

JDEP Strategy Final Report _____

Joint Distributed Engineering Plant (JDEP)

JDEP Strategy

Final Report

Dr. Judith S. Dahmann
John Tindall

The MITRE Corporation

March 2001

March 2001

Table of Contents

	<u>page</u>
Executive Summary	1
Introduction	14
Key Ideas in the Strategy	20
JDEP Capabilities	28
JDEP Participants	45
JDEP Applications	60
JDEP Concept of Operations	72
Summary	81

Supporting Materials (In Separate Volume)

This annotated briefing is the Final Report of a strategy for extending the use of the Joint Distributed Engineering Plant (JDEP) to support a broad set of applications across the Department of Defense building on the initial JDEP efforts focusing on Joint theater air and missile defense.

Joint Distributed Engineering Plant (JDEP)

JDEP Strategy

Executive Summary

Purpose and Topics

- Purpose of this Presentation
 - **Outline JDEP Track 3 strategy for the development of a plan of action and milestones**
- Topics
 - **What do we mean by 'strategy'?**
 - **What is the proposed strategy?**
 - **What next?**

This section provides a executive overview of the key points in the Joint Distributed Engineering Plant (JDEP) strategy presented in this report.

In the overview we begin with a brief discussion of the JDEP initiative, its formation, purposes and users. We then discuss what we mean by a 'strategy' and the role the strategy will play in JDEP implementation. The key ideas in the strategy for use of JDEP across the DOD are then summarized. Finally, we close by reviewing the steps now underway to implement the management structure and processes and the key activities to make this strategy a reality for the JDEP initiative.

Joint Distributed Engineering Plant (JDEP) Defined

“ The JDEP program was established as a DoD-wide effort to link existing service and joint combat system engineering and test sites (including design activities, software support activities, test and evaluation facilities, training commands, and operational units). JDEP is designed to improve the interoperability of weapon systems and platforms through rigorous testing and evaluation in a replicated battlefield environment.”

[DPG Update FY 2002-2007, Guidance, p.112]

The JDEP is defined in the Defense Planning Guidance which authorized funding for phased JDEP development to reuse the hardware and software in the loop capabilities distributed across the laboratories and ranges owned by the Services and Joint agencies to create environments to support development, test and assessment of Joint systems

Three Track "JDEP" Implementation Approach

- JDEP is now being considered in three tracks:
 - Track 1: JDEP TAMD Initial **Event**; limited build to establish JDEP concept
 - Four system implementation to demonstrate concept and provide useful results to SIAP system engineer
 - Track 2: **Expand** implementation to address broader JTAMD issues
 - Based on lessons learned from track 1, add systems and sites to support JTAMD integration and interoperability testing
 - Track 3: **Extend** JDEP beyond JTAMD to other mission areas
 - Begin in parallel with Tracks 1/2 to extend JDEP to meet the similar needs of other mission areas
 - **Focus of JDEP Strategy**

February 2001

As a new effort, JDEP is being developed in a series of three largely parallel activity tracks.

Track 1 has been the focus of the first year of the JDEP initiative. It is a small (four site) event designed as a starting point for JDEP activities. This is a limited build to establish the JDEP concept, involving a four system implementation to demonstrate the concept and provide useful results to the SIAP system engineer. This event will provide a first proof of principle for the initiative as a whole. Lessons learned from this event will be used to support further activities in the initiative.

Track 2 will expand implementation to address broader JTAMD issues. Based on lessons learned from track 1, track 2 will add systems and sites to support JTAMD integration and interoperability testing.

Finally, Track 3 will extend JDEP beyond JTAMD to other mission areas. It is important to begin this in parallel with tracks 1 and 2 to examine how to extend JDEP to meet similar needs across mission areas and to ensure that the activities in tracks 1 and 2 are on the path to future, broader JDEP capability.

This report described the strategy for JDEP expansion in track 2 and extension for track 3.

Broader Purposes of JDEP

- In the long-term JDEP will build interoperable forces by providing a tool for:
 - **Developers to engineer interoperability into systems**
 - **Testers to test and evaluate interoperability among systems**
 - **Warfighters to assess the operational capabilities of forces**
- Track 3 JDEP strategy needs to consider these broad purposes

February 2001

JDEP is expected to support multiple user communities. These are:

- 1-- The **system developers** who are developing new systems and upgrading existing systems to meet user interoperability needs by providing a tools to support system integration during the engineering of systems and system upgrades
- 2-- The **test and evaluation** community to conduct interoperability testing of systems
- 3-- The **warfighter** to assess the capability available to the operational

The types of hardware and software in the loop (HW/SWIL) capabilities supported by JDEP are costly and are needed by all three communities. It is very important that we find ways to leverage investments in these capabilities for reuse and to support the full range of users.

What Do We Mean by "Strategy" ?

- The JDEP 'Extension Strategy' is
 - A **vision** of how JDEP will support SoS developers, testers and warfighters across mission areas over time
 - A **conceptual framework** for choosing management structures, selecting applications and addressing user issues
 - The **basis for taking the next steps** in defining specific program objectives, actions and milestones
- The strategy is NOT
 - The identification of the specific mission areas JDEP will address
 - Plan of action defining how these areas will be addressed
 - Definition of the management structure for JDEP activities

The strategy provides the foundation for defining the structure, applications and activities of JDEP

February 2001

JDEP is underway with the implementation of the initial JTAMD track 1 event. To provide a broader context for the ongoing activities of the initiative, a strategy was needed to provide the common ground for the wide variety of organizations to use as they work together to create a broad-based JDEP.

As a result, the strategy was intended to address the foundational elements on which the community could work together. Hence it is high level, by design providing a visionary framework on which to base the next steps towards implementation.

The strategy does not identify the specific areas to be addressed or a plan of action to address them. Nor does it define a management structure or process to support the mission areas. Rather, it is intended to provide the foundation for the community to work together to do this, as part of the JDEP initiative building process.

The 'Strategy' in a Nutshell

- The **need**
 - Doctrine and operations are increasingly dependent on Joint SoS
 - This demands new approaches to SoS development, test and assessment
- **JDEP** addresses this need by providing users with the means to
 - Access DOD-wide assets, tools, and knowledge to address their SoS issues and
 - Create SoS environments by linking existing, distributed system HWIL assets
- Under the **strategy**
 - HWIL assets are built and used for individual system development and test
 - These assets are shared and applied in different configurations to address SoS

"Build, use, share"

February 2001

In the US, with JV 2010 and JV 2020, there is increasing emphasis on joint warfighter operations, in which individual systems operate in concert to provide the users with a joint, interoperable systems of systems (SoS) capability. In order to provide the warfighter with this type of SoS capability, new ways of developing, testing and assessing systems need to be created, to support individual system developers and to consider the needs of the SoS environment throughout the development and deployment process.

JDEP supports this new way of doing business by providing access to the tools created to support individual system developers for reuse in different combinations to address new needs of SoS development, integration and test. By reusing these development assets in linked applications we can create SoS development, test and assessment environments.

The idea behind the strategy can be summarized as 'build, use, share'. Developers of individual systems **build** software and hardware-in-the-loop (HWIL) capabilities and **use** these to support their own developments. If they then **share** these with the developers, testers and users of other systems which will operate together with their system, the DOD can create the environments needed to develop the SoS capabilities to meet the warfighters' needs.

JDEP Capabilities and Events

- JDEP **capabilities** are
 - HWIL/SWIL assets and processes,
 - owned by different organizations,
 - reused in different federations to address different SoS issues,
 - 'coordinated centrally' to support reuse and access by multiple users for different purposes

Common across users; how they are used and for what purpose varies
- JDEP **events**
 - occur whenever a set of JDEP components are 'federated' to address a user's needs
 - may be large or small with multiple events running concurrently
 - in many cases will not be a single event, but rather an ongoing event series

February 2001

JDEP capabilities include the collection of 'piece parts' which can be assembled in different ways to meet the variable needs of different users in the conduct of hardware and software in the loop (HW/SWIL) integration and testing. These include, among other things, systems, stimulators, data exchange specifications, test procedures, data collectors, and analysis plans. They also include simulations and scripts which may augment the HW/SWIL end items depending on the nature of the user needs, and the scenarios needed to provide an operational context for SoS integration and test. These are costly, and once created, need to be used as much as possible to support existing needs. A JDEP technical framework is the technical means to ensure these 'piece parts' can be assembled and applied to multiple uses in a cost effective way. The JDEP capabilities will be 'owned' by different organizations (JDEP capability 'suppliers'), and JDEP will support the coordinated use of these capabilities for different user applications.

JDEP events occur each time a set of JDEP components are configured and used to meet a specific user's needs. These events are expected to be numerous routine activities which may be small (two or three system) configurations to address the specific needs of a developer, tester or war fighter, perhaps in conjunction (following or preceding) with larger events. When events take place, how often and with which participating capabilities will all be driven by the nature and frequency of user needs.

JDEP Participants

- JDEP **users** define the problems to be addressed by the JDEP federation and applies the results to meet their needs
- JDEP **providers** support users in several ways
 - **Coordination and technical support organization** helps users to identify, access, and configure assets to meet their SoS needs based on growing experience
 - **Event conductors** direct specific events on behalf of users
 - **Suppliers** share their assets with different users to address SoS issues
- JDEP **management** looks across all JDEP uses and events to
 - Provide infrastructure investment,
 - Oversee asset coordination, and
 - Arbitrate access to scarce resources

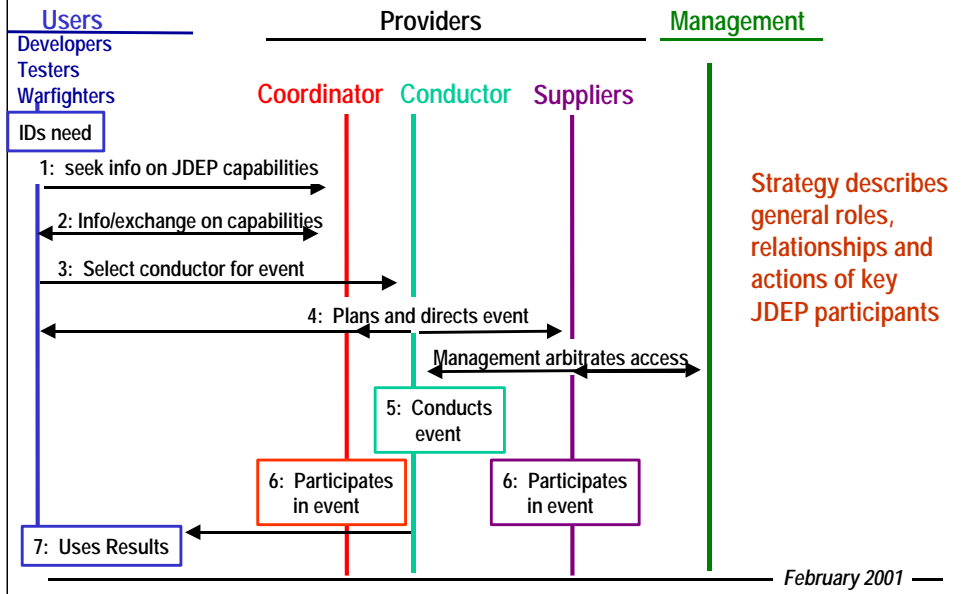
February 2001

JDEP **users** are the developers, testers, and war fighters who have a need for a HW/SWIL loop environment to address their specific integration or test needs. They may be developing or upgrading a system which has interoperability requirements, they may be testing a system or system of systems (SoS) to see if these requirements have been met, or they may be assessing the degree to which the systems meet the needs of their operational use. Different users will come with different needs. These users will bring these different issues to JDEP when they need a HW/SWIL environment.

Users will be supported by JDEP **providers**, who assist the users in identifying the capabilities they need from the JDEP inventory, who supply the capabilities they own to meet the users needs, and, who support users in the conduct of the event by configuring the capabilities to meet the needs of the user, planning the event, conducting event activities, and collecting and analyzing the data to meet the user needs. The user then applies the results of the event to their own problem which led them to conduct the event in the first place.

Finally, there will be an overarching JDEP **management** responsibility which considers the full complement of JDEP capabilities and applications and provides the supporting management direction and oversight.

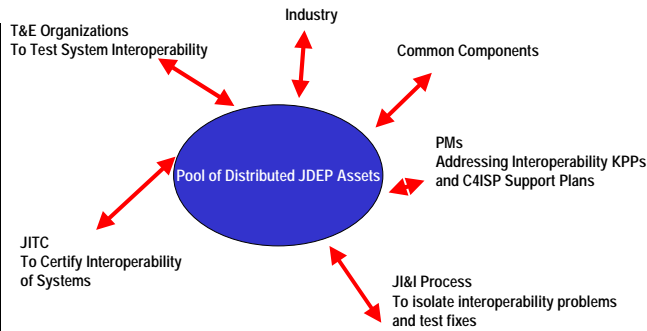
'Steady State' CONOPS for a JDEP Event



Finally, the dynamic relationships among the various JDEP participants are described in a "concept of operations" to illustrate the general process of interaction among the players as they execute their respective roles and responsibilities in the formation of a JDEP event. This is depicted as the 'steady-state' condition, that is when the JDEP is operational and implementing the strategy. In the schematic, and in discussions in the body of the report, the basic steps in this general process are laid out chronologically, beginning with the user identification of a need for a HW/SWIL capability to the generation of results from a completed event to be applied to the user's problem.

In Sum, JDEP....

Matrixing Assets Across User/Provider Communities to Support SoS Integration and Interoperability



Assets owned by different communities are (logically) 'pooled' and shared among these communities for different SoS uses

- ... enables DoD to operate at the enterprise level to build on current capabilities to address the growing number of SoS integration and interoperability needs
"Build, Use, Share"
- The JDEP extension strategy is a first step towards this end

February 2001

To summarize, this strategy for JDEP has examined the SoS realities and growing needs in the DoD, and has presented an approach which is built on the concept of collaboration and resource sharing to address needs of system of systems integration and interoperability of developers, testers, and war fighters.

What Next?

- **Develop implementation plan**
 - Strategy outlines types of things to be done by different participants, in both
 - general JDEP support across applications and
 - within specific application areas (e.g. JTAMD)
 - Next step is to determine specific actions, milestones and resources
- **Establish JDEP management structure and organization**
 - Strategy suggests what needs to be done
 - Next step is defining which organizations participate in what roles
- **Select areas and issues to be addressed**
 - Strategy describes how events would be conducted
 - Next step is to identify objectives in key areas and the specific users, issues and events to be supported
- Relationship of strategy to Tracks 1 and 2
 - **Track 1** provides insights into JDEP strategy implementation
 - **Track 2** represents the first major JDEP application area and fundamentals of the strategy should guide Track 2 activities

As discussed above, the JDEP strategy is intended to provide the basis for the development of the JDEP implementation plan and the JDEP management structure and process, and for the selection of issues and areas for JDEP applications in JDEP tracks 2 and 3.

The JDEP Executive Steering Group accepted this strategy in January 2001, and chartered open task groups from the JDEP 06 Level Management Team to develop recommended organization structures and plans for JDEP development to support applications of JDEP capabilities in both the JTAMD mission area and beyond. These recommendations will support the development of a plan of action and milestones for the JDEP initiative.

Joint Distributed Engineering Plant (JDEP)

JDEP Strategy

Final Report

Introduction

JDEP Motivation

- JDEP was initiated based on a memorandum
 - **Principal Deputy USD/AT&L and the Director, Force Structure, Resources and Assessment, JS/J8**
 - **" We believe an approach taken by the Navy to use a land-based distributed engineering plant (DEP) to address integration and interoperability problems for the fleet (air and missile defenses) may be an appropriate concept to address joint interoperability issues (collaboratively) between all services" (2 June 1999)**
- Memo stood up a GOFSG with tasks to
 - **Set up and charter a Joint Engineering Task Force (JETF)**
 - **Oversee and assess JETF efforts to**
 - **Develop the approaches and costs to construct a Joint DEP**
 - **Recommend how to best proceed**
 - **Build consensus and establish ownership**

February 2001

The Joint Distributed Engineering Plant (JDEP) was initiated in June 1999 based on a memorandum from the Principal Deputy, Deputy Under Secretary of Defense for Acquisition, Technology and Logistics (DUSD/AT&L) and the Joint Staff J8.

In the supporting documents, the section entitled "Background, JDEP History and Status" discusses the creation and implementation progress of JDEP in more detail.

Joint Distributed Engineering Plant (JDEP) Defined

“ The JDEP program was established as a DoD-wide effort to link existing service and joint combat system engineering and test sites (including design activities, software support activities, test and evaluation facilities, training commands, and operational units). JDEP is designed to improve the interoperability of weapon systems and platforms through rigorous testing and evaluation in a replicated battlefield environment.”

[DPG Update FY 2002-2007, Guidance, p.112]

The JDEP is defined in the Defense Planning Guidance which authorized funding for phased JDEP development to reuse the hardware and software in the loop capabilities distributed across the laboratories and ranges owned by the Service and Joint agencies to create environments to support development, test and assessment of Joint systems

Three Track "JDEP" Implementation Approach

- JDEP is being implemented in three tracks:
 - Track 1: JDEP TAMD Initial **Event**; limited build to establish JDEP concept
 - Three system implementation to demonstrate concept and provide useful results to SIAP system engineer
 - Track 2: **Expand** implementation to address broader JTAMD issues
 - Based on lessons learned from track 1, add systems and sites to support JTAMD integration and interoperability testing
 - Track 3: **Extend** JDEP beyond JTAMD to other mission areas
 - Begin in parallel with tracks 1/2 to extend JDEP to meet the similar needs of other mission areas
 - **Focus of JDEP Strategy**

As a result, JDEP is now viewed as three tracks. Track 1 is the JDEP TAMD initial event. This is a limited build to establish JDEP concept involving a three system implementation to demonstrate concept and provide useful results to SIAP system engineer. Track 2 will expand implementation to address broader JTAMD issues. Based on lessons learned from track 1, track 2 will add systems and sites to support JTAMD integration and interoperability testing. Finally, Track 3 will extend JDEP beyond JTAMD to other mission areas. It is important to begin this in parallel with tracks 1 and 2 to examine how to extend JDEP to meet the similar needs of other mission areas. This project addresses the development of a strategy for JDEP track 3.

Broader Purposes of JDEP

- In the long-term JDEP will build interoperable forces by providing a tool for:
 - **Developers to engineer interoperability into systems**
 - **Testers to test and evaluate interoperability among systems**
 - **Warfighters to assess the operational capabilities of forces**
- JDEP strategy considers these broad purposes

As a capability to support hardware and software in the loop (HW/SWIL) integration and testing, JDEP is expected to support multiple user communities. These are:

- 1-- The **system developers** who are developing new systems and upgrading existing systems to meet user interoperability needs by providing tools to support system integration during the engineering of systems and system upgrades
- 2-- The **test and evaluation** community to conduct interoperability testing of systems
- 3-- The **warfighter** to assess the capability available to the operational

The types of HW/SWIL capabilities supported by JDEP are costly and are needed by all three communities. It is very important that we find ways to leverage investments in these capabilities to reuse them to support the full range of users.

JDEP Strategy

- Goal of the strategy is to extend the capabilities of JDEP to support HW and SW in the loop integration and interoperability testing for applications across mission areas to meet needs of the developer, the tester and the war fighter

- The strategy is described in the following sections
 - Key Ideas in JDEP Strategy
 - JDEP Capabilities
 - JDEP Participants
 - JDEP Applications
 - JDEP Concept of Operations

The goal of the JDEP strategy is to identify an approach for providing HW and SW in the loop integration and testing support to users across mission areas to meet the growing needs of the war fighter for interoperable systems.

This part of the report describes the JDEP strategy and a concept of operations for the broad based use of JDEP for multiple users across multiple mission areas. This report begins with the key ideas in the strategy and then addresses different aspects of the strategy in more detail, ending with a discussion of the concept of operations for extended version of JDEP.

Key Ideas in JDEP Strategy

Key Ideas in JDEP Strategy

- The JDEP strategy is based on a set of key ideas
 - JDEP Capabilities
 - JDEP Technical Framework
 - JDEP Users
 - JDEP Providers
 - Capability coordination and technical support
 - JDEP event conductors
 - JDEP capability suppliers
 - JDEP Events
- These ideas together form the core of the strategy

The JDEP strategy addresses the need to apply the capabilities provided by JDEP to support HW and SW in the loop integration and testing to meet the growing needs of the war fighter for interoperable systems across mission areas. While the pilot application is to support JTAMD, the need for support of this type cuts across the Department.

In describing this strategy we examine the types of HW/SWIL and supporting capabilities that we can reuse for multiple SoS purposes and the technical framework needed to make this feasible. We examine the prospective near-term users of JDEP and their role in future applications of JDEP capabilities as well as the functions needed to support users with flexible reusable capabilities. Finally we discuss JDEP events, what they may look like, how frequently they may occur, a concept of operations for how they will be created and implemented, and how the results will be used.

The 'Strategy' in a Nutshell

- The **need**
 - Doctrine and operations are increasingly dependent on Joint SoS
 - This demands new approaches to SoS development, test and assessment
- **JDEP** addresses this need by providing users with the means to
 - Access DOD-wide assets, tools, and knowledge to address their SoS issues and
 - Create SoS environments by linking existing, distributed system HWIL assets
- Under the **strategy**
 - HWIL assets are built and used for individual system development and test
 - These assets are shared and applied in different configurations to address SoS

"Build, use, share"

February 2001

In the US, with JV 2010 and JV 2020, there is increasing emphasis on joint warfighter operations, in which individual systems operate in concert to provide the users with a joint, interoperable systems of systems capability. In order to provide the warfighter with this type of SoS capability, new ways of developing, testing and assessing systems need to be created, to support individual system developers, and to consider the needs of the SoS environment throughout the development and deployment process.

JDEP supports this new way of doing business by providing access to the tools created to support individual system developers for reuse in different combinations to address new needs of system of system (SoS) development, integration and test. By reusing these development assets in linked applications we can create SoS development, test and assessment environments.

The idea behind the strategy can be summarized as 'build, use, share'. Developers of individual systems **build** SW and HW-in-the-loop (HWIL) capabilities and **use** these to support their own developments. If they then **share** these with the developers, testers and users of other systems which will operate together with their system, the DOD can create the environments needed to develop the SoS to meet the warfighters' needs.

JDEP Capabilities and Technical Framework

- JDEP is
 - a collection of **capabilities**
 - including systems, stimulators, simulations, data exchange specifications, test procedures, data collectors, analysis plans etc.
 - used to support hardware /software in the loop integration and testing
 - built to a **common technical framework** so they can be reconfigured to meet needs of different **users**
- JDEP capabilities
 - are provided by **suppliers** (capability owners) to **users**
 - are 'coordinated centrally' to support reuse and access by multiple JDEP **users** in different functional areas for different purposes
- JDEP **technical framework**
 - provides component-based technical framework for reconfigurability and reuse of JDEP **capabilities** by different **users** for different purposes

February 2001

What do we mean by JDEP **capabilities** and why do we need a JDEP **technical framework**?

JDEP capabilities include the collection of 'piece parts' which can be assembled in different ways to meet the variable needs of different users in the conduct of HW and SW in the loop integration and testing. These include, among other things, systems, stimulators, data exchange specifications, test procedures, data collectors, and analysis plans. They also include simulations and scripts which may augment the HW/SWIL end items depending on the nature of the user needs, and the scenarios needed to provide an operational context for SoS integration and test. These are costly, and once created, need to be used as much as possible to support existing needs. A JDEP technical framework is the technical means to ensure these 'piece parts' can be assembled and applied to multiple uses in a cost effective way. The JDEP capabilities will be 'owned' by different organizations (JDEP capability '**suppliers**'), and JDEP will support the coordinated use of these capabilities for different user applications.

The **JDEP technical framework** is the definition of the components of a JDEP configuration, interfaces (specifications) for the way the components work together, and the guidance on how to configure and apply the components to a users needs. It is the general 'blueprint' for assembly of the 'piece parts' to address a particular issue.

JDEP User and Provider Functions

- The JDEP **user**
 - defines the problem to be addressed by the HWIL/SWIL capability created by configuring JDEP capabilities to meet the user's specific integration, interoperability test and assessment needs

- The JDEP **provider** functions
 - include several different activities needed to support the user in locating, accessing and applying needed capabilities to meet the users specific integration, interoperability test and assessment needs

The initial phase, JDEP (track 1) is focused solely on Joint Theater Air Missile Defense (JTAMD). This is a pilot effort intended to generate lessons learned for the implementation of subsequent JDEP applications. In this initial event, there is overlap between the users of JDEP capabilities and the providers of those capabilities. In extending JDEP to provide support across mission areas (track 3), as we move into a broader set of applications, it will be important to consider the roles of each of these separately.

JDEP **users** are the developers, testers, and war fighters who have a need for a HW/SWIL loop environment to address their specific integration or test needs. They may be developing or upgrading a system which has interoperability requirements, they may be testing a system or system of systems (SoS) to see if these requirements have been met, or they may be assessing the degree to which the systems meet the needs of their operational use. Different users will come with different needs. These users will bring these different issues to JDEP when they need a HW/SWIL environment.

Users will be supported by JDEP **providers**, who assist the users in **identifying** the capabilities they need from the JDEP inventory, who **supply** the capabilities they own to meet the users needs, and who support users in the **conduct of** the event by configuring the capabilities to meet the needs of the user, planning the event, conducting event activities, collecting and analyzing the data to meet the user needs. The user then applies the results of the event to their own problem which led them to conduct the event in the first place.

