding our human performance efforts, comes to us from the MITRE Corporation. Mike and Shirley are both here on career-development assignments. Mike is from the Naval Air Warfare Center – Training Systems Division. Shirley is from the Federal Aviation Administration.

The DMSO continues to be *the* catalyst organization for M&S in the DoD. We can best serve the M&S community by spotting and cultivating M&S tools, trends and technologies and working the M&S policy issues to get them into the hands of the people who need them. M&S is an enabling, cost-saving tool that can and will serve us well as we engage technology, even skipping generations in the process, to transform our forces for rapid response to threats that range from terrorism to peacekeeping to conventional warfare.

As always, we solicit your comments and advice in keeping us honest, productive and informed team players.

Respectfully,

Michael Lilienthal, Ph.D., CPE
CAPT MSC USN

Distributed Cooperative Attack Experiment demonstrates Smart Sensor Web capabilities

By Lt. Col. Eileen Bjorkman, USAF, DMSO
Mr. Dave Greinke, Strategic Analysis Inc.
and Mr. Kevin O'Neal, Air Force Research Laboratory

On October 30, the Smart Sensor Web test team conducted a Cooperative Attack Experiment to demonstrate a lower-echelon ground warfighter's ability to redirect airborne autonomous attack weapons to a target on the ground. The experiment used distributed live and virtual simulation facilities at Ft. Benning, Ga., Eglin AFB, Fla., and Ft. Belvoir, Va.

This is the latest experiment in a series being conducted under the Deputy Under Secretary of Defense for Science and Technology's (DUSD[S&T]) "Smart Sensor Web" (SSW) Project.

During the experiment, live sensors at Ft. Benning identified a potential target (a live tank) and produced an alert that was sent via the Defense Research and Engineering Network (DREN) to the Cooperative Attack Testbed at Eglin. The alert message was intercepted by a simulated reconnaissance unmanned aerial vehicle (UAV) that was re-directed autonomously to verify the target. An operator representing a lower-echelon warfighter monitored video from the UAV and notified a simulated battalion-level tactical operations center (TOC) after a snapshot of the target had been obtained. The TOC verified the target and then passed the targeting data to simulated loitering Wide-Area Search Munitions (WASMs) that then redirected, engaged and destroyed a simulation of the target.

The WASM used in the experiment was the Low Cost Autonomous Attack System (LOCAAS) being developed at the Air Armament Center at Eglin AFB. The LOCAAS is launched from an aircraft (e.g., an F-16) and then loiters on the battlefield searching for targets to destroy using its own sensors and an automated target recognition system. When the LOCAAS finds an appropriate target, a multi-mode warhead optimized to destroy a heavily armored, actively protected, or soft target is detonated. Multiple weapons can be launched at one time to cover a wider area on the battlefield if necessary. The cooperative attack concept uses multiple weapons in conjunction with additional off-board sensors and sharing of information regarding potential targets among the weapons.

The cooperative attack experiment had two main objectives:

- Demonstrate that WASMs can use off-board sensor information in addition to their on-board sensors and inter-weapon communication to enhance their overall effectiveness.
- Demonstrate that autonomous munitions can provide important data (target recognition, damage information or snapshot images) through the SSW for use by battlefield decision makers.

This experiment highlighted the potential of cooperative engagements using lower echelon warfighters and higher echelon assets. Technologies and processes used during the experiment have application to modeling and simulation for Joint Urban Operations and for the ongoing LOCAAS program.

SSW Project Background

The DUSD (S&T) initiated the SSW project in FY 2000 as one of the Defense Department's top five Science and Technology (S&T) priorities. The project was inspired by the 1996 Defense Science Board (DSB) study on "Improved Application of Intelligence to the Battlefield," which emphasized the need for an enhanced situational awareness capability for the lower-echelon warfighter (battalion and below). This was followed by the DUSD (S&T)-sponsored 1998 "Advanced Research in Emerging Sensors" (ARES) Symposium, which focused on the emergence of small, low-cost, distributed sensors as an enabling technology to support this need. At about the same time, a Defense Advanced Research Projects Agency (DARPA) *Information Science and Technology Study* (ISAT) identified the need for technology development in energy-constrained ad hoc networks and confirmed the conclusion of the ARES study regarding the value of distributed sensing. In 1999, the DUSD(S&T) developed the overall vision for the SSW as an intelligent, web-centric distribution and fusion of sensor information that would provide greatly enhanced situational awareness to warfighters at lower echelons—the right information at the right time on the battlefield.

