DEPARTMENT OF DEFENSE

Testing in a Joint Environment Roadmap
Strategic Planning Guidance
Fiscal Years 2006-2011

Final Report
November 12, 2004

Director, Operational Test and Evaluation

Testing in a Joint Environment Roadmap

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OFFICE OF THE SECRETARY OF DEFENSE
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WASHINGTON, DC 20301-1700

OPERATIONAL TEST AND EVALUATION

OFFICE OF THE SECRETARY OF DEFENSE
2004 NOV -8 AM 10: 37

DEP SEC DEF HAS SEEN Approved PW NOV 12 2004 M 11/12

ACTION MEMO

November 8, 2004/10:00 A.M.

FOR: DEPUTY SECRETARY OF DEFENSE

FROM: Thomas P. Christie, Director of Operational Test and Evaluation

SUBJECT: Strategic Planning Guidance (SPG) Task for Joint Testing in Force Transformation Roadmap

- I recommend that you approve the "Testing in a Joint Environment Roadmap" report (TAB A) for execution in response to the SPG task to establish the capability for Joint Testing in Force Transformation, when resources are provided in the FY06 budget cycle. DOT&E obtained coordination from JCS, the USD(AT&L), the USD(P&R), the Services, and JFCOM. TAB B summarizes those coordinations and DOT&E's treatment of each organization's comments during the coordination process.

- The Department will employ capabilities-based processes to acquire weapons and support systems addressing joint missions. We must conduct test and evaluation (T&E) in joint operational environments. The Roadmap recommends a significant infrastructure solution for both operational and developmental T&E in response to the SPG guidance that states *"the Department will provide new testing capabilities ... as part of new capabilities-based processes."* Persistent connectivity, critical for net-centric development and testing, will also meet other needs — experimentation, development, and training. Our technical approach is sound and necessary now for net-centric and other transformational priorities.

- We have consensus and momentum across the Department, and agree that execution of this Roadmap depends on the approval of funding, an issue being addressed within the PPBE system and the POM06 Program Review. I am committed to resolve any additional concerns in close coordination with USD(AT&L) and others during implementation planning and execution.

COORDINATION SUMMARY: See TAB B

DEPSECDEF DECISION:
APPROVED: PW 11/12/04
DISAPPROVED:
OTHER:

Attachments:
As stated

Prepared by: Mike Crisp, Deputy Director Air Warfare, 703-692-1708

TSA SD	X OSD 17780-04
SA DSD	
SRMA DSD	Pre-Decisional
EXEC SEC	M. 11/8

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Coordination Summary

The guidance required coordination with the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)); the Under Secretary of Defense for Personnel and Readiness (USD(P&R)); the Chairman, Joint Chiefs of Staff (CJCS); the Service Secretaries; and the Commander, Joint Forces Command (JFCOM). A synopsis of coordinating responses is provided as follows:

USD(AT&L) – Formal coordination on November 5, 2004. "I have reviewed the Strategic Planning Guidance Final Report on Testing in a Joint Environment Roadmap dated November 2, 2004, and concur."

Comments were incorporated and agreement reached.

USD(P&R) – Formal coordination August 13, 2004. "The *Testing in a Joint Environment Roadmap Strategic Planning Guidance, Final Report July xx, 2004* captures the policy changes needed to institutionalize the requirement for testing in a joint environment. … I concur with the Joint Testing in Force Transformation Roadmap."

CJCS – Formal coordination July 27, 2004. "… We concur subject to incorporation of enclosed comments."

All comments were either incorporated, or negotiated and agreement reached.

Secretary of the Army – Formal coordination July 29, 2004. "The Army concurs with the draft final report with the following comments and strongly recommends their consideration for inclusion in the final document:"

All comments were either incorporated or accommodated in the final report, and will be addressed further during implementation planning as appropriate.

Secretary of the Navy – Formal coordination July 29, 2004. "The Navy appreciates the opportunity to participate in the development and review of the "Testing in a Joint Environment Roadmap" and strongly supports the need to "test like we fight." This roadmap has the potential to provide the Services with a necessary testing and evaluation capability. … I am encouraged by your efforts and request you continue with the development of an implementation plan that creates a capability for joint testing with defined milestones with clear exit criteria. I see significant opportunities for leverage of the architectures and infrastructure being developed for the Global Information Grid (GIG) and related Service implementation programs. Close coordination will be needed. I also believe that as we enter the implementation phase we must proceed cautiously to ensure that there is no duplication of infrastructure, and that the resource-constrained requirements for joint testing in our acquisition programs are commensurate with the value of the information provided to leadership."

No specific issues were cited requiring response.

Secretary of the Air Force – Formal coordination July 30, 2004. "The Air Force fully supports your efforts to transform the test community to "institutionalize the evaluation of joint system effectiveness." ... There are other initiatives within the Department, such as the DoD's, which overlap your efforts. Because the roadmap is heavily reliant on modeling and simulation, requirements to support test and evaluation should be coordinated with, and included in, the M&S master plan. This coordination is vital before any funds are identified to establish a new organization and infrastructure. ... Any funds identified in FY05 should be for technical support to coordinate with parallel efforts, ... Finally, the acquisition community must be given adequate time to accommodate the transformation spelled out in the roadmap. Program offices impacted by the requirements associated with increased levels of joint testing have not budgeted for these costs. Therefore, we recommend phasing in the prototype acquisition requirements in the FY07-FY08 timeframe in order to minimize the impact to the FY06 budget formulation activities already completed."

DOT&E has negotiated the concerns of overlapping Department efforts with AF-XI and has reached agreement. Current validated and accredited models and simulations are crucial to be able to conduct realistic and adequate T&E. DOT&E is participating in an Acquisition M&S Working Group tasked to update the M&S master plan that will address the development or update, validation, and maintenance of models and simulations to ensure needed virtual and constructive threat and system representations, as well as standard, readily available simulation environments. The Group will make recommendations to the USD(AT&L) regarding funding to support systems engineering and T&E M&S requirements.

DOT&E understands the perceived impact to the acquisition community. However, true capability-based acquisitions with defined joint missions will be new programs, budgeted in future cycles to include the M&S and testing in joint environment requirements. Joint requirements added to legacy programs will need to be addressed the Services and Agencies on a case basis.

JFCOM Formal coordination September 13, 2004. "Thank you for the opportunity to coordinate on the "Testing in a Joint Environment." U.S. Joint Forces Command (USJFCOM) supports the policy, actions and recommendations contained in the Roadmap, subject to inclusion of JFCOM's already submitted comments which I understand you have agreed to work during implementation. It is important to the joint warfighter that implementation of this roadmap be fully synchronized with Joint Battle Management Command and Control (JBMC2) and Joint National Training Capability (JNTC) efforts. JFCOM looks forward to working with DOT&E as you lead the implementation of this roadmap for the benefit of our joint warfighters.

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FOREWORD

Thorough testing of weapons and supporting systems is a critical function for the Department. As we move force structure, doctrine, and acquisition toward being born joint, we need to change our test and evaluation processes and capabilities. We should test using the joint mission environments in which we expect the weapons and systems to operate.

As directed by the Strategic Planning Guidance, we have developed a roadmap proposing changes that will enable the test and evaluation community to "test like we fight." This roadmap promotes:

- Institutionalizing the need to test in realistic joint operational environments. This will require changes to Department policy and enforcement by leadership.
- Defining capabilities in common, measurable, war fighting terms. This is essential to establish an evaluation continuum over the life-cycle of systems.
- Establishing a persistent connectivity between battle labs, hardware-in-the-loop simulations, developmental test facilities, and live force instrumentation. This is necessary to achieve net-centricity and interoperability.
- Using this persistent connectivity to achieve robust live, virtual, and constructive joint mission environments for joint experimentation, development, test, and training. This is needed to make comparable the results of these communities.

As a step forward to conducting realistic and adequate joint testing, the Department should:

- Share test and Joint National Training Capability venues and resources.
- Allow for increased use of the Guard and Reserve forces, where appropriate.
- Revitalize modeling and simulation to achieve the Department vision of a decade ago.

I strongly support approval of this roadmap, look forward to guiding its implementation, and remain committed to its success through my testing advocacy and oversight role.

Thomas P. Christie
Director

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EXECUTIVE SUMMARY

TASK

The Strategic Planning Guidance (SPG) directed the Department to *"provide new testing capabilities [*for *test and evaluation in a joint operational context] and institutionalize the evaluation of joint system effectiveness as part of new capabilities-based processes."* It tasked the Director, Operational Test and Evaluation to *"develop a roadmap for the Deputy Secretary of Defense… that identifies the changes needed to ensure that test and evaluation is conducted in a joint environment and facilitates the fielding of joint capabilities."*

The guidance required coordination with the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)); the Chairman, Joint Chiefs of Staff (CJCS); the Service Secretaries; the Commander, Joint Forces Command (JFCOM); and the Under Secretary of Defense for Personnel and Readiness (USD(P&R)).

DISCUSSION

The Secretary's guidance establishes new Department policy to be *institutionalized*, that we will *conduct testing in a joint environment* where applicable, and directs that we *provide the resources required*. These new T&E capabilities are applicable to both Developmental T&E (DT&E) and Operational T&E (OT&E).

Joint operations have become the mainstay of warfighting. Force Transformation will require that the T&E community place a much greater emphasis on testing joint warfighting capabilities developed in response to the Joint Capabilities Integration and Development System (JCIDS) process. T&E must ensure that our combatant commanders (CoComs) can rely on equipment to operate together effectively without introducing problems to the warfighters.

Taken as a whole, the proposals in this roadmap are important enablers for acquiring capabilities that are 'born joint' and testing legacy equipment and systems that are 'made joint.' The T&E roadmap identifies changes that will prepare the Department for "testing like we fight," and will *provide a critical prerequisite for net-centric development and testing.* The proposals support the Secretary's top priorities: "Strengthening combined/joint warfighting capabilities" and "Transforming the Joint Force."

ACTIONS

1. The Department must establish a framework for lifecycle evaluation of systems and systems-of-systems in a joint operational environment that begins with the JCIDS process. A common task-based language derived from the Universal Joint Task List (UJTL) is essential. It should identify missions and operational tasks, including the specification of measures and conditions. The explicit joint mission capability needed must be identified in the Capability Development Document (CDD) and Capability Production Document (CPD) with enough specificity to define "jointness" for both program managers (PM) and testers. The rationale behind key performance parameters (KPP), thresholds, and objectives must be articulated clearly. [sec. 2.2.1]

2. Current test planning processes must be updated and expanded to clearly identify needs for adequate testing of joint warfighting systems or systems-of-systems in their mission environment(s). The PM's T&E strategy must address the DT&E and OT&E needs for joint missions, and ensure these needs are documented in each system's T&E Master Plan (TEMP). Multi-Service testing, including that by an Operational Test Agency (OTA), will require test teams that include members of other Services for designated joint mission test events, as appropriate. [sec. 2.2.2]

3. Live forces, both the warfighters and their equipment, must be used to evaluate systems and systems-of-systems in a joint operational environment. Today's limited availability of forces to support T&E will be compounded when joint mission capabilities are tested in assigned mission environments. Properly trained and equipped guard and reserve forces can supplement active units to provide the necessary live forces for OT&E in the joint context. Current in-service and production-representative military equipment must be available to live forces in both test and supporting roles to provide an adequate and realistic joint mission environment. [sec. 2.2.3]

4. Development of interoperable or common mobile instrumentation, embedded or non-intrusive, is required where feasible. Such instrumentation is required for Services, ranges, and the systems engineering, testing, training, and experimentation communities. Open data sharing must be promoted across the Department and other government agencies, including industry and academia where appropriate. Contracting practices must be adjusted to promote data sharing while protecting proprietary data. As a resource to promote sharing technical data, the Assistant Secretary of Defense for Networks and Information Integration (ASD(NII)), USD(AT&L), and DOT&E should establish an Engineering and T&E Community of Interest (COI). Common data archive and retrieval capability must be established. [sec. 2.2.7, 2.3.2.3, 2.3.3, and Appendix B]

5. A persistent, robust modern networking infrastructure for systems engineering, DT&E, and OT&E (including Initial OT&E (IOT&E)) must be developed that connects distributed live, virtual, and constructive (LVC) resources, enables real-time data sharing and archiving, and augments realistic OT&E/IOT&E of joint systems and systems-of-systems. A major

enhancement to the current Joint Distributed Engineering Plant (JDEP) has been fully studied separately by USD(AT&L) and the Defense Information Systems Agency (DISA) as a common integrating connectivity solution for many needs across the Department. All the elements of a program plan that support the roadmap's recommendations are available separately. Full development of networking capabilities requires a field-level program management office to oversee engineering and operational functions including scheduling. [sec. 2.3, 2.2.3, and 2.5.1]

DOT&E and the OTAs must approve the selective use of distributed simulation for augmenting the live forces and equipment necessary for OT&E/IOT&E. Approval will be on a case-by-case basis as part of the normal test planning and TEMP approval process. [sec. 2.2.3]

6. Effective strategic partnerships must be established. DOT&E and the Services must partner with USD(P&R) and JFCOM to exploit opportunities to combine training exercises and test events in a common joint environment whenever possible. A collaborative prioritization and vetting process must be established to ensure testing, demonstration, experimentation and training objectives are not compromised. The primary purpose of Joint Training remains to prepare the operational forces to fight and win wars. The synergy of the infrastructure being developed for the Joint National Training Capability (JNTC) and the infrastructure necessary for testing in a joint environment must be leveraged to the fullest extent, using a common set of protocols, standards, and procedures. [sec. 2.2.4]

DOT&E must also partner with USD(AT&L) and the ASD(NII) (and others as needed) to develop the common, fully enhanced network infrastructure program addressed above as a core element for the Department. This network infrastructure is a critical institutional investment for the Department, providing a key enabler for net-centricity developments and testing, and improved capability across many domains (T&E, science and technology, training, experimentation, modeling and simulation (M&S), information assurance, interoperability, etc.). A universal distributed capability will meet additional important T&E needs including interoperability certification and information assurance testing, and will be an enabler for interoperable ranges and large footprint testing. [sec. 2.3.2.7]

The Department must commit to develop/update models and simulations to ensure the needed virtual and constructive threat, environment, and system representations are funded and available via the enhanced networking infrastructure to support systems engineering and T&E requirements, as well as training and experimentation. [sec. 2.2.5, 2.3.2.4, and 2.4.2.1]

7. Department policy and instructions, directives, and regulations must be updated as applicable to institutionalize that “testing in the joint environment is required” for all joint warfighting systems acquired or modified under the JCIDS process, and enable the creation and maintenance of the infrastructure necessary to generate the joint mission environment. [sec. 2.4]

RECOMMENDATIONS

I recommend the Deputy Secretary of Defense:

1. Approve the proposed changes and considerations presented in this roadmap and direct its execution, depending on the identification of funding. Direct the implementation planning to be under the leadership of DOT&E in full partnership with the offices of USD(AT&L), USD(P&R), and ASD(NII), the Joint Staff, the Services, JFCOM, and others as required. As the major proponent for acquisition and DT&E, the office of USD(AT&L) will be a key partner in implementation planning. Identification of a long-term sponsor and steps for transition to this sponsor will be addressed during implementation planning. DOT&E will work closely with the designated long-term sponsor in its T&E oversight and advocacy role.

2. Direct the development of a common, fully enhanced network infrastructure capability, and the phased establishment of the responsible field-level program management office. Direct DOT&E to work with the USD(AT&L), the Under Secretary of Defense (Comptroller) (USD(C)), the Director of Program Analysis and Evaluation (D,PA&E), effected Components, and the Joint Staff to identify available FY2005 funds for realignment/reprogramming to initiate this development.

3. Direct DOT&E to pursue FY2006-2011 funding for the continuation of the common, fully enhanced network infrastructure program, and other roadmap-associated costs, during the Program Objective Memorandum (POM) 2006-2011 Program Review.

4. Direct the Department update DoDD 5000.1, DoDI 5000.2, and other directives to institutionalize testing in the joint environment as an enabler for Force Transformation.

COLLATERAL REQUIREMENTS

Because these actions are critical to execution of this Roadmap, I further recommend:

1. The Deputy Secretary of Defense direct establishment of a common task-based language derived from the UJTL, for concept development, functional analyses, JCIDS capabilities, acquisition, T&E, training and experimentation, and mandate its use in all JCIDS documents.

2. The Chairman update his Chairman Joint Chiefs of Staff Instruction (CJCSI) 3170.01D to ensure all JCIDS CDD and CPD documents define, or reference the source for, the explicit joint mission capability needed in task-based terms derived from the UJTL, and to provide for feedback of T&E results to the Functional Capability Boards (FCB) as appropriate.

3. The USD(AT&L)-led Acquisition M&S Working Group, with other Office of the Secretary of Defense (OSD) offices, the Services, and Defense Agencies, develop an Acquisition M&S Master Plan that addresses the development or update, validation, and maintenance of models

and simulations to ensure needed virtual and constructive threat and system representations; standard, readily available simulation environments; and identify required funding to support systems engineering and T&E M&S requirements.

4. The ASD(NII), USD(AT&L), and DOT&E establish an Engineering and T&E Community of Interest (COI) to ensure system engineering, and DT&E and OT&E data are made visible, accessible, and understandable across the Services, Agencies, developers, and other parties.

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1.0 INTRODUCTION

1.1 PURPOSE

In a meeting in December, 2002, Secretary Rumsfeld offered the Operational Test Agency (OTA) commanders the opportunity to provide ideas related to his initiatives and priority list. I responded in my memorandum of December 13, 2002, as follows:

> *"… While other recommendations are forthcoming, I believe one item should top the list:*
>
> - *To strengthen our joint warfighting capabilities, the Department should not only "train as we fight" but also "test as we fight."*
>
> *The Department has acted to improve joint operational training through the creation of a Joint National Training Center. I believe it should act to also create a Joint Test and Evaluation Capability.*
> …
> *Infrastructure requirements (ranges, instrumentation, etc.) for both training and testing are similar. We should base future infrastructure decisions on a corporate perspective that satisfies both joint operational training and joint operational testing priorities."*[1]

The Strategic Planning Guidance (SPG) tasking me to develop a roadmap to enable test and evaluation (T&E) in a joint environment is the result of the initiative the Secretary and I addressed in 2002, and the Secretary's commitment to "get folks working on those ideas."

> *"**Joint Testing in Force Transformation** (U)*
>
> *(U) Developing and fielding joint force capabilities requires adequate, realistic test and evaluation in a joint operational context. To do this, the Department will provide new testing capabilities and institutionalize the evaluation of joint system effectiveness as part of new capabilities-based processes. The Director, Operational Test and Evaluation (D(OT&E)) will develop a roadmap for the Deputy Secretary of Defense no later than May 2004 that identifies the changes needed to ensure that test and evaluation is conducted in a joint environment and facilitates the fielding of joint capabilities."* (Pre-Decisional)[2]
>
> The SPG's Appendix E, item E08, requires coordination with the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)); the Chairman, Joint Chiefs of Staff (CJCS); the Service Secretaries; the Commander, Joint Forces Command (JFCOM); and the Under Secretary of Defense for Personnel and Readiness (USD(P&R)).

