

## Operational Realism Via Net-Centric Test & Evaluation: From Concept Development to Full-Rate Production and Sustainment

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*As the Defense Information Systems Agency's Operational Test Agency since 1987, the Joint Interoperability Test Command (JITC) has integrated operational realism into major test programs and efforts through a variety of methods and strategies. Developing and using net-centric test approaches is a fundamental concept that JITC uses to enhance the operational testing environments for Information Technology and National Security Systems. Complementing JITC's net-centric testing strategies are three other key mission activities that enable JITC to assess and test Information Technology and National Security Systems in operationally realistic environments: JITC's roles and responsibilities with numerous military exercises around the globe, JITC's core mission of interoperability certification through testing, and expanding and executing the Department of Defense Interoperability Communications Exercise.*

**B**ased upon lessons learned since the middle 1990s (beginning with the Global Command and Control System), and lessons that continue to be learned with programs like Net-Enabled Command Capability (NECC) and Net-Centric Enterprise Services (NCES), the Joint Interoperability Test Command (JITC) has concluded that successful testing of Information Technology and National Security Systems (IT and NSS) in operational environments must incorporate a net-centric testing approach that accurately represents the Net-Centric Information Environment (NCIE) as defined in the Net-Centric Operations and Warfare Reference Model (NCOW-RM). This article addresses the JITC's current efforts of integrating operational realism into net-centric testing strategies and highlights this work through a discussion of JITC's substantial involvement with interoperability certification testing and military exercises around the globe. These testing activities involve systems and programs in various system acquisition lifecycle stages from concept development

to full-rate deployment and even legacy systems in sustainment. Finally, as an illustration of assessing and testing IT and NSS in an operationally realistic environment, this article addresses the Department of Defense (DoD) Interoperability Communications Exercise (DICE) that JITC develops and executes with the Joint Staff (JS).

### Background

JITC is a field element of, and directly reports to, the Defense Information Systems Agency (DISA). DISA is the DoD Agency responsible for planning, developing, and supporting the IT and NSS that serve the National Command Authority under all conditions of peace and war. JITC is considered by the Office of the Secretary of Defense's (OSD's) Director, Operational Test and Evaluation (DOT&E) to be the DoD's only joint Operational Test Agency (OTA). Counting the four Service OTA's, this gives the DoD a total of five OTAs.

JITC directly contributes to DoD combat operations success by providing interoperability test and evalua-

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tion (T&E) services for emerging and legacy IT and NSS, while also providing on-call support to the deployed warfighters. As designated by OSD and the JS, JITC is the only DoD organization with the mandate and authority to certify DoD IT and NSS to ensure they meet interoperability and net-readiness requirements for joint military operations. JITC's mission is to provide a full range of agile and cost-effective T&E and certification services to support rapid acquisition and fielding of global net-centric warfighting capabilities. Our vision is to be a world-class T&E organization that advances global net-centric testing in support of warfighting capabilities.

As DoD's sole joint interoperability certifier of IT and NSS, in addition to directly reporting to DISA, JITC has direct reporting responsibility to the JS. Also, since JITC is designated as DISA's OTA, we have a direct reporting responsibility to the OSD DOT&E.

JITC works closely with the DISA T&E executive, Dr. Steven Hutchison, and DISA's Test and Evaluation Management Center (TEMC) director, Luanne Overstreet. Among other key roles and missions, Dr. Hutchison, Ms. Overstreet, and the TEMC provide long-term, strategic management of DISA's T&E resources and investments and work T&E policies with JS and OSD. JITC reports directly to the DISA chief-of-staff, COL (USA) Alan R. Lynn.

### **Operational realism via net-centric T&E**

Over the past decade, the DoD acquisition and testing communities have slowly but surely realized that acquisition and testing concepts and approaches for standard weapon systems (e.g., ships, tanks, and aircraft) cannot be used effectively for IT and NSS systems. This is particularly true with respect to testing net-centric IT and NSS in operationally realistic environments. As we transition to a fully net-centric enterprise, the operational environment for IT and NSS will be the global information grid (GIG). As a result, it is critical that a persistent, distributed test environment be stood up on the GIG to allow for the testing and certification of net-centric capabilities. Likewise, it is imperative that the operational community embrace net-centricity as the way ahead. JITC has recommended to JS that every program developing net-centric capabilities be required to address net-centricity as a critical operational issue. A program's ability to support net-centric operations by operating in the NCIE and, as appropriate, provide for the ongoing evolution and maintenance of the NCIE, is critical to realizing the DoD vision of transformation to a net-centric enterprise.