JDEP User Functions

- 'JDEP components' are applied in 'JDEP federations' configured to address integration and interoperability issues defined by the **JDEP user**, who is responsible for
 - **Defining issues to be addressed, including**
 - the participants (e.g, systems) in the test and the system interfaces
 - the test objectives IAW the JDEP users own process
 - **Serving as the lead in definition of the test events**
 - **Leading in the planning for analysis of event data**
- The **JDEP user** is supported by JDEP provider functions in
 - **Locating JDEP components to meet user needs(i.e. systems, test plans, data collectors...)**
 - **Providing services to the user in the conduct of the event**
 - **Supplying the specific components needed to meet user needs**

February 2001

JDEP **users** are the drivers in the employment of JDEP capabilities. In and of themselves the 'piece parts' (or 'JDEP capabilities') are not of use to address SoS issues. It is when they are assembled into configurations (or 'federations') and linked together to meet the needs of an SoS user (a 'JDEP federation') that they have value. To apply JDEP HW/SWIL capabilities to a system of system (SoS) application, it is necessary that there be a clear idea about the capabilities that are needed, the way they are expected to work together, and the reason for creating the federation. These will provide the basis for the technical construction of the federation. The user needs will also define the conduct of the event, the data to be collected and the plan for the analysis. The results will be applied to address the user issue, under the process the user is following to achieve their objective. This discussion is very general because there are a range of ways JDEP can be used. As a HW/SWIL capability, user applications will logically involve questions at the engineering level, questions which could not be satisfactorily addressed with analysis or simulation, but require actual systems. These could be design questions early in a system development where a prototype needs to be tested in the context of the other systems it will be employed with. It could be a test of system upgrades to improve data exchange between the systems. Or it could be the evaluation of the operational performance of a complex of systems to meet a user operational need. In each case, the user (the system designer, the system integrator or tester, or the operational user) has a question that can best be answered by actually linking operational HW or SW .

JDEP users are supported by JDEP **providers** in using JDEP to meet their needs. As is discussed next, the provider organizations assist users in accessing and applying the capabilities required to address their issues.

JDEP Events

- A JDEP **event**
 - occurs when a set of JDEP components are configured to address a user's needs
- The JDEP user
 - defines **event** objectives which drive the structure of the JDEP configuration and conduct through the selection of components, integration/test analysis plan, etc.
- JDEP **events**
 - occur based on user needs
 - with multiple events running concurrently supporting different users applying different capabilities, assuming no conflict over access to capabilities
 - depending on the user needs, large events may be preceded or followed by smaller events involving subsets of participants to address specific issues
 - may combine needs of multiple users when the opportunity for such economies of scale exist, by events which support users either concurrently or sequentially
 - in many cases not be a single event, but rather an ongoing event series

February 2001

JDEP events occur each time a set of JDEP components are configured (or 'federated') and used to provide the environment to meet a specific users needs. These events are expected to be numerous routine activities which may be small (two or three system) configurations to address the specific needs of a developer, tester or war fighter, perhaps in conjunction (following or preceding) with larger events. When events take place, how often and with which participating capabilities will all be driven by the nature and frequency of user needs.

Competition for access is expected to be an issue, when owners are using their own assets for their needs and the same asset is needed as a component in an SoS application under JDEP. Mechanisms to arbitrate access will be needed, as will investments in both added HWIL capabilities and validated simulations of the high demand systems for use in JDEP applications where such use as appropriate.

If there are multiple users which all need common systems or a common scenario, it may be possible to couple these and create a **common event or an event series** to meet the composite set of user needs more efficiently. The JDEP coordination function will facilitate this since there will be visibility into the range of JDEP events being planned.

While we discuss JDEP events as single point activities, this may be misleading in two ways. First, to conduct an event requires a **series of activities** to plan and configure the federation and following the execution of the federation, data analysis will take place, all over a more extended period of time. These will be part of the user's process to address the issue which motivated the use of JDEP. In addition, in many cases, if users choose to use JDEP it will be for a set of activities not one single event. Hence JDEP users may be actively applying JDEP capabilities repeatedly during a part of their development process or at key points in a spiral development process. Hence, it will become important for the configurations used for one event to be able to be 'recalled' and even recreated, to support subsequent events for this user. In an SOS environment, this information may be needed for a new JDEP user (e.g. to assess interoperability of upgraded version of their system) for a subsequent JDEP application.

JDEP Provider Functions

- These reusable, reconfigurable components are the domain of the different **JDEP provider** organizations that support users with three functions
 - **Coordination and technical support** of JDEP capabilities
 - Identifying available components which meet the specific needs of a user
 - Identifying, procuring, developing and maintaining general purpose tools (e.g. security devices) which could be used across different JDEP applications
 - Defining, maintaining and testing the technical specifications of the JDEP components as defined in the JDEP technical framework
 - Building knowledge about events and the process of event conduct
 - **Event conductors**
 - Providing services to JDEP users to conduct events including planning, configuring, conducting JDEP events, including data collection and analysis, and independent evaluation of results, if the nature of the event warrants
 - **Suppliers** of JDEP capabilities
 - Make their systems available to users, applying the technical framework

February 2001

There are three major JDEP provider functions. **First**, to make reuse of existing capabilities a reality, it is necessary for potential users to be able to locate capabilities which meet their needs and arrange to use them for their purposes. The inability to find and assess potentially reusable capabilities is classically a major impediment to reuse. In the JDEP strategy, a primary JDEP function is to coordinate the reuse of existing HW/SWIL capabilities, and supporting elements, to allow users to readily assess what is available and access those capabilities which meet their needs. This **coordination and technical support** function is key to the JDEP extension strategy. The types of capabilities which will be required include representations of specific systems needed in a SoS environment. It also includes those components which would be required to create and run any JDEP federation, and need not be created by each user for their application, but rather could be provided for use across JDEP applications. Finally, as mentioned earlier, to facilitate the reuse of components, a technical framework for composing capabilities into federations tailored to meet their needs will be needed. Defining and maintaining this framework is another general JDEP provider function. This set of provider functions can best be done commonly for JDEP as a whole because they apply across the full range of potential JDEP uses and they cumulate the knowledge needed for future applications.

Second, once the needed capabilities are identified, the work begins to configure them to meet the users needs and structuring their use in an event or series of events. This task is done for each event, tailored to the needs of the users, by a team lead by an **event conductor**, who assembles the right mix of expertise as dictated by that event. In the case of certain types of T&E events, the conductor may be accompanied by an independent **evaluator**.

Finally, the owners of the capabilities or the **suppliers** make their capabilities available for reuse and participate in the SoS applications which include their systems.

JDEP Capabilities

JDEP Capabilities

- JDEP capabilities are the reusable components which can be reconfigured for use to address SoS integration and interoperability issues
 - These include both runtime capabilities, such as
 - **Systems representations** of blue or threat systems or interfaces to ranges
 - Federation wide **environment representations** such as weather, terrain, communications, or electronic warfare
 - General purpose reusable **runtime utilities** such as federation monitors and managers, data collection systems, viewers, scenario drivers, etc..
- and supporting tools, processes and data, such as
- **Planning templates for analysis and test plans**
 - **Configuration documentation guides**
 - **Processes** for developing, certifying (security) and verifying, validating and accrediting (VV&A) federations
 - **Common scenarios or terrain databases**

February 2001

As introduced earlier, JDEP capabilities are the 'piece parts' developed by 'owners' for their own use, which can be assembled for use to support SoS applications for different users.

There are two classes of capabilities: those used to support JDEP 'federations' at 'runtime', that is, during the execution of JDEP events and those which support the preparation, planning and development of the application.

The runtime capabilities include the representations of the systems themselves (both friendly and threat systems), the representation of 'area phenomena' which will generally affect the SoS as a whole (such as terrain or weather), and finally, the utilities needed to operate a distributed federation of capabilities in an event.

A set of processes and supporting plan templates and guides can also be created for reuse across JDEP applications. These support the planning and development process generally, as well as specific activities which are common across applications, including security certification and validation, verification and accreditation (VV&A) of the JDEP federation for the needs of the user application

JDEP Capabilities: Systems Representations

- Systems representations can take several forms
 - **Blue systems**
 - Instances of US systems HW or SW available in labs, PM facilities and other locations for use with *stimulators* or *communications interfaces* for use as either the systems under integration or test or as part of the federation context or 'environment'
 - **Threat systems**
 - Either instances of threat systems HW or SW to provide context for SoS integration or interoperability
 - **System simulations**
 - Either blue or threat systems represented by simulations
 - **Ranges**
 - Interfaces to ranges where 'live' instances of systems are located to allow for inclusion of assets in the field

February 2001

As this slide reflects, in JDEP federations, blue force or threat systems may be represented as HW/SWIL capabilities in a laboratory environment, actual end items on instrumented ranges, or simulations. The type of representation selected will be driven by the needs and availability of the HW/SW for the user application.

While the inclusion of simulations may appear to be an extension of the view of JDEP as focused on HWIL, it should be recognized that HWIL capabilities rarely exist without some supporting simulation. As will be discussed later under the topic of 'sim-stim,' most HWIL facilities are equipped with 'stimulators' that incorporate representations of key systems or subsystems (e.g. sensors, communications). In effect these have 'simulations inside'. The strategy says that, at minimum, this needs to be recognized and these simulations be considered as explicit elements in a JDEP federation. These need to be selected and configured with the right characteristics to meet the specific needs of the application.

Beyond this, access to key HWIL assets may be limited, and there may be circumstances where the use of a simulation of a system will support a users need. Further, early in the process, there may be only a simulation of a new system. This may be used in a federation with both simulations and HWIL to address SoS integration issues.

Runtime Support Utilities

- There is a suite of commonly used runtime utilities or tools which would be needed across JDEP applications, including tools to support
 - **Technical federation management and control**
 - **Data collection**
 - **Test scripting or driving**
- Rather than develop these for each application, a suite of reusable tools could be developed and provided for reuse by JDEP users
- Again, there are tools of this type which could be incorporated into the JDEP reusable capabilities suite

February 2001

When you operate a distributed system, there is a need for supporting utilities to monitor, manage and control the distributed components as well as to view or collect data. These utilities will be needed in most JDEP applications to support the execution of events. Rather than have each user create unique capabilities for themselves, a suite of reusable utilities, based on available tools, will be made available to JDEP users.

There are currently capabilities of this type available and in use by different organizations. JDEP will identify these assets for reuse by others, perhaps obtaining a suite of such capabilities which could be distributed by the JDEP Coordination and Technical Support Team as part of its support to JDEP users. Current capabilities will continue to be used where they apply; JDEP will build on these by fostering reuse.

System Capabilities: 'Environmental' Representations

- Runtime capabilities which increase the operational realism of the environment by providing common context for the system of systems in areas where effects are felt across SoS such as
 - **Communications**
 - **Weather**
 - **Electronic warfare**
- These type of effects are often not incorporated into HWIL test environments; whether they are appropriate or needed depends on the objective of the event
- Ideally, this type of capability would not need to be specially created for each event, but components could be reused across events
 - **Work on capabilities of this sort is underway and could be leveraged by JDEP**

When SoS operations are conducted, the behavior of the systems and the way they work together can be affected by factors which go beyond these systems themselves but affect the whole SoS. These type of 'area phenomena' include terrain, weather, communications and electronic warfare. This type of effect is difficult, if not impossible, to represent 'live' in a HWIL event and hence, when included in a HWIL environment, it is supported by simulation.

In this and other types of JDEP capabilities, there is activity underway in the community to support this type of capability. The concept is that JDEP would work with these activities and incorporate the appropriate developments into the JDEP capability.

Supporting Tools and Processes (1)

- Similarly, there is a set of support functions which are used repeatedly across applications, which could be supported with common tools
- These include
 - **Plan templates**
 - **Configuration documentation tools**
 - **Federation development process**
 - **Security certification process**
 - **Verification, validation and accreditation guidelines**
- By providing a common set of reusable support constructs in these areas, along with a body of expertise in their use, JDEP can hopefully increase the ease of using HWIL environments for SoS issues
 - **Some of these capabilities exist today and would be adopted by JDEP, rather than replaced**

In addition to runtime capabilities, JDEP will provide a set of common capabilities to support the development of JDEP events and plans. Again the idea here is that by providing a common set of capabilities to JDEP users, this will ease their ability to readily apply JDEP runtime capabilities to meet their needs.

Supporting Tools and Processes (2)

- Plan templates
 - **By providing some common template for the construct of SoS integration, analysis and test plans, plan creation and use of results will be expedited**
- Configuration documentation tools
 - **Common ways to document federation configurations will ease the reuse of federations and support lessons learned over multiple events**
- Federation development process
 - **Common high level process for creating JDEP federations will aid users in the process of making efficient use of JDEP capabilities to meet their needs**
- Security certification process
 - **A common process for security certification based on the DISA standard processes (DITSCAP) would aid use of JDEP for classified events**
- Verification, validation and accreditation (VV&A) guidelines
 - **Commonality in VV&A practices and documentation would aid in reuse**

These supporting development tools and processes include templates and document guides for test and analysis plans and federation configurations. They also include process guidance to help users to develop their federations and in that process address security and VV&A issues for their applications. By providing and applying common constructs for plans and configurations across JDEP events, specific information from those events can be more readily retained and reused to support subsequent events, forming a growing knowledge base about SoS applications.

Technical Framework

- The idea behind JDEP is that existing capabilities can be 'federated' to support SoS applications
- The way these components are 'composed' to create a 'federation' would be described in a component-based technical framework which includes
 - **The types and functions of components**
 - **The interfaces between components**
 - **Guidance on how to configure components into federations**
- In JDEP, the challenge is to create such a framework which meets the variety of needs of the different users of the capabilities with both:
 - **Sufficient **structure and standardization** to get efficiency through ease of reuse and reconfigurability and**
 - **Sufficient **flexibility** to support different user needs and accommodate legacy capabilities with realistic investment**

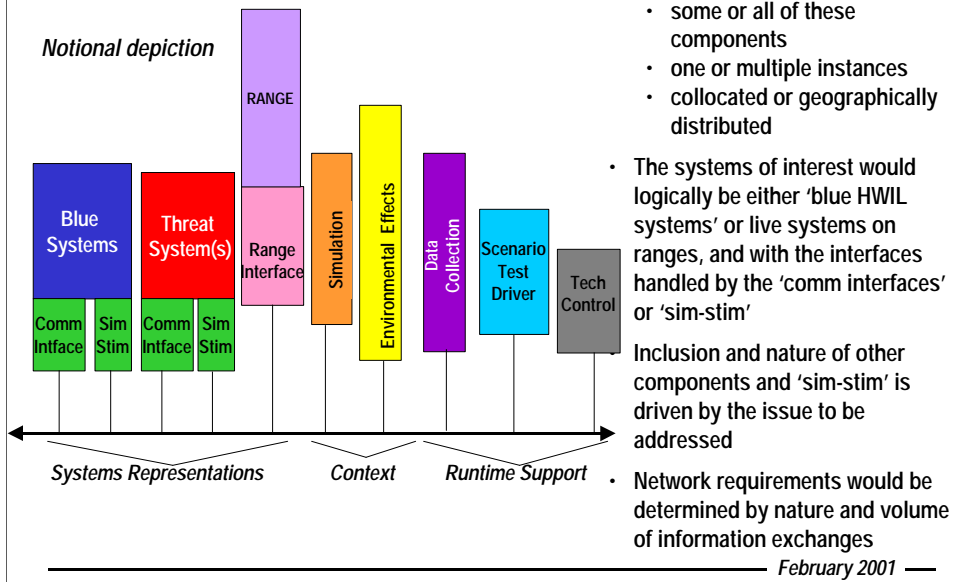
In order to assist in the reuse process, a blueprint is needed which provides the framework for the reuse of available capabilities. As a technical framework for composition of JDEP capabilities into federations, this framework will provide a lay down of the different **types of components** which compose a JDEP federation, the **interfaces** among those components, and **general guidance** on how different components work together to form a federation. No such specific framework exists, but there is a lot of experience as well as existing and new architectures and interface standards which will be used to create this frame work. In JDEP, it will be important to balance the desire for structure and standards that will aid in ease of composition and reconfigurability with flexibility needed to accommodate both the variety of user needs and the state of current, legacy components.

Drivers to the JDEP Technical Framework

- Components need to be **reusable** and flexibly **reconfigurable**
 - to allow for efficient 'composition of appropriate 'federations' of components to address varying user integration and interoperability test issues
- Support a **mix** of components as required by issue and supported by available resources
 - **live/scripted/simulated components,**
 - **distributed/co-located systems**
- Support small as well as large **scale** federations driven by user integration and interoperability problems
- Support **legacy** as well as new elements

To be of use to JDEP, this technical framework needs to provide the blueprint for reuse and reconfiguration of available components into federations to support new SoS applications. It has to be able to accommodate the different types of components which will be incorporated into these configurations, and it needs to support geographically distributed federations and federations with varying numbers of nodes and volume of traffic. Finally, the framework needs to be practical, because its primary function, at least in the near term, is the configuration of legacy capabilities, and, if possible, it would be advantageous to avoid the need for a large investment to upgrade these to get extended use of JDEP underway.

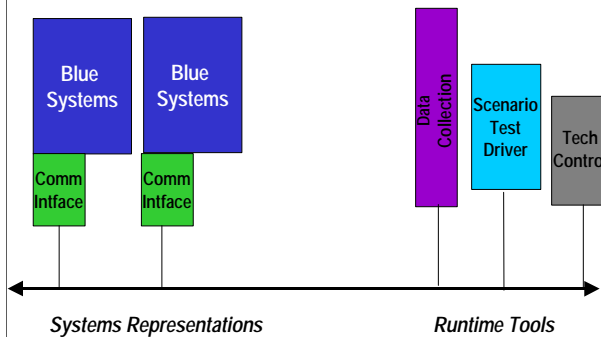
Major Components in Framework Illustrated



This slide depicts a notional view of the major types of components which will be incorporated into a JDEP federation. Any specific instance of a federation used in a JDEP event would include some subset of these component types. Since JDEP is primarily targeted at HW/SWIL SoS needs, a typical federation would include one or more instances of blue systems, either as HW/SWIL components equipped with stimulators or communications interfaces. These systems may also be actual end-items on an instrumented range and incorporated into the federation through a range interface. Depending on the nature of the event, other elements such as environmental effects (weather, electronic warfare, etc.), threat systems or other blue systems as either HWIL or simulations may be included. In any case, some or all of the runtime support utilities would be employed to operate the federation and collect needed data.

Notional C2 Interconnectivity Event Illustrated

Notional depiction



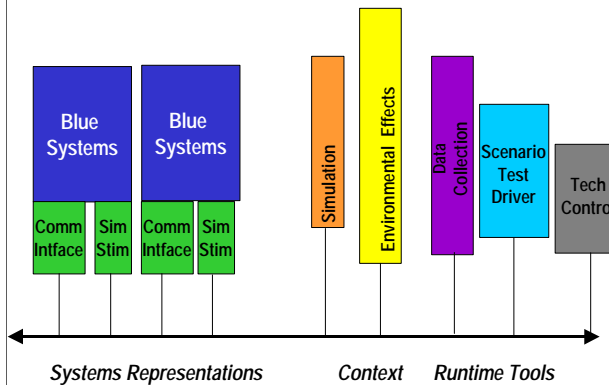
- A C2 Interconnectivity event would apply a subset of the types of components
 - Two instances of the blue systems under test
 - Equipped with communication interfaces
 - A test driver which would drive the event through a script
 - A data collector
 - A tech control station
- "Other" components may not be required

February 2001

This slide depicts one possible variant of a federation using a subset of the components. In this notional case, the event focuses on communications interconnectivity between two blue systems. Two HWIL systems, with communications interfaces, with support utilities constitute this notional federation.

Notional C2 Interoperability Test Illustrated

Notional depiction



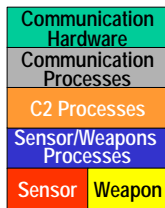
- A C2 interoperability test with an interest in the behavior of the blue systems in an operational environment might add
 - A simulated representation of the other blue forces systems and the threat
 - A representation of the communication environment
- In this case the blue systems would need to not only exchange C2 messages but be stimulated by simulation battlespace activities
 - Consequently, the blue systems would need to be 'equipped' with a 'sim-stim' interface

February 2001

In this notional example, the use of the federation is to assess C2 interoperability. This federation also has two blue systems with communications interfaces, but adds other elements to the test environment including other blue and threat systems in the simulation component along with environmental effects (possibly weather) to add operational realism to the environment for the purposes of this application.

Inside the "Sim-Stim" and "Comm Interface"

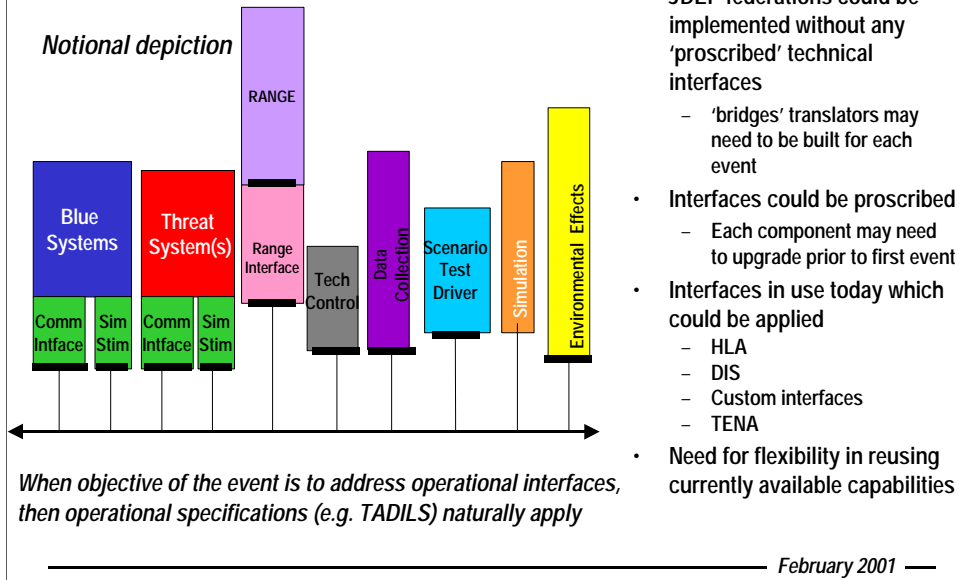
- In a HWIL capability in a lab environment the operational HW and SW is supplemented by some representation of selected aspects of that system to facilitate its use in HWIL applications
 - A HWIL system's "sim-stim" capability typically
 - models the physical platform (movement position), the sensor collector capabilities, and the physical characteristics of the weapon system)
 - injects this data into the 'processor' components of the system, along with other external data about the environment which would effect the system
 - What a 'sim-stim' component includes, and to what degree of detail (i.e. fidelity), is driven by the needs of the application
 - The "comm" interface typically
 - replaces the communication hardware (e.g. radio) with an interface to a surrogate communications method (e.g.) the network to emulate the communications among the distributed networked systems



February 2001

Of note are the 'sim-stim' and communications interfaces, shown as components which accompany the HW/SWIL systems. In a lab based, HW/SWIL environment, you are essentially providing a set of drivers to a system to create the effect of the system operating in a more realistic physical environment. Because the systems are typically stationary in distributed laboratories, the HWIL systems need to be augmented by elements ('compensating' components in key areas such as platform physical behavior and communications exchanges) to reflect their behavior in a more realistic physical environment. This 'compensation' is done in the 'sim-stim' and 'comm interface' components. Depending on the nature of the use of the HWIL capability, these replace elements of physical system (radar receiver, radios, platform movement, etc.) with the appropriate simulations of these system attributes, while exercising the actual hardware and software in the other areas. The decision as to what to represent in the sim-stim or comm interface, and the degree of detail to represent, depends on the nature of the use and is a factor to be considered when creating a federation to meet a user's needs.

Interfaces Among Components



In creating the JDEP framework, we will need to determine the degree to which the interfaces between components should be specified. Federations of components can be developed using the framework without specifying the interfaces. However, this means that with each new federation, component interface 'translators' or 'bridges' would potentially need to be developed as part of the process of assembling the federation, adding to the time and cost to each event, with specific translators being driven by the particular components in that event. On the other hand, if interfaces are specified, this would mean that JDEP components would potentially need to be upgraded to work with the interfaces before they could be considered in the inventory, increasing the 'cost of entry' but lowering the cost of 'doing business' (i.e. creating federations) since the components would be built to a common interface, rather than needing to create multiple n-way translators. Interfaces which reflect the exchanges of C2 information will naturally incorporate the specifications for operational data exchange (e.g. TADILs). Beyond this, there are interfaces and standards (DIS, HLA, TENA) which are being employed to varying degrees by different types of components. These can be practically incorporated into the technical framework. In order to achieve JDEP's objective of broad-based component reuse, a flexible approach to interfaces will be needed.

Network Support to JDEP

- **Networking will be integral to JDEP given the geographical distribution of capabilities**
- **Important to isolate specific JDEP applications from selection of one specific network technology and configuration**
 - Different events will need different bandwidth and performance characteristics
 - Different federations may use different networks
 - A given federation can upgrade or change networks as network technology or business cases demand, without affecting the applications
 - Sites have installed network connectivity which could be leveraged for JDEP events, depending on the characteristics of those events
- **For JDEP this means more flexibility in network options overtime and with different applications**
 - Planning for network support would be an important part of event planning
 - In cases where users are conducting a series of events, then creating standing, dedicated networks may be required; there may be other cases where existing network capabilities may be sufficient

Because JDEP capabilities are currently located in a variety of locations, networking of these components is a key element in JDEP configurations. Again because of the variety of different applications envisioned, the network approach to federations will have to be tailored to the needs of that federation, and an important part of event planning will involve the network. It will be important to leverage the existing network infrastructure to meet JDEP needs wherever possible. But it also needs to be recognized that JDEP applications will have their own requirements and there will be circumstances where new, dedicated network links maintained as a 'standing' capabilities may be the right choice for certain, high demand, persistent JDEP uses.