SSW Objectives

The overall objective of the SSW project is to identify and examine, in depth, the critical technical issues associated with the development of a deployable enhanced situation awareness system for the lower echelon warfighter.

Three sub-objectives include:

- Identify critical technical issues in an operational context, demonstrating in a testbed environment the applicability of these technologies to selected joint applications.
- Develop an assessment capability using live and simulation testbeds.
- Identify opportunities to transition Smart Sensor Web capabilities and results to other S&T programs.

SSW Testbeds

To support the operational context of the project, live and virtual testbeds were developed to provide platforms for conducting experiments to identify and assess the key technical elements associated with the development of such a system.

The virtual distributed testbed is centered at the Night Vision and Electronic Sensors Directorate (NVESD) at Ft. Belvoir, with DREN links to various sites (see Figure 1). The live portion of the testbed is located at the McKenna Military Operations on Urban Terrain (MOUT) site at Fort Benning, which is operated and maintained by the Dismounted Battlespace Battle Laboratory (DBBL) of the U.S. Army Infantry School (see Figure 2) there.

The SSW testbed is representative of a system for increased situational awareness, and provides data collection from sensors and simulated sensors, data movement via communications assets, data manipulation and information creation via programs and processors, and information presentation to the warfighter via hardware and software. Because of its open architecture configuration, additional advanced technology can be inserted and evaluated for each component, and additional instrumentation can be installed as required.

SSW Experiments

In order to conduct the SSW experiments, evaluation and testing procedures were developed to measure the contribution of individual and integrated components, live and virtual sensing systems, and networked communications systems to overall situational awareness during three vignettes:

- The mission planning, pre-assault, and an assault phase of a small unit operation in a MOUT environment using live soldiers.
- The recovery of a downed aviator using live and virtual assets.

See CAE SSW, p. 5

CAE SSW

Continued from p. 4

- The use of autonomous WASMs in a collaborative attack.

The final SSW experiments will be conducted at Ft. Benning in January.

For more information

For more information contact Lt. Col. Bjorkman at (703) 998-0660 or *bjorkman@dmso.mil*.

Groundhog Day

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you bring more than 30 disoriented and otherwise preoccupied bright people into a warehouse facility and get them to patch together 60-plus computers … and get them to play nice. In other words, what has 60 legs, 30 heads and a doggedly determined attitude? Answer: the JBE integration team.

We, all of us, in two and a half days tied together and were on the way to integrating (and excuse the acronyms as this would go on forever) JSAF, JCATS, WARCON, MSTARS, IDAL Cockpit, AWSIM, GCCS-M, VBMS, HLA Control, F22 Cockpit, C2PC, C4I Gateway, JIMM, BFTT and MIL II Cockpit. But it didn't happen without the odd drama, and a head start given from the Millennium Challenge '02 experience. The question I had for everyone on the integration team was, in this year of 2001, how come we all can't show up, plug in and get on with business. How many times do we have to do this before we "get it right."

I think it all comes back to something I like to call the ten commandments of integration. Okay, maybe suggestions, but that doesn't sound as good. I had this vision of Charlton Heston having spoken to the burning bush coming down from Mount DMSO with the inscribed tablets saying:

1. Consistency – Thou shalt be consistent at the meetings as in the test bay. Stick to what you promised and understand what you promised.

2. Flexibility – Thou shalt understand that thy model is not the center of the universe. This means get it right early and adjust as needed. It doesn't mean change at will just before and during testing.

3. Configuration Management – Thou shalt maintain master records and files. Know what you have, control it, maintain it and manage it (something we like to call systems engineering).

4. Documentation – Thou shalt document. Document faults and resolutions, even if you know the answer, as changes may not formally go into the environment for months – if remembered at all. Document, document, document! Am I being too vague?

5. Coordination – Thou shalt find who is important and who is a gatekeeper. Follow good project management philosophy. Find out who is an engineer, who is the logistician, who holds the money and who should keep their nose out of your lab. Then deal with those people like they were family.

