DCEE Simulation-to-C4I Capabilities and Architecture Overview

Ron A. Keter
Joint Forces Command (JFCOM) / Joint Experimentation (J9) Directorate
KES Inc. San Diego, CA
yak@spawar.navy.mil

ABSTRACT

The Distributed Continuous Experimentation Environment (DCEE) is a permanent simulation center designed by US Joint Forces Command (JFCOM) to provide a persistent, live, constructive and virtual experimentation environment to support JFCOM, other combatant commanders, the Services, other governmental agencies and multi-national partners in the process the discovering new ideas, methodologies and technologies to facilitate concept exploration and refinement. Additionally, DCEE will serve as the core experimentation and support element for a host of JFCOM-sponsored activities and events, including support of the Joint National Training Center (JNTC) operational environment, Limited Objective Experiments (LOEs), seminars, major war games, human-in-the-loop (HITL) and constructive analytical studies and experiments. At the center of DCEE activities is a core simulation suite that will accurately emulate and stimulate the joint battle space, including the integration of live and training range driven forces, which will effectively drive real world C4ISR systems, in operations centers distributed around the globe, and experimental C4I (xC4I) tools supporting an adaptable collaboration and information exchange environment within the DCEE.

Building upon the successful simulation-to-C4I architecture utilized during Millennium Challenge 2002 (MC02), DCEE will provide a robust platform for Joint C4I experimentation, prototype development/integration, and concept validation. In support of JNTC, DCEE will facilitate the integration of tactical and operational level C4I data from training centers and ranges to construct a national Common Operational Picture (COP).

ABOUT THE AUTHOR

Ron Keter is a graduate of the University of California at Los Angeles (UCLA) with over ten years of experience in naval and joint C4ISR technology applications and operations including support and management of simulation-to-C4I initiatives for U.S. Joint Forces Command (JFCOM)-sponsored exercises Millennium Challenge 2002, Unified Vision 2001 and Attack Operations 2000. Mr. Keter presently serves as C4I lead for the JFCOM/Joint Experimentation Directorate (J9) M&S and C4I Technology team supporting joint experimentation and force transformation. Mr. Keter is an employee of KES, Inc., an engineering services corporation headquartered in San Diego supporting Space and Naval Warfare Systems Command (SPAWAR).

DCEE Simulation-to-C4I Capabilities and Architecture Overview

Ron A. Keter
Joint Forces Command (JFCOM) / Joint Experimentation (J9) Directorate
KES Inc. San Diego, CA
yak@spawar.navy.mil

THE SCOPE OF DCEE SIM-TO-C4ISR

The Distributed Continuous Experimentation Environment (DCEE) concept will push the boundaries of distributed simulation-based experimentation with new technologies, concepts, equipment and network architecture in support of Joint Experimentation. Figure 1 represents the reach of DCEE in concept development, refinement and implementation.

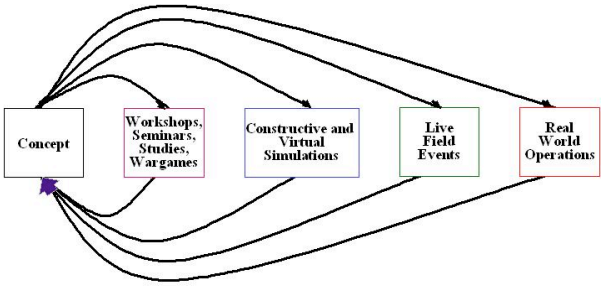

Figure 1. DCEE Experimentation

In order to support the types of events and experiments, concept refinement and real-world implementation, DCEE will be composed of a suite of simulation systems and interfaces capable of not only simulating current or future battle space requirements but will also be able to stimulate and emulate existing and proposed Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C^4ISR) systems. Effective simulation-to-C^4I (Sim-to-C^4I) capability will enable DCEE to reach out and experiment with Service and Joint command centers, Component Commands, and major operational and training command elements within the Defense Research and Engineering (DREN) Wide Area Network (WAN). Existing communication networks and pathways will further thrust DCEE data and products to a global experimental audience.