Simulations as a JDEP Component Type

- By definition, JDEP is a capability which supports HW/SWIL SoS support
- Simulated elements may be incorporated to address aspects of the environment which cannot be done 'live'
 - Elements of the systems of interest are simulated in the 'sim-stim' for a systems (e.g. platform movement)
 - Area-wide effects (e.g. effects of communication or electronic warfare) are simulated
 - Threat systems are typically simulated
 - Blue systems, which need to be present to meet the needs of the event but do not require HWIL can also be simulated
- Simulations offer advantages
 - flexibility, portability, and cost (although not always low cost)and disadvantages
 - questions of validity
- Need for valid system representations is likely to increase as demand for SoS integration and test out strips available of HWIL assets

February 2001

JDEP has been fundamentally viewed as a HW/SWIL SoS capability, however, it is important to recognize the integral role of simulation. Even in a 'pure' HWIL application, simulation is used in the sim stim and comm interfaces to the HWIL components. Simulation is a necessary prerequisite for immersing the HWIL into increasingly realistic operational environments. Blue systems can be represented in simulations, allowing for use of these simulated representations in lieu of HWIL when appropriate. This could be useful in replacing high demand systems needed in multiple applications. It can also be useful in the early stages of development, before prototyping, when only simulated representations are available and SoS issues need to be addressed. Simulations have advantages in terms of flexibility and portability, and cost of reproduction (creating added copies). However, since these are 'representations' and are not the 'real thing', the validity of the representation and its appropriateness to the application need to be addressed whenever simulations are used in these applications.

Building on Current Capabilities

- JDEP will be an umbrella program which provides the mechanisms to apply the substantial inventory of capabilities to issues of SoS integration and interoperability, including HWIL assets, tools and processes, networks, and technical standards
 - **However, it is important to recognize that these extant capabilities have been developed and are being used for other purposes**
 - **Competition for access to these resources needs to be addressed by JDEP**
- Investment will be required to support, upgrade and augment these capabilities with both HWIL and simulation for SoS application based on an understanding of SoS interoperability needs
 - **This needs to be done in partnership with the SoS users, the owners of the capabilities and the organizations responsible for their development and maintenance**

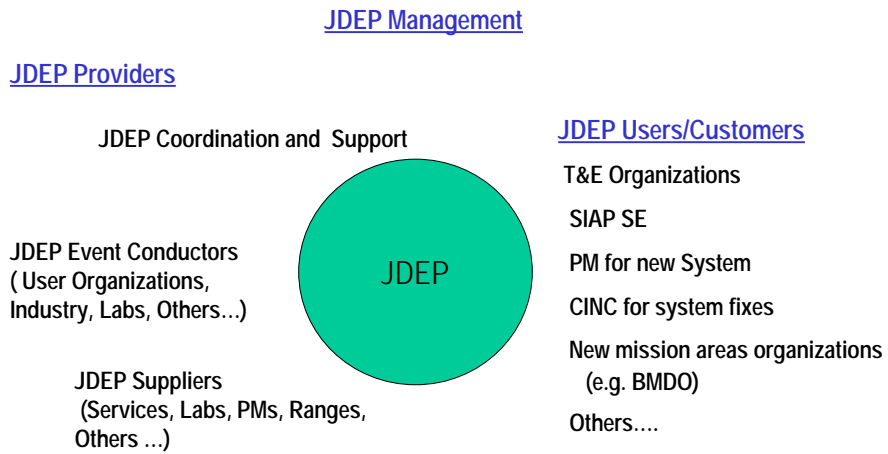
February 2001 —

As capabilities have been discussed, the emphasis has been on the promise of reuse of existing system representations to create SoS environments to support integration and interoperability, as well as reuse of standards, interfaces, processes and tools.

It is important to recognize that while existing capabilities provide a rich base on which to build, to effectively address SoS will involve added investment. This investment needs to be done in concert with both the user of the SoS capabilities and with the providers, including the current 'owners' of the needed capabilities and the organizations responsible for developing and maintaining these, so future investments serve the broad DoD community.

JDEP Participants

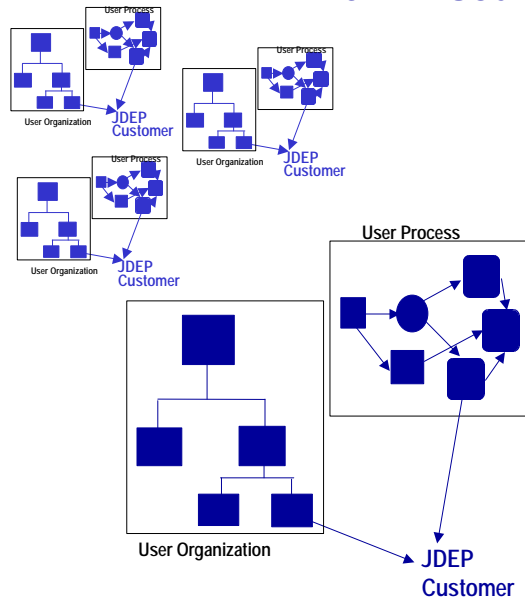
'JDEP Participants' Under Strategy



February 2001

In this slide, the different types of JDEP participants are depicted. In this section these participants, users, providers and management are discussed.

JDEP Users (1)

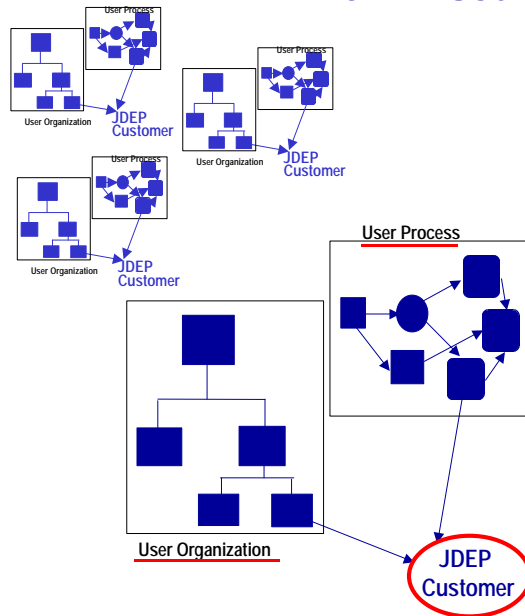


- JDEP users are drawn from different organizations and communities to use JDEP capabilities to address their integration and interoperability test and assessment needs when they require a HW or SW-in-the-loop capability to address these needs
- At any given time, there could be multiple, concurrent JDEP users applying JDEP capabilities to address their issues

February 2001

User needs are the drivers for the creation of JDEP federations and conduct of JDEP events. In the JDEP extension, JDEP will provide support to a variety of different users to meet needs for HW/SWIL SoS environments to address their needs. The results of these JDEP events will support the users in the conduct of their business, reporting through their organizational structure and operating in accordance with their own processes. For instance, a user may be a PM assessing the KPP for his/her system, reporting to his/her Service acquisition authority. The needs driving the construction of the JDEP event will be defined by the the PMs acquisition strategy, user requirements, etc. JDEP's goal is to support this and other users in addressing their particular SoS needs.

JDEP Users (2)

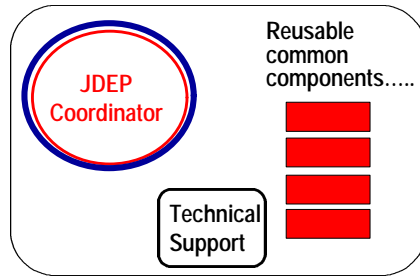


- A user representative (or “**JDEP Customer**”) approaches JDEP for support in creating an environment to support integration and interoperability, to meet a specific need
- The JDEP customer represents the user needs which have been defined by the user’s **organization** and following the **process** defined for that user domain
- JDEP capabilities are configured and executed to address the user issue; the results feed back into the user process under the oversight of the user organization

February 2001

As is shown in this slide, the representative of the user who is directly involved in the development and conduct of a JDEP event is termed the ‘JDEP customer’. This is the person who technically acts for the user organization to address the specifics of the selection, configuration and application of JDEP capabilities.

JDEP Coordination and Support (1)

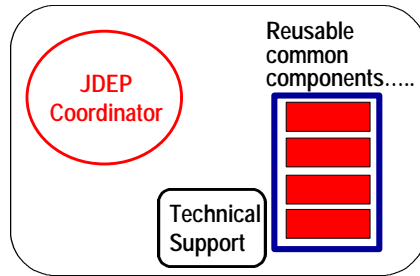


- The JDEP **coordinator** supports users by identifying assets to meet their needs and assisting them in accessing and configuring these assets
- Working with owners of available (suppliers), the coordinator has a broad based knowledge of the available assets and their capabilities and the conditions of their availability
- The coordinator has a solid and evolving understanding of how to configure assets using the technical framework to address a variety of user needs with a supporting technical team with expertise in key areas
- This serves as the basis for the coordinator to work first with users to identify the potential for use of JDEP to meet their needs, and then with their event conductors to realize this potential

February 2001

The second major participant in JDEP is the JDEP Coordinator. The JDEP coordinator is key to the JDEP extension strategy because it is the Coordinator who performs the core function of asset and information sharing in JDEP. The **coordinator** works with the **users** to understand their needs for HWIL and support assets to address their issues, the **suppliers** to understand what assets are available, and with the different event **conductors** to configure and apply these assets to meet the user needs. In this way the coordinator is a keystone in the strategy.

JDEP Coordination and Support (2)

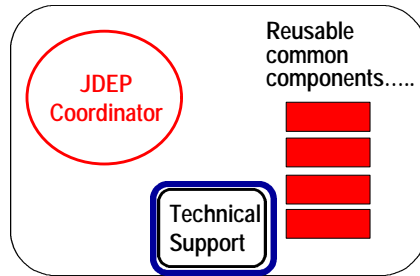


- The JDEP coordinator is also responsible for **components** which are common across JDEP applications and which can be reused by multiple JDEP users
- These include runtime utilities:
 - Technical management and control tools
 - Data collectors
 - Viewers
- These also include supporting processes
 - Common processes for federation development, security certification and VV&A
 - Plan and configuration templates
 - Databases and scenarios
- In addition, the lessons learned from previous applications are available for 'reuse' by subsequent JDEP users through the coordinator

February 2001

A second important function of the JDEP coordinator is the development, maintenance and distribution of the common, reusable runtime support utilities and the general supporting processes and templates which can be applied across JDEP user applications.

JDEP Coordination and Support (3)

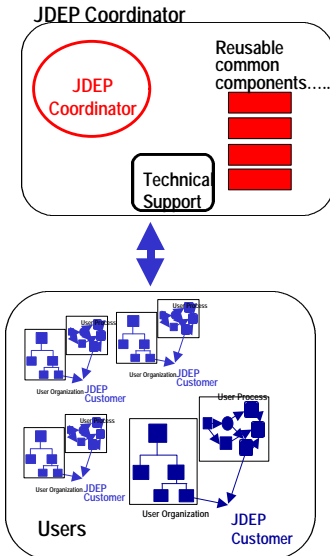


- The JDEP coordinator maintains a **technical support** team to develop and maintain
 - the component based technical framework
 - a growing knowledge base on the use of JDEP components
 - a configuration managed database of JDEP applications
- The technical support group works as part of the teams that support JDEP events building knowledge about the JDEP applications that can be recorded for follow-up events and used as the basis for support to subsequent users; the coordinator develops and maintains a center of expertise on JDEP capabilities and their application to the range of user needs

February 2001

Finally, the coordinator will maintain a technical support team which will serve as a center for expertise on the use of JDEP to support user applications and a database of information (configurations, results, lessons learned) from completed JDEP events. This technical support team may partner with organizations with particular expertise in areas of importance to JDEP users (e.g., networking). Working with the user and supplier communities, this team will develop and maintain the technical framework. Working as part of the teams which are conducting JDEP events, the technical support team will develop a knowledge base which can be applied to subsequent JDEP applications.

Relationship Between User and Coordinator



- The **JDEP coordinator**
 - has a broad purview across the full range of JDEP capabilities and application areas
 - supports the user with information about
 - available capabilities to address user need
 - common tools to support event
 - approaches to configuring or constructing an event, based on general expertise across numerous JDEP applications
- The **JDEP user**
 - has a specific integration or interoperability need which could be addressed by a HW/SWIL capability based on an ongoing user process in response to a user organization

February 2001

There will be one coordinator organization which will serve as the focal point to serve the range of potential JDEP users.

JDEP Event Conductors (1)



- JDEP **conductors** support JDEP users in the execution of JDEP events
 - each JDEP event has a conductor
- The conductor may be drawn from the labs, the PM organization, a T&E organization or industry
- The JDEP event conductor works with the user, suppliers and coordinator to configure, plan, and conduct a JDEP event, including the planning and conduct of data collection and analysis, supported by a team selected to meet the execution needs of the event
- The JDEP event team, lead by the conductor, includes the coordinator, acting as an advisor, and suppliers as well as a range of expertise, drawn as necessary from different organizations to meet the users needs

February 2001

Each JDEP event will have a conductor who will head the team responsible for the planning and conduct of JDEP events in support of the user. The team will be made up of the mix of individual organizations and individuals who all contribute to the conduct of the event.

JDEP Event Conductors (2) 'Event Evaluators'

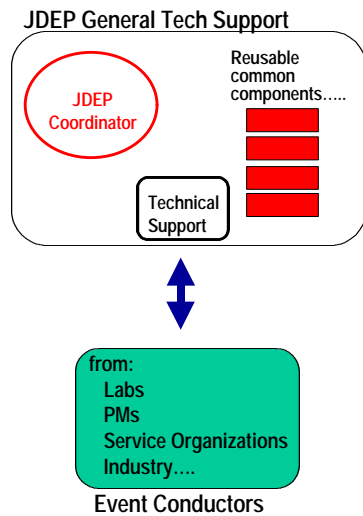


- When JDEP events support test and evaluation activities, there will be the need for an independent **evaluator** as part of the event team
- The 'evaluator' may be selected
 - directly by the user
 - designated by the agency requiring the test activity or by policy
- The 'evaluator' will participate as part of the event team to ensure that evaluation objectives can be met and to provide independent assessment support
- Whether an independent evaluator is required will depend on the user needs for an event

February 2001

Different types of events will have particular needs. T&E events, for instance, may require an independent evaluator, who will be a key player along with the conductor and coordinator in JDEP activities designed to support testing of interoperability. The evaluator here is viewed as part of the team since participation by the evaluation in the creation of the event is important, to ensure that the event provides the data needed for the assessment. However in many cases, the evaluator will play a special role, given their need for independence.

Relationship Between Coordinator and Conductors



- There is one **JDEP coordinator** with
 - a broad purview across the full range of JDEP capabilities and application areas
 - a broad based understanding of general requirements of configuring JDEP federations
 - works with the users and conductors of each event to share their expertise and build on the added experience
- On the other hand, the **event conductor**
 - has specific responsibility for the conduct of a particular event; leads the team for that event
 - was selected by a user for the task
 - has expertise in the subject matter and the conduct of such events

February 2001

There is one coordinator, while there will be many conductors. The coordinator has broad knowledge about JDEP capabilities and their application. The event conductor has specific expertise and responsibility for an event in support of a particular user need.

Given the potentially large numbers of events and variety of event objectives, it is unrealistic to think that one organization could conduct or direct all events which employ the large pool of potential JDEP capabilities. Further, particularly in system development, program managers will want their development teams to conduct events they sponsor to support their own development efforts. Finally, the linkage of facilities to support system test environments is becoming more common as systems become more complex. As a result there is growing expertise in the planning and execution of this type of event in both government and industry which will support JDEP events.

JDEP Suppliers (1)

JDEP components.....from supplier organizations



- JDEP **suppliers** are drawn from different organizations and different communities
- Suppliers are found in labs, in PM organizations, in industry and in T&E facilities
- Suppliers 'own' capabilities, which are needed by other organizations to address interoperability issues
- Suppliers capabilities are accessed, configured, and networked to create environments tailored to meet user's needs
- In the cases where relevant assets are already managed across Services or DoD (e.g. ranges), JDEP will partner with the existing organizations

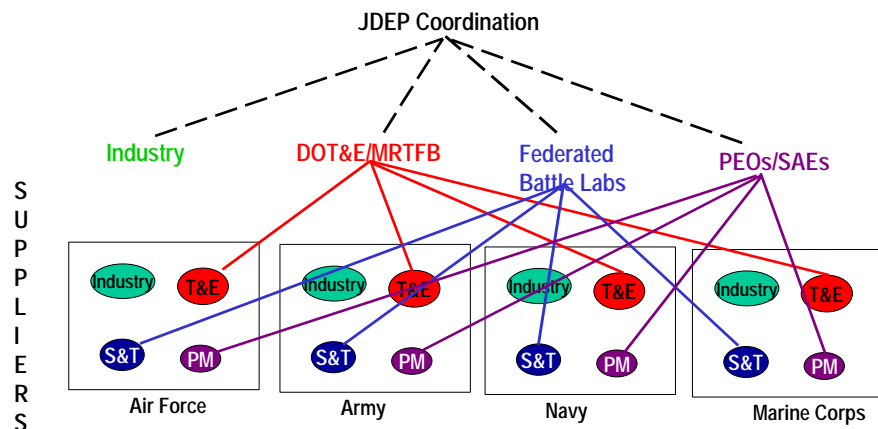
February 2001

The suppliers are the organizations with the piece parts (the simulators, sim-stim, comm interfaces, etc.) which were developed for a specific system applications and which will be reused as part of a JDEP federation to meet a SoS need.

These organizations have developed these capabilities to support their own development of their own systems. They are now needed by others as they develop systems which work as part of a SoS larger environment.

JDEP Suppliers (2)

Linking Assets through Alliances Across Services and Communities
To Support Interoperability

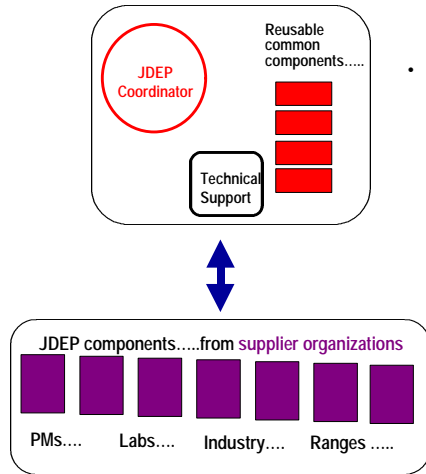


February 2001

HW/SWIL capabilities, as well as supporting capabilities, can be found in all the Services across the labs, ranges, PM organizations and in industry. The idea behind JDEP is that by effectively reusing these we can begin to address SoS activities in a HW/SWIL environment. In some cases, the Services and the DoD (the range community, for instance) have already put into place a mechanism to coordinate use and investment in these facilities. JDEP intends to provide the organizational environment for these organizations to work cooperatively with the SoS user to apply their diverse resources across the DoD to integration and interoperability needs.

The only way this can effectively be realized is by building alliances among the organizations currently supporting capabilities and their use today, to work together to share assets in ways that support SoS development, testing, and warfighter assessment.

Relationship Between Coordinator and Suppliers



- The **JDEP coordinator** maintains information about capabilities which support user needs; these capabilities are owned and provided by **suppliers**
- To support this, there will be an ongoing relationship between the coordinator and suppliers to
 - 'register' assets as JDEP capabilities
 - determine how assets fit into technical framework
 - ensure asset accessibility/usability
 - functional capabilities (VV&A status)
 - physical access (network capabilities)
 - security considerations
 - costs
 - schedule
 - MOAs with participating facilities would ensure the coordinator has up-to-date information and would document special relationships with JDEP (availability, costs, etc.)

February 2001

In order for the coordinator to assist users in identifying the right capabilities to meet their needs and to help them get access to those capabilities, the coordinator will work with the suppliers to understand the capabilities they have available, how those capabilities fit into the technical framework and how users can get access to the capabilities (schedule, costs, lead-time, etc). In addition, for selected capabilities which users may need but would not otherwise be maintained, the coordinator may establish special arrangements with suppliers on behalf of the broader user community.

JDEP Management Functions

- **JDEP management functions**
 - Develop the terms of reference, the roles and responsibilities for JDEP participants, and guidance for the JDEP enterprise
 - Develop a JDEP management and investment plan
 - Provide oversight to the JDEP coordination and general support activities
 - Including MOAs and special relationships with suppliers
 - Support arbitration over access to assets when needed
- **JDEP management oversight**
 - Given the nature of JDEP, it is important that the management oversight
 - be representative of the players
 - provide sufficiently high-level oversight and advocacy for JDEP support to interoperability across the department
 - have broad purview which goes beyond any one mission area

Finally, there will be an overarching JDEP management organization which considers the full complement of JDEP capabilities and applications and provides the supporting management direction and oversight. Given the composite nature of the JDEP enterprise, the oversight and direction to JDEP management will need to be representative of the full range of JDEP participants and will necessarily have broad purview, looking beyond any one mission area. This is the group that will arbitrate access to resources when necessary, and address issues of broad investments to support SoS integration and interoperability.

JDEP Applications

How can JDEP be applied to DOD SoS Issues?

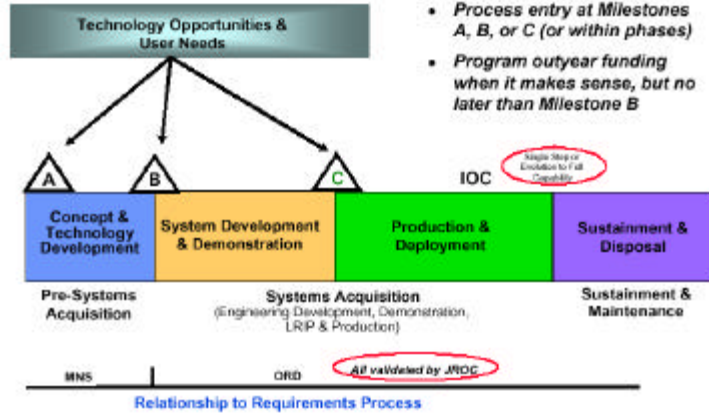
- SoS requirements are growing and there is a need, driven by policy and regulation, to address SoS integration and interoperability issues throughout the lifecycle
 - **From initial requirements definition through fielded system upgrades**
- In selected areas (notably, Joint Theater Missile Defense), there are organizations designated to address SoS responsibilities
- Beyond this, however, SoS responsibilities are distributed across multiple organizations
- JDEP provides the means for these different organizations to access and apply capabilities to address the integration and interoperability needs of this diverse set of potential users

February 2001 —

While ideally, JDEP would be a component of mission area capabilities and management, there is currently only limited organizational structure in place to support these types of activities for selected areas (e.g. JTAMD). In the meantime, there are growing needs for SoS environments to address current interoperability policy requirements. The JDEP extension strategy recognizes this longer term vision. The strategy proposes that near-term capabilities to support near-term users will serve to build the capabilities and experience needed to address the longer-term SoS user needs.

It is important to recognize that JDEP capabilities can be applied throughout this process. While predecessor activities (Navy DEP) have focused on assessing system capabilities from a warfighter perspective, to the degree attention can be devoted to the earlier phases of the process, to address SoS issues during early development, the greater the likelihood that the warfighters will get systems delivered to them with the needed capabilities.

Process in 5000.1 Instruction

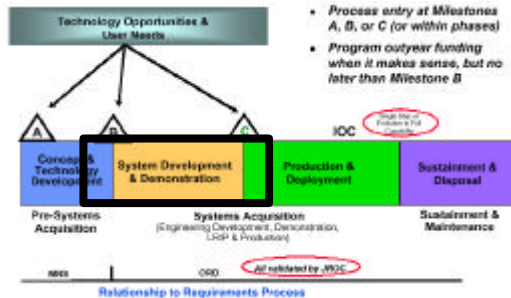


•There are DoD requirements to address interoperability at each milestone (A, B, and C)

February 2001

This slide depicts the new acquisition process as defined in 5000.1 I. DoD regulations call for interoperability to be addressed at each milestone in this process, beginning with requirements.

JDEP and the Acquisition Process (1)

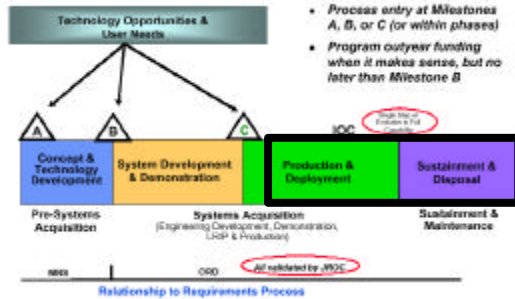


- Early in the acquisition process, simulation is typically used to address SoS issues
 - JDEP needs to be part of a logical progression from simulation-based interoperability activity beginning early and carrying on through deployment
- Once an end item (prototype or otherwise) is available, JDEP could be employed to support SoS using HWIL along with simulation
 - Integration
 - Developmental testing
 - Operational testing
 - Pre-deployment checkout (as done in DEP today)

February 2001

Beginning at the outset of the acquisition process, simulation and analytic tools are increasingly used to address SoS and interoperability issues. Once there is an end item available, HW/SWIL integration and testing can be instituted, supported by simulation. These HWIL activities need to build on and reuse elements of the simulation-based early work. In some cases, the measures or assessment tools will support the use of HWIL capabilities. In other cases, the earlier results will provide guidance on the issues best addressed in a HW/SWIL environment. Finally, in yet other cases, where virtual prototypes have been used to address systems of systems, some of the simulated components may be incorporated into a HWIL federation.