The Secretary's Joint Testing in Force Transformation guidance establishes policy that the Department will conduct its testing in a joint environment where applicable, and will provide the resources required. This policy supports two of the Secretary's top priorities: "Strengthening

1 The full memorandum and the Secretary's reply are at Appendix A.
2 Though approved in the SPG, this guidance remains Pre-Decisional until the roadmap is approved.

combined/joint warfighting capabilities" and "Transforming the Joint Force"; and the Quadrennial Defense Review's (QDR) pillar for "Strengthening Joint Operations".

1.2 GOAL

The Department will be able to conduct adequate, realistic, and timely T&E in a joint environment to enable informed decisions regarding development, acquisition, and deployment of joint warfighting systems or systems-of-systems.

1.3 SCOPE

The objective of this roadmap is to define the changes that will position T&E capabilities to fully support adequate T&E of warfighting capabilities developed under new capabilities-based acquisition methods in the appropriate joint mission environment. Testing in a joint environment requires changes in the following areas:

- Test and evaluation methodology and processes.
- A networking T&E infrastructure able to generate the joint mission environment.
- Policy and regulations to implement testing in a joint environment as a Department-level policy, and institutionalize this expanded T&E capability.
- Prudent organizational recommendations and a Department-wide common business process to support the networking infrastructure.
- Initial resourcing to begin development and implementation.

1.4 KEY DEFINITIONS

- "Testing in a Joint Environment" – A more accurate description of the capability this roadmap will address than the title of the SPG paragraph, "Joint Testing in Force Transformation". The report avoids the term "joint testing" because this terms connotes testing that requires participation of more than one Service, which is not always true, and is easily confused with the Joint Test and Evaluation (JT&E) program.
- "Testing" and Test and Evaluation (T&E) – The term "testing" (or test) is used for simplicity/brevity in some cases. Throughout the context of this report, the term "testing", where applied, is synonymous with T&E. T&E is used as a collective term for DT&E and OT&E when used alone, while DT&E and OT&E will be used to distinguish when needed. Joint interoperability certification testing is included.

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- "Joint Mission Environment" – The operational context in which the capability being developed must perform.

- "Joint Mission Infrastructure" – Collective term for the hardware/software – the combination of representations of friendly and enemy forces and the geophysical environment, as well as the supporting infrastructure, required to generate the joint mission environment necessary for capability development and T&E.

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2.0 TESTING IN A JOINT ENVIRONMENT ROADMAP

2.1 JOINT CAPABILITIES IDENTIFICATION AND ACQUISITION

The long-term objective of Force Transformation is to match current capabilities more closely to the warfighting needs of the Combatant Commanders (CoComs) and transform the requirements definition and acquisition business practices to capabilities-based processes that ensure future capabilities are designed, developed, tested, and fielded to fully support joint operating, functional, and integrating concepts. The CoComs are the ultimate customers of capabilities-based acquisition and testing. Force Transformation requires both modernization of existing legacy military capabilities to more closely meet joint needs, and filling capability gaps using capabilities-based acquisition that is fully focused on providing the needed joint mission capability. As noted in the *Joint Operations Concepts* document: "The Joint Force must move beyond deconfliction to fully integrated elements with all functions and capabilities focused toward a unified purpose. This means that the capabilities provided by the Services, combatant commands and combat support agencies are 'born joint' and fully integrated. Thus the Joint Force Commander will have a set of inherently interoperable and synergistic joint capabilities to employ. Legacy equipment and systems will be 'made joint' to the extent possible until such time as replacement by 'born joint' equipment is feasible."

Full implementation of the Joint Capabilities Integration and Development System (JCIDS) defined in CJCS Instruction (CJCSI) 3170.01D as the means to develop and communicate desired system capabilities to the acquisition and T&E communities will be the most significant change that will affect how T&E will be conducted in the future. For illustration purposes in this roadmap, Figure 1 shows JCIDS decisions that define a materiel solution as the initiation of the capabilities-based acquisition process. The procedures established in the JCIDS support the Chairman of the Joint Chiefs of Staff (CJCS) and the Joint Requirements Oversight Council (JROC) in identifying, assessing, and prioritizing joint military capability needs. JCIDS is the source of the Initial Capabilities Document (ICD), CDD, and CPD, replacing the older Mission Needs Statement (MNS) and Operational Requirements Document (ORD). Additionally, the JCIDS is a key element in the Chairman's efforts to realize the initiatives directed in the Secretary's Transformation Planning Guidance (TPG). JCIDS will move materiel developers and testers away from the Service-centric system requirements of the past towards the necessary joint-centric capability development for future systems. JCIDS will drive both the requirement for jointness in acquisition systems, and the test and acquisition community's need for a matching systems engineering and test capability that will support JCIDS-based system and system-of-systems developments and T&E.

Testing in a Joint Environment Roadmap

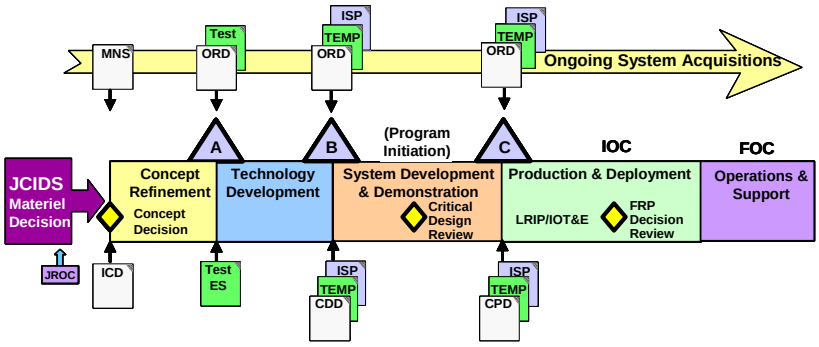

Figure 1. JCIDS and Capabilities-based Acquisition

T&E is a fundamental part of the acquisition process. The products of acquisition are the subject of T&E. Historically, the Service acquisition requirements have been scaled to meet their Title 10 obligation to train and equip each Service, and have given little consideration to the joint mission environment in which systems will be expected to fight. The acquisition PM developed and delivered the system that met specific system requirements. T&E focused primarily on system-centric testing to assess the effectiveness and suitability to meet those requirements and specifications. The requirements related to interoperability of Command, Control, Communications, Computers and Intelligence (C4I) have gone the farthest in outlining the conduct of T&E and various specialty certifications in a joint context, but they still focus primarily on system-centric requirements.

The Joint Testing in Force Transformation guidance in the SPG requires the T&E community to respond and implement the core test capabilities necessary for meeting its responsibilities under the new approach of capabilities-based acquisition. The fundamental mission of T&E will not change – to provide decision makers assessments of the operational and live fire effectiveness, suitability, and survivability of systems under development. *What will change* is the demand to be able to conduct T&E of these systems against the JCIDS-defined joint-centric capability requirements in a realistic joint operational environment. Current Service T&E capabilities are world-class, but focus primarily on testing in a system-centric operational environment that does not fully reflect the complexity of the joint environment. Limited testing for joint or interoperability requirements may exist for current acquisition programs, but it is generally conducted in a loosely coupled manner. This loosely coupled approach reflects actual funding profiles. To develop and field capabilities 'born joint', the Department needs a more robust, focused, and tightly coupled T&E capability that places testing in a joint environment and joint interoperability testing at the core of T&E activity, rather than as an extension to system-centric testing.

Significant changes to acquisition processes have been introduced as part of the Department's focus on Transformation. Taken together with the changes in the capabilities identification process, the Department has overhauled its materiel acquisition business practices.

Changes to acquisition also seek to reduce acquisition cycle time significantly. Increased reliance on evolutionary acquisition processes that address capability needs in a series of time-phased increments with modular open systems, advanced concept technology demonstrations (ACTD), and flexible entry into systems acquisition via multiple process paths such as ACTDs and JFCOM Transformation Change Proposals, are some of these initiatives. The evolving acquisition practices impact the way T&E is conducted and must be considered in this roadmap. The testing in a joint environment capability is needed throughout a system's acquisition and employment lifecycle and will be used to ensure joint mission capability needs are satisfied to meet Acquisition Decision criteria. Acquisition programs will be held responsible for meeting the mission criteria imposed in JCIDS documents.

2.2 CHANGES TO T&E METHODS AND PROCESSES

T&E must adapt test methodologies to be prepared to test systems and systems-of-systems in assigned joint mission environments and accommodate evolving acquisition processes. However, testing in a joint environment will not require new test milestones, but will be conducted in the context of existing DT&E and OT&E (including IOT&E) events defined in each TEMP. Testing in the joint environment will provide the necessary resources and scenarios to meet the realistic combat conditions necessary for an adequate IOT&E. The definition of joint missions in JCIDS documents will simply mean existing tests will include the broader context of the joint mission environment(s) applicable. The basic requirements for operational testing established in Title 10 USC Section 2399 and supporting Department policies will remain unchanged. Additionally, testing in a joint environment will not add a new type of operational test or test reporting requirement. Rather, results will be reported within existing required test reports.

2.2.1 FRAMEWORK FOR DEFINITION OF CAPABILITIES

The acquisition and T&E communities need a clear and standardized definition of the explicit joint mission capability needed to guide the design, development, and evaluation of the materiel solution. There must be enough specificity in terms of missions and operational tasks and measurable performance metrics and conditions (derived from the UJTL) for PMs to understand the meaning of "jointness" and know what to build, and for testers to determine what/how to test.

The Department still struggles to settle on the specific process and manner for defining joint warfighting capability gaps and materiel capability needs. The basic assumption in new 5000 and 3170 series directives and instructions was that operational, systems, and technical integrated architectures were the preferred method for describing interactions and assessing future capability needs. Yet the integrated architectures are not proving adequate for defining capability needs.

To establish a framework for evaluating systems and systems-of-systems in a joint operational environment throughout their lifecycle, the FCBs must define the desired capabilities, operational tasks, attributes, and metrics which describe what systems should be able to do in the ICDs, CDDs, and CPDs. The Department must establish a common task-based language (derived from the UJTL) that identifies missions and operational tasks including the specification of measures and conditions, to support concept development, functional analyses, JCIDS capabilities definitions, systems engineering, T&E, training and experimentation. The FCBs should articulate the rationale behind the capabilities that drive the key performance parameters (KPP), thresholds, and objectives. Policy changes are addressed in section 2.4.2.2 and Appendix C.

2.2.2 ENHANCED TEST PLANNING AND EXECUTION

It is in the test planning process that the scope of the requirements for testing in the joint environment will be determined on a case-by-case basis. Today's fundamental test planning methodology will be unchanged, but its scope must be expanded to address the joint missions defined in the JCIDS documents. There may be some systems for which testing in a joint environment is not necessary. Testing in this joint environment will be required for programs for which joint missions and performance attributes have been identified by the JCIDS process. Some programs will require multi-Service testing directed by a lead OTA, with support provided by other Service OTAs. Teams that conduct T&E in the joint mission environment must include members of other Services for designated joint mission test events, as appropriate.

The PM will develop the T&E Strategy and T&E Master Plan (TEMP) (or equivalent) to respond to capabilities required in the CDD and CPD using the customary test planning working groups in accordance with chapter 10 of the Defense Interim Acquisition Guidebook. The test planning documents will summarize the planned testing, including those elements that will require testing in a joint mission environment, and define the systems and level of fidelity required to assess the system's performance of the joint mission. TEMPs for these programs will identify test events that must be conducted in a joint environment. In cases where multi-Service participation is identified, the TEMP review and approval process must provide for coordination with applicable Service OTA commanders. Figure 2 illustrates the test planning flow.

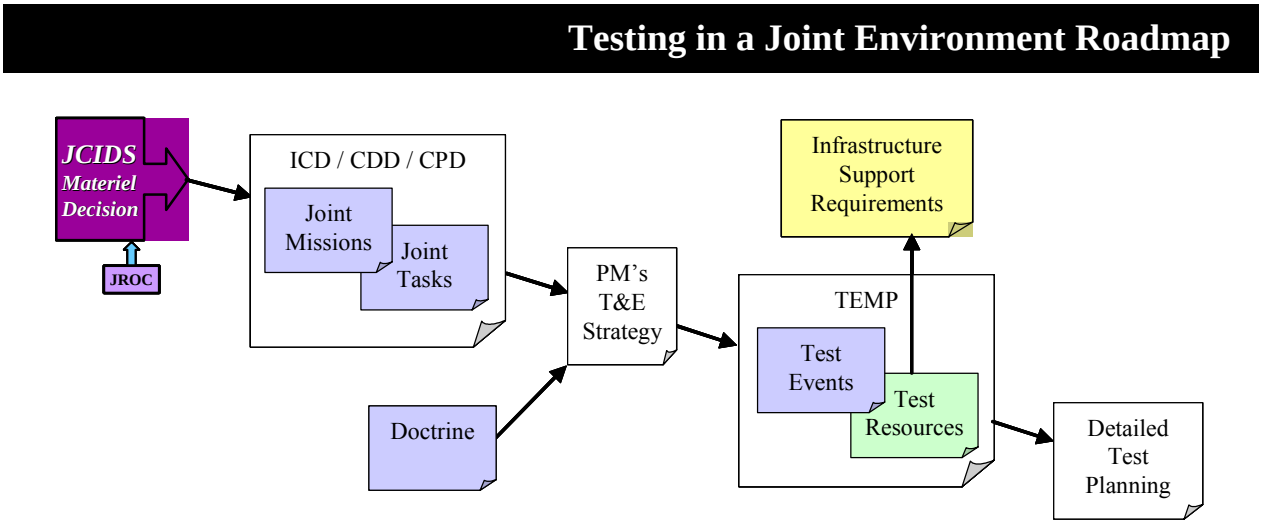

Figure 2. Test Planning Flow

Joint missions and tactical tasks will be derived from the JCIDS capabilities documents as well as relevant Joint and Service doctrinal sources. The integrated architectures and Information Support Plans will be available as additional planning resources. Determination of the necessary spectrum of test events, and definition of the blue and red forces and theater of operations for each event, is required to determine the test resources and the infrastructure support needed. The set of friendly forces and systems required to operate with the system or system-of-systems being tested will be derived from the relevant joint operational architectures. Test planners will need an understanding of interactions between friendly forces for tactical missions and tasks, and which of these interactions must be replicated in a test. Knowledge of the appropriate threat environment, and other elements such as neutral forces or non-combatants that should be replicated, is required. Mission decomposition techniques (mission to task to capability to solution) can support this analysis. The final component of the test environment is the geo-physical environment, and variables in this environment such as terrain or sea conditions, climate and weather, and light conditions. For example, one would likely want to test a land combat system in both open and restricted terrain, such as deserts and urban areas, under both day and night conditions.

Once the test parameters (missions/tasks, friendly forces, threat, and physical environment) are defined, planners must determine the most appropriate means of replicating each of these parameters. Live systems operating in live environments will remain the core of T&E. However, the networked joint mission environment will offer the opportunity for use of virtual and constructive representations of systems, forces, threats, and physical environments, which can be seamlessly linked to live systems in order to extend and enhance the test environment. Often cost, availability, or maneuver space limitations preclude the use of live forces to replicate all necessary combat interactions. In the past, these interactions were often simply not tested. With a networked mission environment, a broader scope of testing can be planned within these limits.

2.2.3 LIVE FORCES AND EQUIPMENT FOR OT&E

Adequate OT&E requires live forces and equipment for realism. The primary goal for DOT&E and the Services is to provide the Department and the Congress adequate, realistic operational testing. Operational test designers need the realistic mission joint environments – friendly forces and equipment, threats, and geophysical environments – required to assess military capabilities that are 'born joint' as identified in JCIDS capability documents. Yet assembling the multi-Service (and coalition) force for a test may be the limiting factor for testing the joint forces of tomorrow. Today's heavy world-wide operational force commitments and the added forces required for testing in the joint environment make the assembly of the required live forces either difficult or impossible. A shortfall in live forces for adequate OT&E is not acceptable. The needs for actual live forces with production-representative military equipment, including the supporting joint (and coalition) forces, will vary widely based on the system and joint missions assigned, and must be addressed and resolved on a case-by-case basis during development of the PM's T&E Strategy and the TEMP.

Test, training, and experimentation missions each have different, independent objectives. However, they often share common resource needs and analytical methodologies. A prime consideration to address the shortfall in live forces for adequate OT&E is to consider each JFCOM/JNTC and CoCom exercise for potential applicability to meet testing requirements in TEMPs and test plans. However, when such exercises do not meet test objectives, or are not fully adequate to represent the test mission, unique test events will still need to be conducted. Common test, training, and experimentation interests and the integration of test events with training events, when applicable and mutually compatible, are addressed in section 2.2.4.

As another option, when required active units cannot be made available to provide the necessary live forces for OT&E in the joint context, properly trained and equipped guard and reserve forces can be employed to fill this gap. The guard and reserve roles and responsibilities may not currently include support for OT&E. The use of guard and reserve forces and equipment needs to be addressed more specifically during the implementation planning for this roadmap, and the actions necessary to overcome any foreseeable hurdles must be defined.

A third course of action to fully provide the robust joint mission environment required for each test, identified from JCIDS documents, is through augmenting essential live systems and forces with accredited virtual and constructive resources. DOT&E and the OTAs must authorize carefully controlled use of distributed simulations to augment, not totally replace, live forces in OT&E (including IOT&E), and to complete the joint operational environment, with a focus on increasing realism at reasonable cost. Approval will be on a case-by-case basis as part of the normal test planning and TEMP approval process. A significant infrastructure solution is fully addressed in section 2.3 and Appendix B. Policy changes to require and enable the use of this capability are addressed in section 2.4.2.1 and Appendix C.

2.2.4 PARTNERSHIP ACROSS TEST, TRAINING, AND EXPERIMENTATION

Creating separate joint venues and joint mission infrastructures for systems engineering, T&E, training, and experimentation is not effective, efficient, or affordable. At a hearing of combined sub-committees of the House Armed Services Committee on March 18, 2004, Dr. Paul W. Mayberry, Deputy Under Secretary of Defense (Readiness) testified:

> "JNTC is a tremendous resource with value and benefit well beyond training. The "T" can also stand for "testing." The underlying pillars for JNTC are the same as those required for a realistic operational test event. We must partner with the testing community to maximize our commonality in the areas of instrumentation, data collection, cross-functional use of ranges, as well as long-term range sustainment. The same arguments can be made for the experimentation community, as they need to validate emerging operational concepts."

It will be mutually beneficial to create a partnership between the systems engineering, testing, training, and experimentation communities sharing LVC resources, but maintaining independence between the separate missions. While the general requirements of systems development, testing, training, and experimentation within the joint mission infrastructure are similar, specific requirements for factors such as resolution, latency, etc., will likely be different for many of the elements. For each community, the joint mission infrastructure should be accredited for specific applications.