As a major step towards supporting our mission and our vision statements and for integrating operational

realism into JITC's net-centric testing, JITC realigned in 2007 so that test portfolios would be better aligned with the DoD IT portfolio management mission areas (*Figure 1*). This alignment enables JITC to use T&E as a means to measure the actual contributions of the portfolio against established outcome-based performance measures. In doing this, T&E becomes a means by which recommendations are made to continue, modify, or terminate the individual investments within the portfolio.

In partnership with DISA's TEMC, JITC is searching for more rapid and agile ways to test and certify net-centric capabilities. TEMC representatives on JITC capability test teams (CTTs) provide JITC CTT leads with recommended solutions for conducting agile T&E, improving collaboration, reducing redundancy, and speeding the delivery of capabilities to the warfighter. A key enabler to realizing these concepts will be the Federated Development and Certification Environment (FDCE). During FY07 and continuing into FY08, JITC has partnered with DISA to execute a series of T&E pilots using the NECC program as a test case. This has yielded a collection of test processes, tools, and lessons learned that will greatly benefit the JITC, and DISA's NECC program. Using the pilots as a learning process, JITC has also come to realize the necessity of the FDCE as a means to realize the capability T&E mantra of "one team, one time, one set of conditions." The FDCE is conceived as a virtual environment that is intended to address the challenges associated with concurrent and distributed Service management. Its purpose is to provide the policies, processes, and infrastructure that allow capabilities to be progressively refined, tested, and certified in increasingly rigorous situations leading to an operational environment.

The NECC Joint System Team composed of representatives from JITC, Service OTAs, DISA, and Joint Forces Command has begun using the FDCE as a means of streamlining the T&E lifecycle for NECC. The FDCE provides a collaborative workspace on the GIG for net-centric capabilities to register, define requirements, plan and track test status, and share information. The use of this tool allows for testers across the systems acquisition lifecycle to leverage each others work, as well as influence and define test events so that they meet the objectives of multiple stakeholders. In doing this, operational testers are able to provide guidance and direction on incorporating operational realism into developmental testing activities. This approach can be seen in *Figure 2*, JITC's Lifecycle T&E Approach. By having early JITC involvement in the acquisition lifecycle, joint requirements are better defined to support the