JDEP and the Acquisition Process (2)

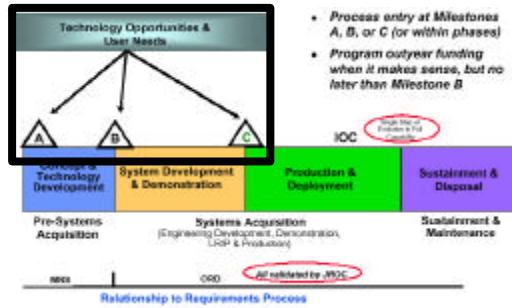


- There are a large number of deployed systems which
 - had no explicit interoperability requirements when developed
 - now need to interoperate to meet today's Joint user needs
- JDEP offers a means to address the interoperability of these legacy systems
 - offers a more controlled environment to examine SoS interoperability
 - place to isolate problems and test fixes

February 2001

While JDEP can support new systems, it is also a potentially useful tool to support the reengineering and upgrades of existing systems, which are large in number, and are being considered for investment to meet current interoperability needs. By using a JDEP environment to examine the nature of interoperability issues with deployed systems, it may be possible to more effectively create a sustainable approach to system upgrades for interoperability and avoid the risk of successive, find and fix interoperability patches which, while they address immediate needs, can lead to longer term problems.

JDEP and the Acquisition Process (3)



- The 5000.1 explicitly allows for the introduction of new capabilities based on technology opportunities, such as successful Advanced Concept Technology Demonstrations (ACTDs)
- It is often the case that ACTDs and similar environments offer prototypes as early system builds
- JDEP would offer the opportunity to examine these new system prototypes from an interoperability perspective early in the process

February 2001

Finally, the new instruction provides added support for spiral development and the injection of advanced technology prototypes into the acquisition process. In both of these instances, JDEP provides the ability to use realistic SoS environment to address interoperability issues with incremental development.

What are the near-term applications of JDEP?

- 1 Developers and testing of **new systems**
 - to integrate or test interoperability of new systems
 - as part of the development process to assess interoperability requirements, KPPs, C4ISP support plans throughout the life cycle
 - in support of system test and evaluation, or
 - as a 'pre-deployment' checkout
- 2 Support interoperability fixes to **deployed systems**
 - to identify interoperability problems among deployed systems now being used in a new way or
 - to integrate and test fixes to these systems
- 3 To assess SoS capabilities in **mission areas**
 - to support assessment of systems of systems issues in joint mission areas
 - to support war fighters in assessing system of system capabilities

February 2001

It is very important that JDEP activities focus clearly on real near-term needs of users. While the need for general joint mission area capabilities is recognized, in many cases the necessary pre-requisites for effective use of HW/SWIL environments enabled by JDEP, are just emerging. In the meantime there are a number of areas where JDEP capabilities could be applied today to build the base for added mission area applications over time.

New system developments are addressing interoperability as part of the development process. As these systems proceed and begin to produce systems, there is a need for a cost-effective way to integrate and test these capabilities during development and as a mechanism for pre-deployment checkout.

Likewise new interoperability needs of existing system are being identified. JDEP capabilities are needed to isolate the current interoperability problems and to test the fixes to these problems.

Finally, mission areas like JTAMD and others will have growing needs for JDEP capabilities to examine ways to use current and new systems to meet new joint doctrine and concepts of operation.

JDEP for New Systems

- JDEP capabilities can be used to integrate or test interoperability for new systems
 - DoD policy calls for definition and support of interoperability throughout the life cycle
 - Once a system has an initial HW/SW development, JDEP could be used to support integration or verification of interoperability with end items
 - as part of the development process, in support of system test and evaluation, or as a 'pre-deployment' checkout
 - When simulated system representations are available early, initial simulation-based efforts can be used as a base for later HWIL testing
- Supports current policy on interoperability KPPs and C4ISP support plans
- As systems mature, a viable 'common environment' will be needed to support interoperability testing; without this individual PMs will create their own environments for their own needs, leading to
 - no reduction in incremental cost with each new system and no assurance that overall systems will be interoperable

February 2001

With the increasing emphasis on interoperability for new system developments, programs will need to identify ways to demonstrate their systems meet their interoperability requirements as they mature. This could mean pre-deployment checkout of SoS capabilities as is done today with the Navy DEP, or better, integration events earlier in the development process to address interoperability issues when the system is early enough in the process to make fixes as part of the development. In some cases this is back in the design phase. To the degree that virtual prototypes are developed, JDEP assets could play a role in these activities as well.

In the absence of a capability such as JDEP, these programs are likely to have to make investments in their own capabilities, if they can afford this, to address interoperability for themselves. This will not only be costly, but with different programs separately developing their own SoS assessment environment we run the risk of mismatches in environments leading to non-interoperability of systems. By reusing common resources, not only are investments in common resources leveraged across programs, but the 'leave behind' from each successive program assessment will build up the base for subsequent users.

JDEP for Legacy System Fixes

- Systems developers could use JDEP to support interoperability of deployed systems to meet user needs
 - to identify interoperability problems among deployed systems now being used in a new way or
 - to integrate and test fixes to these systems
- Support current Joint integration and interoperability processes
 - JFCOM Joint Integration and Interoperability Process (JI&I Process)
- Recommended use of JDEP by JFCOM to support interoperability testing of Army Maneuver Control System (MCS) and the Marine Corps Tactical Combat Operations (TCO) system to meet joint user needs

Second, JDEP offers a resource for deployed systems to use to diagnose interoperability problems and evaluate options for their remedy. This may include system upgrades, or may address a non-material approaches to system of system employment. Given the large number of systems which were developed and fielded before the current trend toward joint doctrine, JDEP might be most valuable for this class of user in the near-term.

JDEP for Joint SoS

- JDEP could be used to address Joint SoS issues in joint mission areas
 - to support assessment of systems of systems issues in joint mission areas
 - such as JTAMD and others as they evolve
- As areas of specific joint interest are identified (e.g. time critical targets), environments will be required to assess the extent to which current system capabilities meet need of joint operations and to test new capabilities as they emerge

Finally, JDEP is best suited for joint system of systems applications such as JTAMD or cross mission issues such as the Single Integrated Air Picture (SIAP). As there is more and more attention devoted to the SoS 'families' in the DoD, JDEP will be an important resource to assess the current state of play with the systems now in place and to evolve the systems to better meet the needs of the Joint war fighter.

JDEP as Part of a Larger 'Toolbox'

- This strategy focuses on use of JDEP to support users, however it is important to explicitly recognize that JDEP
 - is part of a larger set of capabilities available to developers, testers, and war fighters to address their full range of needs
 - addresses a subset of those needs where system level, HW/SWIL capabilities are needed to address specific issues
- As noted earlier, analytic tools and simulations
 - are used early in the life cycle to address many of the issues JDEP can support once an end item has been created, and
 - will continue to be used side by side with JDEP
- Simulations, both man-in-the-loop and constructive, are also used throughout the life cycle
 - to support a number of areas, including concept assessment, operations plan assessment and mission rehearsal and training
 - JDEP assets may be used here when specifics require HWIL capabilities

February 2001

While it is apparent that JDEP can be a very useful capability, it is important to recognize that it is part of a larger suite of tools used in the development, test and assessment of war fighter SoS capabilities. HW/SWIL testing can be costly and manpower intensive, and hence should be reserved for use when other less costly approaches cannot support the need. Simulations and analytic methods, as well as simulation-based exercises can address a number of issues which may not require the HWIL capability provided through JDEP.

Building up JDEP Applications

- Strategy is framed in broad terms, looking at JDEP in the 'objective' or steady-state case, where JDEP will serve a broad range of users
- It is recognized that implementing this strategy will be an incremental, phased process
 - **Established areas such as JTAMD will be leaders; funding is already allocated for JDEP capabilities to address JTAMD specific needs**
 - **Other established, related areas (e.g. joint interoperability certification) may be 'adopted' into the JDEP enterprise adding more capabilities for reuse**
 - **As more capabilities are identified (e.g. range assets); these too will be added to the inventory for potential reuse by others**
- As additional SoS mission areas or mission slices are identified, JDEP will provide a resource for these areas
 - **Added, specific investments are likely in these areas**
 - **As with JTAMD JDEP track 2, these will be handled in a similar manner with new capabilities adding to a growing reusable asset base**

February 2001

This discussion of applications is quite expansive, and could appear unrealistic, looking at the capability available today. This view of the strategy presented here is understood to be far-reaching and focuses on a view of the objective or steady state. To progress to this steady state will require a thoughtful incremental build approach, with clear focus on each added application area, both to ensure value is being provided at each step, and also to learn about the process with each experience, and adjusting the way ahead based on that experience.

Key to this is the identification of areas where there are needs for the type of capabilities described in the strategy. By establishing alliances with the organizations responsible for these areas (eg. Joint certification and testing), and partnerships to pool and share assets, the strategy can support a new way of meeting the composite needs of multiple users throughout the develop and deployment process.

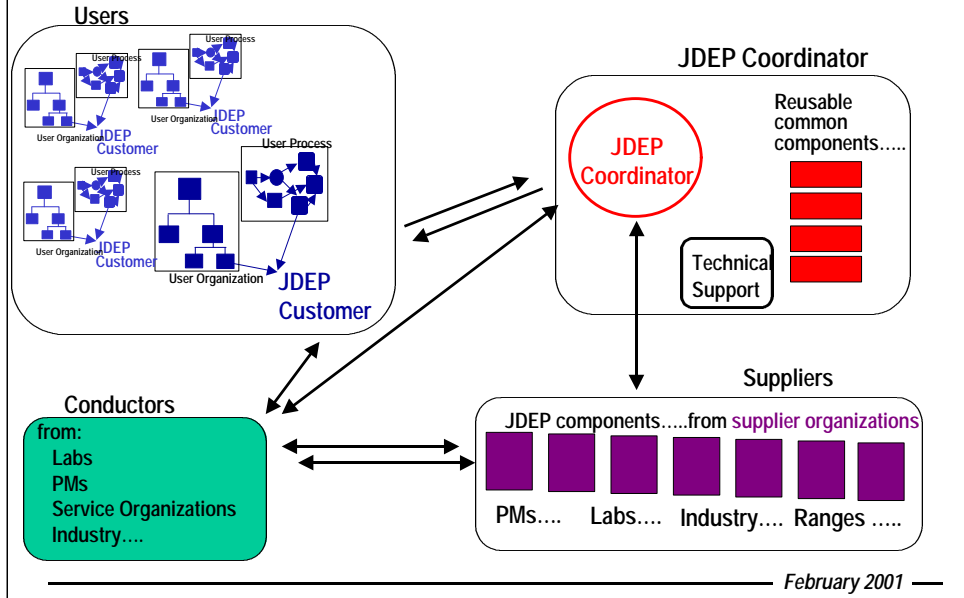
JDEP Concept of Operations

So, in the view of the strategy, what is JDEP?

- JDEP is a collection of **capabilities** used to support hardware /software in the loop integration and interoperability testing and assessment, built to a **common technical framework** so they can be reconfigured to meet needs of different **users**
- Capabilities are provided by **suppliers** to **users**, and are 'coordinated centrally' by a JDEP **coordinator** to support reuse and access
- The JDEP **coordinator** provides community functions to potential **users**:
 - Maintain technical framework to support ease of reuse and reconfiguration of JDEP capabilities
 - Maintain a set of common tools, processes and data for reuse in different JDEP applications
 - Maintain an inventory of JDEP capabilities and advise JDEP users on the location and costs associated with the items they need for their requirements
- JDEP **event conductors** will lead the teams who support the conduct of events
 - Includes event planning, conduct, data collection and analysis
- JDEP **management** provides infrastructure investment, oversees the JDEP coordinator support, and facilitates the arbitration of access to scarce resources

In this final section, we step back and examine how the various pieces described in the preceding sections work together in a JDEP concept of operations or CONOPS.

Schematic of Event CONOPS



This slide reflects the four major participant groups discussed in an earlier section and the interactions among them.

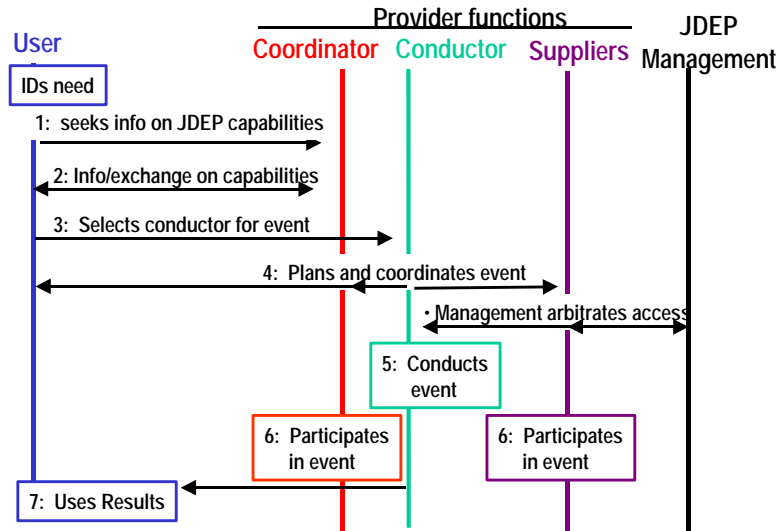
Notional 'Steady State' CONOPS for a JDEP Event

1. **User** identifies a need for SoS HW/SWIL integration or test as a result of ongoing user process
2. **User** through a designated user representative (JDEP 'customer') goes to **coordinator** for information on availability of assets to meet need
3. **Coordinator** provides list of system specific and common components to address needs (including names of **suppliers** and profiles of capabilities, locations, availability, cost); coordinator iterates with user with respect to user's needs, constraints and capabilities, until user finds 'package' which meets needs and resources
4. **User** selects **'conductor'** who works with **coordinator** and **suppliers** to develop plan, conduct the event, collect and analyze data to meet **users** needs (iterating with **users** as required), providing direction to the conductor and suppliers for their services in the conduct of the event; If access to resources becomes an insoluble problem, JDEP Management is called in to arbitrate
5. **Conductor** organizes and conducts the event
6. **Coordinator** participates in order to assess ability of JDEP to meet needs and develop lessons learned
6. **Suppliers** participate in event
7. **Users** take results and apply them to their process

February 2001

In this slide, the basic steps in the formation of a JDEP event are laid out chronologically, beginning with the user identification of a need for a HW/SWIL capability to the application of results from a completed event to the users problem.

'Steady State' CONOPS for a JDEP Application

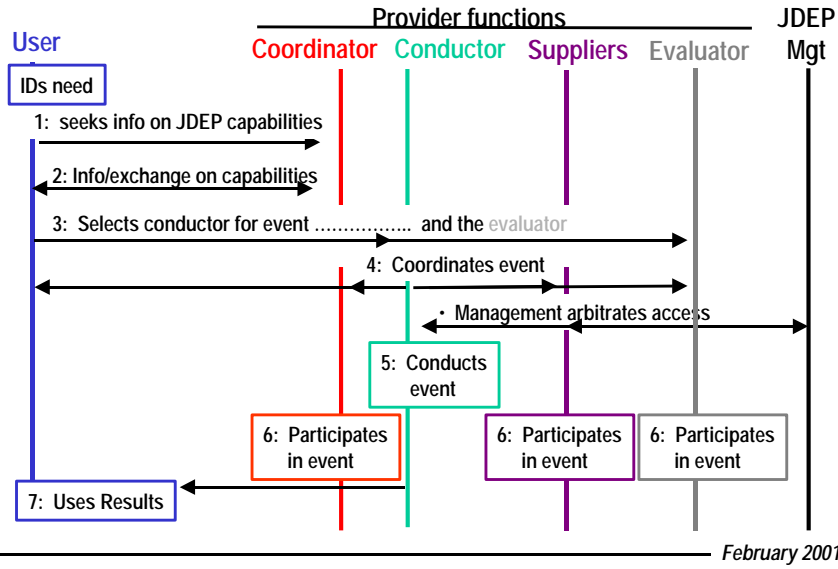


February 2001

This pictorially depicts the current view of how JDEP events would be created and executed in a set of general, logical steps, as described in the previous slide.

This schematic was used to provide a structure to the conduct of the paper use cases which were used to support the development of the strategy. (See support documents). These use case walkthroughs serve to better articulate the roles and responsibilities of the players of different type, missing areas (players, actions) and will serve to refine and adjust the strategy and provide bases for organizational and business model aspects of the strategy. Finally, this assisted in identifying key considerations in actions and investments needed to move from strategy to capability.

Certain Types of Events May Have Added Players Independent Evaluator for T&E Events



This depicts this same sequence of JDEP event actions with the addition of the role of the evaluator. In T&E applications of JDEP an independent evaluator will likely play an important role in the process.

Who Pays for What? (Steady State Case)

- Concept is that JDEP will combine central and application funding
- Central funding will support broad-based common enterprise capabilities
- Specific funding for applications of JDEP to meet user needs
- Application funding might be resources from
 - a Service or Joint program to meet the integration or interoperability needs of that program
 - JDEP funding designated to support a specific mission area or slice or a cross cutting issue (e.g. Single Integrated Air Picture); the JDEP track 2 support to TAMC is an example of this
 - Industry to examine issues on behalf of a customer or on their own behalf (e.g. new system concept)

A major question in the CONOPs is where the resources are applied and by whom. This strategy calls for a combination of some central funding for general reusable capabilities, with a focus on specific funding for the applications of the capabilities to address specific user needs.

Central Infrastructure Funding

- Coordinator activities will be centrally funded, including
 - support to users in identifying and accessing needed capabilities, coordinator participation in the event, and lessons learned
 - maintenance of JDEP technical framework, a knowledge base of available JDEP capabilities, and technical framework and technical expertise in applying JDEP capabilities to the range of user issues
 - collaboration with suppliers to maintain data on capabilities, including availability and cost
 - common runtime and other supporting tools, processes and data to be leveraged across JDEP uses
- JDEP management support and planning will be funded centrally (for investments, application partnerships, etc.)
- Common infrastructure support (e.g. network, selected common use reusable supplier capabilities, etc.) will be funded from common resources

There is a set of functions in the JDEP strategy that benefit the community at large and would not usually be undertaken by any current user or provider organization. These functions would be centrally funded for the benefit of the broad set of current and future users.

Application Funding

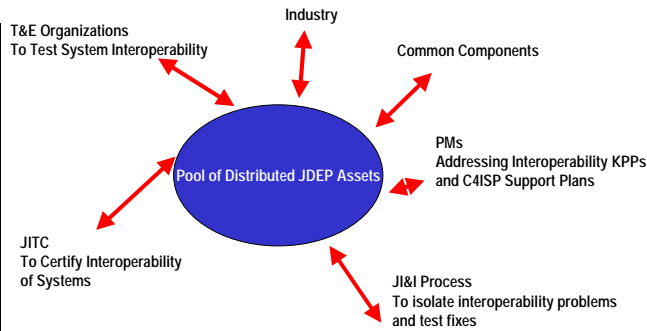
- Conduct of the events, including participation of conductor and suppliers will be the responsibility of the organization sponsoring the application
- This may be done on an the basis of an individual event or event series to meet specific needs of an organization, government or industry
- It may also be designated funding for JDEP expansion and application to a specific area, such as JDEP track 2 JTAMD support

On the user side, it is envisioned that users would be responsible for the costs of planning and executing events and for their own participation in the event (including costs of their HW/SWIL capabilities). This may be by government organizations or industry to support specific events or event series, or it may be through 'block funding' to support a range of mission area functions, such as the TAMD JDEP funding (Track 2).

Summary

In Conclusion, JDEP

Matrixing Assets Across User/Provider Communities to Support SoS Integration and Interoperability



- ...enables DoD to operate at the enterprise-level to build on the current capabilities to address the growing number of SoS integration and interoperability needs
- This JDEP extension strategy provides a first step towards this end

Assets owned by different communities are (logically) 'pooled' and shared among these communities for different SoS uses

Build, Use, Share

February 2001

To summarize, this strategy for JDEP has examined the SoS realities and growing needs in the DoD, and has presented an approach which is built on the concept of collaboration and resource sharing to address needs of system of systems integration and interoperability of developers, testers, and war fighters.

Joint Distributed Engineering Plant (JDEP)

JDEP Strategy

Final Report Supporting Materials

Dr. Judith S. Dahmann
John Tindall

The MITRE Corporation

March 2001

Table of Contents

	<u>page</u>
Part 1: Background, JDEP History and Status	1
Part 2: Strategy Development Approach and Process	14
Part 3: Strategy Drivers	32
Part 4: Relationship of JDEP to Interoperability Policy and Regulations	54
Part 5: Relationship of JDEP to DoD Interoperability Processes	69
Part 6: JDEP Use Cases	83

This annotated briefing is the Interim Report of a MITRE task to develop a strategy for extending the use of the Joint Distributed Engineering Plant (JDEP) to support missions area applications beyond Joint theater air missile defense.

Joint Distributed Engineering Plant (JDEP)
JDEP Strategy

Final Report Supporting Materials

Part 1: Background, JDEP History and Status

Purpose

- Purpose: to provide an overview of the Joint Distributed Engineering Plant (JDEP) history and current status as background to an initiative to develop a future directions strategy for JDEP

The purpose of this section is to briefly outline the history and the progress to date of the Joint Distributed Engineering Plant (JDEP) as background for the discussion of the development of a strategy to extend the JDEP to support a broad set of mission areas.

JDEP Motivation

- JDEP was initiated based on a memorandum
 - From Principal Deputy USD/AT&L and the Director, Force Structure, Resources and Assessment, JS/J8
 - “ We believe an approach taken by the Navy to use a land-based distributed engineering plant (DEP) to address integration and interoperability problems for the fleet (air and missile defenses) may be an appropriate concept to address joint interoperability issues (collaboratively) between all services” (2 June 1999)
- Memo stood up a GOFSG with tasks to
 - Set up and charter a Joint Engineering Task Force (JETF)
 - Oversee and assess JETF efforts to
 - Develop the approaches and costs to construct a Joint DEP
 - Recommend how to best proceed
 - Build consensus and establish ownership

The Joint Distributed Engineering Plant (JDEP) was initiated in June 1999 based on a memorandum from the Principal Deputy, Deputy Under Secretary of Defense for Acquisition, Technology and Logistics (DUSD/AT&L) and the Joint Staff J8. The memo started the exploration of a JDEP concept by standing up a Joint Engineering Task Force (JETF) under the oversight of a General Officer - Flag Officer Steering Group (GOFSG).

Navy DEP Background

- DEP is a Navy initiative
- Responded to recognized need for air defense System of System engineering and testing of Battle Group (BG) Systems prior to deployment (D-Day)
- A component of 'D Minus 30' process of BG deployment
- Distributed, land-based systems Hardware (HW) and Software (SW); integrated over a network for interoperability testing
- Results documented in 'Capabilities and Limitations' document which accompanies deployed BG systems to inform users
- By CNO policy - successful DEP testing is a prerequisite to BG deployment.

February 2001

The direction in the memorandum was to extend the interoperability testing currently provided by the Navy in the Navy Distributed Engineering Plant (DEP) to support Joint system of systems testing. Key attributes of the Navy DEP are presented here. DEP was a Navy initiative which responded to the recognition that system of systems engineering is key to successful operations. As a result a systematic process for the work-up to battle group deployment was created called the D-30 process. The DEP is a component of this process. DEP is a configuration of linked, land based systems designed to allow for pre-deployment testing of battle group theater air missile defense systems prior to deployment. By Navy policy, successful DEP testing, which results in a statement of the battle group capabilities and limitations for the operational user, is a prerequisite to battle group deployment.

JDEP GOFSG and JETF Goal and Tasking

- Collective goal of GOFSG and JETF was to establish a “Joint Alliance” that would
 - Finalize design and build a joint prototype “Plant”
 - Develop a joint test plan and procedures
 - Validate network, simulation/stimulation, and a joint “Plant”
 - Conduct joint interoperability tests
 - Perform data management and analysis

[JETF Final Report V1,4]
- JETF Task
 - “... develop the approaches and costs necessary to construct a Joint Distributed Engineering “Plant” (JDEP) that leverages systems from all the Services to support Joint Force interoperability”

[GOFSG Memo, 2 June 1999]

The memorandum established a General Officer/Flag Officer Steering Group (GOFSG) supported by a Joint Engineering Task Force (JETEF). These groups were charged with the creation of a JDEP to support joint integration and interoperability testing with explicit direction to focus on joint theater air missile defense (JTAMD).

Initial JDEP Purpose in JETF Report

[JETF Final Report, p. 196, 15 November 1999]

- **Threshold** “warfighter, current systems focus”
 - Joint Force interoperability testing of currently and soon-to-be fielded JTAMD Family of Systems (FoS)
 - Identify and fault isolate interoperability problems
 - Joint Force interoperability system engineering to design, develop, and test near-term interoperability fixes
- **Objective** “developing systems focus”
 - Joint Force TAMD FoS interoperability system engineering
 - Design, develop, and test longer term interoperability fixes
 - FoS effectiveness to assess operational benefits of interoperability (low fidelity endgame modeling)
 - FoS effectiveness to assess full end-to-end performance (low fidelity endgame modeling)
 - Joint Force TAMD FoS interoperability requirements development

In the near-term, the JDEP is to identify and fault isolate interoperability problems of fielded or soon to be fielded JTAMD systems and test fixes to these problems with the addition of developmental systems thereafter.

Defense Planning Guidance

[DPG Update FY 2002-2007, Guidance, p.112]

8. (U) Joint Distributed Engineering Plant (JDEP). The JDEP program was established as a DoD-wide effort to link existing service and joint combat system engineering and test sites (including design activities, software support activities, test and evaluation facilities, training commands, and operational units). JDEP is designed to improve the interoperability of weapon systems and platforms through rigorous testing and evaluation in a replicated battlefield environment. PBD 725 provided a \$45 million downpayment across the FYDP to establish the JDEP in phases. The Services shall program the balance of the Joint Engineering Task Force estimate consistent with this phased approach.