There are two areas of overlapping equities.

2.2.4.1 SHARED PROCESS/VENUES

The event planning and execution process for systems engineering, testing, training, and experimentation events have much in common, and the venues where testing, training, and experimentation events in the joint context are conducted are virtually identical. Department infrastructure must be effectively utilized, and the shared use by testing, training and experimentation customers presents a perfect opportunity to get the most effective use out of existing and evolving infrastructure. Joint training has formed a mutually-beneficial partnership with the T&E ranges, beginning with Millennium Challenge 2002, which provided early lessons learned related to the issues associated with combined test, training, and experimentation. These lessons laid the ground work for JNTC as an integrated LVC environment, and the lessons continue proving the value of a common joint mission infrastructure for support of training, the Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities (DOTMLPF) process and system-of-systems testing.

JFCOM will continue to work with Services and combatant commands to improve the approach to joint experimentation. The proposed JNTC networking (called the Joint Training and Experimentation Networking (JTEN)) will provide the realistic, accessible training, systems

engineering, testing, and experimentation environment for the warfighter's training and experimentation requirements. The warfighter will have ready access to the Joint Command and Control, and Communications and Computers, Intelligence, Surveillance and Reconnaissance systems from various locations throughout the world, as well as the communications paths to a multitude of M&S, instrumentation, research and development, and Joint and Service training locations. JNTC will schedule a series of Joint training events for the warfighter each year; however, the infrastructure is also available for events that are not part of the JNTC schedule. Users will be afforded the opportunity to schedule use of the networking for their training, testing, and experimentation requirements.

Assembling the joint force for a test could very easily be the limiting factor for testing the forces of tomorrow. Joint forces, once assembled for testing, training and experimentation, should be scheduled with balanced and coordinated priorities to participate in support of testing, training, and experimentation requirements – live or virtual. A collaborative prioritization and vetting process must be established to ensure testing, demonstration, experimentation and training objectives are not compromised. While sharing may be a strong benefit, it cannot dilute the primary purpose of Joint Training which remains to prepare the operational forces to fight and win wars. Under the U.S. Unified Command Plan 2000 (UCP 2000), JFCOM is the transformation agency for the Department, representing the CoComs. JFCOM is also designated as the primary Joint Force Trainer, Joint Force Integrator, Joint Force Experimenter and Joint Force Provider. The testing in a joint environment roadmap will impact these mission areas. The roadmap's implementation plan will be developed in partnership with JFCOM and other coordinating Components to ensure conformance with UCP 2000.

2.2.4.2 COORDINATED INVESTMENTS

The Training Transformation program's JNTC investments are being coordinated with Service T&E and training range modernization plans, beginning with the JNTC PROGRAM OBJECTIVE MEMORANDUM (POM) 2006-2011 program development. An example of early success is JNTC's adoption of the Test and Training Enabling Architecture (TENA) as a means to develop required interoperability among test and training ranges and simulation centers. Additional areas of mutual investment/co-use which will promote efficient use of Department resources are:

- Networks
- Instrumentation
- Opposing Force (OPFOR) Capabilities
- LVC Integration of Simulation Environments
- Knowledge Management

2.2.5 SYSTEMS ENGINEERING AND DEVELOPMENTAL TESTING

The SPG's Reformed Acquisition Management task makes the case that the Department needs revitalization of its systems engineering process. Systems engineering is the comprehensive, iterative technical management process that transforms required operational capabilities into an integrated system design solution through concurrent consideration of all requirements throughout a system's lifecycle. Systems engineering integrates the technical inputs of the entire design team – managing interfaces, technical risk, and technology transfer, and verifying that designs meet operational needs. DT&E provides the "verification loop" of systems engineering, characterizing technical risk and providing confidence that the design properly addresses the capabilities required. Through systems and system-of-systems engineering, joint capabilities will be incorporated in systems' design, and systems will be 'born joint'.

Two key initiatives defined in Reformed Acquisition Management include: 1) the need for a persistent, robust distributed networking capability that can link the specific remote sets of HITL, M&S, and other resources with the live system in development to accomplish the systems engineering or testing required for a spectrum of transformational initiatives; and 2) the need for revitalized M&S across the Department. The Department must renew its commitment to develop standard and validated models and simulations to ensure needed virtual and constructive threat, environment, and system representations are funded and available via the common, fully enhanced network infrastructure to support systems engineering and T&E requirements, as well as training and experimentation. The Testing in a Joint Environment Roadmap and the Reformed Acquisition Management SPG task are mutually supportive and have been pre-coordinated. The distributed networking capability is fully addressed in section 2.3 and Appendix B. M&S requirements are discussed in 2.3.2.4, and in Appendix B.

Constructive simulation can support systems engineering for the system or system-of-systems being developed, from Concept Refinement through Critical Design Review. The system and joint mission capabilities can be assessed with virtual HITL simulations during DT&E. Early operational assessments (OA) can be conducted using constructive and virtual system representations of the system under test and other systems using the distributed networking to assess trends in joint mission effectiveness. A production-representative system can interact with systems in an exercise or dedicated test event during later OT&E, again using an appropriate mix of LVC simulations.

2.2.6 CHANGING ACQUISITION PROCESSES

T&E processes must adapt to support changing acquisition processes. The development strategy must define the acquisition path (i.e., evolutionary increments or spirals, any ACTDs) early in the acquisition process. T&E should be involved early in the capabilities process and in design of the PM's T&E strategy. Testing should be integrated throughout acquisition. The use

of combined (contractor test, DT&E, OT&E, and joint warfighter) teams will support the timely development and fielding decisions desired by the Department.

2.2.7 IMPROVED DATA SHARING

Changes are needed to promote open data sharing across the Department and other government agencies, including industry and academia, where appropriate, to increase the T&E contribution to reduced acquisition cycle time. Contractors often refuse to share data they consider proprietary and protected. Contracting practices must be adjusted to promote data sharing while protecting proprietary data. The establishment of common data archive and retrieval capability for warfighters, developers, testers, trainers, and experimenters will both provide data when needed without having to recreate it, and enable comparative evaluations. Capabilities for data archive and reuse repository are addressed in section 2.3.2.3 and Appendix B.

Changing acquisition processes will require the design of new weapon systems with provisions that enable T&E anywhere, anytime. New weapon system programs must consider designing in embedded instrumentation capability to provide inherent T&E capability responsive to accelerated acquisition processes. Instrumentation must be interoperable or common, mobile, embedded or non-intrusive whenever possible, for use by developers, testers, trainers, experimenters, and logisticians. Interoperability is required between Services, ranges, laboratories, industry, and systems engineering, testing, training, and experimentation. Instrumentation needs are discussed further in section 2.3.3.

The ASD(NII), USD(AT&L), and DOT&E must establish an Engineering and T&E Community of Interest (COI) to ensure system engineering, and developmental and operational test data are made visible, accessible, and understandable across the Services, Agencies, Developers, and other stakeholders. The Engineering and T&E COI will follow the specifications published by ASD(NII) for metadata, discovery interface, asset publication. The Engineering and T&E COI must also interact and be compatible with the Warfighter and Business Domain COIs. Requirements should be established using today's networks, instrumentation, and information technologies; and plan ahead for transition to the net-centric environment of the Global Information Grid (GIG).

2.2.8 IMPACTS TO ACQUISITION PROGRAMS

Acquisition programs must plan and budget for the cost of their participation in joint mission infrastructure testing, to include, where appropriate, paying for the services of other platforms that might not already be a part of that joint event. To facilitate participation in the distributed joint mission infrastructure, PMs must plan for funding and development of standard constructive models and virtual HITL simulations of acquisition systems, compatible with the joint mission infrastructure architecture. To be effective, the currency of these representations

must be maintained for the lifecycle of the system, both to support changes in their capability, and to support development and testing of other military capabilities. USD(AT&L) will work closely with acquisition programs and appropriate agencies to evaluate how best to facilitate the desired end state. M&S requirements are discussed below in section 2.3.2.4, and in Appendix B.

2.2.9 IMPACTS ON OPERATIONAL/DEVELOPMENTAL TEST

The impact on the Service developmental test capabilities and OTAs will depend on the types of programs each organization manages. Testing in a joint environment will be required for those programs that have critical interactions with other systems in the joint missions assigned. Not all programs will have joint mission requirements. Planning for testing in a joint environment must be accomplished from the perspective of those missions, with joint mission planning documented in each system's TEMP. Some additions to each developmental and operational test organization may be required to provide expertise in joint mission architectures and to absorb the increased scope of testing.

2.2.10 JOINT INTEROPERABILITY CONSIDERATIONS

Joint force capability development and the Net Readiness Key Performance Parameter (NR-KPP) will impact interoperability testing in a number of ways. Future systems will build common interfaces around the Information Assurance, Net-Centric Operations and Warfare Reference Model (N-COW RM), integrated architectures, and Key Interface Profiles (KIPs). The interfaces will require greater standards conformance testing during early development to ensure the interfaces are developed properly and can plug into the GIG. Common interfaces will help to streamline interoperability testing, and will potentially reduce the burden of testing hundreds of separate interfaces. Systems will be tested early and with sufficient frequency to assess the degree to which interoperability supports evolving joint capabilities.

Interoperability testing and certification in accordance with CJCSI 6212.01C will be an integral part of testing in the joint environment, focusing on assessing the end-to-end information exchange. More reliance on operational testing in the joint context is expected to assess operational effectiveness of shared information. In addition, interoperability testing will evolve to employ greater end-to-end testing using joint mission tasks. To reach maximum effectiveness, interoperability testing must capitalize on the joint mission infrastructure capability, operational testing, and combatant command exercises.

2.3 CHANGES TO T&E INFRASTRUCTURE

2.3.1 THE CASE FOR SIMULATIONS TO AUGMENT LIVE FORCES

The joint environment will be augmented through the sharing of infrastructure capabilities and LVC representations of systems. These will include discrete capabilities available at Service

and Agency test sites, training, and depot/system manager locations; acquisition program capabilities; and from industry. This will provide a distributed network of capabilities available to a vast array of users with very diverse requirements, not discrete networks or network managers serving exclusive interests. The Joint Theater Air Missile Defense Office has made regular use of the baseline JDEP capability as a development and T&E resource. During Millennium Challenge 2002, JFCOM used distributed networking and TENA for linking T&E ranges and other resources, to demonstrate the feasibility of the joint training concepts planned for the JNTC. In the summer of 2004, JNTC conducted a major joint training exercise using distributed resources, centered around the Combined Joint Task Force Exercise 04-2. This exercise also was a major demonstration of combining joint training exercises with T&E, including follow-on OT&E (FOT&E) of Aegis software upgrades, and the participation of five JT&E projects.

There are other communities of interest that need access to the same (or a subset of the same) universe of capabilities. A May 2004 article in Signal, referencing comments at an Armed Forces Communications and Electronics Association (AFCEA) "West 2004" conference in February 2004, stated:

> "Rear Adm. Thomas E. Zelibor, USN, Director, Space, Information Warfare, Command and Control Division, called for a joint testing domain that would link all the Service laboratories and test facilities. This would allow testers to plug in all of their boxes to determine whether they "play joint." Customers would reap dividends in the battlespace. Building in certain characteristics will permit composing whatever is needed without resorting to middleware, he continued. "It's not plug and play; it's plug and fight," Adm. Zelibor declared."

This roadmap makes a strong business case for the priority development of the core connecting infrastructure capability that will enable testing in a joint environment, and is the overarching capability without which achievement of the desired force transformation will be much more difficult and costly. The objective is to provide a universal persistent capability for all acquisition programs, including Service-specific smaller acquisition programs. There is a significant common need for a persistent, robust distributed systems engineering and test network that can link the specific remote sets of HITL, M&S, and other resources with the live system in development to accomplish the systems engineering or testing required for a spectrum of transformational initiatives, as well as to support training exercises and experimentation. Figure 3 illustrates various specific processes and initiatives needing this common capability.

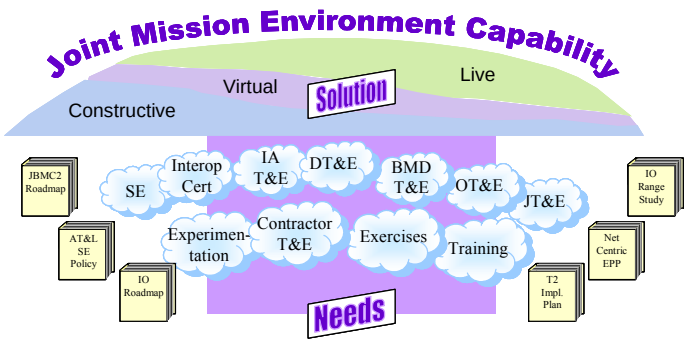

Figure 3. Overarching Single Solution for Broad Spectrum of Needs

The roadmap promotes full development and deployment of a persistent, robust distributed test system to link a large number of diverse LVC resources (Figure 4) that will enable joint operating environments and provide all the essential tools for systems engineering, testing, training, and experimentation. This overarching capability is the linchpin required for testing in a joint environment as well as systems engineering and a number of other pivotal requirements.

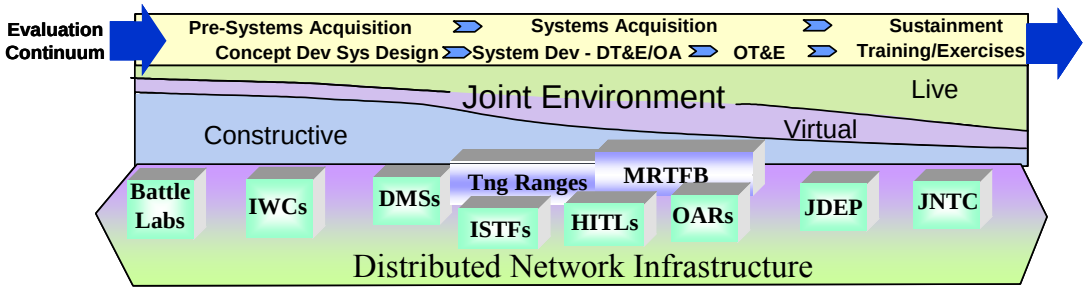

Figure 4. Core Infrastructure Capability
Distributed Network of Test, Training and Systems Engineering Facilities

This distributed networking of capabilities will serve as a valuable systems engineering and testing asset for PMs across the acquisition lifecycle to achieve the joint mission requirements defined by the CDD and CPD. From Concept Refinement through Operations and Support, the system's interaction with the joint mission environment will be evaluated along an evaluation continuum (Figure 5) using various LVC combinations.

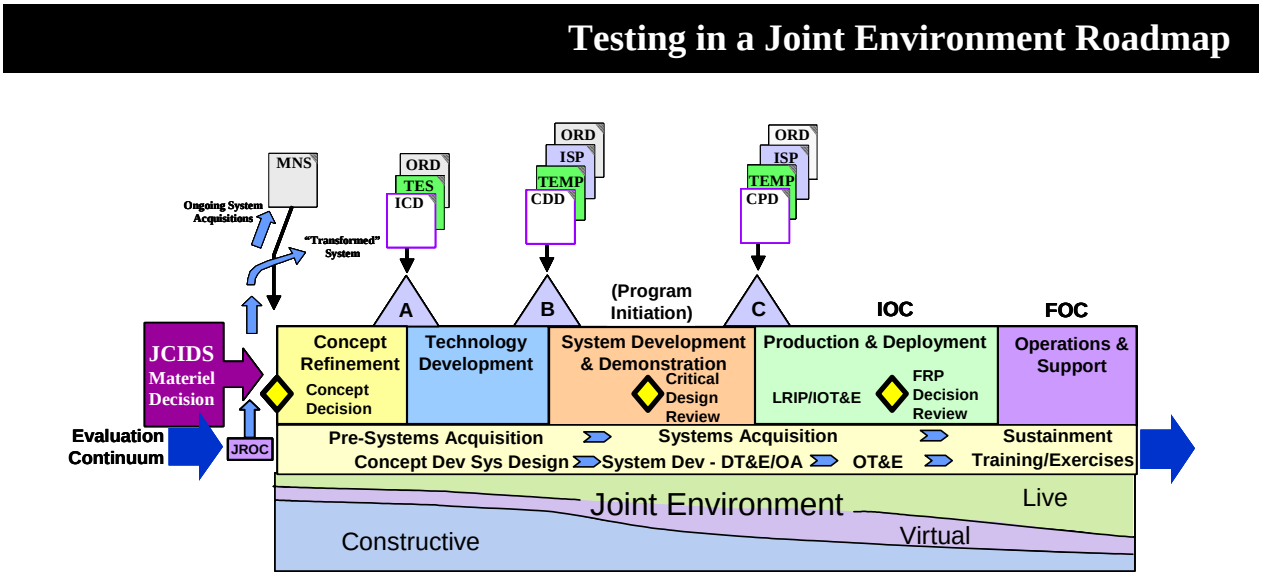

Figure 5. Evaluation Continuum

In addition to testing in a joint environment and systems engineering, other important T&E needs for a distributed capability include interoperability certification, information assurance (IA) testing, interoperable ranges, and contractor, developmental, and operational (including large footprint testing) testing. Net-centric capability development and testing, a major transformational priority addressed in both the net-centric Enhanced Planning Process (EPP) and the Joint Battle Management Command and Control (JBMC2) Roadmap, will be highly dependant on this capability. Concurrent initiatives that enhance the use of M&S to support distributed design, engineering, integration, and test capabilities will provide quality accredited resources needed for the full testing capability of this distributed network.

2.3.2 THE DISTRIBUTED TEST INFRASTRUCTURE

It is seldom practical, and rarely affordable, to create a purely live test environment with all elements of a joint mission. Any set of joint missions will be complex because of the numbers and variety of combat systems and geographic space involved. The solution is to create the capability to effectively integrate live, virtual, and constructive representations of the necessary elements in order to generate a realistic test environment that augments live testing of the system or systems involved. This test capability will provide a persistent, repeatable, operationally realistic environment in a timely and cost-effective manner for any system or combination of systems and set of joint missions. To conduct a test event in the joint mission environment, three key elements must exist: joint mission environments; core infrastructure capability; and system/threat/environment representations.

2.3.2.1 OVERVIEW OF FUNCTIONAL CAPABILITY

A persistent, repeatable, operationally realistic networking infrastructure will provide the ability to create the complex and realistic test environments needed to test in a joint environment. Figure 6 illustrates the common joint mission infrastructure. The top layer symbolizes the library of available virtual and constructive representations that, linked together, provide for generation of the required mission environments. Each additional layer represents a specific mission environment. Working from a persistent infrastructure of connectivity, common data exchange middleware, data description standards, common archiving, configuration and execution tools, test planners will be able to select from the library of virtual and constructive resources to supplement available live systems. System availability and required fidelity will determine the appropriate combination of LVC representation. Use of this infrastructure will permit rapid, facile and cost-efficient creation and execution of tests over a full range of required test environments.