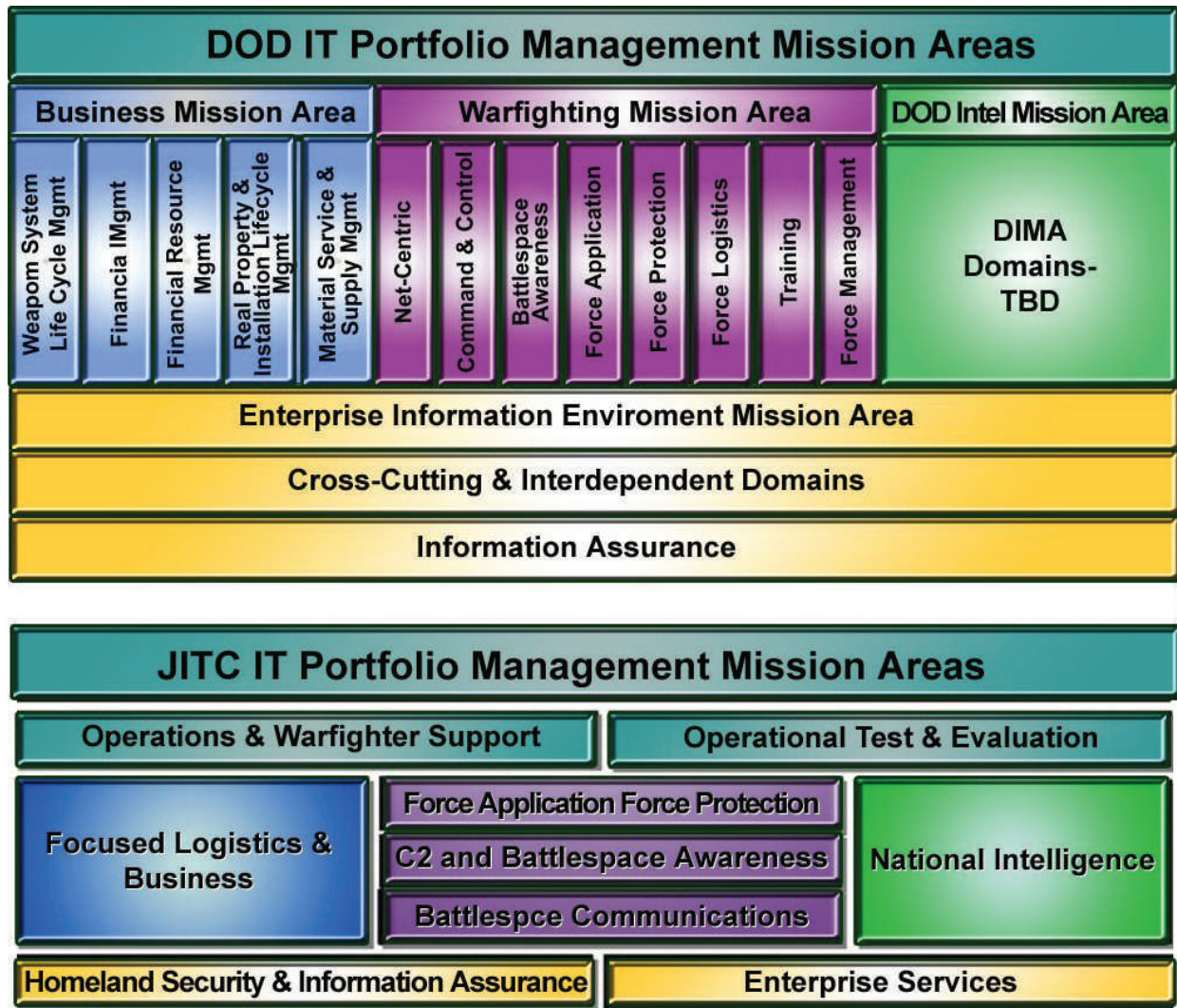


Figure 1. Joint Interoperability Test Command's portfolio relationship to Department of Defense

rigorous T&E required for fielding suitable and effective net-centric warfighting capabilities. JITC's "lifecycle" T&E approach is to leverage the entire requirements and acquisition lifecycle depicted at the top of Figure 2.

While the Service OTAs are heavily involved in testing major weapon systems as well as IT and NSS, JITC *specializes* in IT and NSS testing. A significant component of JITC's IT and NSS charter is interoperability testing through assessment of compliance with the elements of Net-Ready Key Performance Parameter (NR-KPP). Building upon experience with the elements of NR-KPP, JITC is uniquely poised to conduct operational T&E of net-centric capabilities. JITC has full-spectrum knowledge and understanding of all doctrine, organization, training, materiel, leadership and education, personnel, and facilities considerations for the net-centric enterprise to include policy

and governance, community of interest requirements, and enterprise level architectures focusing on joint capability areas. Net-centric testing methodologies involving service oriented architectures and the elements of NR-KPP help develop test documents that better support the integration of operational realism into testing IS and NSS.

Rigorous development of operationally relevant net-centric test methodologies requires an understanding of what it means to be truly "net-centric." Net-centricity is a concept, not a particular technical implementation. As defined by John G. Grimes, DoD Chief Information Officer, "net-centric means people, processes, and technology working together to enable timely and trusted *access to* information, *sharing of* information, and *collaboration among* those who need it most." (Grimes 2006) Supporting technologies include net-centric standards, Service Oriented Archi-