6. Communication – Thou shalt broadcast to the team regularly. Get a central bulletin board set up – a web portal would be nice, email reflector even – and run regular conferences on the telephone. Keep everybody who needs to be in the loop, in the loop.

7. Resource – Thou shalt get dollars, equipment and people. Make sure that if you have responsibility, even if you don't have authority, that you get the resources you need.

8. Discipline – Thou shalt honor thy Integration Leader. Stick to process, to routine and think with one integration mind. Don't disappear into your own private Idaho cutting code in isolation. You might be surprised how quickly issues are dealt with when aired publicly.

9. Never Assume – Thou shalt never assume anything, lest you be struck by lightning, or at least a blunt object**.** Never assume anything and, please, no throw away lines, like "that was agreed to at the *Fomerama*." Not everyone knows your model as well as you.

10. Leadership – Thou shalt treat thy peers with respect and shield them from heat and distraction. Probably the most important commandment. Make sure that the staff you have at integration are free to do their job without fear of distraction or lack of resources. Remember leadership works upwards as well as downwards.

So to cut a long story short, we have a way to go before we in the M&S business are all out of work because the simulations are so stable that the warfighters don't need us anymore. But I am encouraged by the very clever people out there (my team in particular), the standards we have (yes, they do actually work) and the vision for a joint integrated modeling and simulation environment. Perhaps the groundhog days are numbered after all.

See you at IITSEC.

ITEA's Tidewater Chapter hosts 2d annual 'M&S in OT&E' symposium

By Brian J. Hall
Deputy Assistant Chief of Staff for Information Operations
Commander, Operational Test and Evaluation Force

The Tidewater Chapter of the International Test and Evaluation Association's (ITEA) *Second Annual Modeling and Simulation (M&S) in Operational Test and Evaluation (OT&E) Symposium* was held at the headquarters for Commander, Operational Test and Evaluation Force (COMOPTEVFOR) in Norfolk, Va. on Oct. 16-18. Despite the recent terrorist attacks, the event went as planned.

The goal of the symposium was to address the issues involved in the use of M&S in Operational Test and Evaluation (OT&E). Additionally, the Symposium brought together key Department of Defense (DoD) M&S policy makers and end users. The theme was to evaluate the acquisition changes in the use of M&S in OT&E. Some of the DoD agencies represented were: Director, Operational Test and Evaluation (DOT&E), Defense Modeling and Simulation Office (DMSO), U.S. Joint Forces Command (USJFCOM), Joint Accreditation Support Activity, U.S. Army Test and Evaluation Command, Air Force Test and Evaluation, Air Force Operational Test and Evaluation Center, Navy Modeling and Simulation Management Office (NAVMSMO), Army Test and Evaluation Center and COMOPTEVFOR.

Over 20 speakers and panelists focused on M&S issues for today and tomorrow. Lee H. Frame, Principal Deputy in the Office of the Director OT&E (DOT&E), delivered a keynote speech discussing DoD M&S policy and the Operational Test Activity Letter of Concern on M&S in OT&E. George Ryan, OPNAV N091, Special Assistant, RDT&E Infrastructure, discussed M&S investment by the Navy; Navy CAPT Richard Bump discussed overall Navy M&S issues. Ken Goad of USJFCOM Experimentation discussed the National Joint Experimentation Environment. The Symposium ended with luncheon speaker John Gehrig, DOT&E Deputy Director for Resources and Ranges, discussing Test and Evaluation Infrastructure Investment.

Some of the M&S Symposium speakers presented examples of M&S that had been successfully verified, validated, and accredited by COMOPTEVFOR.

The Symposium Chair was Tom Ferris of Electronic Warfare Associates, Inc. and the Symposium Technical Chair was Brian Hall of COMOPTEVFOR. Joe Petro, also of COMOPTEVFOR, currently serves as president of the Tidewater Chapter.

The Tidewater Chapter will host its next nationally sponsored symposium titled "Test and Evaluation Across International Boundaries," Oct. 21-24, 2002 in Virginia Beach, Va.