The Way Ahead

Joint Forces Command (JFCOM) / Joint Experimentation (J9) Directorate has a diverse background and experience with simulation-based, human-in-the-loop (HITL) experimentation that not only stimulates C^4ISR systems but incorporates those command and control systems as vital end-user experimentation tools – actually bringing the warfighter into the concept and experiment refinement process by utilizing current day and/or experimental C^4I (xC^4I) platforms. In order to blaze the way ahead we will go back into recent experiment history to outline and fill in the proposed Sim-to-C^4I architecture for DCEE. In describing the Sim-to-C^4I implementation utilized for several different simulation-based experiments, particular attention will be paid to:

- Simulation C^4ISR capabilities
- Interfaces and Gateways used to support Sim-to-C^4I process
- Sim-to-C^4I architectures
- C^4ISR platforms used in experimentation
- Concepts for C^4ISR management

SIMULATION-BASED EXPERIMENTATION AND C^4I

Since inception, J9 has focused efforts on concept development and future technologies in a robust, synthetic battlespace centered upon HITL command and decision (C&D) interface systems. At times, these C&D systems have been either one or a combination of these three options: (1) a simulation-based conceptual rendering of C&D tools that might possibly be available to the joint warfighter in the experiments' given timeframe, (2) utilization of real-world C^4ISR platforms and tools stimulated by simulation or (3) utilization of off-the-shelf end-user C&D systems, customized per experiment requirements, driven by a sim-to-real world C^4I architecture for use as an experimental HITL system.

Numerous live exercises, experiments, Limited Objective Experiments (LOEs), table-top exercises, collaborative studies, etc… have been apart of J9's experimentation plan the past four years. While not delving into the specifics and peculiarities of each type of exercise, we can basically boil down all types of events into these categories:

1. Workshops, Seminars and Studies
   - No simulation, no real-world C^4ISR systems required

- Minimal Collaborative Information Environment (CIE) architecture may be required

2. LOEs and Wargames
   - May be Simulation-only events or
   - A minimal CIE architecture may be required or
   - Some level of Sim-to-C^{4}I system support required
   - Attack Operations 2000 (AO00) and Unified Vision 2001 (UV01) are good examples
3. Major Experiments and Events
   - Majority of time this type of event will be Joint driven
   - Requires a substantial CIE and C^{4}ISR architecture that is sim driven
   - Distributed C^{4}ISR products
   - Millennium Challenge 2002 (MC02) is the pinnacle example of a Major Experiment or Event

A good number of J9/DCEE events will be of the Type 1 category, requiring little simulation or C^{4}ISR support to test and evaluate concepts. However, Type 2 and 3 events are players in the projected calendar of events for J9. Based on past experiences with Type 2 and 3 events, it is given that several LOEs, Wargames and Major Experiments will run concurrent within the DCEE requiring accurate management of material and personnel resources. Proven capabilities and experience, along with new technologies and techniques, will drive the DCEE Sim-to-C^{4}I architecture, equipment and simulation suites.

Examples of C^{4}ISR Support in J9 Experimentation
Presented below are three J9 events which each required a varying degree of C^{4}ISR knowledge, development, equipment and management support.

Attack Operations 2000 (AO00)
AO00 was a Type 2, lab-based experiment utilizing simulation only, no C^{4}ISR platforms and no distributed simulation required. Although experiment did not require actual real-world C^{4}I equipment, AO00 did require an emulation of a future command and control system build internal to the simulation federation. J9 C^{4}ISR *knowledge* and *experience* with real-world systems was a requirement for sim development of the emulated C^{4}ISR platform. AO00 focused on the time-critical-target (TCT) experiment area with the Joint Semi-Automated Forces (JSAF) and the Simulation of Locations and Attack of Mobile Enemy Missiles (SLAMEM) simulation systems formed one simulation federation for AO00. JSAF simulated the battlespace environment, including thousands of civilian entities and clutter in addition to opposition and Blue forces, while SLAMEM simulated a variety of sensor platforms and sensor networks (see Figure 2). The J9 simulation and C^{4}I teams developed a JSAF-based display system and target-pairing tool for use in AO00. Development for both tool sets was driven by future C^{4}ISR concepts utilized in several Joint Advanced Concept Technology Demonstrations (ACTDs). AO00 provided a viable case for simulation driven experimentation in the HITL environment and highlighted the flexibility of both the simulation and C^{4}I teams in future C^{4}ISR experimental concept and tool development