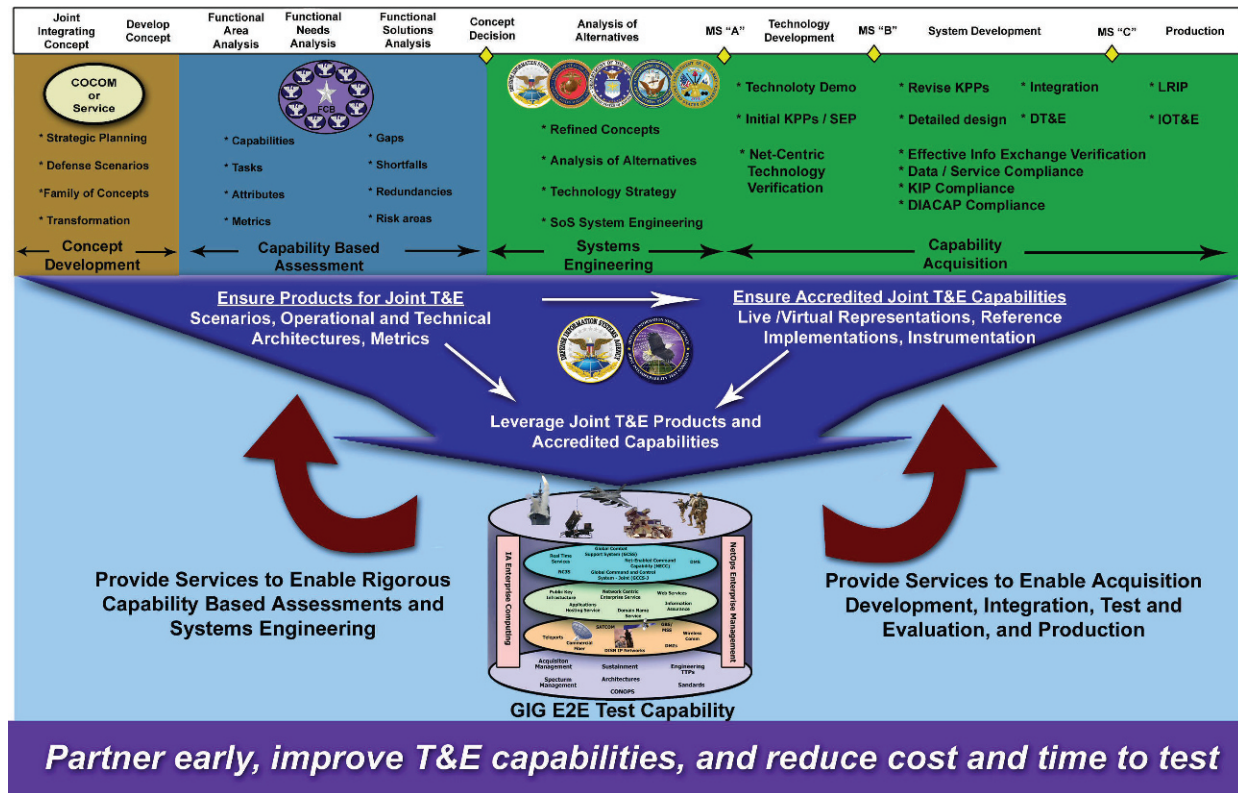


Figure 2. Joint Interoperability Test Command's lifecycle test and evaluation approach

tures, and collaboration tools, but it is important to make the distinction between the concept of net-centricity and the various architectural implementations that support that concept. From an operational perspective, the implementation behind the concepts is only as important as its overall effect on the ability to complete the operational mission.