October Calibration Experiment proves to be 'stress test' for Runtime Infrastructure

By Gil Gonzalez, SAIC,
and Oanh Tran and Greg Tackett, U.S. Army Materiel Command

An October Calibration Experiment, or CalEx, proved to be a "stress test" for the DoD High Level Architecture (HLA) Runtime Infrastructure (RTI) in an environment with unreliable connectivity and highly varying latency.

The Army Material Command's Research, Development and Engineering Center Federation (AMC RDEC Federation) completed the CalEx with an HLA federation using a Real-time Platform Reference (RPR) Federation Object Model (FOM)-plus-extensions across the Defense Research Engineering Network (DREN). The DREN was used as a general-purpose Wide Area Network (WAN).

The experiment involved seven different sites – ranging from Michigan to Alabama to Virginia – with a total of more than 30 federates, including high-fidelity models, man-in-the-loop (MITL) simulators, computer-generated forces (CGF) and HLA tools.

One of the key goals and strengths of the AMC RDEC Federation is the ability to execute over the DREN allowing multiple federates over a geographically dispersed area to collaborate in a common federation execution. While the DREN provided more than sufficient bandwidth required by the federation, it presented unique and unexpected challenges – irregular latency and loss of connectivity – in three major areas: the overall WAN configuration, each local Metropolitan Area Network / Local Area Network (MAN/LAN) configuration, and the RTI.

WAN connection challenge

Connecting the AMC RDEC Federation over a WAN was quite a challenge for the integration team. The WAN configuration requires that each site have a DREN connection that supports both best-effort multicast and point-to-point reliable traffic. In order to allow best-effort traffic flow, each site had to set up a multicast tunnel to the Army Research Laboratory (ARL).

Initial configuration of the tunnels proved to be a learn-by-doing experience for the team members. For example, bandwidth was insufficient; the ARL tunnel machines were underpowered; huge packet latency was observed; and tunnel connections were periodically going down. Since RDEC Federation members using the DREN had no control over the number of routers traversed from one point to the other, whenever connectivity problems occurred, expert DREN support was required. For limited periods of time, identifying and contacting the responsible points of contact for the problem routers overcame these problems. However, this required extensive effort and continuous monitoring which deprived the testers of valuable integration/testing time.

Intermittent connectivity

Intermittent connectivity caused significant impact on RTI performance. For example, best-effort messages were not delivered, which prevented federates from seeing some entities, causing incomplete scenario execution and data logging. Reliable traffic does not use the multicast tunnels, and therefore was not affected by these problems. Instead it was affected by irregular latency or network connectivity disruption between sites, often causing the federation to hang.

The experiment involved seven different sites – ranging from Michigan to Alabama to Virginia – with a total of more than 30 federates, including high-fidelity models, man-in-the-loop (MITL) simulators, computer-generated forces (CGF) and HLA tools.

The MAN/LAN configuration at each site also affected RTI performance by creating unnecessary latency and blocking reliable traffic. For example, most sites had several layers of network equipment between the originating nodes to the DREN connection, adding latency. Some were also behind firewalls, which normally are configured to restrict reliable traffic. Even though federation objects and interactions are best effort (multicast), all federation management communication is reliable. In order for reliable traffic to go through a restricted firewall, specific ports need to be open. This is not necessarily easy because the RTI, if not specified, will arbitrarily select port numbers to establish its reliable connections between systems.

Additionally, there were issues with how local systems were configured. For example, not all systems were using a 100Base-T full-duplex Network Interface Card (NIC), which affected bandwidth and number of packet collisions. In some instances, NICs were not configured to run multicast. Again, these issues were eventually resolved, costing valuable time. However, because the RDEC Federation CalEx was only one of many higher priority concerns of the local network administrators, each day posed a potentially different set of network issues.

Firewall, security problems

The problems the federation experienced with firewalls and other security measures were compounded due to the timing of the record run attempts, after the September 11 terrorist attacks. Threat Condition Charlie operations made for a worst-case interconnectivity state with daily reconfigurations of networks, firewalls, access lists, and other security enablers/connectivity disablers.