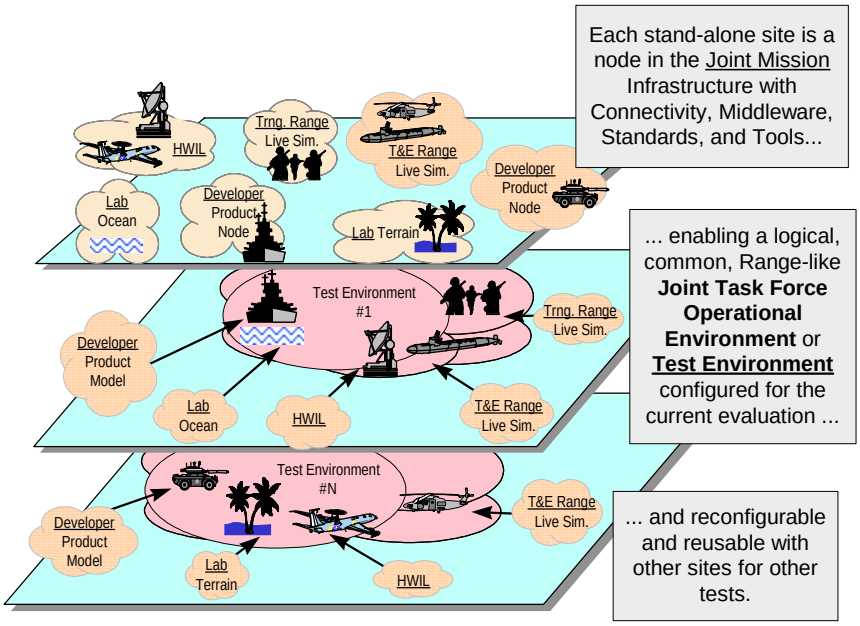

Figure 6. Overview of a Joint Mission Infrastructure

Each joint mission environment will resemble a live, real world, single-site range, and will be configured and managed in a very similar manner. However, this "virtual range" will generally be distributed both geographically and organizationally to access the resources needed for testing in the joint environment, as required by relevant joint missions, operational architectures, and desired system attributes from the CDD and CPD. The components linked via a common technical framework for a given test event will consist of resources specific to the particular test.

These will include live platforms operating on open air ranges, complete systems in integrated system test facilities, and constructive models or virtual/HITL simulations. The standing persistent test infrastructure capabilities will include a data archive capability and object model data descriptions that are used across all tests. The notional joint mission infrastructure is depicted in Figure 7.

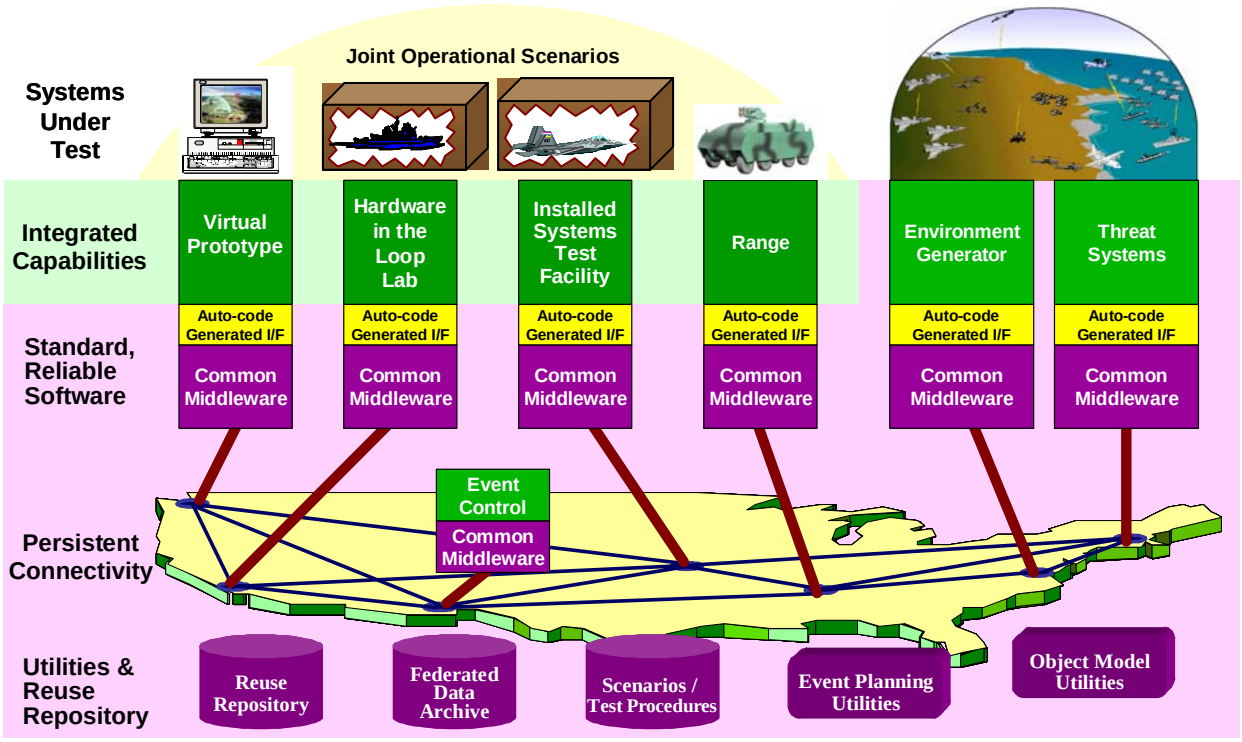

Figure 7. Notional Joint Mission Infrastructure

2.3.2.2 JOINT MISSION ENVIRONMENTS

To effectively test a system in a joint context, the joint mission environments developed by the JCIDS process for a system must be defined to identify the associated warfighting systems. Representative operationally realistic scenarios should describe the Concept of Operations (CONOPS) and Joint Tactics, Techniques, and Procedures, as well as necessary information or services that must be exchanged to satisfy the interoperability (for legacy systems) or publish/subscribe (post/pull) requirements (for net-centric systems). Test procedures, derived from the evaluation needs, will be produced to capture and define all the necessary systems and their configurations, the data collection points and archiving strategy, the event timeline, and any other necessary configuration information so that tests are consistent and repeatable.

2.3.2.3 CORE INFRASTRUCTURE CAPABILITY

The objective core infrastructure will provide the capability essential to generate the joint mission environment that is needed for T&E in all joint mission areas. The core infrastructure capabilities include a persistent data transport capability, common middleware, basic object models, tools and utilities, a data archive capability, and a reuse repository. A major enhancement to the current JDEP, addressing these requirements, has been fully studied separately by USD(AT&L) and the Defense Information Systems Agency (DISA). All the elements of a program plan that support the roadmap's recommendations are available separately. Technical details are provided in Appendix B. This required core infrastructure is the most resource-intensive element needed to achieve the vision of testing in a joint environment.

2.3.2.4 SYSTEM/THREAT/ENVIRONMENT REPRESENTATIONS

Current validated and accredited models and simulations are crucial to be able to conduct realistic and adequate T&E. The USD(AT&L), with other Office of the Secretary of Defense (OSD) offices, the Services, and Defense Agencies, must continue work associated with the proposed recommendations under the SPG task [E17e] for Reformed Acquisition Management. Those proposals called for better leveraging of M&S for capability-based acquisition, and enabling increased test capability for systems and systems-of-systems in a joint environment with greater use of M&S. The USD(AT&L)-led Acquisition M&S Working Group shall develop an Acquisition Modeling and Simulation Master Plan that will address the development or update, validation, and maintenance of models and simulations to ensure needed virtual and constructive threat and system representations, as well as standard, readily available simulation environments. The Group will make recommendations to the USD(AT&L) regarding funding to support systems engineering and T&E M&S requirements. Further, the Department must assure appropriate Department or commercial standards are agreed upon to facilitate needed sharing, reuse, and interoperability of M&S in systems engineering and test activity. The USD(AT&L) shall add DOT&E to the membership of the DoD Executive Council for Modeling and Simulation (EXCIMS) and task that body to oversee the coordination and implementation of all M&S actions related to testing in a joint environment.

Program managers must be able to "plug" the warfighting capabilities under test into a representative joint mission infrastructure that provides sufficient interaction with the cluster of needed systems and threat forces in appropriate scenarios to meet their test objectives. Although there are many ways to categorize the various systems interacting in the joint mission infrastructure, this roadmap organizes them into three major categories: system representations; threat representations; and environment representations. Specifics are discussed in Appendix B.

While new systems developed to JCIDS requirements may be compelled to design their models and interfaces to be compatible with the joint mission environment, legacy systems and those already in development haven’t been subject to the same requirement. These systems are

going to be around for the next 15-20 years. Many have either outdated, or proprietary, models that were not designed to work in this joint environment. However, future systems may need to demonstrate they can interact with the legacy systems to meet their joint mission needs. Provisions for modeling legacy and grandfathered systems to support the joint environment for capabilities-based acquisitions must be addressed by the Acquisition M&S Working Group.

2.3.2.5 JOINT MISSION ENVIRONMENT COMPLIANCE

Testing in a joint mission environment will provide PMs more insight into system performance, provide a more robust test environment and ultimately provide better systems to the warfighter. The full benefit of transformation to testing in a joint environment can be realized by the synergy of this Testing in a Joint Environment roadmap, JDEP (or its successor), the Reformed Acquisition Management initiative (SPG task to better leverage use of M&S in acquisition), and related efforts. This roadmap identifies steps to achieve this synergy.

In essence, the success of the joint mission infrastructure depends on an established level of mutual commitment. The Department must assure acquisition programs of its commitment to resource and develop the distributed adaptive and robust systems engineering and testing capability that includes the full joint mission environment. Component PMs must develop compliant interfaces for testing that will enable use of this capability to provide insight on how their system operates in a joint mission environment – testing at a tempo suitable to maintain the tight acquisition spirals for their respective programs. Since it is critical for success, a mandate for use of the joint mission infrastructure and compliance with its established standards will be established early, providing guidance to PMs and specific engineering and test capability managers so they can focus their resources to develop or upgrade the requisite interfaces.

2.3.2.6 DEVELOPMENT AND TEST FACILITIES AND NETWORKS

Appendix B provides a brief synopsis of the capabilities of systems engineering, test, training, and experimentation facilities that can be integrated to contribute to testing in a joint environment. Some include:

- Joint Distributed Engineering Plant (JDEP)
- Navy Distributed Engineering Plant (NDEP)
- Center for Domain Integration
- Combined Test and Training Support Facility - Army
- Joint Interoperability Test Command (JITC)
- System-of-Systems Integration Lab - Army
- Service Battle Labs
- Marine Corps Systems Command (distributed C2 lab)
- Joint Battle Center (JBC) at JFCOM
- Global Information Grid End-to-End (GIG E2E) Evaluation Capability

- Joint DataLink Information Combat Execution (JDICE) Joint Test and Evaluation (JT&E)

2.3.2.7 PARTNERING THE TEST NETWORK DEVELOPMENT

The persistent, robust distributed networking capability needed for systems engineering and DT&E is *virtually the same networking capability that will provide augmentation for OT&E*, and can provide support for joint training and joint experimentation. A common, fully enhanced network infrastructure can provide the persistent, robust, and distributed connectivity that links live systems with supporting virtual and constructive resources into a world-class capability that will address much of this need. A common program to develop this capability will be a critical institutional investment for the Department, providing a key enabler for net-centricity developments and testing, and improved capability across many domains (T&E, science and technology, training, experimentation, modeling and simulation (M&S), information assurance, interoperability certification, etc.). A strategic partnership between DOT&E, USD(AT&L), and ASD(NII) [and others as needed] to develop the common, fully enhanced network infrastructure as a core solution for the Department is strongly recommended.

2.3.3 INSTRUMENTATION NEEDS

Proper instrumentation is essential to both T&E and training. Instrumentation is a key to establishing the "ground truth" of what has occurred in a test or training event, and to provide feedback to the materiel developer or trainer as to what worked or didn't work. Wherever possible, future instrumentation should be both non-intrusive, preferably embedded, and "interoperable", or common among the test, training, and experimentation communities and among the Services.

Currently, most instrumentation is attached to a system for a specific event. This "added" instrumentation often produces undesirable effects by affecting system performance (e.g., by adding weight or drawing upon system power), or by disrupting a realistic flow of operational events because of instrumentation maintenance requirements. On the other hand, embedded instrumentation is designed into the system to avoid the effects of intrusive instrumentation. Additionally, it is available for use throughout the life cycle of the system, allowing systems to test (or train) "anywhere, anytime". Embedded instrumentation can provide maintenance diagnostics and prognostics, in addition to testing and training uses.

Instrumentation, embedded or otherwise, that is interoperable for testing and training uses across Services is essential for both testing and training in a joint environment. For example, real time casualty assessment (RTCA) instrumentation, which is necessary to adjudicate realistic force-on-force tactical engagements, is a necessary requirement for both testing and training in a joint environment. Currently there is no family of interoperable RTCA instrumentation that handles the full range of combat interactions (e.g., ground-to-ground, air-to-ground, ground-to-

air). Additionally common or interoperable instrumentation is necessary to collect the data necessary to fully assess the variety of C4I components anticipated in joint Network Centric Warfare architectures. Embedded or non-intrusive interoperable instrumentation will be needed to fully understand what is occurring within these complex architectures and to identify and fix shortfalls.

The Department has recognized, in principle, the need for embedded instrumentation for testing and training. Department of Defense Instruction (DoDI) 5000.2 recognizes the need for "affordable" embedded training and testing instrumentation, and JFCOM's Joint Transformation Roadmap calls for a review of policies and procedures to promote embedded training capabilities in future acquisition systems. Similarly, policies and procedures should be adopted to promote embedded testing capabilities in new acquisition systems. In particular, CJSCI 3170.01D should be updated to require that JCIDS capabilities documents address embedded testing and training instrumentation.

Two existing programs, the Central Test and Evaluation Program (CTEIP) and the T&E Science and Technology (TE/ST) program, provide resources that will assist in the development of required instrumentation, either embedded or otherwise. CTEIP, in partnership with the Services, develops and demonstrates new test capabilities, including instrumentation. TE/ST develops or adapts emerging technologies for test applications, to enable test technologies to keep pace with evolving weapons technology.

The Enhanced Range Applications Program (EnRAP) is an excellent example of a CTEIP project that is developing needed test instrumentation which also has the potential for use in joint and service training applications. EnRAP is developing the next generation range data system that will provide enhanced time, space, position information (TSPI) accuracy and selected data bus information on the system-under-test. The needed data can either be stored in an on-board recorder, or transmitted to a ground station by means of an advanced spectrally efficient data link. The EnRAP development project was initiated in FY2001 and is projected to be completed in FY2007. EnRAP is supported by all Services, with an Air Force lead, and will be integrated with selected test ranges and facilities to support T&E. EnRAP is coordinating with Air Force and Navy training instrumentation programs to achieve a common or compatible solution to serve both T&E and training.

One of the objectives of implementation planning will be to ensure that the policies, processes, and procedures for addressing common test and training instrumentation needs and solutions are established and functional.

2.4 CHANGES TO POLICY AND REGULATIONS

2.4.1 NEW DEPARTMENT POLICY

The FY2006-2011 SPG contains a clear statement of Department policy:

> "Developing and fielding joint force capabilities requires adequate, realistic T&E in a joint operational context. To do this, the Department will provide new testing capabilities and institutionalize the evaluation of joint system effectiveness as part of new capabilities-based processes."

A fundamental goal of this roadmap is to provide recommendations as to where and how to appropriately incorporate this Department policy appropriately in existing directives, instructions, and regulations to ensure that it is institutionalized.

2.4.2 REVISIONS TO DIRECTIVES, INSTRUCTIONS, REGULATIONS

Current Department policies do not preclude testing in a joint environment. Most existing regulations neither encourage nor require such testing. Noteworthy exceptions are the interoperability testing and certification requirements in DoDD 4630.5, DoDI 4630.8, and CJCSI 6212.01C that address operational interoperability requirements identified by JCIDS. Thirty departmental documents containing policy, procedures, and guidance were reviewed for change as summarized in Appendix C. Recommendations or suggested changes are identified there, but the details will be developed during implementation planning and submitted to the cognizant offices for review and incorporation. There are four key focus areas where policy changes are necessary.

2.4.2.1 DEFENSE ACQUISITION SYSTEM

Fundamental acquisition system policy should declare that testing in a joint environment is required in a continuum of evaluation throughout a system's or system-of-system's lifecycle. Policies in DoDD 5000.1 and procedures contained in DoDI 5000.2, and other applicable documents, should be enhanced to include statements that establish the guidance for PMs and Operational Test Agencies (OTA) to conduct testing in a joint environment as an integral part of the acquisition process based on requirements/capabilities identified and approved through the JCIDS process. Other areas include:

- Creation of the networked joint mission infrastructure and M&S resources, and integration of developmental systems with the infrastructure.

- Development, upgrade, and maintenance of system-level constructive models and virtual simulations throughout the lifecycle of each system.

- Mandates use of the joint mission infrastructure.

- Embedded instrumentation whenever feasible to provide inherent T&E capability responsive to accelerated acquisition processes.

- Update the Interim Defense Acquisition Guidebook to require identification of joint mission T&E requirements in the TEMP and, in cases where multi-Service participation is identified, provide for coordination with applicable Service OTA commanders as part of the TEMP review and approval process.

- Use of properly trained and equipped guard and reserve forces to augment OT&E.

2.4.2.2 REQUIREMENTS/CAPABILITIES GENERATION

Changes to the CJCS 3170 series are essential to ensure the CDD and CPD documents contain, or reference the source for, the explicit capability needed. There must be enough specificity in terms of tasks and measurable performance parameters for PMs to know what to build, and for testers to determine what/how to test. A common task-based language (derived from the UJTL) is needed that identifies missions and operational tasks including the specification of measures and conditions.

2.4.2.3 RESOURCES

DoD 7000.14-R, the Department of Defense Financial Management Regulations, should be updated to ensure that funding and reimbursement policies for T&E infrastructure and operations facilitate testing in a joint environment. Specific areas that should be addressed include:

- Policy assigning responsibility for funding development, operation, and maintenance of the infrastructure, including the cost of network connectivity to T&E sites.

- Policy assigning financial responsibility to users of the infrastructure, providing for reimbursement to T&E ranges and facilities for direct costs (as applicable), including the cost of travel, logistical support, and execution of the test.

- Policy assigning responsibility for the cost of integrating other necessary systems to create the requisite mission environment, and the costs incurred by participating live systems.

2.4.2.4 SYNTHESIS OF TRAINING AND TESTING

DoDD 1322.18, CJCSI 3500.01B and 3500.02C, regarding joint training, are subject to modification to facilitate, or encourage, the conduct of testing in a joint environment during joint training exercises, and provide for coordination of joint training exercises with testing needs. Modifications to these publications should facilitate coordinated training and testing in a joint environment without compromising either objective.