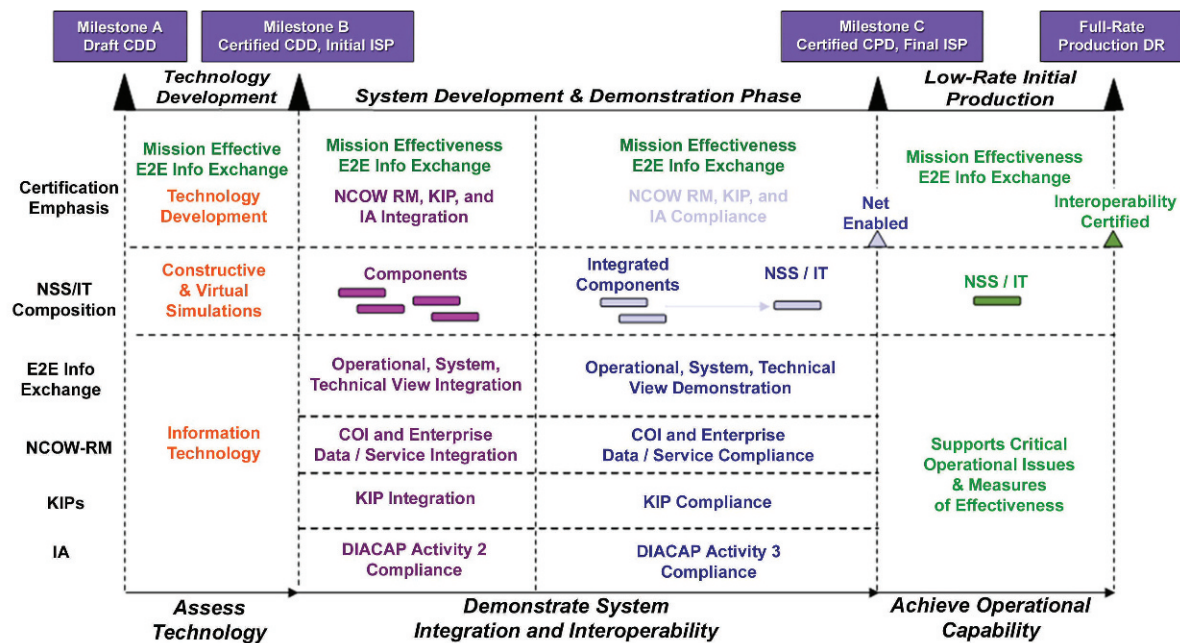
Figure 3 outlines a notional NR-KPP testing timeline. While not every IT and NSS program follows the same development path, Figure 3 provides a general idea of the NR-KPP certification process. It's important to note that the NR-KPP evaluation spans the entire life-cycle, from development of the NR-KPP assessment approach prior to Milestone B to periodic reevaluation based on significant system changes. This is not intended to be viewed as a serial process, but rather a cohesive integrated test approach resulting in net-ready warfighting capabilities that have been evaluated under operationally realistic conditions.

Integrating operational realism into net-centric testing strategies is paramount. As stated by Dr. Hutchison, DISA's T&E Executive, in the Fall 2007 Military Information Technology Journal, "The ultimate objective of an agile T&E strategy is to involve the tester early, to focus on what's important to the Warfighter, and to test as one team, one time and

under one set of operationally realistic conditions (Capability Test & Evaluation mantra)." (Hutchison 2007) As stated in the December 22, 2007 memorandum signed by Dr. Charles E. McQueary, DOT&E, and John T. Young, Jr., Under Secretary of Defense for Acquisition, Technology, and Logistics: "To realize the benefits of modeling and simulation, T&E will be conducted in a continuum of live, virtual, and constructive system and operational environments."<sup>1</sup> Dr. McQueary's and Young's memorandum emphasizes various aspects of T&E in operational environments, the combining of developmental testing with operational testing, and a variety of other T&E policy changes that will be incorporated in the next revision of DoD Instruction 5000.2 and will impact all DoD T&E activities, to include those of the five OTAs.

### Operational realism in interoperability certification testing

IT and NSS interoperability is an important component of operational realism. Among many other testing activities, JITC's core mission involves interoperability certification testing of DoD IT and NSS. Paralleling the Service OTAs that provide independent testing for Service acquisition executives and milestone decision authorities to make procurement and fielding decisions



## NR-KPP evaluation approach developed before MS B

Figure 3. Net-Ready Key Performance Parameter testing timeline

with DOT&E as oversight for major programs, JITC provides independent testing for the DISA component acquisition executive, federal agencies, combatant commands, and the Assistant Secretary of Defense for Networks and Information Integration (ASD/NII) to provide procurement and fielding decisions with DOT&E as oversight for major IT and NSS.

A significant aspect of JITC's IT and NSS testing is interoperability and net-readiness assessments in operationally realistic environments. As DoD migrates to a net-centric enterprise, the operationally realistic environment will rely heavily on incorporation of net-centric concepts such as service oriented architectures, net-centric standards, and collaboration capabilities.

Figure 4 depicts the overall JS J6 interoperability and supportability certification process. Detailed information on the entire process is in the Chairman, Joint Chiefs of Staff Instruction (CJCSI) 6212.01D. This process consists of three primary phases. Program sponsors first submit the requirements/capabilities documents for consideration to the JS requirements/capabilities for an interoperability and supportability certification. Upon receiving an interoperability and supportability certification, JITC tests and evaluates the system.

If JITC issues a Joint Interoperability Test Certification, Joint Staff then considers the system(s) for Joint

Staff J6 system validation. The amount of testing required to make an interoperability certification decision is based on several factors, including: the number and complexity of the interfaces; the interoperability requirements; the criticality of the information exchanged; the risks involved with the technology being used; and, perhaps most significantly, the need for an operationally realistic test environment. The PM/sponsor and JITC work closely to establish a strategy for evaluating interoperability requirements in the most efficient and effective manner, and in an operationally realistic environment.