The RTI is a distributed operating system that creates connections between all federates joining the federation. These connections are reliable, which require robust and stable network connectivity. If these connections are broken due to short periods of network disruption or latency, the RTI does not have a fault tolerance mechanism to automatically recover from these connection failures. This problem will make the federation hang, causing messages to queue up and eventually triggering individual federates or the federation to crash, forcing a recycling of the federation. Recycling the RTI requires restarting the RTI Executive process and removing & rejoining each individual federates. Due to the complexity and scale of such a large federation, this process is very time consuming. For multicast best-effort traffic, with properly configured tunnels, the federation experienced no problems receiving data.

Federation management

Critical to running an HLA exercise over the DREN is having a specific set of procedures that covers the steps required to manage the federation execution from beginning to end. The execution procedures should address how communication will be established between sites to coordinate federation management functions. For example:

See CALEX, p. 7

Three RTIs - 7 versions - complete verifier program

Work under way to modify RTI verification suite to IEEE 1516 specification of HLA

By Chris Turrell
DMSO HLA Technical Lead

[The Runtime Infrastructure(RTI) is the software implementation of the Interface Specification of the DoD High Level Architecture (HLA) for simulation.]

To date a total of three RTIs – seven different versions – have successfully completed verification. These include four different versions of RTI 1.3NG, two versions of Pitch AB's pRTI, and, most recently, the successful verification of Mitsubishi Space Software's ERTI. Details of the Mitsubishi verification experience were highlighted in a paper, "Experiences and Lessons Learned Through DMSO Verification Test for ERTI (No. 01F-SIW-028)," presented at the Fall 2001 Simulation Interoperability Workshop in September. Additional information on the configurations of the verified RTIs is available on the Defense Modeling and Simulation Office's (DMSO) Web site at *www.dmso.mil/index.php?page=72*.

The RTI Verifier program was initiated in the summer of 1998 as a mechanism for ensuring that RTIs used by the DoD modeling and simulation (M&S) community conformed to the HLA specification. In short it was a mechanism to help M&S programs make an informed choice about the HLA products they wish to use.

By February 1999 a mutually beneficial beta development program was undertaken using RTI 1.3NG as a test case to help validate both RTING and development of the verifier. The notion that one day a simulation program would be able to choose among different RTIs was given credence in June 1999 when Sweden's Pitch AB initiated the verification of the pRTI, with the intent of making it commercially available. Since that time the RTI verification process has matured, taking advantage of automation opportunities, adding structure and substance to test reports and initiating a standards interpretation documentation process.

With the September 2000 adoption of the Institute of Electrical and Electronics Engineers (IEEE) 1516 specification of the HLA, work has begun on modification of the verification suite to accommodate the new standard. For the verification team, this unfortunately means rewriting all of the 1800+ tests that are administered during the verification process. On the positive side, however, five different companies have announced their intent to produce IEEE 1516-compliant RTIs. These include Pitch AB (Sweden); Mitsubishi Space Software (Japan); and U.S. companies Science Applications International Corporation (SAIC), MaK Technologies and RAM Laboratories.

While the DMSO has not announced plans regarding future DoD-sponsored RTI developments, the strong presence of vendor interest will no doubt figure into the decision. M&S program managers that are aware of unique or special requirements regarding RTI developments and capabilities may wish to contact the above companies to discuss those requirements directly.

For more information

For more information about the visit the RTI Help Desk at *http://helpdesk.dctd.saic.com/*. For more information about the HLA visit *http://www.dmso.mil/hla* or contact the HLA Help Desk at *hla@dmso.mil*.

CalEx

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- Which site and system will start the RTI Exec?
- In what order will the federates join the federation?
- How will federates be removed from the federation if they are not responding?
- And, how will the federation be recycled when it becomes unstable?

Execution procedures must be defined and agreed by all parties. A reliable, user-friendly and effective communication strategy must also be decided upon and implemented in order to facilitate the communication essential to execute an HLA exercise over the DREN.

In the end, most of the CalEx problems were related to an unstable network. The choke points of the RDEC Federation network for interoperating federates need to be identified and procedures established for mitigating their effects. That said, could the RTI be changed to make it fault tolerant to broken reliable connections? Could an RTI with no reliable connections be developed? This may result in a limited RTI that would not have all RTI services implemented. It is very difficult to determine, without an optimized network configuration, how reliable the RTI is over a WAN.