The JDEP was incorporated into Defense Planning Guidance (DPG) which authorized core funding for phased JDEP development with Services assuming the costs of their systems' integration and participation in JDEP.

Key Points in Initial JDEP Direction

- Base JDEP on Navy DEP
- Focus on Joint Force TAMD mission area
- Establish a collaborative effort among Services; Services fund their play in JDEP
- Focus on interoperability testing of fielded or soon-to-be fielded systems
- Isolate interoperability problems
- Test fixes

February 2001 —

In sum, guidance was for the initial JDEP to be based on the Navy DEP and focused on Joint Theater Air Missile Defense. It was to be a cooperative effort among the Services with shared funding. JDEP activities were initially focused on interoperability testing of fielded or soon to be fielded air and missile defense systems with the charge to identify interoperability problems and to test the fixes to those problems.

JDEP Major Milestones Prior to Formal Program Initiation

- 2 June 1999 Initiating memo forming GOFSG
- 28 June 1999 GOFSG Meeting
- 30 June 1999 JETF established
- 5 Aug 1999 GOFSG Meeting
- 23 Aug 1999 GOFSG Meeting
- July-Oct 1999 JETF proceedings
- 15 Nov 1999 JETF Report published
- 9 March 2000 GOFSG Meeting
- 7 Feb 2000 JROC JDEP Presentation
- 14 April 2000 GOFSG Meeting
- 16 May 2000 GOFSG Meeting
- 11 July 2000 GOFSG Meeting

February 2001

The GOFSG first met at the end of June and the JETF began work at the same time. The JETF reported its results in November 1999, and since then the GOFSG has met regularly. Given the JTAMD focus of the JDEP activities, JTAMDO was given management responsibility for JDEP in the near term. The guidance to undertake JDEP was incorporated into the Defense Planning Guidance which allocated OSD funding for central components of JDEP development and operations and made it the responsibility of the Services to fund the participation of their Service systems in JDEP.

Scoping of JDEP Development Plans

- JETF proposed a large multi-site, multi-year development with incremental builds
 - **Large scope, high costs were an inhibitor to participation**
- March 00 GOFSG: Guidance to use DoD technical architecture for simulation, HLA, in JDEP to support distribution of test scenario events to distributed system stimulators
- April 00 GOFSG: Rescoped development effort proposed
 - **Small initial event proposed as first step; add one AF (AWACS) and one Army system (Patriot) and one E2C to DEP subset (Navy AEGIS); SIAP SE as user**
 - **Revised costs for expanded JDAMD JDEP implementation**
- Recognition that JTAMD was initial focus; long-term goal was **extension** of JDEP beyond JTAMD to other mission areas and application of JDEP to broader interoperability issues

February 2001

The JETF provided a implementation plan which laid out in detail a phased approach for incrementally building up a JDEP capability for JTAMD over a multiple year period. Their objective was to specify capabilities, which could be built on the DEP and fielded as soon as possible. The estimated costs of the proposal were high and the scope of the effort large, and consequently the plan met with some resistance from participants. Because JDEP was viewed by the JETF as a direct extension of DEP, some technologies used in DEP were directly applied to JDEP. In one case, the GOFSG determined that given the long-term nature of JDEP, upgrades to these technologies were needed. Specifically, in March 1999 the GOFSG concurred that the High Level Architecture for Simulations (HLA) would be incorporated into JDEP for the distribution of ground truth and test stimulation data. Further, the costs associated with JDEP were reviewed and estimates revised and the scale of the initial JDEP implementation was reduced to make the first build more accessible. Finally, it was recognized that JDEP was not intended to be a JTAMD only capability, but that following initial experience with JTAMD, JDEP would be extended to support other areas. Further, the future JDEP would support more than just engineering integration and interoperability testing, and would include operational evaluation and user experience with interoperable systems.

Three Track "JDEP" Implementation Approach

- JDEP is now being considered in three tracks:
 - Track 1: JDEP TAMD Initial **Event**; limited build to establish JDEP concept
 - Four system implementation to demonstrate concept and provide useful results to SIAP system engineer
 - Track 2: **Expand** implementation to address broader JTAMD issues
 - Based on lessons learned from track 1, add systems and sites to support JTAMD integration and interoperability testing
 - Track 3: **Extend** JDEP beyond JTAMD to other mission areas
 - In parallel with tracks 1 and 2, examine how to extend JDEP to meet the similar needs of other mission areas
 - **Focus of JDEP Extension Strategy**

As a result, JDEP is now viewed as three tracks. Track 1 is the JDEP TAMD initial event. This is a limited build to establish JDEP concept involving a four system implementation to demonstrate concept and provide useful results to the SIAP system engineer. Track 2 will expand implementation to address broader JTAMD issues. Based on lessons learned from track 1, track 2 will add systems and sites to support JTAMD integration and interoperability testing. Finally, Track 3 will extend JDEP beyond JTAMD to other mission areas. It is important to begin this in parallel with tracks 1 and 2 to examine how to extend JDEP to meet similar needs across mission areas and to ensure that the activities in tracks 1 and 2 are on the path to future, broader JDEP capability. This project addresses the development of a strategy for JDEP extension for track 3.

Broader Purposes of JDEP

- In the long-term JDEP will assist in building interoperable forces by providing a strategy for:
 - **Developers to engineer interoperability into systems**
 - **Testers to test and evaluate interoperability among systems**
 - **Warfighters to assess the operational capabilities of forces**
- Track 3 JDEP extension strategy needs to consider these broad purposes

February 2001

As a capability to support hardware and software in the loop (HW/SWIL) integration and testing, JDEP is expected to support multiple user communities. These are:

- 1-- The **system developers** who are developing new systems and upgrading existing systems to meet user interoperability needs by providing a tools to support system integration during the engineering of systems and system upgrades
- 2-- The **test and evaluation** community to conduct interoperability testing of systems
- 3-- The **war fighter** to assess the capability available to the operational commander

The types of HW/SWIL capabilities supported by JDEP are costly and are needed by all three communities. It is very important that we find ways to leverage investments in these capabilities by reuse and supporting the full range of users.

Current Status of JDEP

- New start action approved by Congress (September 2000)
 - ‘new start’ requirement and OSD funding limits stalled implementation
- Only the Marine Corps initially POM'd JDEP resources, Navy offered use of DEP facility for one event per year but without funds specified, no resources identified for Army or Air Force; OSD funds committed
- JDEP issue (JFCOM sponsor) in the summer issue review cycle resulted in tasking for Services to pay their share of JDEP costs (IAW DPG) and JITC named management organization beginning in FY02
- Specifics of SIAP SE use of JDEP in progress
- JDEP extension strategy development begins track 3 activity

February 2001 —

JDEP plans to begin implementation in FY01. JDEP was authorized by Congress in September 2000 to initiate the program, and a draft charter for the organization is circulating in review. Although most of the Services did not program funds explicitly for JDEP, OSD augmented the budget to resource JDEP activities. Specific plans for the Single Integrated Air Picture (SIAP systems engineer) use of the initial JDEP are still in development.

Joint Distributed Engineering Plant (JDEP)
JDEP Strategy

Final Report Supporting Materials
Part 2: Strategy Development Approach and Process

Purpose

- Purpose: to provide a description of the approach and process used to develop a future directions strategy for JDEP

The purpose of this section is to describe the plans proposed and implemented for the development of a strategy to extend the JDEP to support a broad set of mission areas, including the approach and the process used to develop the strategy

Purpose of the JDEP Extension Strategy Development

- Begin development of strategy for JDEP Extension Strategy Track 3
 - “Track 3: **Extend** JDEP beyond JTAMD to other mission areas”
- Provide a broader view of the role and form of ‘JDEP’ in the larger issues of System-of-System integration and interoperability testing
- Provide the basic guidance to allow for forward planning of out-year JDEP developments
- Build on lessons learned to date from DEP and JDEP Track 1 activities
- Product is a strategy for moving forward into new areas, **not** the specific plans to get there or selection of next application area

February 2001 —

The purpose of this effort is to develop a strategy to support extension of JDEP beyond the JTAMD mission area to other mission areas. It is intended to take a broader view of the role and form of ‘JDEP’ in the larger issues of system of systems integration and interoperability testing and provide the basic framework to guide forward planning for out-year JDEP developments. This activity will build on lessons learned to date from DEP and JDEP Track 1 activities. The product of the task is a strategy for moving forward into new areas with JDEP, **not** a selection of next JDEP application area. The next step will be to refine this strategy and layout a specific plan of action and milestones for implementation.

Issues for Strategy Development

- “DEP” model and future JDEP characteristics
 - realistic assessment of challenges facing joint system of system (SoS) integration and interoperability testing today
- Changes since conception of the “JDEP”
 - policy, organizational, and technical trends that affect the strategy for JDEP extension
- Assumptions in strategy formulation
 - basic ‘givens’ about JDEP capabilities and scope

In preparing to initiate the development of the JDEP extension strategy development, three major drivers were identified in the strategy development. These are addressed in the subsequent slides.

“DEP” Model and Future JDEP Characteristics

- JDEP was based on the application of the “DEP” to Joint SoS integration and testing
- However, there are important differences between the situation in which the DEP has been implemented and the challenges which face Joint integration and interoperability
- The differences need to be factored into
 - **Understanding the results of JDEP tracks 1 and 2 in use of JDEP for JTAMD, and**
 - **Planning for future extension of the JDEP concepts to other areas**

February 2001

First, it is important to examine the Navy DEP experience in light of the characteristics of the environment which will impact future JDEP applications. By direction JDEP was based on the application of the DEP to Joint SoS integration and testing. However, there are important differences between the situation in which the DEP has been implemented and the challenges that face Joint integration and interoperability. These differences need to be factored into understanding the results of JDEP tracks 1 and 2 in use of JDEP for JTAMD, and planning for future extension of the JDEP concepts to other areas.

Defining Characteristics of DEP, the 'Model' for JDEP

- **Policy** requirements for DEP use
 - CNO requirement that each BG be DEP tested prior to deployment
- **Based in a larger systems engineering process, including**
 - Part of structured 30 month battle group (BG) work-up process
 - Clear definition of components to be tested
 - BG elements are well defined
 - Clear definition of interoperability requirements
 - Interfaces among BG systems are also well defined
 - Well specified test objectives
 - Test plans clearly define expected results
- **Sound technical architecture for test conduct, including**
 - The above factors providing the requirements base to design a engineering system
 - Available components to conduct the testing
 - Navy labs house the HW and SW to be tested
- **Clear organizational responsibilities for test design and conduct, and an**
 - DEP organizational structure links the components belonging to different organizations
- **Established business model for funding and operation of the DEP**
 - Centralized funding with support from supporting labs

February 2001

There are a number of defining characteristics of DEP which has served as the basis for JDEP, the 'model' for JDEP. Because DEP grew out of a strong recognition on the part of the Navy of the consequences of a lack of battle group interoperability, strong **policy** support exists for DEP. It is a CNO requirement that each BG be DEP tested prior to deployment, and this high level policy support for DEP forms a basis for other key characteristics of DEP. The Navy's response to the need for improved interoperability was to build a larger **systems engineering process**, which incorporates the use of the DEP as part of 30 month battle group (BG) work-up process. This means that there is a clear definition of components to be tested. Battle Group elements are well defined. There is a clear definition of interoperability requirements since the interfaces among BG systems are also well defined. This provides the basis for well specified test objectives and test plans which clearly define expected results. DEP is based on a sound **technical architecture** for test conduct, including the requirements base to design a engineering system, the available components to conduct the testing by linking the Navy labs which house the HW and SW to be tested. Finally, given the strong top level support for DEP testing, despite the fact that the BG systems are managed across the Navy, DEP has been able to establish clear **organizational** responsibilities for test design and conduct, and an DEP organizational structure links the components belonging to different organizations. Finally, there is an established **business** model for funding and operation of the DEP, with centralized funding and support from Navy labs.

JDEP Situation, As Compared with DEP

- JDEP extends DEP concept to apply to SoS integration
 - with the constituent systems under the development of different services and agencies
 - with different reporting chains
 - with a mix of different requirements, often with different users
 - on different development and delivery schedules
- These differences pose a new set of challenges for integration and interoperability testing
- As DoD moves to a more 'mission' rather than 'system' orientation for requirements and acquisition, the SoS integration and testing process will become more 'natural'
 - **One reason why initial JDEP application is on JTAMD**

When assessing the JDEP Situation as compared with DEP, there are some important differences. JDEP extends DEP to apply to SoS integration with the constituent systems under the development of different services and agencies, with different reporting chains with a mix of different requirements, often with different users on different development and delivery schedules. These differences pose a new set of challenges for integration and interoperability testing. If DoD moves to a more 'mission' rather than 'system' orientation to requirements and acquisition, the SoS integration and testing process will become more 'natural'. One reason why initial JDEP application is on JTAMD is that this is one area where there has been a mission oriented focus with joint organizations focused on the joint mission.

DEP Characteristics and JDEP Tracks 1/2

- JDEP Track 1 and 2, with its focus on JTAMD/SIAP has some characteristics of DEP
 - **Understood components and interfaces, and to a lesser degree the test objective**
- However, the initial JDEP planning has largely focused on the technical configuration of the HWIL systems in the absence of
 - **Strong policy motivation for participation in SoS integration**
 - **Larger systems engineering process to guide SoS activities**
 - **Organizational structure and business model to support SoS integration and test**
- Further, in JDEP tracks 1 and 2, the objective of testing of 'fixes' requires more flexibility and access to JDEP components than the structured DEP model proscribes

February 2001

JDEP Tracks 1 and 2, with their focus on JTAMD/SIAP have some characteristics of DEP. The JTAMD mission area has well understood components and interfaces, and to a lesser degree interoperability test objectives.

However, the initial JDEP planning has largely focused on the identification and configuration of the multiple sites with HWIL JTAMD systems. While these systems can identified and adapted to support be linkage, the effective use of this capabilities is based on a willingness of the systems owners to apply this capability to SoS issues. Even in the JTAMD area, there is limited explicit or compelling policy or regulations to motivate the participants to adapt their current development activities to address system of system integration activities in JDEP. There is no established larger SoS engineering process to guide these activities. Finally there is no organizational structure and business model to bridge the current organizations and funding allocations to meet the objectives of JDEP . Further, in JDEP tracks 1 and 2, the objective of testing of 'fixes' requires more flexibility and access to JDEP components than the structured DEP model proscribes.

Key Characteristics of Future JDEP Applications

- **Ideally**, JDEP would be implemented in a mission area with:
 - A solid **policy** foundation for system of systems (SoS) integration and interoperability in a JDEP
 - An end-to-end systems of **systems engineering** approach with JDEP as one component
 - Available technical components which could be integrated into a flexible standards based **technical framework**
 - **Organizational structure and supporting business model** which would support JDEP activities
- Again, if the DoD moves towards a more SoS or mission area strategy for requirements, doctrine and acquisition, JDEP integration and interoperability testing becomes an integral part of that process
- **In the meantime, need for improved SoS interoperability is well recognized and JDEP extension is directed towards this need**

February 2001

Ideally, JDEP would be implemented in a mission area with a set of key characteristics. These include

1) a solid policy foundation for system of systems (SoS) integration and interoperability in a JDEP with explicit regulations or requirements which would motivate the developers of constituent systems to incorporate the consideration of the role of their system in a larger suite of systems;

2) an end-to-end systems of systems engineering approach which would guide the developers and testers in addressing the role of their systems in concert with other systems in the process of design, development and testing of their system, with JDEP as one supporting component;

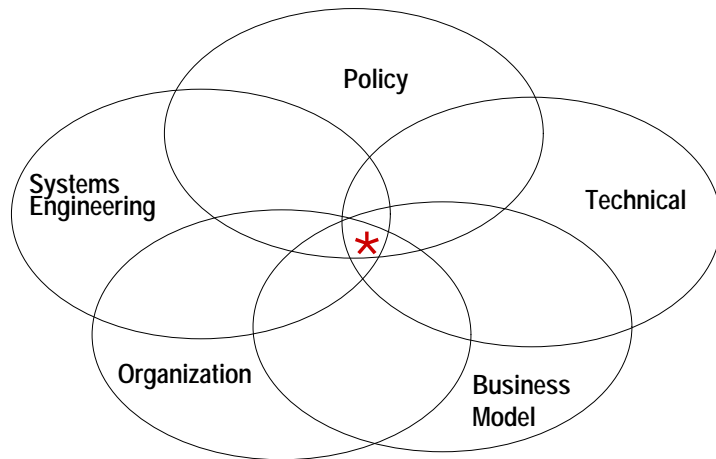
3) available technical components which could be integrated into a flexible standards based technical framework which would support the integration and testing of constituent systems in the system of systems environment ; and

4) an organizational structure which provides the framework for the individual systems to work together to address SoS issues; and

5) a supporting business model which would support JDEP activities by defining how resources would be allocated to the SoS integration and test issues, by the various participants.

Again, if the DoD moves towards a more SoS or mission area strategy for requirements, doctrine and acquisition, JDEP integration and interoperability testing become an integral part of that process. In the meantime, need for improved SoS interoperability is well recognized and JDEP extension is directed towards this need.

Key Considerations



* Ideal case

February 2001

The five considerations:

- 1) the policy context for the application of JDEP capabilities,
- 2) the range of Systems-of-System management and engineering processes which users are employing and will be the context for their need for JDEP capabilities,
- 3) the key needs and risks of a JDEP technical architecture to meet the need of easy, reconfigurability and reuse of JDEP capabilities, and finally issues of,
- 4) JDEP organizational structure, and a
- 5) a business model for resourcing JDEP activities in the near term and in the steady-state.

All five of these need to be considered in the development of the JDEP track three extension strategy.

Realistic JDEP Model

- Realistically, it will be some time before mission areas are well supported (management, policy, SoS engineering processes)
 - **Joint Mission Areas (JMAs) have just been named, JMAs are very broad in nature, and processes for mission capabilities management/capabilities portfolio management are just emerging**
- In the meantime, SoS integration and interoperability testing is needed
 - **JDEP experiences will provide a foundation for maturing mission area SoS engineering and testing capabilities**
- In the JDEP extension strategy development, the challenges of **joint SoS integration and interoperability testing** in today's environment will be examined as they relate to the driving characteristics of the strategy to extend JDEP

Joint Mission Areas (JMAs) were named by the Joint Requirements Oversight Council (JROC) in the summer of 2000. These provide a starting point for structuring operational concepts and systems in a mission area context. The newness of these area definitions emphasizes the fact that there is much to do before the mission area organizational structures and processes are in place which would be require use of JDEP HW/SWIL integration and interoperability test capabilities. However, even without well-established joint mission areas, current operations and systems are employing SoS's and need support in SoS integration and interoperability testing. Rather than waiting for the mission area organizations to mature, by building a capability to conduct SoS integration and test, JDEP can create the foundation needed to support more structured mission area activities as mission area organizations and processes mature. Consequently, as capabilities in JDEP are created to support today's issues, it is important to consider how these capabilities will address emerging mission area needs.

Changes Since Inception of JDEP

- Since JDEP was initiated 15 months ago, added emphasis has been placed on interoperability in a number of areas, including:
 - **Technically** (e.g. Adoption of HLA by IEEE, Development of TENA)
 - **Organizationally** (e.g. JFCOM maturation and initiation of JT&E activities, J I&I Process, T&E infrastructure assessments, FEA interoperability process)
 - **Policy** (e.g. 5000 update, 3170, 6212)
- The JDEP extension study needs to consider these developments in examining options for extended JDEP application
 - Also needs to consider **trends** in the areas

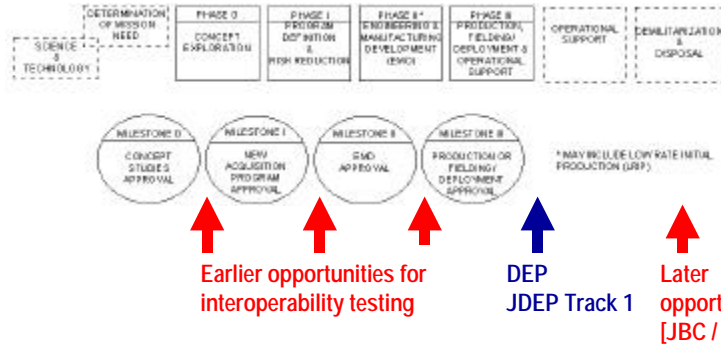
February 2001

The JDEP strategy development also needs to consider the **changes that have taken place since the inception of JDEP.**

Since JDEP was initiated 15 months ago, added emphasis has been placed on Interoperability in a number of areas. In the **technical** arena, interoperability standards have matured and been adopted by industry. HLA has been applied in a number of areas successfully, including support to acquisition and test and evaluation. In September HLA was adopted by IEEE as an industry standard. Development of the Test and Training Range Enabling Architecture (TENA) has continued and matured to the point that offers opportunities for future JDEP capabilities. **Organizationally** interoperability testing has become more widely implemented. JFCOM has matured organizationally and has initiated JT&E activities under the Joint Integration and Interoperability (J I&I) process, Joint Operational T&E has undertaken a major infrastructure assessment in terms of potential support to interoperability. Finally **policy** toward increased interoperability has expanded. This includes updated Defense Acquisition Regulations (5000.1) and Joint Chiefs of Staff Instructions on Requirements Generation (3170.01A) and on Interoperability and Supportability of National Security Systems and Information Technology Systems (6212.01B). The JDEP extension strategy development needs to consider these developments in examining options for expanded JDEP applications well as the trends in organizations, technology and policy.

'JDEP' and Acquisition Policy

Current DoD 5000



- By policy, system interoperability is addressed throughout a system acquisition
- DEP and JDEP now apply just prior to deployment, but could be usefully applied both earlier in the process as well as later for legacy systems
- JDEP's potential may increase further with increased use of **spiral development**
- The changes in acquisition policy and practices need to be considered in the JDEP extension strategy development

February 2001

Current DEP and JDEP track 1 focus on pre-deployment checkout of fielded systems or assessment of interoperability of fielded or soon to be fielded systems.

Under the current policy regulations (5000.1, 3170, 6212), interoperability is be addressed throughout the life cycle. With the large number of legacy systems now being used in ways which required added interoperability than when originated, there are opportunities to use JDEP capabilities throughout the system life cycle.

Since JDEP specifically concerns integration and testing of HW/SW in the loop, JDEP most centrally applies to the the latter phases of the life cycle and the assessment and upgrading of fielded systems to meet new interoperability needs. However, given interoperability policy and current doctrine, there are opportunities for application of JDEP capabilities both earlier in system development and in supporting fielded system upgrades to meet new interoperability needs by the operational user.

Other JDEP Track 3 Strategy Issues: Assumptions

- Track 3: **Extend** JDEP capabilities to other mission areas”
 - What is a ‘mission area’ in this context?
 - Start with J3 mission areas, but recognize that the breadth of these areas require selection of more specific candidate applications which map or cross-cut these
 - What are ‘JDEP capabilities’?
 - Components needed to integrate and test interoperability of systems in an SoS environment (systems, stimulators, scenario generators/simulation drivers, networks, data exchange specs, test plans and procedures, control stations, data collectors, data analysis plans and procedures.)
 - Is Track 3 tied to ‘building on’ Track 1 and 2 capabilities?
 - Different applications will require different system capabilities; JDEP extension should seek to reuse and extend current capabilities as the problem requires
 - Are Track 3 activities tied to the testing of fielded systems? Or can the JDEP be extended to support earlier phases in the system acquisition life cycle?
 - JDEP’s focus is on system integration and interoperability testing; these could be currently fielded systems, proposed system upgrades, coalition systems, legacy systems etc. anytime there are ‘systems’ [end items] available to integrate and test

February 2001

In developing the strategy there are several additional issues that have been clarified as a **starting point** for the strategy development activity. Track 3 is designed to extend JDEP capabilities to other mission areas. With respect to “mission areas”, it is planned that the strategy development will consider the defined J3 mission areas as designated by the JROC, but the breadth of these areas will require selection of more specific candidate applications which map or cross-cut the current mission area designations. Second, ‘JDEP capabilities’ refer to components needed to integrate and test interoperability of systems in an SoS environment. These include the systems, stimulators, scenario generators/simulation drivers, networks, data exchange specs, test plans and procedures, control stations, data collectors, data analysis plans and procedures. When considering the relationship between Track 3 and Track 1 and 2 capabilities, it is recognized that different applications will require different system capabilities. JDEP extension should seek to reuse/expand current capabilities as the problem requires. Finally, there is the question of whether Track 3 activities should be tied to the testing of fielded systems or whether JDEP should be extended to support earlier phases in the system acquisition life cycle. JDEP’s focus is on system integration and interoperability testing throughout the life cycle; these could be currently fielded systems, proposed system upgrades, coalition systems, etc. as soon as there are ‘systems’ available to integrate and test.

General Approach to JDEP Track 3 Strategy Development

- Identify key attributes of strategy for extending JDEP in today's environment, including key considerations for implementing the strategy
 - Policy and management issues
 - Larger systems engineering process
 - Technical framework and available components
 - Organizational structure and business model
- Identify 'reasonable' candidates for track 3 extension which can serve as use cases for assessing strategy and conduct strategy assessment with respect to key considerations and realistic expectations
- Base assessments on identified current and prospective
 - Supporting organizations and facilities (e.g. JFCOM, DISA, Services) and potential business models
 - Current standards-based architectures (e.g. HLA, TENA, XML)
 - Relationship to other interoperability activities (C4ISP, KPP's, IERs)

February 2001

The approach being followed in the development of the strategy is to begin with a review of the history of DEP and JDEP and a realistic assessment of key considerations in developing JDEP capabilities in today's joint system of systems environment. Based on that assessment an initial view of the track 3 strategy has been developed. That strategy will then be assessed and adjusted based on 'paper' use cases with prospective applications of that strategy with logical user applications. The use case applications are not proposals for JDEP applications; rather they are a practical mechanism to assess the strategy. Finally, these use cases and strategy development will be done in the context of current organizations, technology and standards and policy on interoperability.