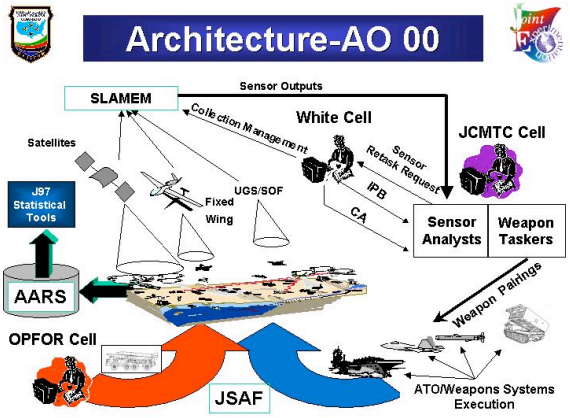

Figure 2. AO00 Experiment Simulation Architecture

Unified Vision 2001 (UV01)
UV01 was a "step up" in J9 experimentation, both in complexity and end-user experiment audience (numbering about 150 personnel). For the first time in a J9 simulation driven experiment, the focus of the experiment would be with a suite of xC^{4}I systems used to support the Operational Net Assessment (ONA), battlespace intelligence and warfighting processes in UV01. This Common Information Environment (CIE) consisted of a variety of tools to support chat, document whiteboard, voice over IP (VOIP), data storage and access, and display of the battlespace – Common Operational Picture (COP).

UV01 CROP
CIE tools used for UV01 were primarily off-the-shelf systems, including Microsoft's Defense Collaboration Tool Set (DCTS) for chat, VOIP (NetMeeting) and digital whiteboard, Warfare Information Grid System (WIGS) as the push/pull web database, and the Extensible Information System (XIS) for COP display and track data fusion. These core CIE elements formed the Common Relevant Operational Picture or CROP. The CROP was the centerpiece of the experiment, networking people together to plan, control and execute a battle plan. XIS was a product of San Diego-based Polexis, Inc. designed to pull data from the Global Command and Control System (GCCS) track database, display tracks and associated data on a desktop mapping environment, and enable the fusion of track

data with other sources of information such as overlays and logistics status. The C4I federation for UV01 was limited to a suite of GCCS servers, no tactical datalink (TADIL) or distributed C4I play. Ten GCCS servers were put in play to support the implementation of three different COP pictures (White, OPFOR, and Blue) and the XIS transfer proxy (installed on each GCCS machine – experimental) for 150 desktop CROP systems.

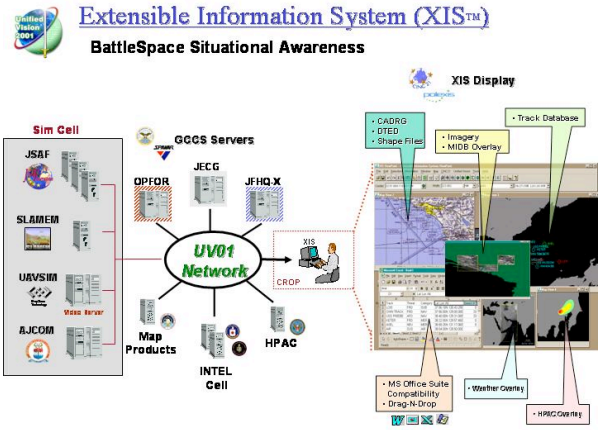

Figure 3. XIS and the UV01 CROP

UV01 Sim-to-C4I

The simulation federation for UV01 consisted of JSAF, SLAMEM, the Advanced Joint Combined Operation Model (AJCOM) and Unmanned Aerial Vehicle Simulation (UAVSIM). As with AO00, UV01 focused on the TCT problem set, however, this time the primary weapon would be the CIE suite. UV01 would assess the CIE suite's ability to measurably affect the TCT engagement timeline and overall campaign strategy in support of Effects Based Operations (EBO). The UV01 Simulation Federation would actively stimulate the CIE suite with sim based COP injects, overlays and message traffic. JSAF simulated the battlespace providing tens of thousands of simulated entities with SLAMEM providing the sensor suite. UAVSIM federated with SLAMEM and JSAF to provide 3D imagery of the battlespace as taken by electro-optics from simulated Predator and GlobalHawk UAV platforms. AJCOM was a stand alone, faster than real time system that provided the lead-up and leap-ahead capability for the UV01 scenario.