The AMC RDEC Federation is committed to resolving these issues in subsequent exercises, as it realizes the significance/advantages of operating over a general purpose WAN, such as the DREN.

Project Albert

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duce other *interesting* results. These concepts are:

- *Data Farming*. Data farming involves the investigation of a wide number of variables, across a wide range of values. In essence, the user is attempting to model many combinations and variations within the data space and *grow* data in an iterative process attempting to answer questions at hand. Data farming is applied to simple models, called distillations, that have been developed specifically for Project Albert, and uses high performance computing assets to run these distillations many times.
- *Data Mining*. Data mining involves the sorting and filtering of the data farming output to identify combinations of variables that generate non-linear or interesting situations. The current suite of data mining tools includes a mixture of manual COTS and Project Albert applications.

The models

The current suite of models used by Project Albert includes *ISAAC*, *Pythagoras*, *Socrates*, and *Mana*. All of these models fall into the category of *agent-based models*. ISAAC was one of the earliest agent-based models, and was developed by the Center for Naval Analyses to investigate the use of agent-based models for replicating combat. Pythagoras uses neural networks and fuzzy logic to represent decision-making and intangible factors and was developed within Project Albert. Socrates, developed jointly by the DMSO and Project Albert, is similar to Pythagoras in concept, but uses value-driven decision logic to represent decision-making and intangible factors. Mana was developed by the Defence Technology Agency of the New Zealand Defence Force and uses a situation-awareness *map* that provides for global interactions and events that can trigger changes in agent personalities.

The workshop

The Australian Army Simulation Office hosted the *4th International Project Albert Workshop* in August. Thirty-nine people attended the workshop, with representatives from the U.S., Australia, New Zealand, Germany, Sweden and Canada. Workshop participants split into five working groups, each of which attempted to apply various combinations of the Project Albert models to answer a series of questions in five areas:

- Control Operations
- Reconnaissance Surveillance Intelligence Force Mix
- Precision Maneuver
- Mission Area Analysis
- Peace Support Operations

For example, the Peace Support Operations working group attempted to use Socrates and Mana to look at the question of how unit cohesiveness impacts the ability to conduct Peace Support Operations in two scenarios: a *convoy escort scenario* and a *food distribution scenario*. The group formed hypotheses regarding the impact of commander trust and unit organization on unit performance, and conducted data farming runs using both laptop computers and the Maui (Hawaii) High Performance Computing Center.

Although the results from the Socrates runs were still to be analyzed at the end of the workshop, the results clearly indicated that commander's trust (a factor in unit cohesion) improves unit effectiveness to a certain extent; however, too much commander trust actually results in a decrease in unit effectiveness and individual members adhere rigidly to doctrine and tactics and fail to take their knowledge of a situation into account. These results are consistent with the results seen by other data farming efforts within Project Albert.

The Mana runs demonstrated that the food distribution problem is best handled using small, dispersed food locations and small units to dispense food. This minimizes Blue force exposure time and makes it less likely that a crowd will attempt to engage the Blue force. One member of the group observed that this was consistent with the dynamics he had seen during food distribution operations in Haiti.

All workshop results including documentation and the models, scenarios, and data used were compiled on a CD-ROM at the end of the workshop. The CD-ROM is available from Mr. Kresho, *jkresho@mitre.org*, or Major Colton, *trevor.colton@defence.gov.au*.

Future direction

The results from the workshop are certainly not final by any means; in fact, they simply allowed workshop participants to gain confidence in the models and to provide baseline results for asking more questions. For example, does unit organization play a role in how commander trust impacts unit performance? Do equipment and tactics play a role? What is the optimum mix of experienced and inexperienced soldiers (given the assumption that some will be inexperienced)? These are just some of the kinds of questions that Project Albert hopes to focus on during the coming year.

The working groups remain together for at least another year to continue to focus on their given problems. The teams will continue to analyze the current data and conduct additional data farming results to gain insights into the questions posed by each group. The Fifth Project Albert International Workshop is tentatively scheduled for July 1-4, 2002 in Germany.

For more information

For more information on Project Albert contact Lt. Col. Bjorkman at the DMSO at *bjorkman@dmso.mil*, or Dr. Horne, Project Albert Executive Director, at the MCCDC at *hornege@mccdc.usmc.mil*.

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