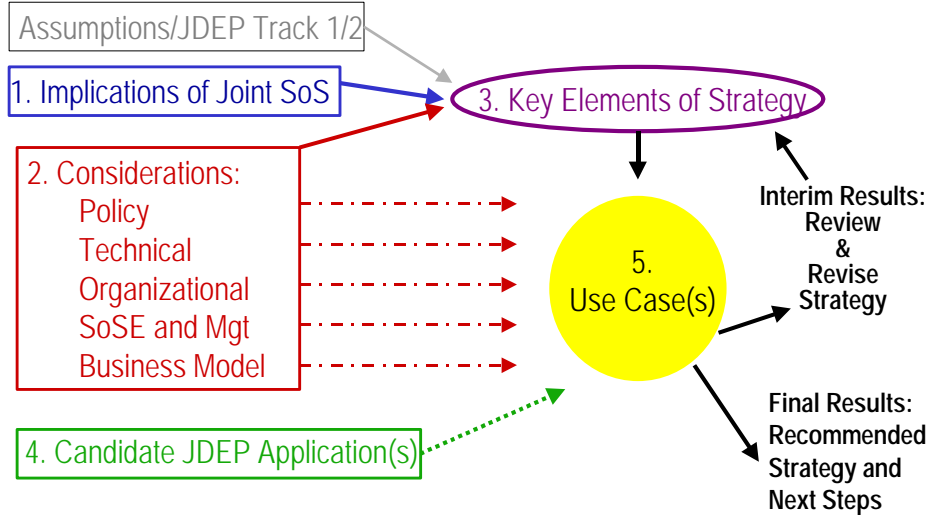
Five Major Steps

- 1 Review the 'realities' of joint system integration and interoperability today, identify the key factors and their impact on a JDEP extension strategy
- 2 Assess state of the practice (SOP) in each of major areas for consideration in JDEP extension strategy
 - Current interoperability policy and effects of spiral development
 - Current organizations currently conducting interoperability testing and their potential role
 - Experience with technical standards based architectures (HLA and TENA)
 - Ongoing efforts to organize and conduct SoS engineering and management
 - Options for 'business model'
- 3 Develop draft strategy based on assessment of realities and SOP
- 4 Identify candidates for use cases and select one (or two)
- 5 Conduct use case(s) to refine and revise strategy

February 2001

The general approach planned to support JDEP track 3 strategy development followed several steps. These are described on this slide and are shown in the figure on the subsequent slide. The first step was to identify the key attributes of strategy for extending JDEP in today's environment, including key considerations for implementing the strategy as were outlined earlier in this paper. These included policy and management issues, the larger systems engineering process, the technical framework and available components to support JDEP testing, and the appropriate organizational structure and business model. These attributes framed a strawman JDEP strategy. The second step was to identify 'reasonable' candidates for track 3 expansion which could serve as use cases for assessing the strawman strategy. Using the use case approach, the strategy was assessed with respect to key considerations and realistic expectations, and refined. These assessments were based on identified current and prospective supporting organizations and facilities (e.g. JFCOM, DISA, Services) and potential business models, current technical standards-based capabilities (e.g. HLA, TENA, XML), and the JDEP relationship to other interoperability activities (C4ISP support plans, KPP's, IERs).

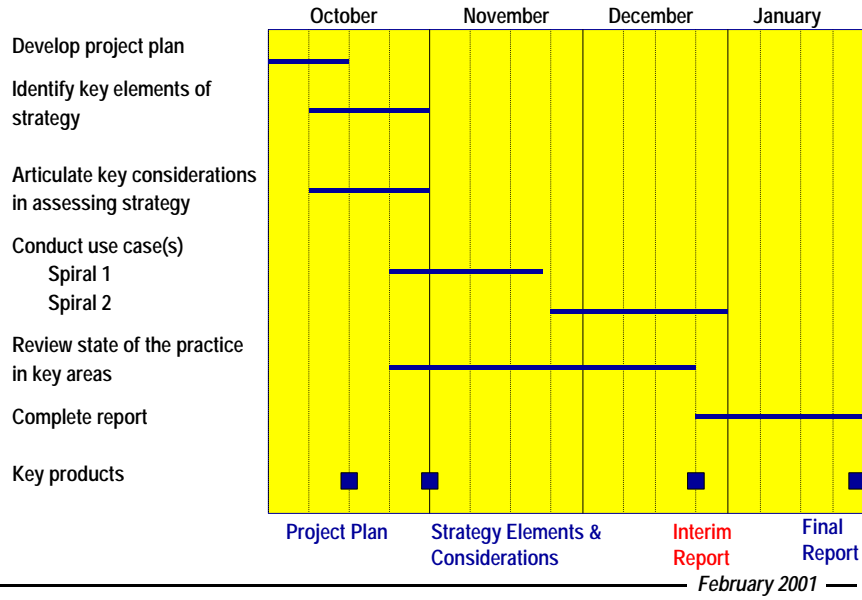
5 Steps Depicted



February 2001

This slide depicts the major steps in the strategy development described on the previous slide.

Tasks and Schedules



The major tasks and timetables are shown in this slide. This annotated briefing constitutes the interim report. The final report will also be in annotated briefing format.

Joint Distributed Engineering Plant (JDEP)

JDEP Strategy

Final Report Supporting Materials

Part 3: Strategy Drivers

Major Drivers in JDEP Strategy Development

- Major drivers in the formulation of a strategy to extend JDEP to support joint mission areas beyond joint air missile defense are:
 - Current Joint SoS characteristics
 - Considerations identified based on an assessment of the DEP experience, including
 - Policy to support joint systems and SoS interoperability
 - Organizational environment
 - SoS management and engineering process context
 - Technical issues
 - Business model considerations

This part of the report reviews the major drivers in the JDEP strategy development. As an initiative to support integration and interoperability of Joint systems of systems (SoS), any strategy for extension of JDEP first needs to take into consideration the realities of today's Joint SoS environment. Further, as was discussed in the initial part of this report, JDEP was modeled after the Navy DEP. The review of the Navy DEP experience in Part 1 suggested there were five areas which should be considered in an extended strategy based on the role of these considerations in the success of the Navy DEP.

Characteristics of 'Joint SoS' Today And Implications for JDEP

Joint SoS Environment Realities

- JDEP is intended to support SoS integration and interoperability testing across multiple mission areas
- In order to develop a realistic strategy for accomplishing this, it is important to appreciate the realities of the environment JDEP is expected to support
- In many ways, Joint SoS is the way of the future driven by joint doctrine (JV2020) and there is considerable movement towards this objective
- However, much of the DoD structure and operations is not currently organized to support Joint SoS development and testing
- The JDEP extension strategy needs to recognize these realities

February 2001 —

Essentially, while doctrine is moving towards increasingly joint operations, much of the structure and organization of the DoD does not directly support Joint SoS. These structural and organizational impediments for SoS pose obstacles to effective JDEP support to SoS needs. However, it is also recognized that there has been considerable movement toward SoS thinking and activity in the past few years and there is a trend towards SoS support in policy and process, both in the Services and at the Department-wide level.

Characteristics of 'Joint SoS' Today And Implications for JDEP (1)

- 1 **Joint SoS areas today are neither well defined nor commonly understood**
 - Very difficult to integrate or test interoperability without SoS 'structure'; for JDEP to be successful it needs to support a real, recognized user need
 - Even when SoS are defined, they inevitably include systems which cross 'mission' lines. This supports notion that any JDEP approach needs to support reuse of 'systems' across JDEP application, just as they are 'reused' in operations
- 2 **Many systems supporting joint areas have been acquired with limited, if any, joint considerations in requirements, delivery timetables, funding**
 - Synchronizing multiple systems is difficult without explicit provisions and funding for integration
 - To be successful, JDEP needs to become a part of 'business as usual', with costs for integration and interoperability testing considered as a cost of doing business
- 3 **Different users, funders and decision authorities control different systems in SoS**
 - Given the diversity in lines of control and responsibility, JDEP needs to address compelling needs driven by requirements and policy of a 'higher' authority

February 2001

In this and the next two slides, key characteristics of the joint SoS environment are summarized. They highlight the fact that there is little agreement today on the definition of joint SoS areas, that many of today's systems did not fully consider SoS issues in their design and development and, when you look across systems which are expected to operate together to support the joint operational user, each system has its own users, funding organization, and decision authorities.

Characteristics of 'Joint SoS' Today And Implications for JDEP (2)

- 4 Limited, if any, requirements for joint integration, testing, fielding processes; unlike the Navy, insufficient appreciation for consequences of a lack of interoperability to make early detection and fixes a priority
 - JDEP needs to be tied to meeting real needs supported by policy where these exist
- 5 Strong Service (title 10) advocacy, but limited joint advocacy (CINCs, JFCOM)
 - Again points to JDEP support to clear policy requirements beyond Service needs
- 6 Services themselves are struggling to deploy complex, under-funded SoS
 - JDEP needs to be flexible to support reuse of Service capabilities when available
 - Need to support a variety of different, emerging SoS engineering, management and development approaches as they emerge
- 7 CINCs (CIPOs) identify issues once systems are deployed, but have little funding or power to make fixes
 - When there is a recognized need, and a need for structured integration and test, JDEP should be prepared to support cost-effectively

February 2001

Further, right now there are few strong, specific requirements for SoS integration, testing and fielding and the appreciation for the consequences of interoperability problems is not sufficient to motivate action to identify and address these issues in the development process. There is little attention on the part of the Services for Joint SoS, and they are struggling with the SoS issues they face within their own Services. The CINCs, as they exercise and deploy using increasingly joint doctrine, are beginning to identify areas where the lack of interoperability poses operational problems. However, the CINCs have very limited resources to address these issues with systems which, when delivered, are typically finished with their development process.

Characteristics of 'Joint SoS' Today And Implications for JDEP (3)

- 8 **Joint Task Forces are tailored to specific needs of particular contingency**
 - Differences across CINCs result from different circumstances, coalition environments of geographical CINCs
 - Leads to wide variety of different SoS configurations, making it very difficult to 'pretest' systems combinations prior to deployment
 - Adds to the costs of JDEP, since it is not affordable to maintain 'copies' of all fielded HW for offline testing
 - Need to find ways to test 'normative case' or use simulated representations of variants of systems where necessary
- 9 **No organizational or management structure in place for Joint SoS**
 - JDEP must be flexible to support integration and interoperability test needs as they evolve supporting organizations which are now responsible, and future organizations as they are created
- 10 **Program budgeting process is tied to individual systems**
 - No natural way to fund SoS, leaving little incentives to PMs (or even PEOs) or contractors to address SoS issues

February 2001

The concept of tailored force packages to meet the needs of JTFs poses added problems for interoperability, because of the increased number of possible combinations of force elements which may be deployed together on short notice. Finally, the lack of organizational structures with responsibility for the integration, testing and integrated deployment of SoS capabilities, combined with the current budgeting approach of focusing funding profiles on individual systems rather than the SoS which constitute the integrated fighting force, limit today's options for addressing these issues.

Implications for JDEP Strategy

- To the degree systems are conceived, developed and tested as part of a larger SoS, JDEP would be a natural and integral part of the development process
- JTAMD is the one area where there is a clear organizational structure for SoS in place
- This means that JDEP needs to have support in other ways if it is to be a viable capability to address near term interoperability needs, and to mature while the Joint SoS concepts take shape

February 2001

What are the implications of current joint SoS environment for JDEP?

While there is a clear need for SoS and a growing policy basis for SoS considerations in new system development, beyond JTAMD, other areas have no SoS clear user and systems development organizations which would be natural 'mission area' users for JDEP. However, as the subsequent sections will point out, while the larger DoD structures are adjusting to the doctrinal shift towards jointness and SoS, the immediate needs to address SoS issues are real. By setting up a structure which will support these near-term users, with an eye on the emerging DoD and joint structures, JDEP can both be maturing its capabilities as the Joint SoS user community congeals, and perhaps assist in that process at the same time.

"Strategy" Considerations

“Strategy” Considerations Summary

- Strategy needs to address 5 considerations:
 - **Policy:** What is the policy context in which JDEP both provides policy support and is supported by policy ?
 - **Organization:** What is the current mix of interoperability organizations and where does JDEP fit?
 - **System of Systems Engineering:** As a set of components to support integration and interoperability testing of systems of systems, JDEP will support the systems engineering process of the user. What is the current state of play with SoS engineering in the DoD?
 - **Technical Architecture:** What is the technical framework for the design and reuse of JDEP components?
 - **Business Model:** How is JDEP resourced? How are resources mapped to the organizational roles and responsibilities

These five considerations were identified in the review of the factors contributing to the success of Navy DEP. These frame five areas to be addressed in considering the shape of the JDEP extension strategy.

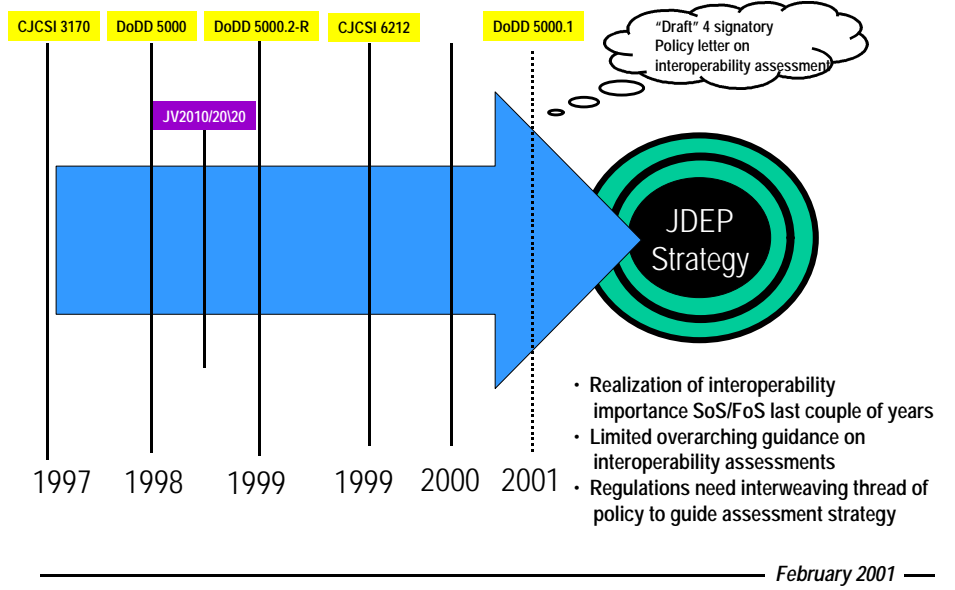
"Strategy" Considerations : Policy

- JV2010 and JV2020 emphasize joint operations and SoS, with the need for interoperability to meet this vision
- As a result, substantial policy and supporting regulations have been instituted over the past three years
- JDEP offers a means to support these policies
- However, for JDEP to be effectively applied, additional
 - **policy on implementation specifics for interoperability verification is still needed as is**
 - **'cross-system' interoperability definitions ('capstone C4ISPs') , to provide common framework across multiple systems**
- Policy on use of JDEP by systems at specific milestones may be considered to ensure commonality of environments in interoperability assessments

February 2001

A review of the current DoD regulations suggests that the emphasis on jointness is US doctrine, in JV 2010 and now JV 2020, is being reflected in increasingly focused policy and regulations on system interoperability. Each revision provides more specific guidance on the interoperability requirements of new systems. There continues to be substantial latitude however on what a program manager is required to do to demonstrate system interoperability. This means that while there are strong policy motivators for environments like JDEP, policy alone does not mean JDEP will be used by programs to address integration and interoperability needs.

Critical Interoperability Regulations



Over the past three years, policies have been providing increased emphasis on system of system interoperability. There will be a need for a way to conduct the system integration and interoperability testing and assessments to address these regulations. JDEP has an opportunity to focus its capabilities on providing the type of support needed by program managers to effectively create interoperable systems which meet the joint war fighter needs.

"Strategy" Considerations : Organization

- Large and growing number of organizations with roles and responsibilities in the area of joint operations and systems of systems, including
 - JROC
 - JFCOM/Joint Integration & Interoperability
 - JITC
 - AT&L Director Interoperability
 - DoD CIO
 - DOT&E
- There substantial existing assets which could be used to address interoperability issues
 - In the Service T&E and R&D communities as well as with program managers
- Rather than replace these, JDEP will provide the support to leverage and reuse these facilities for a range interoperability purposes

February 2001

Along with this movement of policy and supporting regulations has been the shift of organizations created or redirected to address interoperability. Given that interoperability is so entwined in other aspects of system requirements, design, test, etc., it does not make sense for JDEP to create another organization. Rather, it is logical that JDEP approach this opportunity by creating an 'umbrella' initiative to pull together the organizations now in place to collaborate and share resources to provide the HW/SWIL environments needed to support interoperable SoS development, test and operational support.

Organizational Implications for JDEP

- In this context, JDEP will offer an 'umbrella' capability to link current Service, PM and joint facilities to support SoS integration and interoperability testing and assessment
- Facilities, assets and systems remain with 'owners'
- 'JDEP' organization acts as the broker to coordinate and facilitate use of 'JDEP' capabilities, offering common services and a common technical framework to support reuse
- JDEP 'events' could be implemented with support of government or industry organizations to address government (or industry) issues

Following this line of thinking, JDEP would become an umbrella capability, linking those organizations and facilities across the DoD that address individual systems, to form an alliance to reuse system-specific HW/SWIL tools and thereby create an environment to integrate, test, and assess SoS capabilities. JDEP would act as a broker, facilitating the sharing of assets among the owners and users of the capabilities, with implementation of events using these shared assets conducted by government or industry to meet the growing number of user SoS integration and interoperability needs.

“Strategy” Considerations: SoS Management and Engineering

- To be effective, integration and interoperability testing capabilities in a vacuum are insufficient; these need to be applied in the context of a SoS life cycle management and engineering processes
 - **Domain of JDEP user**
- JDEP capabilities must support SoS integration and test as part of the larger, user-specified SoS process
 - **different users have different specific processes**
 - **the current SoS processes are immature and can expect to change a great deal in the near-term as the experience base grows**
- This means JDEP capabilities will need to be agile to operate in context of a variety of user processes which are themselves changing

When the Navy created DEP it was part of a larger process to support managed deployment of Battle Group SoS. For JDEP to be effective, it needs to be supportive of users as they address SoS issues in their development and fielding processes. These processes are in the domain of the JDEP user, and are only now being formalized. A review of these indicates that we still have much to learn about effectively managing such larger complex systems developments.

Multiple Efforts Underway to Develop SoS Processes

- There exist some DoD common tools and efforts to provide common frameworks for describing systems
 - However, these are being used by each Service in different ways
- Number of DoD-level or Joint interoperability processes in development
 - Joint Integration and Interoperability Process (JFCOM)
 - DoD Outcome-Based Interoperability Process (OSD/C3I)
 - Interoperability Test Process (DOT&E)
- Services are also recognizing their own SoS needs
 - Navy Collaborative Engineering Environment (CEE)
 - Initiative underway to develop an approach to Battle Force engineering building on D minus-30 process and DEP
 - AF System of System Initiative Lead by AF CIO and ESC
 - USAF Integrated C2 Architecture
 - Army Battlefield Command and Control System SoS

Fundamentally, there are a variety of processes both documented in regulations and being proposed at both the Service and Joint/DoD levels. Progress is being made, but this is clearly a time of change in this area.

Relationship Between JDEP and these Processes

- As a reusable, reconfigurable inventory of assets, JDEP should be able to support any of these processes when they encounter a need to examine issues in a distributed, hardware/software in the loop environment
- These processes are typically new, and have not yet been used extensively; with experience they are likely to change
- This means that JDEP must be able to support a range of different and evolving user processes

The consequences of this is that JDEP needs to be a very flexible and agile set of capabilities which can support a variety of different user processes, both as they are in place today, and as they are evolve.

“Strategy” Considerations: Technical

- Attention needs to be paid to ensuring that the assets identified for reuse under JDEP can be readily reconfigured without major redesign and development with each subsequent application
 - **Will be important when users want to replicate an older system as a baseline for proposed system changes**
- Also important to recognize that many of the assets in the JDEP ‘inventory’ have been developed for different purposes, at different times using different configuration approaches
- Realistically, JDEP needs to be flexible to accommodate these legacy capabilities along with new developments which may need to be incorporated into a JDEP ‘federation’

From a technical perspective, the major challenge facing JDEP is creating the means to reuse the capabilities available, which were created for use by the systems developer themselves, in new ways to support SoS applications, and to do this efficiently. Care needs to be taken to ensure that the realities of the current capabilities are understood, so that they are applied appropriately to new SoS needs, while at the same time being flexible enough to take advantage of these assets in new and different ways.

Need for a Component-Based Reuse Framework

- Component-based framework is needed to allow for efficient 'composition' of appropriate federations of components to address varying user IO integration and test issues
- Support 'right mix' of live/scripted/simulated components
- Distributed/co-located systems
- Supporting small as well as large scale federations
- Integrating legacy as well as new systems
- Driven by user problem
- Need to leverage simulation in JDEP given high cost of HWIL

February 2001 —

Logically, this requires a framework which will help new users identify the capabilities available and assemble them into an environment which would address their SoS needs, with the objective of efficient reuse and reconfigurability. The framework will need to incorporate the different types of components likely to be appropriate for a diverse set of environments, including simulations as well as HW/SWIL and live, range-based systems. It will also need to consider the fact that these assets will be distributed in different configurations for different applications. The framework will need to support both small and large environments as defined by the SoS issues of the users.

“Strategy” Considerations: Business Model

- Combination of small central funding for basic services and larger funding for application-specific uses
- JDEP use must be tied to real needs and become a routine cost of doing business, hence most costs of JDEP events belong with users
- JDEP basic service support (asset location, common tools, reuse framework) done either by gov't or contractor managed gov't organization
- Arbitration of uses and asset access, on an exception basis
- JDEP events 'conducted' by organizations identified by the user include both government and industry
- JDEP events scheduled in response to needs of users
 - **will include multiple, concurrent small to large events for specific users and larger, combined events supporting multiple users**

Finally there is the issue of who pays for what under an extended JDEP strategy. It will be important that there be some support available for the common functions that support the community at large and that no one user would be willing to support, or that every user would need and it is inefficient to have all users addressing themselves. However, it seems important that the bulk of the resources for integration and interoperability test planning, conduct and assessment rest with the SoS users, who are in the best position to know their substantive needs in this new area. By helping these users address these issues in a common way, using and creating capabilities which can be shared with the others who must interoperate with them from their system perspective, a balance between general capabilities and specific users' needs will be sought.

Summary of Considerations (1)

- Major motivator for JDEP is found in current DoD **policy** and regulations (Interoperability KPPs and C4ISPs) for interoperability
- Multiple **organizations** (Joint and Service) are in place currently working pieces of the problem; JDEP should not replace these, but should
 - **Work across these organizations to bring existing capabilities to bear in a more integrated and efficient way**
 - **Support reuse of existing capabilities toward joint SoS integration and interoperability needs, providing a common DoD-wide direction vector**
- Multiple organizations have evolving **SoS processes** to support their developments; JDEP needs
 - **To respect these processes as an integral part of user operations**
 - **To be sufficiently agile to support multiple, evolving user processes**

February 2001 —

In summary, DoD policy and current regulations provide a strong motivator for JDEP, which has the opportunity to bring together the complex of organizations addressing aspects of SoS integration and interoperability, through their own evolving approaches and process, through a way to pool system specific assets and to share these to address common SoS issues.

Summary of Considerations (2)

- **Technically**, to provide the means to cost effectively federate existing capabilities for Joint SoS purposes, JDEP will
 - Support access to existing capabilities and provide added common capabilities including simulations
 - Create and maintain a technical framework to support capability reuse and reconfigurability, recognizing the legacy investments
- From a **business** perspective, JDEP will
 - Centrally support functions supporting the community at large, including brokering and maintenance of reusable capabilities,
 - Rely on the majority of the resources coming from users who apply these capabilities to meet their integration and interoperability testing needs

JDEP can address this by taking on an enterprise-wide 'broker' role to provide broad access to available capabilities and the technical means for users to locate and make use of those capabilities needed to address their SoS needs, through commonly supported support functions which allow them to more effectively support their own needs through reuse and sharing of assets.

These considerations form the basis for the JDEP extension strategy and concept of operations presented in the following section.