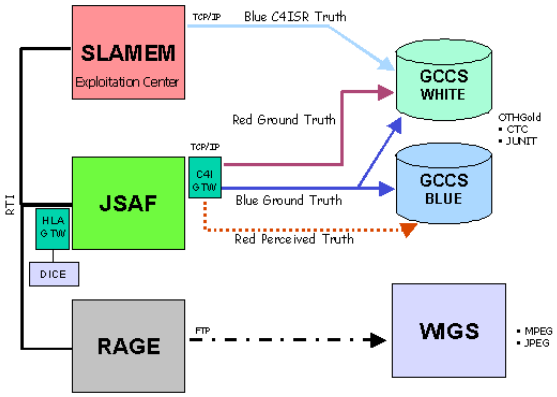

Figure 4. UV01 Sim-to-C4I Architecture

UV01 Technical Challenge

UV01 presented some unique challenges for the J9 simulation and C4I teams, issues that will re-occur in DCEE due to the plug-n-play nature of the simulation suite and C4I/xC4I platforms:

- Where would JSAF/SLAMEM and AJCOM federate?
  - A: GCCS. Every AJCOM leap ahead would result in an updated GCCS track database with JSAF and SLAMEM taking over reporting responsibility for tracks in the HITL phase. AJCOM would re-assume reporting responsibility after the HITL phases in support of leap-ahead and course of action (COA) analysis.
- Would the JSAF C4I Gateway and AJCOM GCCS Interface be able to handle the throughput of hundreds of air, sea and land in the COP?
  - A: Yes. In JSAF, a protocol data unit (PDU) containing an Over The Horizon Gold (OTHGold) formatted message was collected and grouped (about every 15sec) and formatted into one large message to GCCS. This enabled aircraft update rates in the 30sec range, one way to provide the air picture when no TADIL systems are available.
- How would we ensure quality of information (QOI) was consistent with each sim system's injected track data into the COP?
  - A: The J9 C4I team developed a comprehensive sim entity and unit database that detailed the exact track message inputs for each entity, unit, ship or aircraft in the UV01 scenario which was implemented by all simulations. The USS Lincoln and 3rd LAR looked the same on GCCS and XIS no matter which sim injected the track into the COP.
- Were the Sim-to-C4I interfaces flexible enough to support the requirement to stimulate three different GCCS suites?
  - A: Yes. The JSAF C4I Gateway and AJCOM GCCS Interface were both capable of multiple

TCP/IP port connections to various GCCS servers. Simulation development allowed for specified units, ships and aircraft to be flagged as Blue, OPFOR or civilian entities. The JSAF C^{4}I Gateway would recognize and process each flagged entity and forward OTHGold message to the prescribed GCCS server(s).

- Would the XIS transfer proxy work well with GCCS and could it support 150 workstations?
  A: Yes.

Millennium Challenge 2002 (MC02)

Type 3 major joint experiment/exercise. Millennium Challenge 2002 (MC02) was a congressionally mandated, Secretary of Defense directed, U.S. Joint Forces Command (USJFCOM) large-scale Joint field exercise that integrated live and simulated forces in an experimental battlefield environment driven by 42 simulation systems feeding nearly two dozen different command, control, communications and intelligence (C^{4}I) systems. A Joint field experiment was embedded in the exercise for the purpose of exploring and evaluating new war fighting concepts for conducting rapid, decisive, joint operations in the 2007 timeframe.

Figure 5. MC02 Site Map

As with UV01, MC02 focused a good deal of the experiment on the utility of the CROP in supporting EBO. Information Workspace (IWS) replaced DCTS as the chat/VOIP/whiteboard while providing the web database system. The Automated Deep Operations Coordination System (ADOCS) replaced XIS as the desktop COP display and was also utilized as the target pairing tool for a select group of personnel in the joint attack operations cell.

The vast reach of MC02 required a significant C^{4}I architecture and large C^{4}I management cell. The Joint COP federation was comprised of over 50 GCCS/Unified Build (UB) systems, approximately 100 tactical and end-user sub-systems and terminals providing battlefield situational awareness to over 1200 CROP workstations. The MC02 COP integrated live, range and instrumented forces with simulation-based forces into one, transparent command and control environment. Included in MC02 COP management was the incorporation and management of the Joint Data Network (JDN) providing TADIL feeds to the COP. J9 and the Joint Warfighting Center (JWFC) would manage the COP for MC02, producing a host of revolutionary and evolutionary documentation and COP command and control procedures and policies.