2.4.3 STRATEGIC PLANNING

The DTRMC was created to perform T&E budget certification and strategic planning for the T&E infrastructure through a ten year horizon. It will also manage the CTEIP and TE/ST programs for T&E modernization. The DTRMC strategic plan should be updated to include the new/enhanced T&E capabilities documented herein.

2.4.4 UNRESOLVED POLICY DECISIONS

Department acquisition regulations must provide guidance for necessary correction of operational performance or interoperability issues for operationally interdependent systems, when incompatibilities between those systems are demonstrated through testing. Clear direction should identify the organization responsible for adjudicating differences and providing direction to the programs involved. Policy must be established to assign responsibility for funding the changes necessary to correct discrepancies in the legacy systems.

Policy and funding for modeling legacy and grandfathered systems to support the joint environment for capabilities-based acquisitions must be addressed by the SPG's Reformed Acquisition Management task of the Capabilities-Based Planning strategy.

2.5 ORGANIZATION AND RESOURCE CONSIDERATIONS

2.5.1 ORGANIZATION

A program management office is needed as a field office to execute the development of the network infrastructure and coordinate its operations. The program office will fully develop, sustain, modernize, provide configuration control, and operate the desired enhanced network infrastructure. Specific details of its leadership, staffing, and location will be determined in a subsequent implementation plan; but broadly speaking the central program management office (Figure 8) will consist of a director and three divisions for program management, engineering, and operations. This office may or may not require a new organization. Several alternatives for location include use of existing DISA billets and assets, collocation with JFCOM's JNTC Joint Management Office (JMO) in Suffolk, VA, or at an existing Service facility such as the Army's net-centric operation of its ranges established at White Sands Missile Range.

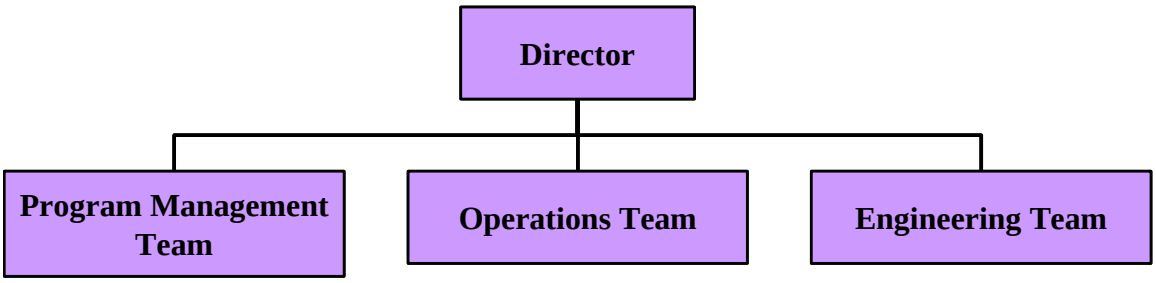

Figure 8. Central Management Office

The program management division will support the director in the oversight and coordination of the entire effort, including the resource management, budget, financial, and contracting functions. The engineering division will provide the expertise necessary to oversee all technical aspects of the infrastructure development, as well as its lifecycle sustainment and modernization. The operations division will provide expertise in the T&E aspects of operating this capability. It will maintain close liaison with the JMO at JNTC to provide a medium for coordination of the test community's participation in joint training events and exercises, as well as participation by the training and experimentation communities in test venues. It will be the central point for coordinating and scheduling use of the capabilities for T&E and systems engineering purposes. In addition to scheduling, the operations division will be the central resource to provide users with information about system capabilities and limitations; available nodes; models and simulations; and JNTC joint training events. The operations division will provide test planning assistance, as needed, to acquisition PMs and OTAs to exploit the joint mission infrastructure capabilities.

2.5.2 THE FUNDING STRATEGY

The requirement to support "testing in a joint environment" is new scope for T&E. A major customer for the T&E capability we are proposing is the Department's priority net-centric development and testing, with testing beginning in FY06 and full enhanced capability needed by FY08. This T&E capability is a pre-requisite for net-centric development and testing. The T&E community can identify a few logical offsets but cannot be expected to take this bill out of non-existing resources. Therefore, this need for a common, fully enhanced network infrastructure must be recognized as a critical corporate Department investment in the future, to be funded institutionally without taxing the users from the Services and Agencies.

Though not easily quantifiable, wise investment now in the proposed common, fully enhanced network infrastructure will reduce many program costs in the future by offsetting the need for multiple duplicative T&E networks. However, like many cost reduction opportunities, the Department must make committed up front investment in the necessary resources.

The funding strategy will be to identify the logical offsets from T&E and infrastructure accounts and seek additional resources directed by the Department as increases to the T&E total obligational authority. In FY05, allocation from existing accounts or reprogramming will be requested/required. For POM2006-2011, the resource requirements must be defined and resolved during the program review.

2.5.3 THE BUSINESS MODEL

Two types of funding will be required, institutional and reimbursable, in a manner similar to the MRTFB under DoDD 3200.11. The central management office will be responsible for institutional planning, programming, and budgeting execution (PPBE) system actions with an OSD sponsor. Institutional funding must be adequate to develop, sustain, and modernize the core infrastructure, and will cover routine operating costs and funding for investments in facilities, equipment, and software that support multiple customers. Indirect, overhead, and other routine operating costs for the central management office will be funded institutionally and not charged to the customer.

The second source of funding will be reimbursement from users for the direct costs incurred by their programs in using this T&E capability. This reimbursed direct cost will include any support that was provided to the specific user, including the cost of labor and utilities used or consumed for the specific benefit of the user. The users will plan, program, budget, and reimburse the central activity for the direct cost of T&E services, and fund any investments in facilities, equipment, and software that will be unique to their particular programs.

2.5.4 MANAGEMENT AND RESOURCING RESPONSIBILITY

To achieve the fully functional infrastructure for testing in a joint environment, management and resourcing responsibilities for the development, sustainment, and modernization of each of the major elements of the infrastructure must be delegated. Except for tasks assigned to the central program management office, management authority and resourcing responsibility for other elements of the infrastructure remain as currently assigned.

- Develop and maintain the core infrastructure capability – OSD sponsor and new central program management office.
- Define joint mission context – Joint Staff and CoComs.
- Develop and maintain system representations – PMs for each particular system.

- Develop and maintain threat representations
  – Cognizant Service or Agency for each particular threat system. [Consider establishing a threat/OPFOR integrated product team or working group during implementation.]
- Develop and maintain environmental representations
  – Designated executive agents for terrain, oceans, and air and space.

2.5.5 FUNDING REQUIREMENTS

Good estimated funding requirements have been developed are captured in four categories: upgrades to the infrastructure, the program office, joint test scenarios, and OTA staffing/support. The infrastructure upgrades cover the funding necessary to establish and expand the needed communication bandwidth on existing Department networks, and annual improvements to common integration software. Additionally, this line includes funding for assessing commercially available tools for utilization with the standard support tools, and the development of new tools to satisfy shortfalls, as required. The line also includes the definition, development, implementation, and maintenance of interface standards. Funding for the program office includes both government labor and travel, and contractor support for the program office discussed in section 2.5.1. Funding for joint test scenarios is to cover the costs of the analytical breakdown of the joint scenarios as defined by the Joint Staff and CoComs to develop a detailed test plan for a weapon system. In this mission decomposition process, each joint mission will be analyzed to determine the needed cluster of weapon systems and threat systems, their associated behavior, the warfighting doctrine, and the operating procedures -- all to the appropriate level of fidelity to adequately evaluate each weapon system's capability to perform the necessary joint tasks. Funding for OTA staffing/support is planned to accommodate their increased workloads.

The detailed resource requirements will be developed more fully during implementation planning. Current estimates are illustrated in Figure 9.

Fiscal Years [3] (CY $M)	FY05	FY06	FY07	FY08	FY09	FY10	FY11
Technical Infrastructure (CY)	11.2	25.7	34.9	40.9	45.8	49.75	51.4
Joint Test Scenarios (CY)	1.9	2.7	3.5	3.8	4.2	4.2	3.8
Management Office (CY)	2.2	2.5	2.5	2.5	2.5	2.5	2.5
OTA Staffing/Support (CY)	1.8	5.0	5.0	5.0	5.0	5.0	5.0
Total Funding Req. (CY $M)	17.1	35.9	45.9	52.2	57.5	61.45	62.7

[3] Data is pre-decisional, published only in this final report.

Fiscal Years [3] (CY $M)	FY12	FY13	FY14	FY15
Technical Infrastructure (CY)	52.0	52.0	52.0	52.0
Joint Test Scenarios (CY)	3.5	3.5	3.5	3.5
Management Office (CY)	2.5	2.5	2.5	2.5
OTA Staffing/Support (CY)	5.0	5.0	5.0	5.0
Total Funding Req. (CY $M)	63.0	63.0	63.0	63.0

Figure 9. Estimated Funding Requirements

2.6 THE ROADMAP

To effectively use any roadmap (e.g., Rand McNally), one must know the point of origin, destination, any waypoints between, and the cost and resources needed. Waypoints help clarify and narrow choices, and ensure success. The roadmap shown in Figure 10 lays out the key phases (waypoints) and the ultimate objective capability (destination) of testing in a joint environment. The roadmap aligns three significant aspects that must be considered to achieve the objective capability to adequately conduct testing in a joint environment: 1) major acquisition programs that potentially could be supported by the capability as it is developed, 2) the key phases of infrastructure as it is developed, including changes in policy and test processes, and 3) the required funding.

2.6.1 PILOT PROGRAMS TO GUIDE THE DEVELOPMENT

To provide value to the Department as quickly as possible and ensure that the development of this networking infrastructure is advancing toward success, the infrastructure must provide capability in increments during its development, rather than only after it is completed. An evolutionary acquisition approach will be used that incrementally builds each aspect of the infrastructure capability. The criteria for determining what goes in each development spiral will be determined considering many factors, including input from industry and technology efforts on what is technically feasible, along with input from warfighters, acquisition programs, advanced technology demonstrations, operational test agencies, and other users of this capability on what improvements are most needed.

Key acquisition programs and major transformation efforts, referred to as "pilot programs", that are representative of different domains across the Department will be used to help guide the development of the capability. As the development proceeds, selected pilot programs may be amended as needed. The choice of pilot programs does not change the ultimate destination of this roadmap, only the waypoints along the way that provide incremental capabilities. If the pilot programs are truly representative, this infrastructure capability will mature and be supportive of other acquisition programs at a faster pace than otherwise. Each acquisition program will need

to analyze its own joint mission requirements and determine when the infrastructure will be mature enough to support the program.

2.6.2 A PHASED APPROACH TO THE ROADMAP

Today's approach for testing in a joint environment is limited to *ad hoc* integration – that necessary for meeting the limited scale near-term joint requirements imposed on grandfathered programs, and by the Net-Ready KPP. Like the initial joint training demonstrations, testing in a joint environment can be conducted, but each event requires a unique *ad hoc* integration of live systems with virtual and constructive resources that is both costly and temporary.

The ultimate destination, or goal, for testing in a joint environment is a persistent, robust, and adaptive interactive capability that is flexible enough to meet the emerging needs of the Department, yet rigid enough to provide a reliable, repeatable, baseline for comparison of future test results. A three-phase path is proposed to achieve a provisional capability, followed by a persistent capability, enroute to fully interactive capability.

2.6.2.1 PROVISIONAL CAPABILITY

The provisional capability phase includes the initial steps of executing this roadmap and provides a foundation capable of supporting the pilot programs. A central program management office will be established to develop a detailed implementation plan, with oversight and advocacy continuing from DOT&E, in coordination with USD(AT&L), USD(P&R), JFCOM, the Services, the Joint Staff, and other Agencies and organizations, as appropriate. The implementation plan will be developed in the first year of the roadmap, clarifying the requisite details and processes to achieve the needed capability, as well as determining the final structure and organization of the central program management office. During this process, all the necessary changes to Department policies, regulations, test methods, and test processes will be identified and initiated.

From an infrastructure stand-point, the focus will be on testing interactions among live systems (with some augmentation using constructive and virtual simulations). The focus on live system interactions will provide support to the warfighter more quickly, since the capability will give insight into how well current operational systems function together. We go to war with real weapon systems, not simulations of weapon systems. Furthermore, by focusing on live system interactions, it will be easier to align to live JNTC events being conducted in FY2005-FY2008. Through this phase, selection of connectivity sites, upgrades to the common middleware, definition of object models, enhancement to tools and utilities, and techniques in data archiving will focus primarily on supporting the pilot programs. In addition, only the joint mission scenarios for those pilot programs will need to be derived from the joint tasks. Date: FY2008.

2.6.2.2 PERSISTENT CAPABILITY

The persistent capability phase will add a standing capability for scheduling support, so that ongoing events can be browsed and selected for potential opportunities to support test vignettes for programs based upon defined joint mission environments. Determining the impacts that new systems will have on the battlefield, and testing of interactions between a virtual prototype and live systems (with some additional augmentation using constructive simulations) will be the focus of this milestone. During this phase, all joint mission environments should be defined so that the joint mission infrastructure can support all acquisition programs. In addition, newer distributed software technologies, currently under development both within the Department's science and technology (S&T) community and private industry, will be mature enough to be incorporated and leveraged in the common middleware in annual upgrades. Likewise, improved collaboration software solutions will be included in the standard software suite of support tools. Date: FY2012.

2.6.2.3 INTERACTIVE CAPABILITY

The interactive capability phase will provide the standing capability for test engineers to seamlessly select between scheduled events or launch their own live, virtual, or hybrid event (using available virtual prototypes and constructive simulations). Aiding design trade-off decisions and testing of interactions between multiple virtual prototypes (with some additional augmentation using constructive simulations) will be the focus of this phase. The operational interactive capability will enable full T&E of capabilities-based systems against the joint performance attributes defined in the JCIDS capabilities documents (ICD, CDD and CPD), and the ability to do so for evolutionary and spiral developments. Date: FY2015.

Testing in a Joint Environment Roadmap

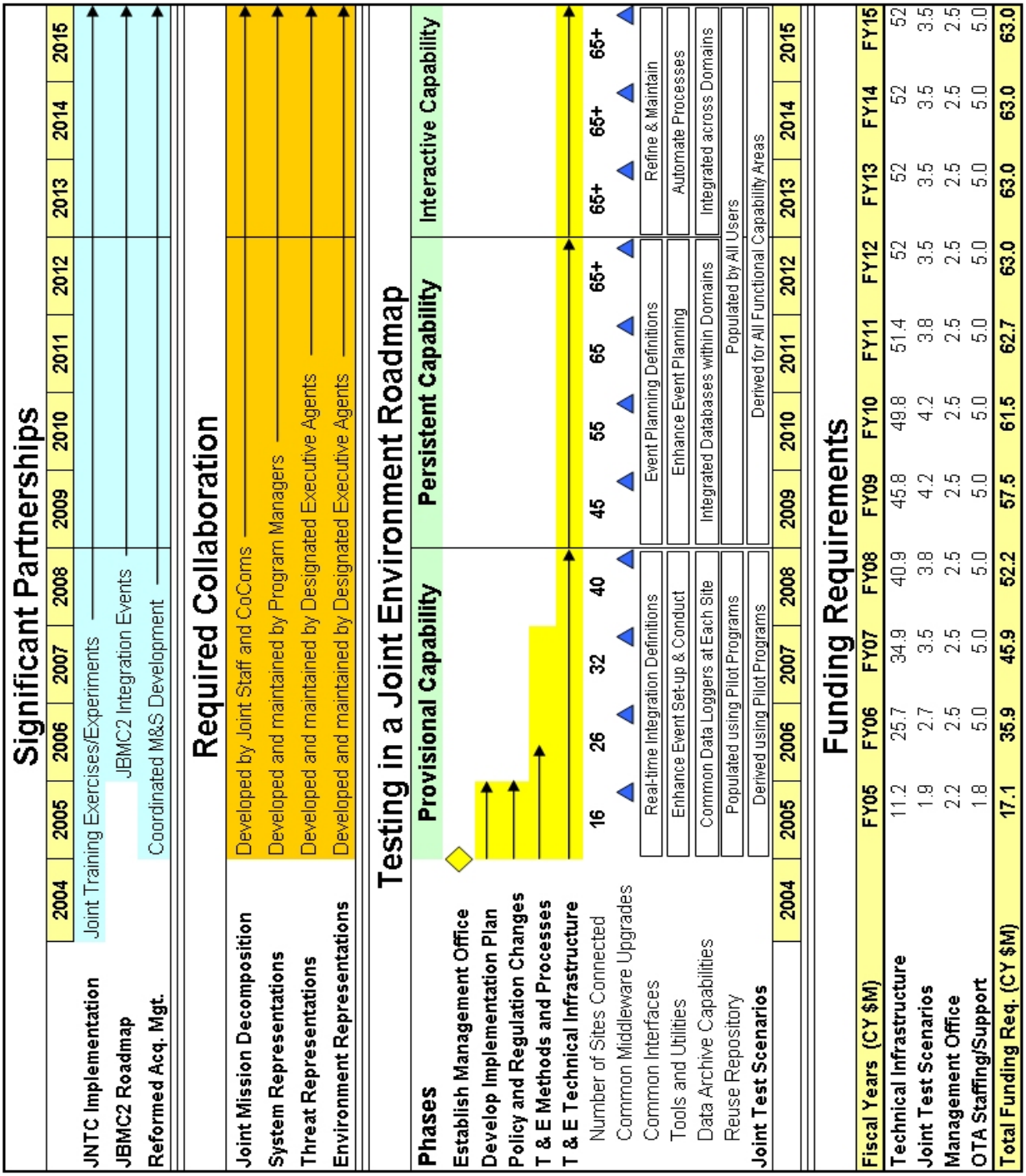

Figure 10. Testing in a Joint Environment Roadmap

2.7 IMPLEMENTATION PLANNING

To ensure smooth execution and implementation of the provisions of this roadmap after its approval by the Deputy Secretary of Defense, an implementation plan shall be developed. The plan developed after roadmap approval will establish an interim organizational oversight and working level structure, and ensure continuity and transition until permanent leadership and organization has been established. The plan will address the concept, management, resourcing, development, coordination, approval, and implementation of the T&E capability for testing in a joint environment in the level of detail needed. Appendix D presents a framework for implementation planning and the considerations to be addressed.

2.8 RECOMMENDATIONS AND COLLATERAL REQUIREMENTS

To be fully prepared for developmental and operational testing in the joint environment in time to support the Department's Force Transformation initiatives, I recommend the Deputy Secretary of Defense:

1. Approve the proposed changes and considerations presented in this roadmap and direct its execution, depending on the identification of funding. Direct the implementation planning to be under the leadership of DOT&E in full partnership with the offices of USD(AT&L), USD(P&R), and ASD(NII), the Joint Staff, the Services, JFCOM, and others as required. As the major proponent for acquisition and DT&E, the office of USD(AT&L) will be a key partner in implementation planning. Identification of a long-term sponsor and steps for transition to this sponsor will be addressed during implementation planning. DOT&E will work closely with the designated long-term sponsor in its T&E oversight and advocacy role.