Joint Distributed Engineering Plant (JDEP)

JDEP Strategy

Final Report Supporting Materials

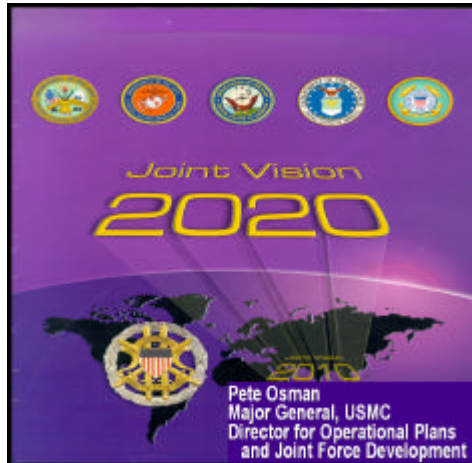
Part 4:
Relationship of JDEP to Interoperability Policy and Regulations

Relationship of JDEP to Policy & Regulations

- 1.) JV 2010/2020
- 2.) Joint Publication 1
- 3.) DoD Regulation 5000.1
- 4.) DoD Regulation 5000.2-R
- 5.) DoD Directive 4630.5
- 6.) DoD Instruction 4630.8
- 7.) DoD Regulation 4120.24
- 8.) DoD Directive 5105.19
- 9.) DoD Regulation 3200.11
- 10.) CJCSI 6212.01B
- 11.) CJCSI 3170.01A
- 12.) C4I Support Plan Guidance & Format (Acquisition Deskbook)
- 13.) DOT&E Interoperability Policy

Complexity characterizes the current Department of Defense (DoD) environment. Technological advances, innovations, and knowledge strategies are becoming a larger part of this landscape than ever before. Moreover, as technological advances, innovations, and strategies occur they impact the performance, capabilities, and importance of other entities in the environment. One system or process will affect other systems or groups of systems in some shape or fashion. The phase was coined that describes a system of systems (SoS), or what is described now as a Family of Systems (FOS) type environment. It is a fluid situation that requires Department coordination, interagency cooperation, and measurable standards to track progress of interdependencies. This is especially true in three areas: major system acquisition, major system testing, and operational war fighting assessments. Joint Vision 2020, the vision of Armed Forces' operations in the year 2020, and before that Joint Vision 2010, recognizes the foundational underpinnings of these interdependencies or the "interoperability" of system of systems or family of systems. Information superiority, dominant maneuver, precision engagement, and focused logistics are all thought of as "pillars" in the Armed Forces vision, but at the base is the interoperability lynchpin that holds all components of the vision up. Additionally, one aspect that cuts across the "pillars" is joint experimentation, and the implications of assessing interoperability for Armed Force systems either in acquisition, testing, and operational conditions.

Guiding Vision For Armed Forces Joint Operations

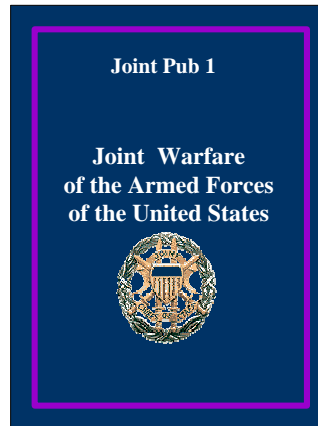


- *Interoperability* is the foundation for Joint Vision 2020
- Full spectrum dominance effectiveness is dependent on improving comms, planning, *interoperability* between organizations; processes; and technology
- Effective *interoperability* depends on the recognition that *interoperability* is about interdependencies and interfaces between and among systems (i.e. it is about families-of-systems or systems-of systems) in a mission area context. (*vision acknowledges criticality of SoS and FoS interoperability - i.e. interdependencies must be tested and exercised*)

February 2001

Interoperability is an integral part of JV2010 and is the foundation for the follow-on Joint Vision 2020. As stated in the briefing charts for JV2020 full spectrum dominance effectiveness is dependent on improving communication (structure and procedures), planning, and ultimately *interoperability* between organizations; processes; and technology. Effective *interoperability* depends on the recognition that *interoperability* is about interdependencies and interfaces between and among systems (i.e. it is about families-of-systems or systems-of systems) in a mission area context. This vision acknowledges the need to assess system performance (e.g. hardware in the loop for the operational test and evaluation). It also places supreme importance on the criticality of the SoS and FoS interoperability and interdependencies that must be tested and exercised to ensure our joint forces can operate in an operational environment.

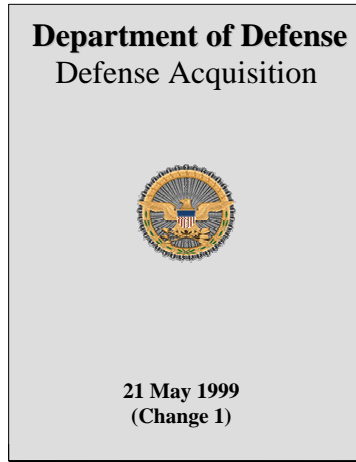
Joint Publication 1: Joint Warfare of the Armed Forces of the United States
(Capstone Doctrinal Joint War fighting Manual)



- The “capstone” doctrinal publication that promulgates that joint force effectiveness is achieved through *interoperability*
- Cites examples of the end-to-end *systems interoperability* requirements to fulfill warfighting needs across the continuum of joint operations
- Further states, “*interoperability*” achieved by “documented policy” covering all aspects of interoperability
- Supports the need for a *JDEP strategy*, “...and a *material development and fielding process* that provides materiel that is fully compatible with and complementary to *systems of all services.*” (*implicitly implies interoperability planned throughout the system life-cycle*)

The “capstone” doctrinal publication that promulgates that joint force effectiveness is achieved through interoperability. This publication cites examples of the end-to-end systems interoperability requirements that are necessary to fulfill warfighting needs across the continuum of joint operations. It further states, “interoperability” achieved by “documented policy” covering all aspects of interoperability. The publication would conceptual support the need for a JDEP strategy capability, and goes on to state “...and a material development and fielding process that provides materiel that is fully compatible with and complementary to systems of all services.” This implicitly shows the need for interoperability planning and assessment throughout the system life cycle for all services. To meet this mandate there should be a Department mechanism for all services to have a means to evaluate interoperability issues for the warfighter so he will be effective in the desired operational scenario. The warfighter should have a means to evaluate his system interoperability performance before that system is bought to the fight.

DoD Regulation 5000-1 (Defense Acquisition)



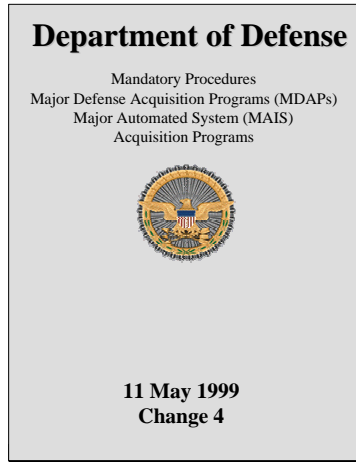
- Department's overarching regulation for major acquisition policy and **total system interoperability** guidance
- ... how the system will be deployed to this environment; the system's compatibility, **interoperability**, and integration with other systems; the operational and support infrastructure (including Command, Control, Communications, Computers and Intelligence (C4I))...
- Directs that "The JROC validates the C4I certification of mission need and operational requirements documents for conformance with joint C4 policy and doctrine, architectural integrity, and **interoperability** standards."
- Important in this evaluation process for new or modified systems are considerations for compatibility, **interoperability, and integration** with existing and future components or systems.
- Document identifies the systems of systems concept, and establishes the JROC as the **interoperability standards** validation authority.

February 2001

The Department's overarching regulation for major acquisition policy and total system interoperability guidance. It proscribes how the system will be deployed in this environment; the system's compatibility, interoperability, and integration with other systems; the operational and support infrastructure (including Command, Control, Communications, Computers and Intelligence (C4I))...etc. It goes on to direct that "The JROC validates the C4I certification of mission need and operational requirements documents for conformance with joint C4 policy and doctrine, architectural integrity, and interoperability standards." Important in this evaluation process for new or modified systems are considerations for compatibility, interoperability, and integration with existing and future components or systems. The Document identifies the systems of systems concept, and establishes the JROC as the interoperability standards validation authority, no directive on testing. This implicitly implies that there should be some system-of-system performance testing throughout the system life cycle to measure the degree of interoperability and integration, thus ensuring an interoperable system when fielded to the warfighter.

DoD Directive 5000.2-R

(Mandatory Procedures for Major Defense Acquisition Programs (MDAPs)
and Major Automated Information System (MAIS) Acquisition Programs)



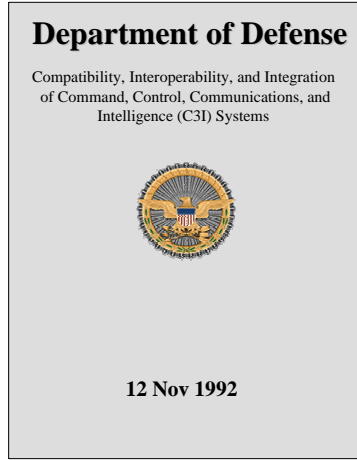
- Department's overarching regulation for major acquisition policy and *interoperability* implications for MDAPs & MAIS
- Threat projections, system performance,... *interoperability*, ... major considerations at each milestone decision point, including the decision to start a new program.
- The Director, DISA certification of interoperability must be completed for C4I systems with *interoperability* requirements before Milestone III.
- ... operational testing program that assesses performance and quality, compatibility, and *interoperability*, and identifies deficiencies shall be conducted, as appropriate.
- Identifies the importance of *interoperability* testing, and stresses the importance of interoperability compliance, and the assessment of these interoperability requirements at each major system milestone.

February 2001

The Department's overarching regulation for major acquisition policy and interoperability implications for Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs. This includes threat projections, system performance,... interoperability, ... major considerations at each milestone decision point, including the decision to start a new program. It specifies that the Director, DISA must provide a certification of interoperability and this must be completed for C4I systems with interoperability requirements before Milestone III. The regulation further states that there must be an operational testing program that assesses performance and quality, compatibility, and interoperability, and will identify deficiencies, as appropriate. Overall 5000.2-R identifies the importance of interoperability testing, and stresses the importance of interoperability compliance, and the assessment of these interoperability requirements at each major system milestone.

DoD Directive 4630.5

(Compatibility, Interoperability, and Integration of Command, Control, Communications, and Intelligence (C3I) Systems)

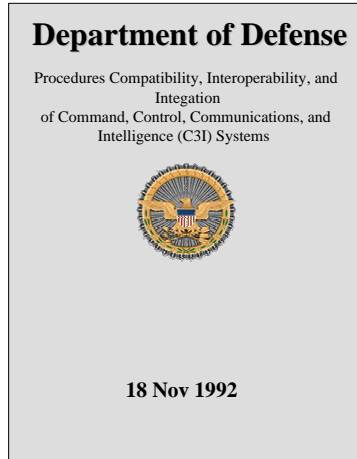


- Specifies forces must have *interoperable* National Security Systems, and Information Technology Systems
- Applies to all new C3I systems (including nondevelopmental systems) and major changes (e.g. release of a new software version) to existing systems that must interact with or be *integrated* into C3I structures of the Department.
- Specifies DoD policy to establish as a long-term objective of a global C3I infrastructure that can accommodate the widest possible range of missions and operational scenarios by allowing users to enter the infrastructure at anytime, anyplace, in the execution of any mission.
- Stresses the need for operational systems that meet the needs of the commanders in the field in the fulfillment of their operational missions, and the *interoperability* of these systems is vital to mission success

This regulation specifies forces must have interoperable National Security Systems, and Information Technology Systems. It applies to all new C3I systems (including nondevelopmental systems) and major changes (e.g. release of a new software version) to existing systems that must interact with or be integrated into C3I structures of the Department. Further implements DoD policy to establish as a long-term objective of a global C3I infrastructure that can accommodate the widest possible range of missions and operational scenarios by allowing users to enter the infrastructure at anytime, anyplace, in the execution of any mission. Moreover, stresses the need for operational systems that meet the needs of the commanders in the field in the fulfillment of their operational missions, and the interoperability of these systems is vital to mission success.

DoD Instruction 4630.8

(Procedures For Compatibility, Interoperability, and Interoperability of Command, Control, Communications, and Intelligence (C3I) Systems)

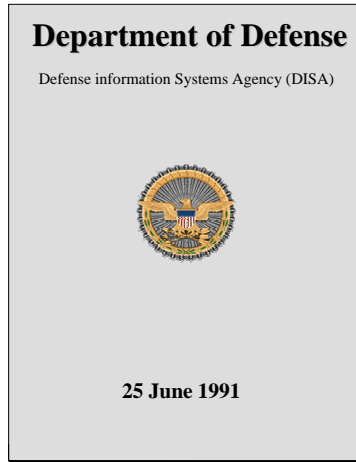


- Specifies all NSS and ITS are for joint use and shall be certified by DISA in the acquisition process.
- Describes the process whereby compatibility, *interoperability*, and integration requirements for new or modified C3I capabilities are stated, coordinated, validated, and approved.
- Applies to all C3I capabilities (including DoD National Foreign Intelligence Programs and Tactical Intelligence and Related Activities) and to the acquisition of new C3I systems (including nondevelopmental systems) and major changes (e.g. release of a new software version) to existing systems, where such capabilities and systems must interact or be *integrated* into the DoD C3I infrastructure.
- Highlights the need for *interoperability* and integration of C3I requirements throughout validation process and shall be updated as necessary throughout the acquisition period, deployment, and operational life of a system.

February 2001

This instruction specifies all NSS and ITS are for joint use and shall be certified by DISA in the acquisition process. Describes in detail the process whereby compatibility, interoperability, and integration requirements for new or modified C3I capabilities are stated, coordinated, validated, and approved. The instruction applies to all C3I capabilities (including DoD National Foreign Intelligence Programs and Tactical Intelligence and Related Activities) and to the acquisition of new C3I systems (including nondevelopmental systems) and major changes (e.g. release of a new software version) to existing systems, where such capabilities and systems must interact or be integrated into the DoD C3I infrastructure. Ultimately highlights the need for interoperability and integration of C3I requirements throughout validation process and shall be updated as necessary throughout the acquisition period, deployment, and operational life of a system. Demonstrates the need for an interoperability assessment strategy that will be available throughout the system life cycle.

DoD Directive 5105.19
(Defense Information Systems Agency (DISA))



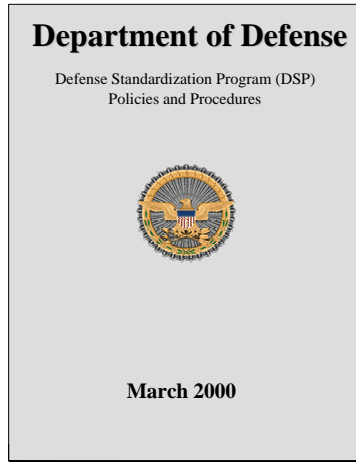
- Specifies Director DISA Serve as the DoD single point of contact for development of information technology standards (information, information processing, and information transfer).
- Directs development and conduct of a C3I systems *interoperability* testing and certification program, in collaboration with the other DoD Components, to verify *interoperability*.
- Director DISA certifies to the developmental and operational testing organizations and the Chairman of the Joint Chiefs of Staff that C3I systems and equipment meet the applicable standards and requirements for *interoperability*, compatibility, and integration based on certification testing.
- Receive, for inclusion in the Joint C3I *Interoperability* Requirements Database, all approved DoD Component MNSs and subsequent ORDs for new developments, acquisition, or modifications of C3I systems.
- Verify that such requirements are consistent with appropriate techniques, procedures, architectures, interface standards, integration requirements, and definitions for the C3I systems.

February 2001

This directive specifies Director DISA Serve as the DoD single point of contact for development of information technology standards (information, information processing, and information transfer). Also directs development and conduct of a C3I systems interoperability testing and certification program, in collaboration with the other DoD Components, to verify interoperability. The Director DISA certifies to the developmental and operational testing organizations and the Chairman of the Joint Chiefs of Staff that C3I systems and equipment meet the applicable standards and requirements for interoperability, compatibility, and integration based on certification testing. The Director DISA receives for inclusion in the Joint C3I Interoperability Requirements Database, all approved DoD Component MNSs and subsequent ORDs for new developments, acquisition, or modifications of C3I systems. The Director verifies that such requirements are consistent with appropriate techniques, procedures, architectures, interface standards, integration requirements, and definitions for the C3I systems. Implicit in this guidance is the need for an environment or strategy to do interoperability certification.

DoD Directive 4120.24

(Defense Standardization Program Policies and Procedures)



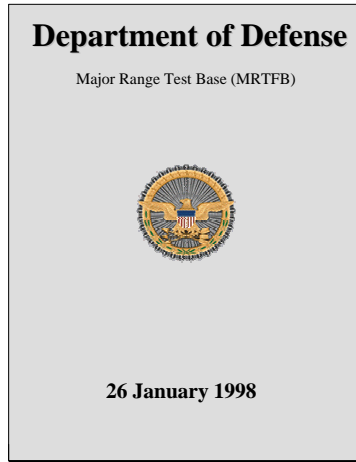
- This document prescribes the policies and procedures for implementing the DSP as required by 10 U.S.C.2451-2457. DoD 4120.3-M, "Defense *Standardization* Program Policies and Procedures."
- *Interoperability* with multinational partners and *among the Military Departments* requires standardization of physical, electronic, and functional interfaces and performance requirements
- Specifies *Interoperability* as one of its goals. More focused towards coalition *interoperability*
- Establishes the Defense Standardization council to *support* the development and use of *interoperability* standards for national and international use.
- Promulgates *interoperability*, compatibility, and integration are key standardization goals that must be satisfactorily addressed for all acquisitions.

February 2001

This document prescribes the policies and procedures for implementing the Defense Standardization Program (DSP) as required by 10 U.S.C.2451-2457. DoD 4120.3-M, "Defense Standardization Program Policies and Procedures." It advocates Interoperability with multinational partners and among the Military Departments requires standardization of physical, electronic, and functional interfaces and performance requirements. It goes on to state and specify Interoperability as one of its goals. It is a document/regulation more focused towards coalition interoperability. DoD 4120 establishes the Defense Standardization council to support the development and use of interoperability standards for national and international use. The regulation promulgates interoperability, compatibility, and integration are key standardization goals that must be satisfactorily addressed for all systems acquisitions.

DoD Directive 3200.11

(Major Range and Test Base (MRTFB))

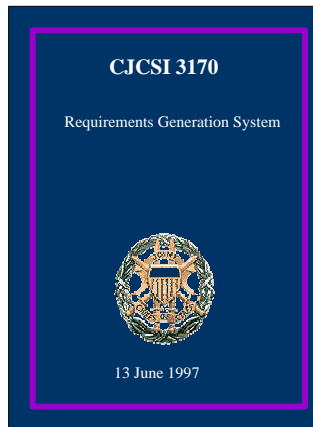


- This document updates policy and responsibilities for the management and operation of specific DoD test and evaluation (T&E) activities
- The MRTFB is a national asset that shall be sized, operated, and maintained primarily for DoD T&E support missions, but also be available to all users having a valid requirement for its capabilities.
- In accordance with DoD 5000.2-R (reference (d)), T&E programs shall be structured to integrate all developmental T&E, operational T&E, live-fire T&E, and modeling and simulation activities conducted by different agencies as an efficient continuum.
- Lists the Joint *Interoperability* Test Command as one of MRTFB

February 2001

This document updates policy and responsibilities for the management and operation of specific DoD test and evaluation (T&E) activities. The MRTFB is a national asset that shall be sized, operated, and maintained primarily for DoD T&E support missions, but also be available to all users having a valid requirement for its capabilities. In accordance with DoD 5000.2-R (reference (d)), T&E programs shall be structured to integrate all developmental T&E, operational T&E, live-fire T&E, and modeling and simulation activities conducted by different agencies as an efficient continuum. This directive lists the Joint Interoperability Test Command (JITC) as one of MRTFBs. Potentially, this set of resources could be leveraged to provide a set of facilities for a JDEP strategy. Interoperability testing could be done IAW JDEP strategy.

CJCSI 3170.01A
(Requirements Generation System)



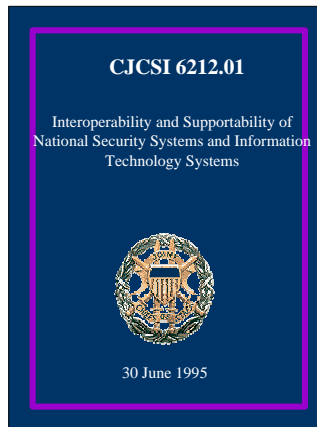
- Specifies common formats to all requirements documentation which should provide better visibility, recognition, and accommodation of joint requirements opportunities and *interoperability* issues earlier in the requirements generation process.
- Mandates *interoperability* Key Performance Parameters for CRDs and ORDs and defines time-phased requirements in support of evolutionary acquisition, addresses program affordability for ORDs, defines US Joint Forces Command role for *interoperability*, and clarification of definitions.
- "All" C4I and ISR systems for purposes of compatibility and *interoperability* and integration are considered joint.
- These functions include *interoperability* certification; intelligence certification; threat validation; aviation munitions *interoperability* and munitions insensitivity certification and the staffing of all documents that the JROC reviews.

February 2001

This JCS Instruction specifies common formats to all requirements documentation which should provide better visibility, recognition, and accommodation of joint requirements opportunities and interoperability issues earlier in the requirements generation process. It mandates development of interoperability Key Performance Parameters (KPPs) for Capstone Requirements Documents (CRDs) and Operational Requirements Documents (ORDs) and defines time-phased requirements in support of evolutionary acquisition, addresses program affordability for ORDs, defines US Joint Forces Command role for interoperability, and clarification of definitions. Promulgates that "All" C4I and ISR systems for purposes of compatibility and interoperability and integration are considered joint. These functions include interoperability certification; intelligence certification; threat validation; aviation munitions interoperability and munitions insensitivity certification and the staffing of all documents that the JROC reviews.

CJCSI 6212.01B

(Interoperability and Supportability of National Security Systems and Information Technology Systems)



- Instruction assigns the Director for C4 Systems, Joint Staff (J-6), is assigned primary responsibility for C4I systems compatibility, *interoperability*, and integration, to include adequate coordination and expeditious resolution of all related issues.
- **One Hundred Percent *Interoperability***. One hundred percent *interoperability* is the free and transparent transport, translation, and processing of information between and among users, no matter what the warrior's environment, platform, and C4I resources of convenience or necessity may be.
- Besides equipment *interoperability*, the instructions further state that it is essential that information within the system only be entered once and be shared thereafter by anyone requiring access.
- Advocates adherence to approved standards will result in improved *interoperability* and permit access to the infosphere described in the C4IFTW concept.
- Interoperability standards are to be identified; however, interoperability standard verification can be influenced by PMs/Contracting Officers (CO), and the tools for evaluating interoperability can be biased towards Service or PM/CO views

February 2001

This JCS Instruction assigns the Director for C4 Systems, Joint Staff (J-6), is assigned primary responsibility for C4I systems compatibility, interoperability, and integration, to include adequate coordination and expeditious resolution of all related issues. One hundred percent interoperability is the free and transparent transport, translation, and processing of information between and among users, no matter what the warrior's environment, platform, and C4I resources of convenience or necessity may be. Moreover, besides equipment interoperability, the instructions further state that it is essential that information within the system only be entered once and be shared thereafter by anyone requiring access. It advocates adherence to approved standards will result in improved interoperability and permit access to the infosphere described in the C4I For-The-Warfighter (C4IFTW) concept. Interoperability standards are to be identified; however, interoperability standard verification can be influenced by PMs/Contracting Officers (CO), and the tools for evaluating interoperability can be biased towards Service or PM/CO views. A JDEP strategy would reduce the complexity of achieving 100% interoperability among systems, and would increase the efficiency of the certification process.

C4I Support Plan Guidance Format (Acquisition Deskbook)

Acquisition Deskbook

C4I Support Plan Guidance and Format



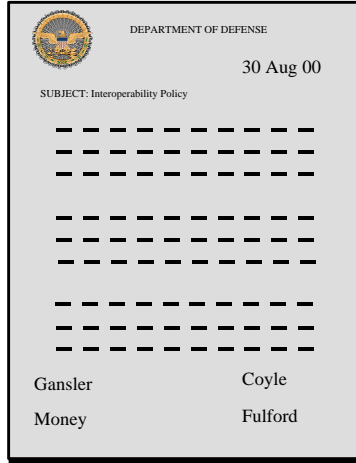
- Outlines the guidance and format for submission of C4ISP support plans and resolution and assessment of issues
- Proscribes the description of architectures and nature of information exchanges in enough detail to ascertain specific connectivity and *interoperability* requirements
- Specifies that the C4ISP write up should include a discussion on *interoperability*, and operations with coalition and allied forces
- By regulation is to be submitted IAW CJCSI 6212 to make system acquisition decisions
- *A JDEP strategy would allow assessment of C4ISP interface issues, with hardware in the loop testing of a particular interoperability issue*

February 2001 —

The desk book outlines the guidance and format for submission of C4ISP support plans and resolution and assessment of interoperability issues. It proscribes the description of architectures and nature of information exchanges in enough detail to ascertain specific connectivity and *interoperability* requirements. It further states that the C4ISP write up should include a discussion *interoperability*, and operations with coalition and allied forces. The C4ISP by regulation is to be submitted IAW CJCSI 6212.01B for use in making system acquisition decisions. *A JDEP strategy would allow assessment of C4ISP interface issues, with hardware in the loop testing of a particular interoperability issue.*

Interoperability Policy

(Assessment, Test, And Evaluation of Information Technology System Interoperability)



- Establishes an *Interoperability* Watch List, and applicable procedures for systems that will be put on the list.
- Establishes procedures for an *interoperability* review to decide what systems will be put on the watch list, and a tracking mechanism to determine if *interoperability* problems are being corrected.
- Provides *interoperability* standards and criteria for evaluation in the following areas: requirements and test documentation; developmental testing; operational assessments; Operational Test Readiness Reviews, Operational Testing.
- States that all National Security Systems (NSS) and IT systems, regardless of ACAT, must be tested and testing results certified by DISA (JITC) for interoperability. Also establishes quarterly reporting requirement.
- An attempt to streamline the interoperability certification in the development, testing, and operational assessment realms, and provides a systemic monitoring apparatus at the DoD level that is currently lacking.