MC02 Simulation Federation

Primary focus for the J9 team was Sim-to-C^{4}I stimulation for all 42 simulation systems. Included in the Simulation Federation were the virtual E-3 AWACS (TACCSF), RivetJoint and F-15 simulators and the MLST-3 (E-2C) TADIL simulator providing Naval TADIL-J/Link-16 stimulation of the MC02 COP.

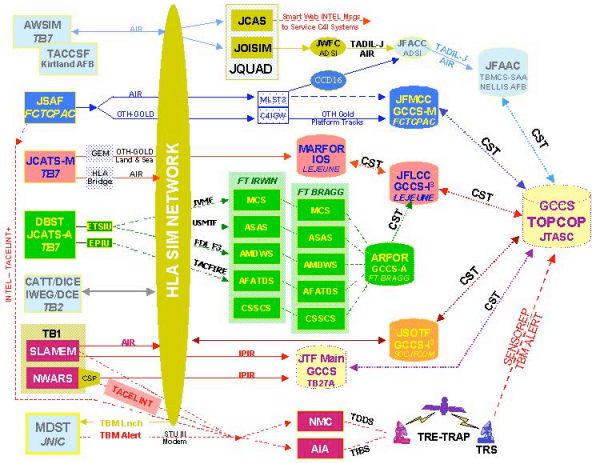

Figure 6. MC02 Sim-to-C^{4}I Architecture

J9 and JWFC personnel were part of the Simulation Federation process from the very beginning. A critical lesson learned from the MC02 spiral development process was the absolute requirement for the development of a C^{4}I entity/unit database. Similar to what was utilized for UV01, the J9 and JWFC distributed track reporting and naming guidance for the dozen or so sim systems injecting tracks into the COP or JDN. The JDN was beast all unto itself that demanded careful coordination with consistent and accurate simulation feed and pre-planned management agreements.

MC02 COP Management

Out of the requirement for simulation management was the realization that the same type of management would be required to operate the COP federation on a 24 hour basis for three weeks. The MC02 C^{4}I team produced the following documents as the sole source guidance for MC02 COP operations:

- MC02 Joint COP Management Directive
- OPTASK COP for MC02

The COP Management and OPTASK COP mandated the following guidance for all simulation systems and C4I centers:

- COP Sync Tool (CST) architecture, permissions and business rules
- Track naming conventions / Quality of Information (QOI) requirements
- Reporting requirements
- Communications and coordination nets
- JDN architecture

The success of MC02 C4I was due in large part to the new concepts in simulation development and COP management. Guiding the process from simulation development through execution was absolutely critical for this type of major event. Elements of the COP Management Directive, OPTASK COP and follow-on MC02 COP/C4I Lessons Learned formed the guts of the recently released Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3151.01A GCCS COP Reporting Requirements. Lessons learned from MC02 Sim-to-C4I operations provided the foundation for continuing experiment success with the new DCEE simulation environment.

DCEE C4ISR ARCHITECTURE

In planning for DCEE C4ISR capability, several assumptions were made:

- DCEE C4ISR systems will include and be able to interface with Joint/Service C4ISR systems.
- Core C4ISR systems will be built and maintained by J9 staff within the physical DCEE complex.
  - J9 had limited numbers of C4ISR platforms and associated equipment.
- Relationships will between J9 and system program offices (example: DISA) will be established and maintained to facilitate access to the software and technical expertise needed to maintain and utilize current installations.
- Core C4ISR architecture should be able to support the following mix of simultaneous or concurrent events:
  - 3 x Type 2 events
  - 1 x Type 2 event and 1 x Type 3 event
- C4ISR systems can be accessed remotely within the DCEE distributed environment.
- Common databases will be shared by multiple systems whenever possible.

Utilizing MC02 as the extreme example of a Type 3 event, DCEE can expect a similar type of architecture and site requirement as programs like the Joint National Training Center (JNTC) continue to advance in scale and begin to utilize the DCEE for Joint Experimentation. Projected multi-national events compound the requirement for full time, C4I and xC4I battle lab hardware, software and personnel to support DCEE operations – resident *within* the DCEE.