2. Direct the development of a common, fully enhanced network infrastructure capability, and the phased establishment of the responsible field-level program management office. Direct DOT&E to work with the USD(AT&L), the Under Secretary of Defense (Comptroller) (USD(C)), the Director of Program Analysis and Evaluation (D,PA&E), effected Components, and the Joint Staff to identify available FY2005 funds for realignment/reprogramming to initiate this development.

3. Direct DOT&E to pursue FY2006-2011 funding for the continuation of the common, fully enhanced network infrastructure program, and other roadmap-associated costs, during the Program Objective Memorandum (POM) 2006-2011 Program Review.

4. Direct the Department update DoDD 5000.1, DoDI 5000.2, and other directives to institutionalize testing in the joint environment as an enabler for Force Transformation.

There are several important enabling actions that must be accomplished concurrently to ensure the Department establishes a robust capability to test systems and system-of-systems in

their joint mission environments. Because these actions are critical to the successful execution of this Roadmap, I further recommend:

1. The Deputy Secretary of Defense direct establishment of a common task-based language derived from the UJTL, for concept development, functional analyses, JCIDS capabilities, acquisition, T&E, training and experimentation, and mandate its use in all JCIDS documents.

2. The Chairman update his Chairman Joint Chiefs of Staff Instruction (CJCSI) 3170.01D to ensure all JCIDS CDD and CPD documents define, or reference the source for, the explicit joint mission capability needed in task-based terms derived from the UJTL, and to provide for feedback of T&E results to the FCBs as appropriate.

3. The USD(AT&L)-led Acquisition M&S Working Group, with other Office of the Secretary of Defense (OSD) offices, the Services, and Defense Agencies, develop an Acquisition M&S Master Plan that addresses the development or update, validation, and maintenance of models and simulations to ensure needed virtual and constructive threat and system representations; standard, readily available simulation environments; and identify required funding to support systems engineering and T&E M&S requirements.

4. The ASD(NII), USD(AT&L), and DOT&E establish an Engineering and T&E Community of Interest (COI) to ensure system engineering, and DT&E and OT&E data are made visible, accessible, and understandable across the Services, Agencies, developers, and other parties.

APPENDICES

Testing in a Joint Environment Roadmap

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Appendix A – References

A.1 REFERENCES

OFFICE OF THE SECRETARY OF DEFENSE
1700 DEFENSE PENTAGON
WASHINGTON, DC 20301-1700

OPERATIONAL TEST AND EVALUATION

INFO MEMO

December 13, 2002, 10:00 a.m.

FOR: SECRETARY OF DEFENSE

FROM: Thomas P. Christie, Director, Operational Test and Evaluation TPC

SUBJECT: Defense Operational Test and Evaluation Council

Thank you for meeting with the Defense Operational Test and Evaluation Council on December 2. The job of the Operational Test Agency commanders is difficult. When they find that systems are immature, below performance expectations, or unsafe, they are unpopular within their own Service. Your demonstrated interest will encourage them to persist in ensuring our weapons will work in combat.

During the discussion, you asked for ideas related to your initiatives and priority list. While other recommendations are forthcoming, I believe one item should top the list:

- To strengthen our joint warfighting capabilities, the Department should not only "train as we fight" but also "test as we fight."

The Department has acted to improve joint operational training through the creation of a Joint National Training Center. I believe it should act to also create a Joint Test and Evaluation Capability. The same principles that guide joint operational training also guide operational testing:

- Provide operational realism
- Use smart opposing forces
- Compare results to ground truth
- Learn through feedback

Infrastructure requirements (ranges, instrumentation, etc.) for both training and testing are similar. We should base future infrastructure decisions on a corporate perspective that satisfies both joint operational training and joint operational testing priorities.

Thank you for the opportunity to address our key test and evaluation issues. I look forward to providing you with the recommendations of the Council, and updating you on the testing and evaluation of our most important weapons programs.

Prepared by: COL William Keegan, 703-697-3655

Figure A.1. DOT&E Memorandum to Secretary of Defense of December 13, 2002

December 18, 2002 7:07 AM

TO: Tom Christie

FROM: Donald Rumsfeld

SUBJECT: Defense Operational Test and Evaluation Council

Thanks so much for your memo of December 13. I will get folks working on those ideas.

Regards,

DHR:dh
121802-3

Please respond by _____

Figure A.2. Secretary of Defense Reply to DOT&E of December 18, 2002

Appendix B – Needed Infrastructure

B.1 INTRODUCTION

It is seldom practical, and rarely affordable, to create a live test environment with all elements of a joint mission. Any set of joint missions will be complex because of the numbers and variety of combat systems and geographic space involved.

B.2 REQUIRED CAPABILITY

The infrastructure solution is to create the networking capability that effectively integrates live systems and forces with virtual and constructive representations of other necessary elements to generate a realistic test environment for the system(s) being tested. This infrastructure will provide a persistent, repeatable, operationally realistic joint mission environment in a timely and cost-effective manner for systems engineering, testing, training, and experimentation. To conduct a test event in a coherent and realistic joint operational context, three key elements must exist: defined joint missions; a core networked infrastructure that links LVC capabilities; and the LVC representations of the needed systems, threat, and physical environment.

B.2.1 FUNCTIONAL CAPABILITY DESCRIPTION

The process for planning for testing in a joint mission environment will be similar to T&E planning today. Planners will develop the PM's T&E strategy and design tests for the system using a combination of other friendly interacting systems, the threat environment, and the physical environment necessary to define the mission environment and achieve specific test objectives. A persistent, repeatable, operationally realistic networked infrastructure will provide the ability to create much more complex and realistic test environments than are currently available.

Figure B.1 is an overview of the common joint mission infrastructure. The top layer illustrates the library of available virtual and constructive representations that, linked together, provide for generation of the required mission environments. Each additional layer represents a specific mission environment. Working from a persistent infrastructure of connectivity, common data exchange middleware, data description standards, common archiving, configuration and execution tools, test planners will be able to select from the library of virtual and constructive resources to supplement available live systems. System availability and required fidelity will determine the appropriate combination of LVC representation. Use of this infrastructure will permit rapid, facile and cost efficient creation and execution of tests over a full range of required test environments.

Testing in a Joint Environment Roadmap

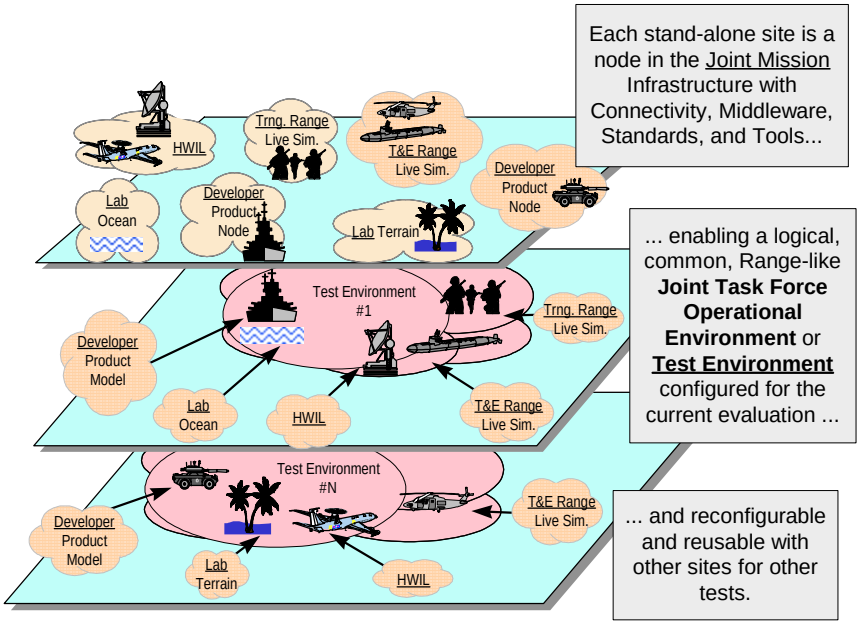

Figure B.1. Overview of a Joint Mission Infrastructure

The capability to test in a joint environment is needed throughout a system's lifecycle. Figure B.2 illustrates the progression of a developmental system through the evaluation continuum from concept development to system retirement. Integration of the system with the joint mission infrastructure, using constructive models, virtual simulations and live systems, provides the persistent joint environment and tools for concept development and design, system development and DT&E, and OT&E. The common technical framework links the developmental systems with subsystems, simulations, and other necessary resources. This framework uses live test instrumentation requirements as its criteria for establishing common data descriptors, formats, data rates, and data structures to be used throughout the test process regardless of simulated, live, or mixed testing. The technical framework provides for reuse of analysis tools and techniques and assures data consistency and data comparability throughout acquisition. Data consistency enables the long desired systems engineering goal of model-test-model – then build.

Testing in a Joint Environment Roadmap

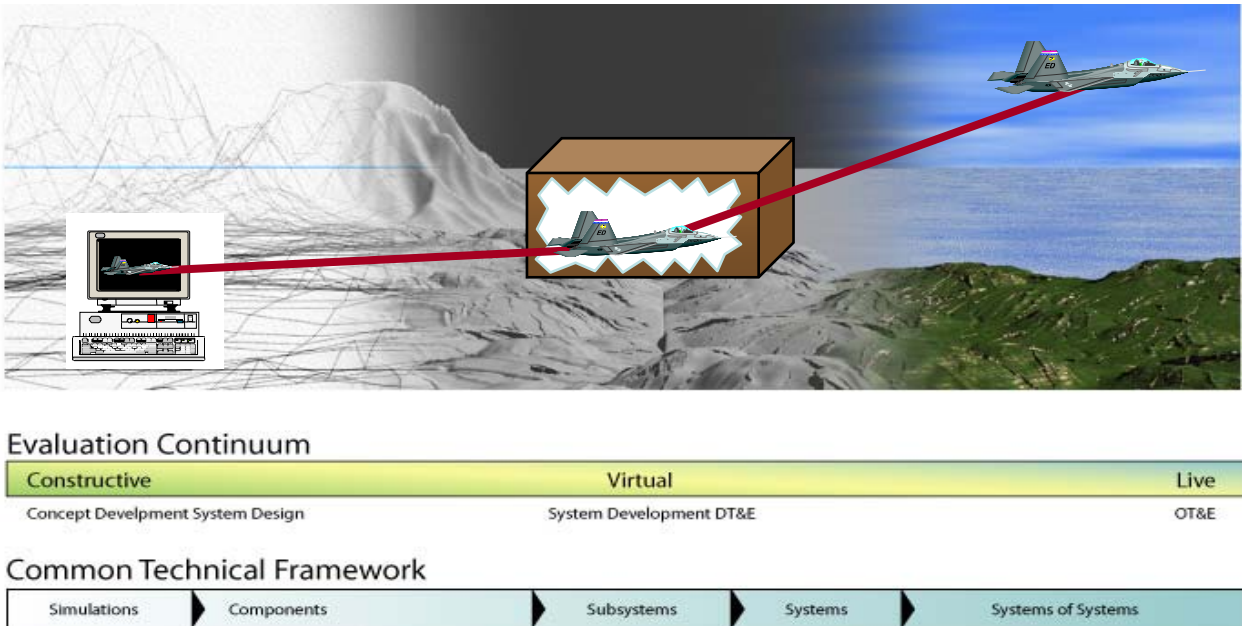

Figure B.2. Evaluation Continuum with Constructive, Virtual and Live Resources

Each joint mission environment will resemble a live, real world, single-site range, and will be configured and managed in a very similar manner. However, this "virtual range" will generally be distributed both geographically and organizationally to access the resources needed for testing in the joint environment, as required by relevant joint missions, operational architectures, and desired system attributes from the CDD and CPD. The components linked via the common technical framework for a given test event will consist of resources specific to the particular test. These will include live platforms operating on open air ranges, complete systems in integrated system test facilities, and constructive models or virtual/HITL simulations. The standing persistent test infrastructure capabilities will include a data archive capability and object model data descriptions that are used across all tests. The notional joint mission infrastructure is depicted in Figure B.3.

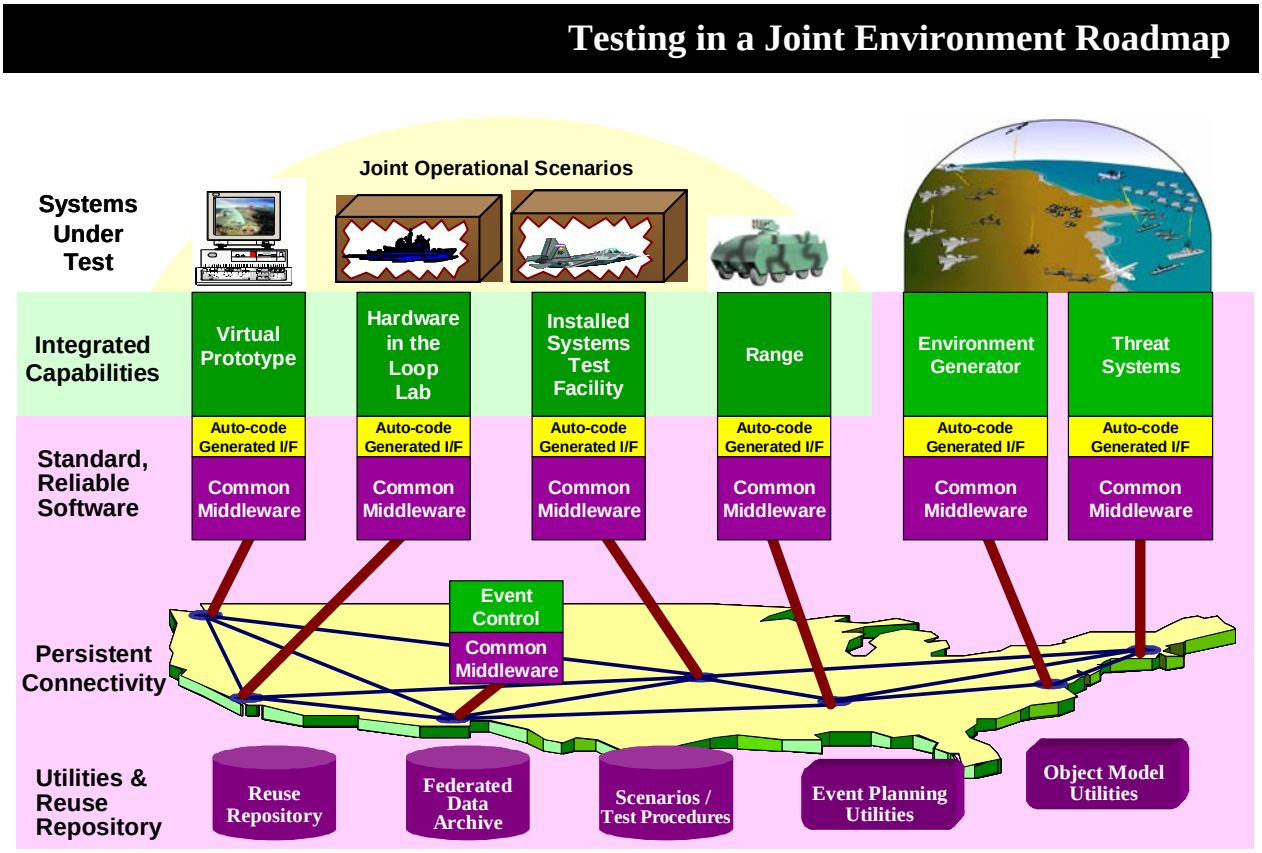

Figure B.3. Notional Joint Mission Infrastructure

B.2.2 JOINT MISSION ENVIRONMENTS

To effectively test a system in a joint context, the joint mission environments involving that system must be defined to the degree that the prerequisite associated warfighting systems can be identified. In addition, operationally realistic, representative scenarios should also exist describing the CONOPS and JTTPs, as well as necessary information or services that must be exchanged to satisfy the interoperability (for legacy systems) or publish/subscribe requirements (for net-centric systems). Finally, test procedures, derived from the evaluation needs, will be produced to capture and define all the necessary systems and their configurations, the data collection points and archiving strategy, the event timeline, and any other necessary configuration information so that the test could be repeated by a different test team.

B.2.3 CORE INFRASTRUCTURE CAPABILITY

The objective core infrastructure will provide the capability essential to generate the joint mission environment that is needed for T&E in all joint mission areas. The core infrastructure capabilities include a persistent data transport capability, common middleware, basic object

models, tools and utilities, a data archive capability, and a reuse repository. This required infrastructure is also the most costly element needed to achieve the vision of testing in a joint environment.

B.2.3.1 PERSISTENT DATA TRANSPORT CAPABILITY

The Persistent Data Transport Capability provides wide-area connectivity between geographically-dispersed development laboratories, Department of Defense (DoD) industry laboratories, test facilities, simulation centers, and ranges as well as any other site linked to the joint mission infrastructure. The Persistent Data Transport Capability is not a new DoD network. Instead, the capability will be created by using existing and emerging DoD networks, including Secret Internet Protocol Router Network (SIPRNET), Defense Information System Network Asynchronous Transfer Mode Services – Unclassified/Classified (DATMS-U/C), DISN Leading Edge Services (DISN-LES), Defense Research and Engineering Network (DREN), and ultimately, the Global Information Grid – Bandwidth Expansion (GIG-BE). Functioning like a virtual private network (VPN) or collection of VPNs, the Persistent Data Transport Capability will be an established "community of interest" on these existing DoD networks, allowing the security accreditation processes to be streamlined. For sites that do not have connectivity on one of the approved DoD networks, the existing networks will be appropriately extended to satisfy the requirements for that site to be incorporated into the joint mission infrastructure. The Persistent Data Transport Capability will build upon and interoperate with the data transport solution for the JNTC, so that Joint Forces Command (JFCOM) training exercises can be leveraged to generate the joint mission environment for testing.

B.2.3.2 COMMON MIDDLEWARE

The Common Middleware is the high-performance, real-time, low-latency communication infrastructure used by applications and tools during execution for all communication between systems. Providing a unified interface to all software applications, the Common Middleware will have features for creating, managing, publishing, and deleting distributed objects (with state information), publish/subscribe messaging, and data streams (e.g., tactical data links, video, audio, raw telemetry, etc.). Furthermore, it will have services to support managing distributed objects in the exercise, such as access control and data integrity to maintain consistency across distributed systems. It will support many different strategies for communication, including type-based subscription, interest-based subscription, multi-cast, "best effort," and reliable delivery, each with various qualities of service associated with them. The Common Middleware will support numerous communication media, such as conventional IP networks, wireless networks, shared memory, and reflective memory, and will be optimized to work over the Persistent Data Transport Capability. The Common Middleware will be based upon best commercial practices; however, it will be designed to easily incorporate new and advancing data distribution technologies with minimal impact to compliant applications. Since the Common Middleware is

fundamental to enable interoperability among all components of the joint mission infrastructure, it will either be owned by the Government or centrally licensed, so that it can be provided "free of charge" to organizations interfacing to the joint mission infrastructure.