### Operational realism in military exercises

Over its 20-year history, JITC has supported a variety of military exercises and coalitions involving various roles and responsibilities. This is a more practical application of supporting the warfighters in their own backyards. Currently, JITC is supporting approximately 15 different exercises and coalitions. The following is a partial list of Fiscal Year 2007 exercises that JITC was involved with:

- **COMBINED ENDEAVOR** — European Command (EUCOM) sponsored event that involves the conduct of interoperability assessments between various North Atlantic Treaty Organization and Euro-Atlantic Partnership Council countries.

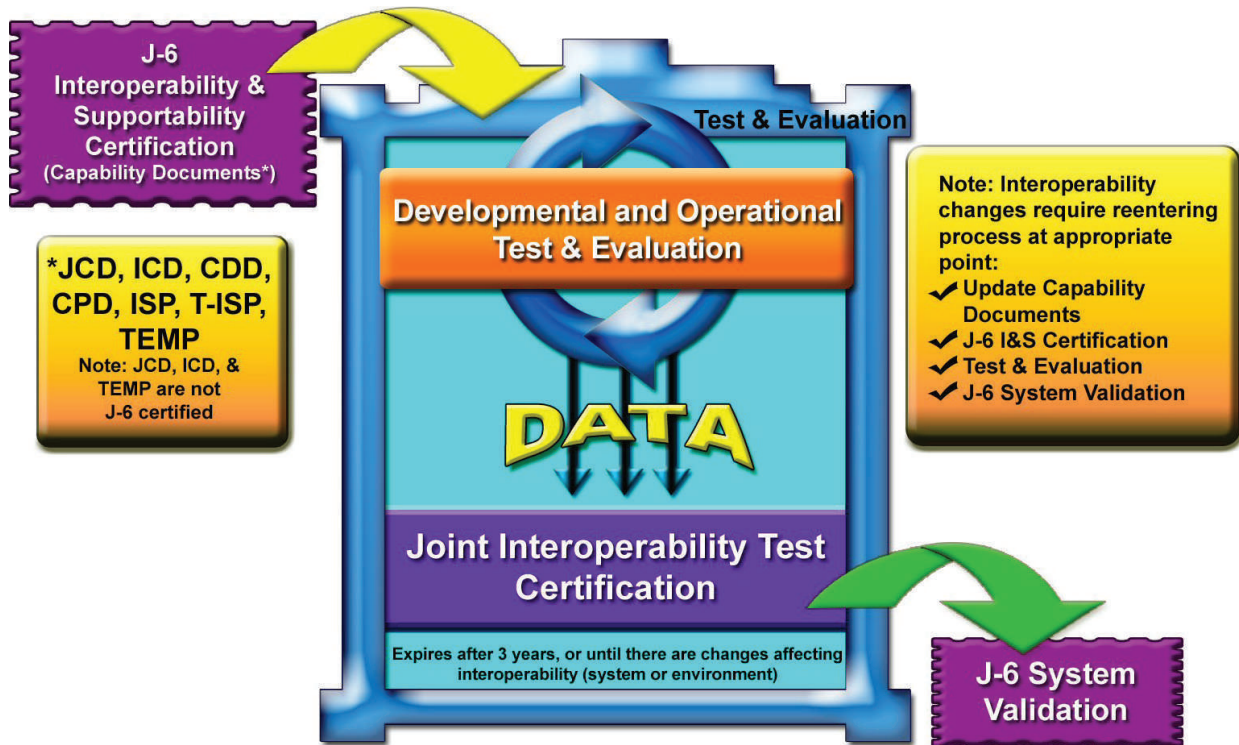


Figure 4. Joint staff Net-Ready Key Performance Parameter test and evaluation process

- **AFRICA ENDEAVOR** — EUCOM sponsored event that involves the conduct of interoperability assessments between the African nations.
- **PACIFIC ENDEAVOR** — Pacific Command sponsored event that involves the conduct of interoperability assessments between various Pacific Rim countries.
- **BALIKATAN** — Annual bilateral U.S./Republic of the Philippines exercise that consists of a staff exercise, humanitarian and civic assistance/civil military operations, and field training exercises.
- **TALISMAN SABER** — Australia/U.S. bilateral exercise merging exercises TANDEM THRUST, KINGFISHER, and CROCODILE.
- **COBRA GOLD** — Thai/U.S. field exercise. This year's exercise is the 26th anniversary of Cobra Gold, and training will focus on a field training exercise, a command post exercise, and civic action projects.
- **AIR FORCE-INTEGRATED COLLABORATIVE ENVIRONMENT** — Support both technical and operational assessments to determine the ability of participating systems to digitally support Joint Close Air Support.