There are five areas of required C4ISR capabilities in each Type 3 event that cover the breadth of Joint operational and tactical level distributed C4ISR:

- Common Operational Picture (COP)
  - GCCS/UB based system.
  - Top level situational awareness (SA) tool.
  - When pared with CIE desktop tools, the COP becomes a C&D system.
  - Standard information format (Over-the-horizon Gold or OTHGold) shared by all services and most allied nations.
- Tactical Datalink
  - Real-time tactical information feed to the COP.
  - Primarily radar track feed and directed target feed from ship-based and airborne sensors.
  - Format standards (TADIL) common to all services and most allied nations.
  - Live ranges will generally have some type of TADIL capability.
- Imagery
  - Feeds from unmanned aerial vehicles (UAVs) and other C4ISR platforms.
  - Essential element of targeting and battle damage assessment (BDA) process.
  - Focus on the Joint Intel, Surveillance and Reconnaissance (JISR) process will be critical to future J9 experiments.
- Intelligence feed
  - Wide variety of Intel systems in the Joint battlespace.
  - Message feeds (text messages) dominate most Intel related systems.
- CIE toolset
  - Essential portion of HITL events. What can people do with information and how can they better share, format, display and transmit that data into products.
  - How to present the battlespace, enable and facilitate ONA and collaboration, and increase overall situational awareness in the HITL environment will continue to be a primary focus for DCEE.

Figure 7 is a notional C4ISR footprint for plug-n-play use in DCEE sim driven events. The above five core capabilities are presented as an integral part of connecting the DCEE to the Joint community and facilitating prototype and concept development through the use of real C4I tools and off-the-shelf xC4I software and hardware.

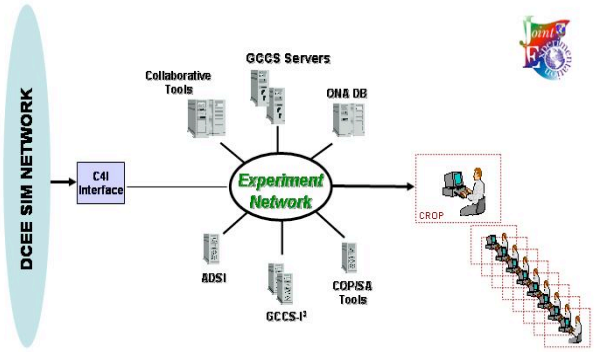

Figure 7. Notional DCEE C[4]I Architecture

DCEE C[4]ISR Equipment

Table 1 is a list of C[4]I hardware and software planned for core DCEE C[4]I capability.

System	Version	Platform	Number
ADSI Air Defense System Integrator	11.103.4	PC/ Proprietary	1
GCCS Global Command and Control System	3.6	SUN Ultra 60 SUN Ultra 250	9 1
GCCS-A GCCS-Army	ABCS 6.x	SUN Ultra 60	1
GCCS- I[3] GCCS-Integrated Imagery and Intelligence	3.4	SUN Ultra 60	3
GCCS-M GCCS-Maritime	3.1.2.1p1	HP TAC 4	1
IOS Integrated Operations System	3.3p12	Ruggedized PC	1
TBMCS-R Theater Battle Management Core System Remote	1.1	PC	2

Table 1. DCEE C[4]ISR Equipment

System Summary

Below is a brief description of the elements that make up the core DCEE C[4]I suite.

Global Command and Control System (GCCS). The core component of the DCEE C[4]I suite will be GCCS in its Joint flavor. GCCS is the system of record for strategic and operational command and control functions.

GCCS will serve as the COP system for DCEE experiments. GCCS enables distribution of the COP among sites in a particular experiment's architecture as its message standard, OTHGold, is widely supported by Joint and Allied C[4]I systems. A network of GCCS systems will provide the DCEE, through DREN and SIPRNET networks, with connectivity to the Joint C[2] community including all theater command centers in support of Combatant Commander staffs. Additionally, GCCS can forward the COP to Windows platforms via DISA supported software like Command and Control Personal Computer (C2PC) and a variety of off-the-shelf programs like the ADOCS used in MC02. GCCS is distributed over the network via a DII-COE protocol called COP Sync Tool (CST). CST supports tactical commanders by providing an automated method of transferring and synchronizing data for a COP across the battlespace at near real-time speed over a network.