B.2.3.3 BASIC OBJECT MODELS

Standard data definitions and defined interfaces are critical to streamline integration of the joint mission infrastructure. Prescribing the interface, data, and functionality, an object model enables semantic interoperability among the various capabilities in the joint mission infrastructure by proving a standard "language" that all systems use to communicate. This capability is essential to provide semantic understanding between operations of diverse systems. Classic examples of object models include the entities in the exercise (airplane, tank, ship, threat systems, terrain features, etc.) as well as supporting systems, such as instrumentation systems (radar, Global Positioning System, telemetry, etc.). Object models encode all the information exchanged between systems. To assist developers in designing their interface to the joint mission infrastructure, it is critical to provide "building block" object models that are segmented and standardized across communities of interest. Therefore, rather than having to build their interfaces either from scratch or by trying to re-engineer object definitions from past events for different purposes, developers will have a variety of standard interface definitions that they leverage to compose the definition of their larger system. Examples of Basic Object Models include ubiquitous data definitions (e.g., time and position), as well as generic definitions (e.g., platform), which every developer could utilize. Basic Object Models also include standard software algorithms, such as coordinate translations and conversion routes. Incorporating standard software algorithms with Basic Object Models is critical to minimize "translation error" and other impacts from the joint mission infrastructure that could obscure true effects or otherwise hinder an evaluator in tracing the root cause of problems back to a particular system.

B.2.3.4 TOOLS AND UTILITIES

The Tools and Utilities provide functionality that allows the joint mission infrastructure to serve as a useful test environment and to operate efficiently and cleanly. The tools consist of a suite of software applications used to plan, prepare, configure, operate, monitor, and analyze the results of a joint test event involving the joint mission infrastructure. Planning tools will make it easy to schedule incorporation into a pre-planned event in the joint mission infrastructure, including determining which DoD capabilities are needed based upon the test objectives and defining the scenario derived from the joint mission environment. In addition, these planning tools will help test engineers map test objectives and needed test resources by drilling down from the operational architecture of the joint mission environments. One significant tool essential to transform testing in a joint environment is the scheduling tool for events and supporting assets, including all elements of the joint mission infrastructure. Scheduling of the assets in the joint mission infrastructure, especially live assets participating in exercises, will be a complex

undertaking. Not only will it involve coordination of LVC assets, but it will also require coordination with acquisition system schedules; most of which will have fixed decision points and unplanned delays could severely impact production. Other tools will monitor, control, and optimize operation of the joint mission infrastructure, including performance and health status of the various elements and integrated assets. Analysis tools must be designed that will greatly assist evaluators in tracing the root cause of problems discovered during large system-of-systems test events to the individual system with the shortfall.

The utilities are a suite of software applications that directly help engineers design and incorporate DoD capabilities into the joint mission infrastructure, such as manage the reuse repository content or verify the compliance of a DoD capability. The most significant utility arguably is the auto-code generation utility, which generates source code for the interface between the DoD capability (simulations, labs, instrumentation, etc.) and the joint mission infrastructure. Following model-driven architecture development principles, this auto-code generation capability will merely require developers, who are designing or upgrading assets to be "plugged-in" the joint mission infrastructure, to define their systems' interfaces in a standard definition language (e.g., Unified Modeling Language). From this standard definition, the auto-code generator will generate the source code for the developers to incorporate into their software, making it easy for new DoD capabilities to be added to the joint mission infrastructure.

B.2.3.5 DATA ARCHIVE

The Data Archive stores all of the persistent information associated with a test in the joint mission environment. It will be a high-performance, distributed, temporally-organized database capable of supporting real-time queries. It will provide the following critical functions:

a. Store scenario and other important pre-event information and plans.

b. Store initialization information so that test events can be reliably repeated and analysis applications have a reference point when performing their analysis.

c. Support high performance data collection during event executions so that all relevant data created can be reliably stored for later retrieval.

d. Store information at multiple collection points, since many distributed test events will store critical information locally, but not preclude a centralized collection and consolidation capability in the future.

e. Support a "temporal" understanding of collected information, so that analysis applications can understand the state of the joint mission infrastructure and all of its participants as a function of time.

f. Support queries during the test event, as much as possible, to provide immediate insight into certain types of behavior or results during a test event.

g. Support post-event analytical queries.

h. Support security and access control so only authorized applications may access information based on a pre-defined security plan.

i. Support the ability of test engineers to manage data across multiple databases uniformly as if they were in a single data collection system.

j. Support the ability for test engineers to collaborate and exchange information prior to a test event.

k. Support the ability to correlate data, recorded at multiple locations or from different sources, regarding a system under test.

Since all of the needed functionality above could not be satisfied by a single database running on a single computer, the Data Archive is expected to be a federated multi-database running on many computer systems across the Department, all interconnected as nodes in the joint mission infrastructure. Currently, the Central Test and Evaluation Investment Program (CTEIP) has a comprehensive study on managing test data, and it is envisioned that this study will provide significant definition of specific requirements as well as design considerations for the joint mission infrastructure data archive. Ultimately, the goal is to collect and archive information, as well as meta-data (i.e., data about the data), so that data collected by one test team is understandable and useful to other test teams.

B.2.3.6 REUSE REPOSITORY

The Reuse Repository contains all the information regarding systems and capabilities that are either a part of the joint mission infrastructure, or interface with the joint mission infrastructure. It is, in essence, a large, unified, secure database-of-databases. It appears to the users as a single "logical" repository, and it is designed to unify all the information necessary for DoD capabilities (virtual prototypes, threat simulations, HITL laboratories, ranges, environment generators, etc.) to be easily reused in future events. The reuse repository will contain all the various basic object models, common software and algorithms, and system representations, including their interfaces, pedigree, standardization status, security status, prior usage, and any other information needed to reuse the various DoD capabilities. Each category of information and details about specific reusable capabilities may be stored in separate data stores in various locations, using different underlying schemes, such as relational databases, object-oriented databases, hierarchical databases, or even flat files. However, from the user perspective, the reuse repository appears to be a single, net-enabled, unified container of information.

B.2.4 SYSTEM/THREAT/ENVIRONMENT REPRESENTATIONS

Program managers must be able to "plug" the warfighting capabilities under test into the joint mission infrastructure and have their respective systems be immersed well enough to meet their test objectives. Although there are many ways to categorize the various systems interacting in the joint mission infrastructure, this roadmap organizes them into three major categories: System Representations, Threat Representations, and Environment Representations.

B.2.4.1 SYSTEM REPRESENTATIONS

System representations are live, virtual, or constructive simulations of warfighting systems. System representations are not only of the system under test, but also all the systems that system is expected to interact with in the joint mission infrastructure (including sensor systems, communication systems, non-DoD systems (NSA, FAA, Homeland Defense systems, etc.), and allied systems. Since they are the actual capability with which the nation goes to war, live systems will always be the most significant elements to integrate into the joint mission infrastructure, providing the most operationally realistic test events.

For live systems, their interface to the joint mission infrastructure will often be via tactical means, such as stimulators injecting information into sensors for the system under test, or instrumentation publishing/subscribing information to the C4I subsystem of the system under test, but it could also be via non-tactical methods, such as embedded instrumentation. However, live systems are expensive to use to support a test event, and traditionally are difficult to obtain.

Constructive and virtual representations of acquisition systems must be developed to be compatible with the joint mission infrastructure architecture. These representations should be created as design and development aids for an acquisition program and used throughout its acquisition process, progressing from a virtual prototype, to HITL laboratories, to range testing, to ultimate fielding. Most importantly, it should be realized that a system's interface should be consistent throughout all these acquisition phases, regardless of whether it is a live, virtual, or constructive representative. This interface consistency enables data coherency throughout the acquisition process, so that predictions from virtual prototypes could be compared to results from live systems in a more "apples-to-apples" assessment.

A virtual prototype should be available for use in the joint mission infrastructure and should be maintained by the program. Rather than drop the constructive and/or virtual M&S after they create the actual hardware, program offices should acquire these capabilities as deliverables from their prime contractors and maintain these simulations, even after their systems enter production. Although this process will initially increase the cost to a program, the benefit will be reaped many times by all systems that are on the joint battlefield. Furthermore, programs will be reimbursed for the use of their virtual representations to support a test in the joint environment

by the program office responsible for the system that is under test, which should help defray sustainment costs for their virtual representations.

This continual cycle of model-check-model will dramatically enhance available models and simulations, ultimately improving confidence in the insight provided by them. Over time, verification and validation data for virtual and constructive system representations will become more readily available since comparison of constructive models with virtual and real systems, and comparison of virtual systems with test data from real systems, will become available.

There are numerous efforts within DoD to develop and maintain constructive models and virtual representations of systems and networks along with the required databases. The envisioned joint mission infrastructure will have to leverage on those activities, adding or modifying capabilities to meet the specific requirements for joint mission assessments. Because the M&S efforts being used were developed for other specific applications, it will be necessary to establish a comprehensive, yet efficient, accreditation process to ensure that existing capabilities are adequate for joint force assessments. Accreditation of individual models, as well as accreditation of the interactions required of those models, will be necessary. A structured process will be established to take advantage of existing M&S verification and validation (V&V) efforts, and to create additional V&V databases based on comparisons among constructive, virtual and live test events within the joint mission infrastructure.

B.2.4.2 THREAT REPRESENTATIONS

Development or modification of threat representations (threat weapons and command and control systems, as well as threat scenario development) will be required to support testing in a joint environment. Developing a joint force infrastructure capable of replicating joint mission environments will require close coordination with the intelligence community to develop virtual and constructive simulations of red forces for a range of potential operational scenarios with realistic signatures such as infrared, electro-optical and radio frequency. These threat representations must be maintained and made available to the joint mission infrastructure similar to the system representations. These threat representations must be integrated into both the live and virtual domains as applicable.

B.2.4.3 ENVIRONMENT REPRESENTATIONS

A critical aspect to the joint mission infrastructure is a common context. There must be a common understanding of the environment or the test results will be skewed. Representing and generating the natural environment in a standard, computer-intelligible fashion is a mammoth task. Each element of the environment – the Earth's shape, terrain, terrain features, urban areas, bathymetry, sea state, atmospheric conditions, and the weather – must be represented in a standard way. The Synthetic Environment Data Representation and Interchange Specification

(SEDRIS), a program run by the Defense Modeling and Simulation Office (DMSO), has established a process to standardize and unify the multitude of environment definitions, including those developed by non-DoD activities. Not only do these standards need to be adopted, but the Department also needs to re-energize the Modeling and Simulation Executive Agents for Terrain, Oceans, and Air and Space. The Department needs to ensure adequate investment is included in budgets to satisfactorily populate DMSO's Master Environment Library to support the conduct of testing in a joint environment.

B.2.4.4 DEVELOPMENT AND TEST FACILITIES AND NETWORKS

An overview of capability of systems engineering, test, training and experimentation facilities that can be integrated to contribute to testing in a joint environment includes:

Joint Distributed Engineering Plant (JDEP):

Navy Distributed Engineering Plant (NDEP):

Center for Domain Integration: Air Force operational and developmental test bed

Combined Test and Training Support Facility: Army test bed for C3 systems, mainly systems engineering, but expanding capabilities for DT testing

Joint Interoperability Test Command (JITC): multitude of labs beyond JDEP

System of Systems Integration Lab: - Army distributed capability for Systems engineering and DT, support to OT and training for Future Combat System program)

Service Battle Labs: can be linked together for force development experiments and training

Marine Corps Systems Command: distributed C2 lab

Joint Battle Center (JBC): JFCOM's Joint C4ISR Battle Center (JBC) is an essential instrument to improve joint C2 warfighting capabilities by prototyping and assessing timely solutions to meet joint force capability needs and by conducting interoperability demonstrations under its Interoperability Technology Demonstration Center (ITDC). JBC provides end-to-end analysis and validation of functional capabilities through its operational and interoperability assessments early in the lifecycle of a program. The ITDC specifically addresses joint operational, system-of-systems, technical, software, and procedural interoperability.

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Global Information Grid End-to-End (GIG E2E) Evaluation Capability: ASD(NII) distributed capability for GIG communications and networks at systems engineering level - links together test beds of various programs multi-Service.

Joint DataLink Information Combat Execution (JDICE) JT&E: AF lead, developing a distributed test capability

Appendix C – Changes to Directives, Instructions and Regulations

C.1 INTRODUCTION

Implementation of capabilities-based testing in a joint environment must be facilitated by the modification of applicable policy and procedural provisions in directives, instructions and regulations issued by the DoD and the CJCS. As the DoD and CJCS documents are modified, implementing Service, Defense Agency, and CoCom publications and policy statements will require appropriate revisions to support testing in a joint environment.

C.2 SCOPE

Thirty relevant DoD and CJCS policies and regulations related to T&E, requirements generation, acquisition, interoperability, as well as the technical and management disciplines that will affect the execution of testing in a joint environment were examined. The purpose was to identify specific areas where changes are required to institutionalize such testing. The following publications are subject to potential revision during the implementation planning to incorporate provisions applicable to capabilities-based testing in a joint environment.

JCS Publications:
CJCSI 3170.01D
CJCSM 3170.01A
CJCSM 3180.01
CJCSI 3500.01B
CJCSI 3500.02C
CJCSI 5123.01A
CJCSI 6212.01C

DoD Publications:
DoDD 1322.18
DoDD 3200.11
DoDD 3200.15
DoDD 4630.5
DoDI 4630.8
DoDD 4715.11
DoDD 5000.1
DoDI 5000.2
DoD 5000.3-M-4
DoDD 5000.59
DoDI 5000.61
DoDD 5010.41
DoDD 5129.47
DoDI 5134.1
DoDD 5141.2
DoD 7000.14-R
DoDD 8100.1
DoDD 8500.1
DoD 8510.1M
DoD Interim Acquisition Guidebook

Joint Warfighting Publications:
Joint Pub 3.0
Joint Pub 3-13.1

C.3 PROPOSED CHANGES

Proposed changes will be submitted and coordinated with cognizant offices during the implementation phase using established revision processes for review and coordination. The following subsections highlight important areas of change proposed in directives, instructions and regulations. Some specific examples are provided.

C.3.1 Defense Acquisition System

Fundamental acquisition system policy should declare that testing in a joint environment is a requirement. Policies should be enhanced to include statements that establish the guidance for PMs and Operational Test Agencies (OTA) to conduct testing in a joint environment as an integral part of the acquisition process based on requirements/capabilities identified and approved through the JCIDS process. Requirements should be established for integration of developmental systems with the networked joint mission infrastructure. Those requirements should include the development, upgrade, and maintenance of constructive models and virtual simulations throughout the lifecycle of each system. Policies should mandate the use of the joint mission infrastructure.

DoD Instruction 5000.2. The following are examples of possible changes to DoD Instruction 5000.2, "Operation of the Defense Acquisition System," dated May 12, 2003.

Paragraph 3.5. Concept Refinement, Subparagraph 3.5.4.4., Consider a new sentence as follows: A test plan to ensure that the goals and exit criteria for the first technology spiral demonstration are met. *The test plan must consider testing in a joint environment to meet joint capability requirements identified in the ICD.*

Paragraph 3.7. System Development and Demonstration, Subparagraph 3.7.1.1., Recommend adding a new sentence after the existing second sentence: Development and demonstration are aided by the use of simulation-based acquisition and test and evaluation integrated into an efficient continuum and guided by a system acquisition strategy and test and evaluation master plan (TEMP). *The TEMP must address testing in the joint environment based on joint performance parameters identified in the CDD.*

Paragraph 3.7. System Development and Demonstration, Subparagraph 3.7.5., System Demonstration., Recommend modifying the fourth sentence as follows: Successful development test and evaluation to assess technical progress against critical technical parameters *and joint mission requirements*, early operational assessments, and, where proven capabilities exist, the use of modeling and simulation to demonstrate system integration are critical during this effort.

Paragraph 3.7. System Development and Demonstration, Subparagraph 3.7.6., Recommend modifying the first sentence as follows. The Department of Defense may not conduct operational testing (i.e., operational assessment (OA), IOT&E, or FOT&E) until the DOT&E approves, in writing, the OT&E portions of the combined developmental and operational test plan for programs on the OSD T&E Oversight List, and the adequacy of the plans (including *joint mission assessment requirements and* the projected level of funding) for the OT&E to be conducted in connection with that program (reference (h)).

E5. Enclosure 5 Integrated Test And Evaluation (T&E), Paragraph E5.1., The PM, in concert with the user and test and evaluation communities, shall coordinate developmental test and evaluation (DT&E)~~,~~ *and* operational test and evaluation (OT&E)~~,~~ *in a joint environment,* LFT&E, family-of-systems interoperability testing, information assurance testing, and modeling and simulation (M&S) activities, into an efficient continuum, closely integrated with requirements definition and systems design and development. The T&E strategy shall provide information about risk and risk mitigation, provide empirical data to validate models and simulations, evaluate technical performance and system maturity, and determine whether systems are operationally effective, suitable, and survivable *in the intended mission environment* against the threat detailed in the System Threat Assessment. …

E5. Enclosure 5 Integrated Test And Evaluation (T&E), Paragraph E5.1.3., T&E Strategy, Subparagraph E5.1.3.1., Recommend modifying the first sentence as follows: Projects that undergo a Milestone A decision shall have a T&E strategy that shall ~~*primarily*~~ address M&S, including *development, upgrading, and maintenance of constructive models throughout the system's lifecycle*;~~,~~ identifying and managing the associated risk~~,~~; and ~~*that shall evaluate*~~ *evaluating* system concepts against mission *capabilities including joint mission* requirements.

E5. Enclosure 5 Integrated Test And Evaluation (T&E), Paragraph E5.1.4., T&E Planning, Subparagraph E5.1.4.4., Suggest modifying the subparagraph as follows: Test planning and conduct shall take full advantage of existing investment in *the DoD Joint Mission Infrastructure,* DoD ranges, facilities, and other resources, including the use of embedded instrumentation.

E5. Enclosure 5 Integrated Test And Evaluation (T&E), Paragraph E5.1.4., Subparagraph E5.1.4.9. Interoperability Testing., Recommend changing the first sentence of the subparagraph as follows: All DoD MDAPs, programs on the OSD T&E Oversight list, post-acquisition (legacy) systems, and all programs and systems that must interoperate, are subject to interoperability evaluations throughout their life cycles to validate their ability to support *both Service and Joint* mission accomplishment.

E5. Enclosure 5 Integrated Test And Evaluation (T&E), Paragraph E5.1.5. Developmental Test and Evaluation (DT&E), Subparagraph E5.1.5.3., Recommend changing the subparagraph as follows: Stress the system under test to at least the limits of the Operational Mode Summary/Mission Profile*/Joint Mission Profile*, and, for some systems, beyond the normal operating limits to ensure the robustness of the design;

E5. Enclosure 5 Integrated Test And Evaluation (T&E), Paragraph 5.1.7. Operational Test and Evaluation (OT&E), Subparagraph E5.1.7.1., Recommend modifying the subparagraph as follows: OT&E shall determine the operational effectiveness and suitability of a system under realistic operational conditions, including combat *and performance in the joint mission*

environment; determine if thresholds in the approved CPD and critical operational issues have been satisfied; and assess impacts to combat operations.