We have a long standing history of working closely with combatant commander sponsored exercises and various

contingencies. JITC supports various exercises by providing technical consultation at planning conferences and through review of documents for interoperability issues. We're able to take advantage of exercise involvement and assess and/or evaluate programs and systems in final fielding environments. JITC testers and evaluators assess operational environments and integrate information from the warfighters to our testing efforts to add credibility to our test planning and test executions. JITC provides "Warfighter Hotline Support" by answering operational and technical questions 24 hours a day, 7 days a week. If needed, we deploy task organized teams that are custom tailored for combatant commands and joint operational requirements. Subject matter experts provide interoperability and information assurance throughout the planning and execution phases of each exercise.

Our involvement with military exercises and coalitions along with testing experiences in various operational environments for a variety of IT and NSS has led to JITC becoming a leader in building and developing joint mission environments. Using our expertise, we've been a pathfinder and this has improved our capabilities of testing and certifying IT and NSS in joint distributed mission environments. Our federation expertise has included evolving operationally realistic joint T&E mission environments for a number of IT and NSS systems. As part of a continuing effort to integrate operational realism into our testing, we intend to leverage our unique experiences





*Figure 5. Operational realism Q.E.D.: The 9,500-foot-high Huachuca Mountains serve as a backdrop for a variety of Joint Interoperability Test Command test shelters and antennas, including: high-gain spiral satellite communication ultra-high frequency (SATCOM UHF) antennas; line-of-sight Army-Navy transportable radio communications-170 antennas; and, a 20-foot parabolic Army-Navy transportable SATCOM-85B antenna*

and expertise in establishing joint test environments for support of key transformational DoD programs. In the past four years, JITC has supported approximately 35 joint test environments with more than 50 CONUS/OCONUS sites involving several functional areas/programs. Some of the major functional areas supported include: Joint Tactical Data Link, Integrated Air and Missile Defense, Joint Battle Management C2, and the Distributed Common Ground Station.

As a continuation of adding operational realism to testing of IT and NSS, we continue to support the development and execution of net-centric testing using service oriented architectures and NR-KPP concepts. Additionally, our core interoperability certification mission and involvement with various military exercises coalitions and contingencies present opportunities for assessing and testing in operationally realistic environments.

JITC owns and operates critical test assets that contribute to integrating operational realism into

testing programs for IT and NSS at Indian Head, Maryland, the National Capital Region, and Fort Huachuca, Arizona (*Figure 5*).

### **Operational realism in the DoD interoperability communications exercise (DICE)**

JITC is committed to being a leader in the DoD for federation expertise including evolving operationally realistic joint mission environments for T&E. As such, JITC, with Joint Staff support, develops and executes the largest annual DoD communications exercise, known as the DoD Interoperability Communications Exercise (DICE).

DICE has been conducted annually since 1989 and has certified over five-hundred (500) systems. In 2007, DICE became a triannual event. By moving to a triannual event, DICE better supports the JS Command, Control, Communications, and Computer





Figure 6. During a recent Department of Defense Interoperability Communications Exercise event, participation included communications equipment such as Northern Command's (NORTHCOM's) Mobile Command Platform (MCP). The left photo is an external view of the MCP and the right is a view inside the MCP.

Systems Directorate (J6) Interoperability and Supportability Certification process as well as facilitating acquisition to the field for systems needed to support the warfighter.

DICE is a major JITC initiative supported by the J6 JS, and the Joint Forces Command. It allows the warfighter to acquire, certify, and deploy systems in less than one year which supports DISA's "Surety, Reach, Speed" strategic vision. DICE also reduces the cost of interoperability testing by maximizing network efficiencies and providing a venue where the Services, combatant commanders, and agencies can interact at no additional cost. DICE is growing and evolving in stride with the warfighter and the warfighter's communication needs. JITC conducts DICE in support of joint interoperability experimentation, testing and evaluation of communication systems as well as execution and transformation initiatives.