There are multiple versions of GCCS:

- GCCS: Hosted on a Sun OS. Generic Joint version released by DISA.
- GCCS-A: The Army's version of GCCS. Hosted on a Sun OS.
- GCCS-M: Maritime version of GCCS. Hosted on an HP platform.
- GCCS-I[3]: Integrated Imagery and Intelligence. The Joint ISR version of GCCS hosted on a Sun OS.
- IOS: Integrated Operations System. Ruggedized, USMC version of GCCS.

Most simulation systems have some type of C[4]I interface or gateway capable of supporting OTHGold messaging. Sim-to-C[4]I capability with DCEE simulation systems will be minimized as most of the participating simulation systems in DCEE have stimulated GCCS or OTHGold systems in the past and/or have developed a C[4]I interface to GCCS. However, a standard Software Standard directive is currently in development to assist in mandating require Sim-to-C[4]I specifications for DCEE operations.

Air Defense Systems Integrator (ADSI): ADSI is the key tactical datalink (TADIL) correlation and forwarding system for the U.S. Air Force. Although fielded by all services, ADSI is primarily utilized at Air Operations Centers to receive and correlate multiple radar and Intel system inputs, creating a coherent air picture for the Air Component Commander. ADSI supports a wide variety of U.S. and NATO TADIL standards such as Link-11 (TADIL-A/B) and Link-16 (TADIL-J).

An in-house ADSI system in place will enable the DCEE to both produce and receive a tactical air and ground target picture with sites all over the world via DREN, SIPRNET, and/or STU phone line. The ADSI picture can be forwarded to GCCS, fusing the air and ground target picture with the Blue force and Red Intel pictures.

Theater Battle Management Core System (TBMCS): TBMCS is the Combat Air Force (CAF) information and decision system supporting combined and joint air operations for the Joint Forces Commander (JFC). It integrates the Contingency Theater Automated Planning System (CTAPS - the force level planning system), Wing Command and Control System (WCCS - the wing level execution system), and Combat Intelligence System (CIS - the intelligence system) under a common core of services. TBMCS functionality includes intelligence processing; air campaign planning, execution and monitoring; aircraft scheduling; unit-level maintenance operations; unit- and force-level logistics planning; and weather monitoring and analysis. At the force level, TBMCS supports the JFC through the Air Operations Center (AOC) and Air Support Operations Center (ASOC). At the unit level, TBMCS supports the Wing Commander through the Wing Operations Center (WOC), Maintenance Operations Center (MOC), and Squadron Operations Center (SOC).

TBMCS is used primarily to produce and publish the Air Tasking Order (ATO) and Airspace Control Order (ACO); both products form the backbone of air operations in all theaters of operation. A DII-COE component of TBMCS called Situational and Awareness Analysis (SAA) provides the Air Component Commander with a fused air picture, combining an ADSI air and ground target feed with a COP feed.

In light of cost, DCEE will acquire a TBMCS Remote license and hardware vice the entire TBMCS suite. TBMCS Remote will facilitate ATO transfer and display, as well as connect the DCEE with other Air Operations Centers via SIPRNET.

DCEE C^{4}ISR Management Cell

Building upon the success of COP management in MC02, DCEE will maintain a permanent C^{4}I management team during all Type 2 and 3 events. Experimentation at DCEE will include concepts and technologies utilized in advanced C^{4}ISR applications and operations.

Final Thoughts on DCCE C^{4}ISR

The planned C^{4}ISR architecture for DCEE will facilitate Type 3 level experiments and events, reaching globally, in support of Joint level operations. By supporting C^{4}ISR operations in a continuous and distributed experiment environment, DCEE will continue the J9 tradition of pushing the envelope of concept development and refinement of Joint C^{4}ISR technologies, applications and operational doctrine.

ACKNOWLEDGEMENTS

J9: Mr. Tony Cerri, Mr. Jim Blank, Mr. Rae Dehncke
JFWC: LTC John Vinett, Mr. Henry Hughes, Mr. Mike Perrault, Mr. Chuck Peters (SPAWAR-SD)

REFERENCES

Various Authors, Joint Warfighting Center (2002), *MC02 Joint COP Management Directive*

Various Authors, Joint Warfighting Center (2002), *MC02 Joint COP Quicklook Report*

Chairman of the Joint Chiefs of Staff Instruction (CJCSI) (2002)
3151.01A GCCS COP Reporting Requirements.