DoD Interim Acquisition Guidebook. Recommend that the acquisition guidebook be changed to provide that joint mission T&E requirements be identified in Test and Evaluation Master Plans (TEMPs) and that, in situations involving multi-Service participation, all applicable Service OTA commanders are expected to coordinate during review and approval of the TEMP.

TENA Implementation Directive. A draft DoD TENA Directive is being prepared under the auspices of the Business Initiative Council to make TENA the standard architecture for test and training range systems interoperability. Recommend this directive be completed and issued by FY2005.

JDEP Utilization, Management and Operation Directive. A JDEP Utilization, Management and Operation Directive may be appropriate to govern JDEP compliance and its management and operations as a central Department-wide systems engineering and testing capability. Recommend the need for such a directive be reviewed during implementation planning, and if needed, prepared and issued by FY2006.

C.3.2 Requirements/Capabilities Generation

Changes to the CJCS 3170 series for the Joint Capabilities Integration and Development System (JCIDS) are essential to ensure the CDD and CPD documents contain, or reference the source for, the explicit mission capability needed, including the joint mission requirement.

CJCSI 3170.01D. The following suggested changes are provided as examples:

Paragraph. 4. Policy, Subparagraph 4.c., Recommend the following additions to the first two sentences: New solution sets must be crafted to deliver technologically sound, *testable,* sustainable, and affordable increments of militarily useful capability. All capabilities shall be developed, *tested,* and procured to leverage the unique attributes of other DoD Components, international systems from allies and cooperative opportunities.

Enclosure A - Joint Capabilities Integration And Development System (JCIDS) Process, Subparagraph 2e. Defining Capabilities., Suggest adding the following wording to subparagraph 2.e.(2): (2) Capability definitions should be general enough so as not to prejudice decisions in favor of a particular means of implementation, but specific enough to evaluate alternative approaches to implement the capability *and provide for measurement of system performance through the T&E process for the lifecycle of the system*.

Enclosure A - Joint Capabilities Integration And Development System (JCIDS) Process, Subparagraph 5a(2)(b) Capability Development Document (CDD)., Recommend modifying the first sentence, and adding one additional sentence as follows: The CDD provides the operational performance attributes, including supportability, necessary for the acquisition community to design the proposed system, and the T&E community to evaluate the proposed system in the anticipated joint environment. ~~*including*~~*It includes* key performance parameters (KPP) and other parameters that will guide the development, demonstration and testing of the current increment. *Operational testing will assess the operational effectiveness and suitability of the system and its performance in the anticipated joint mission area environment*.

Enclosure A - Joint Capabilities Integration And Development System (JCIDS) Process, Subparagraph 5b, Performance Attributes and KPPs., Suggest changing the fourth sentence as follows: … This will be used to guide the acquisition community in making tradeoff decisions between the threshold and objective values of the stated attributes *and the T&E community in assessing system performance including the joint mission requirement*. Operational testing will assess the operational effectiveness and suitability of the system and its ability to meet the production threshold values. Additional discussion of attributes and KPPs is provided in reference c.

Enclosure A - Joint Capabilities Integration And Development System (JCIDS) Process, Subparagraph 7c(1), FCB Membership., Suggest revising subparagraph 7c(1)(o) as follows: (o) Other *OSD offices*, DoD, and non-DoD agencies (as required)

Enclosure B – Responsibilities, Paragraph 2, Functional Capabilities Boards, Suggest the following additions be incorporated in subparagraph 2.h., h. Ensure that D,PA&E, USD(AT&L), *DOT&E,* and ASD(NII) have the opportunity to participate in or review the analysis conducted in support of ICD designated as JROC Interest. D,PA&E, USD(AT&L), *DOT&E,* and ASD(NII) should be engaged early to ensure that the analysis plan adequately addresses a sufficient range of materiel approaches.

CJCS 3170 Series. Recommend that **t**he Chairman of the Joint Chiefs of Staff 3170 series of publications be amended to establish a process for providing T&E feedback to the applicable Functional Capabilities Board or Boards regarding any important gaps in mission capability that are identified through testing.

C.3.3 Resources

DoD 7000.14-R, the DoD Financial Management Regulations should be adjusted as necessary to ensure that any changes to established reimbursement policies required to implement testing in a joint environment are incorporated in the documents. Similarly, any changes to current requirements to budget for costs of testing a system under test, testing of

systems that must interface with the system under test, or components of the test infrastructure itself, should be included in the sections of policy documents that apply to budget formulation and execution.

The DoD Financial Management Regulations comprise a multi-volume publication of policies applicable to appropriated fund activities, revolving fund activities, multiple types of appropriations, and a variety of reimbursable arrangements that depend on the type of customer and the provider of services as well as the type of service or support being rendered. The identification of appropriate changes to that publication is best accomplished through the efforts of knowledgeable subject matter experts during the implementation phase of the roadmap.

C.3.4 Synthesis of Training and Testing

DoDD 1322.18, CJCSI 3500.01B, and 3500.02C, regarding joint training, are subject to modification to facilitate, or encourage, the conduct of testing in a joint environment during joint training exercises, and provide for coordination of joint training exercises with testing needs.

CJCSI 3500.01B. The following are examples of possible changes to CJCSI 3500.01B, "Joint Training Policy for the Armed Forces of the United States," dated 31 December 1999.

Enclosure A, Introduction., Consider modifying paragraph 5 as follows: 5. Other Joint Activities Affecting Joint Training. Other joint activities or events that impact on the planning and conduct of joint training include All Service Combat Identification Evaluation Team (ASCIET) events, Joint Warrior Interoperability Demonstrations (JWID), Advanced Concept Technology Demonstrations (ACTD), ~~and~~ Joint Warfighting Experiments (JWE), *and testing in a joint environment*. Occasionally, to take advantage of joint force expertise and minimize impact on unit training schedules, some joint experimentation objectives, *or testing of systems in a joint environment*, will be added as an adjunct to joint training exercises. *Training events provide venues to demonstrate emerging capabilities of systems under development and influence system requirements at an early stage in the acquisition cycle.*

Enclosure B, Joint Training Policy., Suggest modifying paragraphs 1.a., 3.a, 3.d.(2) and 6.a. as follows:

1.a. Use Joint Doctrine.. Joint training will be accomplished in accordance with approved joint doctrine. … When ~~*it is necessary to introduce*~~ experimentation events *or testing in a joint environment* ~~*into*~~ *are included in* joint training exercises, combatant commanders will ~~*use care to*~~ ensure that exercise participants understand that doctrinal deviations are for experimentation *or test and evaluation* purposes, and may not change doctrine and procedures for future operations.

3.a. Use the Joint Training System.. The JTS provides an integrated, requirements-based methodology for aligning training programs with assigned *joint* missions consistent with command priorities and available resources. ….

3.d. (2) … Of necessity, many of ~~*these*~~ *those* experiments*, as well as testing systems in a joint environment*, will be conducted during exercises and war games, but care will be exercised to make clear distinctions between objectives for training and outcomes of *tests and* experiments. To ensure that training does not become a secondary objective during military exercises, a careful balance must be orchestrated in the overall CJCS Exercise Program that optimizes *the* conduct of *tests and* experiments without jeopardizing training objectives of combatant command staffs, component staffs, and assigned forces. Additional guidance to ensure deconfliction, synchronization, and rationalization of the objectives of JE *and testing systems in a joint environment* will be published in future versions of CJCSI 3500.02, CJCSM 3500.03, and the Joint Training Master Schedule. …

6.a. … Training and exercises can help identify and alleviate many problems before unity of effort is degraded. *This is particularly applicable to training events and exercises that include testing the interoperability of systems employed by U.S. forces and systems employed by allied nations.*

Enclosure C, The Joint Training System., Suggest changing subparagraph d.(1) as follows: (1) … Forces, equipment, transportation, and funding must be prioritized, matched, and coordinated to ensure the right mix of training events. *Integrating demonstrations of the capabilities of systems under development to perform in a joint environment into training events should be given full consideration during the planning process.* Additionally, …

Enclosure D, Training Responsibilities., Suggest modifying paragraph 4.e as follows: e. Worldwide management, rationalization, and scheduling of the JTMS. USJFCOM executes this responsibility through coordinating JTMS schedule deconfliction. It also maintains and deconflicts the schedule for worldwide JTF HQ and functional component training events for the CJCS, supported CINCs, Services, ~~*and*~~ Joint Experimentation, and *testing* events that may impact on training requirements.

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Appendix D – Implementation Planning

D.1 Introduction

An implementation plan shall be developed upon approval of the testing in a joint environment roadmap. The implementation plan will articulate the required organization; policies, processes, and procedures; and resources at the necessary level of detail to establish the T&E capabilities described in the roadmap. It will also describe the tasks required to achieve this capability with a detailed implementation schedule. This plan will establish an interim organizational oversight and working level structure, and ensure continuity and transition until permanent leadership and organization have been established.

D.2 Framework for Implementation

DOT&E is designated the lead for fully developing the capability for testing in a joint environment and shall, in full partnership with the offices of USD(AT&L), USD(P&R), and ASD(NII), the Joint Staff, the Services, JFCOM, and others as required, lead the development of the implementation plan, coordinating with PPBE principals and others as required. DOT&E shall establish an implementation planning team within 60 days of approval of this roadmap, and the initial implementation plan will be completed, coordinated, and approved by DOT&E on or about June 30, 2005. Identification of a long-term sponsor and steps for transition to this sponsor will be addressed during implementation planning.

The implementation plan will describe the "who, what, when, where, how, and why" of the development and operation of the capability needed to enable testing in a joint environment in the necessary level of detail. At a minimum, the implementation plan will address:

Organization, including OSD sponsorship, Service/Agency responsibilities, ownership of technical infrastructure, and organizational concepts and interrelationships.

Funding for development, modernization, and sustainment. Definition of PPBE responsibilities for OSD, Services, and Agencies. Develop initial FY2005 budget changes, issues, BCP, PCPs, etc. Develop PPBE documentation required for FY2006. Establish an operating budget beginning in FY2005 for implementation planning.

Policy, directives, regulations including the identification and drafting of specific changes required in DoD publications/issuances concerning acquisition, joint capabilities, budget and financial management, organization, and training. Draft a specific directive governing the development, operation, funding, and mandated use of the infrastructure to provide the capability to support testing in a joint environment.

Testing in a Joint Environment Roadmap

Define required elements of the technical infrastructure and identify key tasks and timelines for achievement of this architecture.

Establish a schedule effecting phased stand-up of the needed capability. Identify any milestone decision points.

Function as implementation organization until responsibility is transferred to the owning organizations.

Establish working liaisons with communities of interest, such as a possible OPFOR IPT with JFCOM, DIA, etc.

Address unique requirements for testing in the joint environment that includes coalition forces, or T&E in support of foreign military sales.

Appendix E – Glossary – Definitions and Acronyms

E.1 Definitions

- "Joint Mission Environment" – The operational context in which the capability being developed must perform.

- "Joint Mission Infrastructure" – Collective term for the hardware/software – the combination of representations of friendly and enemy forces and the geophysical environment, as well as the supporting infrastructure, required to generate the joint mission environment necessary for capability development and T&E.

- "Testing" and Test and Evaluation (T&E) – The term "testing" (or test) is used for simplicity/brevity in some cases. Throughout the context of this report, the term "testing", where applied, is synonymous with T&E.

- "Testing in a Joint Environment" – A more accurate description of the capability this roadmap will address than the title of the SPG paragraph, "Joint Testing in Force Transformation". The report avoids the term "joint testing" because this terms connotes testing that requires participation of more than one Service, not always true, and is easily confused with the Joint Test and Evaluation (JT&E) program.

- "Evolutionary Acquisition (EA)"– The preferred approach that fields an initial operationally useful and supportable capability in as short a time as possible with the explicit intent of delivering the ultimate capability in the future through one or more increments. There are two approaches to evolutionary acquisition: 1) incremental, and 2) spiral. With the incremental approach, a desired capability and end state requirements are known at program initiation, and these requirements are met over time by the development and fielding of increments as technology maturity permits. With the spiral approach, a desired capability has been identified, but end state requirements are not entirely known at program initiation. Each increment of a spiral program provides the user with the best available capability at that time and then future requirements are developed and refined over time based on demonstration, risk management, and continuous user feedback. Spiral development is the preferred approach to evolutionary acquisition.

E.2 Acronyms

Acronym	Long Title
ACASS	Advanced Close Air Support System

ACTD	Advanced Concept Technology Demonstration
AFCEA	Armed Forces Communications and Electronics Association
AFOTEC	Air Force Operational Test and Evaluation Center
ASD(NII)/DoD CIO	Assistant Secretary of Defense for Networks and Information Integration/Department of Defense Chief Information Officer
AWACS	Airborne Warning and Control System
BCP	Budget Change Proposal
BMDT&E	Ballistic Missile Defense T&E
C2W	Command and Control Warfare
C4I	Command, Control, Communications, Computers and Intelligence
CDD	Capability Development Document
CDR	Critical Design Review
CJCS	Chairman, Joint Chiefs of Staff
CJCSI	Chairman, Joint Chiefs of Staff Instruction
CJCSM	Chairman, Joint Chiefs of Staff Manual
CoCom	Combatant Commanders
COI	Community of Interest
CONOPS	Concept of Operations
CPD	Capability Production Document
CTEIP	Central Test and Evaluation Investment Program
CY	Constant Year
D(OT&E)	Director, Operational Test and Evaluation
D(PA&E)	Director, Program Analysis and Evaluation
DATMS-U/C	Defense Information System Network Asynchronous Transfer Mode Services – Unclassified/Classified
DepSecDef	Deputy Secretary of Defense
DISA	Defense Information Systems Agency
DISN-LES	DISN Leading Edge Services
DITSCAP	Department of Defense Information Technology Security Certification and Accreditation Process

DMSO	Defense Modeling and Simulation Office
DMS	Digital Models and Simulations
DoD	Department of Defense
DoDD	DoD Directive
DoDI	Department of Defense Instruction
DOT&E	Director, Operational Test and Evaluation
DOT&E/S&TR	Director, Operational Test and Evaluation/Systems and Test Resources
DOTMLPF	Doctrine, Organization, Training, Material, Leadership and Education, Personnel, Facilities
DREN	Defense Research and Engineering Network
DT&E	Developmental T&E
DT/OT	Developmental and Operational Testing
EnRAP	Enhanced Range and Applications Program
EO	Electro-Optical
EPLRS	Enhanced Position Location and Reporting System
EPP	Enhanced Planning Process
EXCIMS	Executive Council for Modeling and Simulation
FAA	Federal Aviation Agency
FCB	Functional Capabilities Board
FCS	Future Combat Systems
FCT	Foreign Comparative Testing
FMR	Financial Management Regulation
FOC	Full Operational Capability
FOT&E	Follow-on Operational T&E
FRP	Full Rate Production
FY	Fiscal Year
GIG	Global Information Grid
GIG-BE	Global Information Grid – Bandwidth Expansion
GIG-E2E	Global Information Grid – End-to-End

GOC	Ground Operations Center
GPS	Global Positioning System
HITL	Hardware-in-the-loop
IA	Information Assurance
ICD	Initial Capabilities Document
I/F	InterFace
IOC	Initial Operational Capability
IOT&E	Initial Operational T&E
IP	Defer to Implementation Plan
IPT	Integrated Product Team
IR	Infrared
ISP	Information Support Plan
ISTF	Integrated Systems Test Facility
IT	Information Technology
ITDC	Interoperability Technology Demonstration Center
IWCs	Information Warfare Commander (US Navy)
JBC	Joint Battle Center
JBMC2	Joint Battle Management Command and Control
JC2E	Joint Command and Control Environment
JCAS	Joint Close Air Support
JCIDS	Joint Capabilities Integration and Development System
JCS	Joint Chiefs of Staff
JDEP	Joint Distributed Engineering Plant
JDICE	Joint DataLink Information Combat Execution
JFCOM	Joint Forces Command
JITC	Joint Interoperability Test Command
JMO	Joint Management Office
JNTC	Joint National Training Capability
JROC	Joint Requirements Oversight Council

JSF	Joint Strike Fighter
JT&E	Joint Test & Evaluation
JTAMDO	Joint Theater Air Missile Defense Office
JTEN	Joint Training and Experimentation Networking
JTMS	CJCS Joint Master Training Schedule
JTS	Joint Training System
JTTP	Joint Tactics, Techniques and Procedures
KIP	Key Interface Profile
KPP	Key Performance Parameter
LCS	Littoral Combat Ship
LFT&E	Live Fire Test and Evaluation
LRIP	Limited Rate Production
LVC	Live, Virtual and Constructive
M&S	Modeling and Simulation
MNS/ORD	Mission Needs Statement/Operational Requirements Document
MRTFB	Major Range and Test Facility Base
MS-A	Milestone A
MS-B	Milestone B
MS-C	Milestone C
N-COW RM	Net-Centric Operations and Warfare Reference Model
NDEP	Navy Distributed Engineering Plant
NR-KPP	Net Readiness Key Performance Parameter
NSA	National Security Agency
NSS	National Security Systems
O&M	Operations and Maintenance
OA	Operational Assessments
OAR	Open Air Range
OPAREA	Operating Area
OPFOR	Opposing Force

OSD	Office of the Secretary of Defense
OT&E	Operational T&E
OTA	Operational Test Agency
PCP	Program Change Proposal
PEO	Program Executive Officer
PM	Program Manager
POA&M	Plan of Actions and Milestones
POM	Program Objective Memorandum
PPBE	Planning, Programming and Budget Execution System
QDR	Quadrennial Defense Review
RDT&E	Research, Development, Test and Evaluation
RF	Radio Frequency
RJ	Radar Jammer
ROM	Rough Order of Magnitude
RTCA	Real Time Casualty Assessment
S&T	Science and Technology
SE	Systems Engineering
SEDRIS	Synthetic Environment Data Representation and Interchange Specification
SIL	System Integration Laboratory
SIPRNET	Secret Internet Protocol Router Network
SPG	Strategic Planning Guidance
SUT	System Under Test
T&E	Test and Evaluation
TACP	Tactical Air Control Post
TBD	To Be Determined
TEMP	Test and Evaluation Master Plan
TE/ST	Test and Evaluation Science and Technology
TENA	Test and Training Enabling Architecture
TES	Test and Evaluation Strategy

TPG	Transformation Planning Guidance
TSPI	Time Space Position Information
UJTL	Universal Joint Task List
UCP 2000	U. S. Unified Command Plan 2000
UML	Unified Modeling Language
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology and Logistics
USD(C)	Under Secretary of Defense for Comptroller
USD(P)	Under Secretary of Defense for Policy
USD(P&R)	Under Secretary of Defense for Personnel and Readiness
V&V	Verification and Validation
VPN	Virtual Private Network
VV&A	Verification, Validation, and Accreditation

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