DICE replicates a geographically dispersed Joint Task Force environment and is the only DoD exercise dedicated solely to interoperability testing and certification. It also provides an excellent forum for testing and experimentation with emerging technologies, allied communications initiatives, regressive testing with legacy equipment, and realistic joint communications training. DICE provides an outstanding venue for integrating operational realism for planners, operators, developers, and testers from the DoD and its partners to collaborate on communications and interoperability solutions—whether the solutions are equipment or procedural in nature.

While the main focus of DICE is the warfighter, this exercise further mitigates risk by creating a dynamic training environment. This environment provides participating warfighters and civil responders

opportunities to develop and improve their proficiencies in information systems-related mission essential task lists and tactics, techniques, and procedures, and helps ensure that systems can communicate prior to actual operational fielding need (Figure 6).

Ultimately, DICE reduces the Warfighters' risk of operational failure by aggressively testing new versions of software, equipment, and employment techniques in an operationally representative Joint Task Force communications network while allowing operators and developers to train and collaborate in various operationally representative environments and architectures.

## Summary

The future test environment will involve network-centric warfare and an architectural foundation for the GIG to integrate DoD IT and NSS test programs. JITC's vision for the future of net-centric T&E in an FDCE ties the Defense Information Systems Network to the operational community, the capability area proponents, the Service ranges and facilities, the DISA acquisition and development communities, the Service acquisition and development communities, and our industry partners. The integration of these communities, proponents, ranges, and facilities will help integrate warfighters, IT and NSS architectures, scenarios, metrics, live and simulated capabilities, Enterprise IT services, Component IT services, and capability developers into one master test environment that can be used by all DoD elements. A careful integration of this future master test environment into the existing DoD major range and test facility base (MRTFB) infrastructure is vital to the future success of DoD operational testing and the existing MRTFB.

The integration of operational realism into testing IT and NSS has proven to be a formidable challenge for JITC and the DISA TEMC. IT and NSS cannot be tested like standard weapon systems during developmental, operational or combined testing. As a result, DISA's IT and NSS test efforts will continue to expand in military exercises, interoperability certification testing, and DICE. Most significantly, JITC and the DISA TEMC will continue to develop net-centric test capabilities and establish policies and procedures to field net-centric capabilities faster as integrated mission capabilities in operational environments. □

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*and Evaluation Division as the Net-Enabled Command Capability (NECC) Capability Test Team lead. A graduate of the Army intern program, she has nine years of experience in both government and industry focusing on the research, development, engineering, test and evaluation, and acquisition of command and control systems. She holds a bachelor of arts degree in mathematics and a master of engineering degree in systems engineering from Stevens Institute of Technology, Hoboken, New Jersey. Previous assignments at Fort Monmouth's Communications Electronics Research, Development, and Engineering Center include project lead for the Network Enabled Battle Command Science and Technology Objective, and information management integrated product team lead for the Objective Force Warrior program. A former member of the Army Acquisition Corps, Ms. Mackenzie received Level III DAWIA certification in systems engineering in 2005, and is currently qualified for Level III DAWIA certification in test & evaluation.*

*DANIEL (DAN) W. KNODLE works in JITC's Test Engineering Branch as a computer scientist. A former Air Force officer, DoD contractor and commercial telecommunications manager, he has more than 29 years of information technology and command, control, communications computers and intelligence test and evaluation, engineering and operational experience. He's a graduate of the Teleprocessing Science Master of Science program from the University of Southern Mississippi. Previous assignments include the 485<sup>th</sup> Engineering Group (communication system design), the Air Force Tactical Communications Test Team, the Air Force Operational Test and Evaluation Center, DISA Europe and, as a senior manager at Sprint Internet Operations. During his tenure at JITC, he has assisted with the developments of the Joint Distributed Evaluation Plant and the Net Ready Key Performance Parameter test concepts.*

## Endnotes

<sup>1</sup>McQueary, C. E., Young J. T. Jr. 2007. "T&E Policy Revisions." Memo signed December 22, 2007 by Dr. Charles E. McQueary, Director, Operational T&E, and John T. Young, Jr., Under Secretary of Defense for Acquisition, Technology, and Logistics.

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