February 2001

This document establishes an *Interoperability* Watch List, and applicable procedures for systems that will be put on the list. It would institute procedures for an *interoperability* review to decide what systems will be put on the watch list, and a tracking mechanism to determine if *interoperability* problems are being corrected. The document provides *interoperability* standards and criteria for evaluation in the following areas: requirements and test documentation; developmental testing; operational assessments; Operational Test Readiness Reviews, Operational Testing. It goes on to states that all National Security Systems (NSS) and IT systems, regardless of ACAT, must be tested and testing results certified by DISA (JITC) for interoperability. It would also establish a quarterly reporting requirement. This an attempt to streamline the interoperability certification for the development, testing, and operational assessment realms, and would provide a systemic monitoring apparatus at the DoD level, something that is currently lacking.

Joint Distributed Engineering Plant (JDEP)

JDEP Strategy

Final Report Supporting Materials

Part 5: Relationship of JDEP to DoD Processes

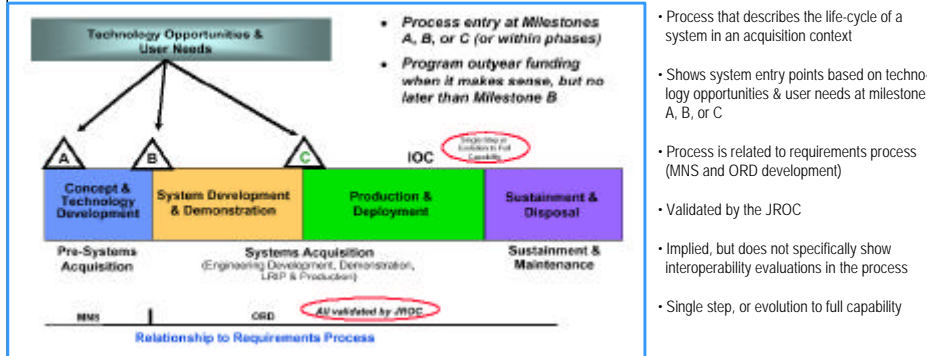
Relationship of JDEP to Other DoD Interoperability Processes

- 1.) DoD 5000.1 Acquisition Process
- 2.) Interoperability T&E Process
- 3.) CJCSI Certification Process
- 4.) C4ISP Process
- 5.) JI&I Certification Process
- 6.) Outcome Based Interoperability Process

February 2001

During the course of the JDEP strategy development study there have been six DoD processes identified, and evaluated, that could be influenced in some way by a JDEP capability. These six processes are the 1.) DoD Acquisition Process; 2.) Interoperability T&E Process; 3.) CJCSI Certification Process; 4.) C4 Intelligence Support Plan (C4ISP); 5.) Joint Interoperability and Integration (JI&I) Process; 5.) and Outcome Based Interoperability Process. The DoD Acquisition Process, DOT&E Testing Process Command, JITC Certification Process and C4ISP Processes are based on the DoD 5000 series of regulations CJCSI regulations, other DoD testing documents, and associated memorandums of instruction. These four processes are well established, and inculcated throughout the Department. The JI&I Process has been instituted relatively recently (within last three years within the Department), and is directed by the sponsoring organization's documentation (JFCOM). Finally, the Outcome Based Interoperability Process is an initiative established by ASD(C3I) to better manage the interoperability of systems throughout the system life-cycle, and within the differing architectural views (system, operational, and technical). For the study the above were the major DoD processes identified and assessed within the JDEP strategy; however, these might not be all inclusive of some other interoperability assessments throughout the Department, and the Major Commands that might leverage a JDEP capability.

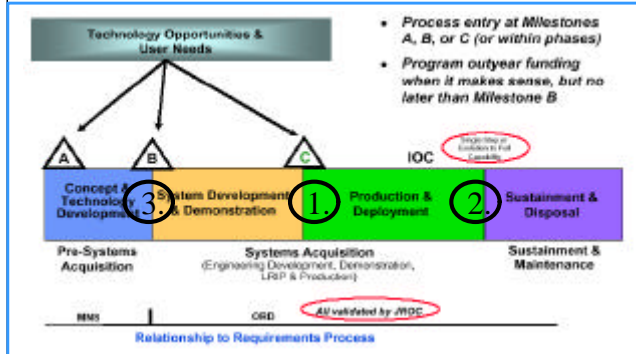
DoD 5000.1 Acquisition Process



February 2001

The DoD Acquisition Process describes the life-cycle of a system in an acquisition context. Systems can enter the cycle based on technology opportunities & user needs at milestone A, B, or C (see diagram for new DoD 5000 series process description). Process is related to requirements process, Mission Needs Statement (MNS, and the Operational Requirements Document (ORD) development. The process phases are validated by the JROC at specific system acquisition phases. Interoperability evaluations are implied, but do not specifically show in the process description charts. System acquisition process can be single step, or evolution to full capability. This reflects the new DoD 5000 series acquisition process model that is based on spiral development and evolutionary acquisition.

JDEP Relationship To The DoD 5000.1 Acquisition Process



1. JDEP could be used for the interoperability of "End Items" during system development. JDEP as part of the acquisition process with earlier use for more likely improvements links to pre-end-item development test is important

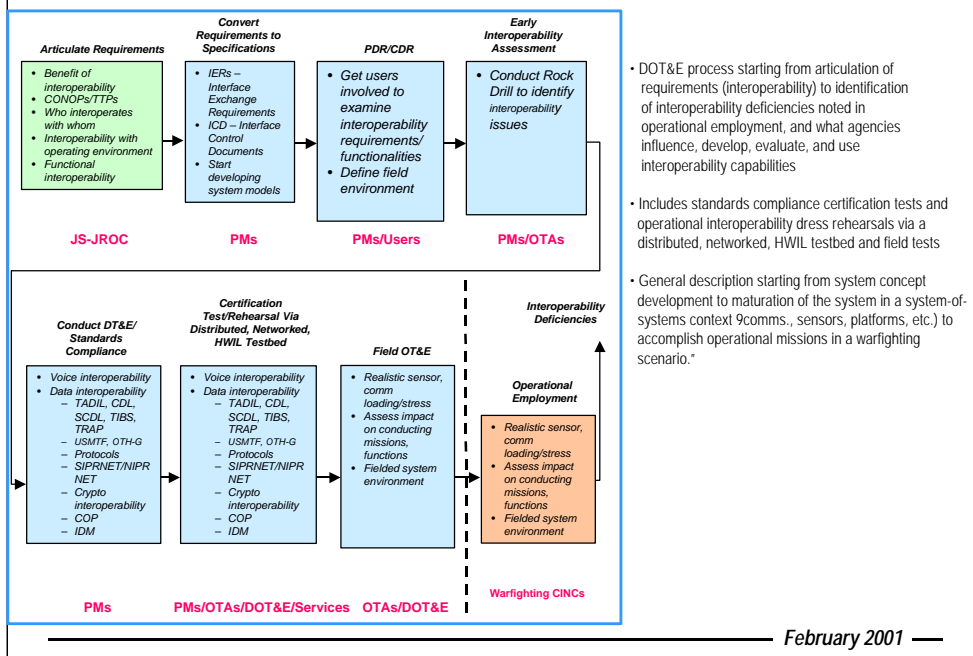
2. JDEP could be used for post-deployment interoperability test & evaluation. Testing of deployed systems (large number of legacy systems) is important part of JDEP strategy

3. 1 and 2 are where JDEP could reside however JDEP needs to be designed to collaborate with B

February 2001

JDEP could be used for the interoperability assessment of "End Items" primarily during system development & demonstration, and for the production & deployment phases. During both phases JDEP could be part of the acquisition process with earlier interoperability assessment thus leading to more likely improvements in the system. Additionally, JDEP could be part of a system "capstone" interoperability assessment during IOC. While the thrust of the usage for JDEP should be in the systems acquisition phases, JDEP should maintain the linkage with the pre-systems acquisition phase for the underlying analysis that supports the concept & technology development of a new system, and the perceived interoperability issues associated with the new system. A mechanism for earlier assessment would make the process more efficient in terms of trying to correct interoperability problems after the system is fielded to the operational commander.

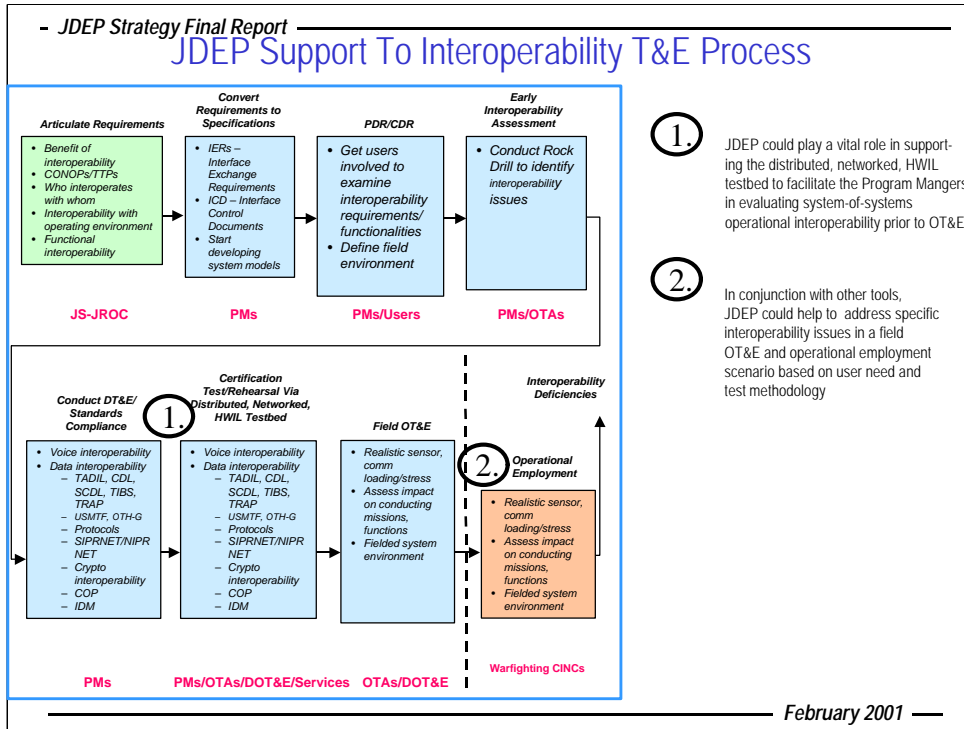
Interoperability T&E Process



- DOT&E process starting from articulation of requirements (interoperability) to identification of interoperability deficiencies noted in operational employment, and what agencies influence, develop, evaluate, and use interoperability capabilities
- Includes standards compliance certification tests and operational interoperability dress rehearsals via a distributed, networked, HWIL testbed and field tests
- General description starting from system concept development to maturation of the system in a system-of-systems context (comms., sensors, platforms, etc.) to accomplish operational missions in a warfighting scenario.*

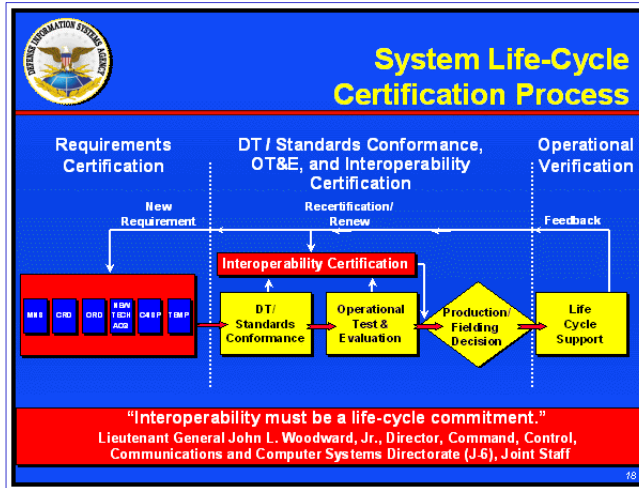
February 2001

The DOT&E test process starts from articulation of requirements (interoperability) to identification of interoperability deficiencies noted in operational employment, and what agencies influence, develop, evaluate, and use interoperability capabilities. A general description of the testing process starts from system concept development testing to maturation of the system to point where it can be used in actual warfighting scenarios and environment (communications, sensors, platforms, etc.) test environments. The testing process includes description of standards compliance and certification via a distributed, networked, hardware-in-the-loop test-bed. This diagram depicts the major participants in a DOT&E test environment, and can be influenced by other agencies not shown in the process. The degree of testing goes from conceptual (rock drills) to more rigorous where there is hardware in the loop, and application in an actual operational environment.



JDEP could assist in the DOT&E evaluation at the point in the test process where test evaluation assets are distributed, networked, and there is HWIL/SWIL available to test the real user need of interoperability for the user's system. In conjunction with other tools, JDEP could help to address specific interoperability issues in a field OT&E and operational employment scenario based on user need and test methodology. The emphasis here could be on the use of JDEP to do an interoperability assessment of a specific warfighter interoperability issue in an operational scenario, along with other tools that measure interoperability but are outside the scope of a JDEP strategy. JDEP would not validate/assess a war-fighting CONOPs, but could be used to address a discrete interoperability issue within the CONOPs for the warfighter. The tester would have to use a full range of tools to get at the full range of interoperability issues involved in a war fighting CONOPs.

CJCSI Certification Process

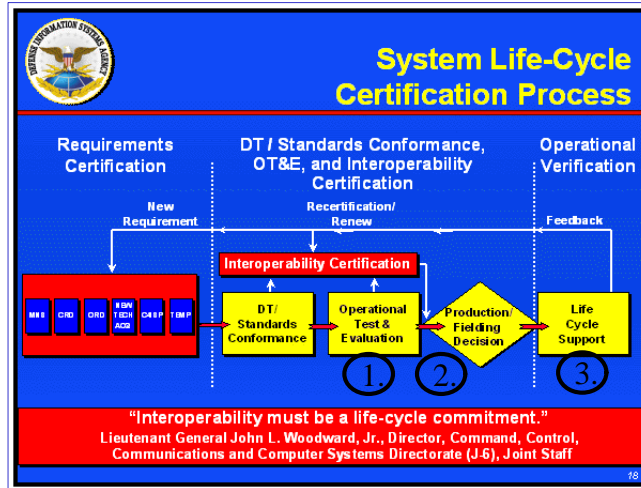


- Interoperability certification requirements are cited in DoD/CJCSI regulations (DoD5000 series, CJCSI 3170, 6212.01B, etc.) guide the certification process
- JITC enables a life-cycle system certification process
- Involved at some level of interoperability assessment for system test and development, operational test and evaluation, joint interoperability certification, and warfighter support
- CJCSI and JITC interoperability perspective is from a equipment, forces, and procedures aspect

February 2001

Department of Defense and JCS regulations direct some type of interoperability certification for the system used in a joint environment. The DoD 5000 series of regulations specifically state the need for JITC to certify NSS and ITS systems to meet the needs of interoperability and supportability. JITC is a certification agency for interoperability and is referenced in DoD 5000.1 and DoD 5000.2-R, and CJCSI 3170 as such. JITC can be involved at some level in the system life cycle interoperability and supportability certification. This level could be a paper certification of approved interoperability standards or more detailed resource intensive evaluation of interoperability standards conformance in a developmental test setting or in the operational test and evaluation arena. JITC has an interoperability perspective that is focused on equipment, forces, and procedural interoperability aspects.

JDEP Relationship To The CJSCI Certification Process

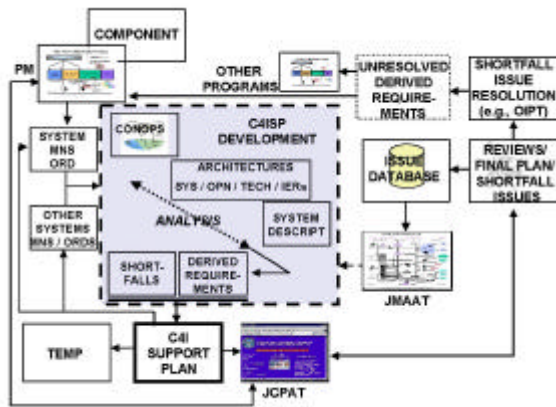


1. A JDEP strategy would allow the CJSCI and the user a capability to assess the Key Performance Parameters (KPPs) of a system for certification purposes in a more efficient manner
2. JDEP would allow certification to occur in an environment based on user needs that could approximate the user's operational environment
3. Common processes, scenarios, plans, database collection techniques, and institutional certification knowledge could be maintained in a JDEP strategy

February 2001

A JDEP strategy would allow JITC and the user a capability to evaluate the Key Performance Parameters (KPPs) of a system for certification purposes in a more more efficient manner. For example, the disparate systems necessary in a family of system interoperable test could be brought together based on user needs in a more organized and routinized manner. This would make the required certification process more of a help than a hindrance to the user. JDEP would allow certification to occur in an environment based on user needs that could approximate the user's operational environment. This will assist in achieving a more robust test of the interoperability and certification conformance standards required for system certification. The decision maker will have a better feel for the interoperability requirements delivered to his operational forces. The Common processes, scenarios, plans, database collection techniques, and institutional certification knowledge could be maintained in a JDEP strategy. Ultimately, this could make certification a "normal way" of doing business for the user (PM, commands, etc.)

C4I Support Plan (C4ISP) Development Process

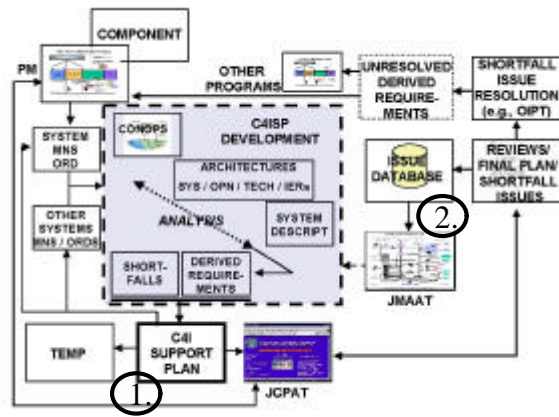


- Directed by DoDD 5000.1 for a system to have a C4ISP done before program initiation, and then maintained current throughout the acquisition of the program.
- Looks specifically at C4ISR supportability and interoperability
- Requires an analysis of all three architecture views (operational, system, and technical) for a system
- Has associated tools and methodology: JCPAT, Issue Database, JMAAT, and Strategy-To-Task methodology
- Living document. Maintained current throughout the acquisition. Formally reviewed before milestones and decision points, and when CONOPs or C4I requirements change.
- Is a critical document in system evolution
- Ties ORD, CONOPS, architectures to get at derived requirements and C4ISR shortfalls

February 2001

Directed by CJCSI 6212.01B, and other DoD directives and instructions for a system to have a C4ISP done before it reaches the Milestone (MDA) or Principle Staff Agency (PSA) office for milestone decisions. It is an attempt to look at integration and interoperability in all three architecture views (system, technical, and operational) for a system. It is envisioned to have various tools to do the assessments: Strategy to Task, JCPAT and JMAAT. The C4ISP is evaluated at some level at each milestone decision review period or significant change in the acquisition program. The C4ISP is becoming a critical document in system development and evolution. The process also attempts to tie CONOPS with architectures to get at requirements for the system.

JDEP Relationship To The C4I Support Plan (C4ISP) Development Process

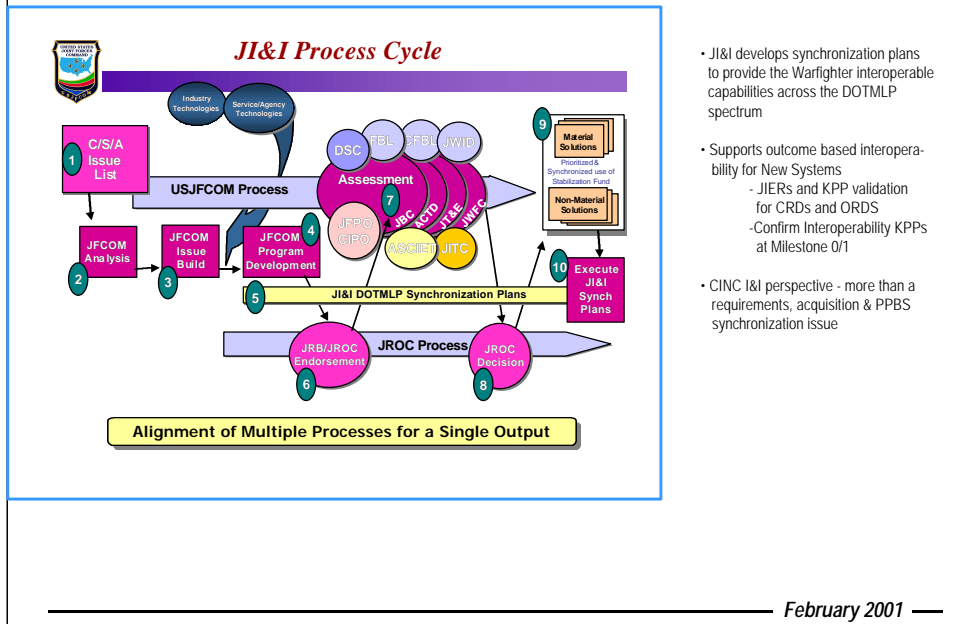


1. JDEP potentially could provide the user a method to assess KPPs interoperability issues when there is HWIL available
2. Dependent on system maturity level (e.g. HWIL availability) JDEP could be one way to evaluate a system interoperability issue

February 2001

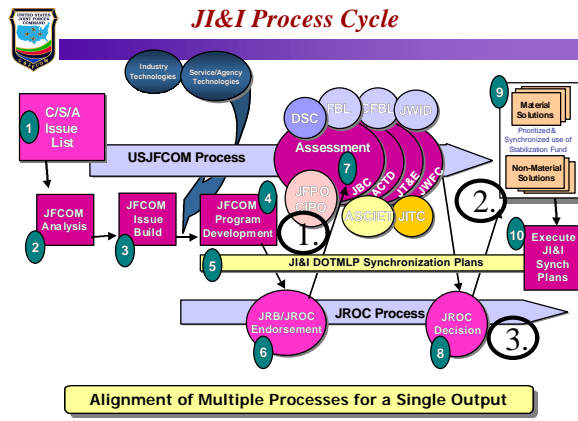
JDEP potentially could provide the user (either a PM, command, etc.) a method to assess Key Performance Parameters (KPPs) interoperability issues when there is Hardware in the Loop (HWIL) available. Additionally, dependent on system maturity level (e.g. HWIL availability) JDEP could be one way to evaluate a system interoperability issue that is a result of the detailed analysis that is done to develop the C4ISP. Where there is HWIL, the JDEP environment would be the place where KPPs and select important Information Exchange Requirements (IER) for systems could be evaluated in a Family of Systems. An important point here is that JDEP would take the output of the C4ISP process, and provide a means to assess an interoperability issue for the user as defined in the JDEP strategy.

Joint Interoperability and Integration (JI&I) Process



The JI&I process is envisioned to develop synchronized plans to provide the Warfighter interoperable capabilities across the Doctrine, Organization, Training, Material, Leadership, Personnel (DOTM-LP) spectrum. It Supports outcome based interoperability for New Systems Joint Information Exchange Requirements (JIER) and Key Performance Parameter (KPP) validation for Capstone Requirements Documents (CRDs) and Operational Requirements Documents (ORDS). The Process is thought to be able to confirm Interoperability Key Performance Parameters (KPPs) at Milestone 0/1. Therefore, from a CINC interoperability and integration perspective it is more than a requirements, acquisition, and Planning Programming Budgeting System (PPBS) synchronization issue because the process is an attempt to coordinate across DOTMLP which is much more than just system requirements, acquisition, and PPBS. JFCOM is still maturing this process to fully implement the goals of the integration and interoperability process.

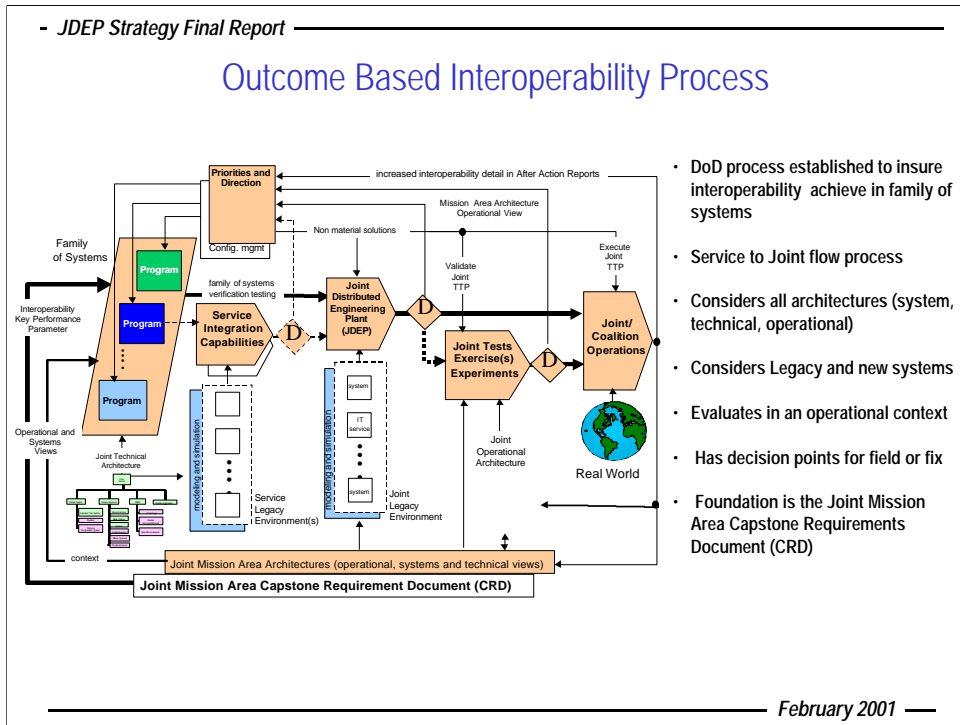
JDEP Relationship To The JI&I Process



1. Where there is HWIL, JDEP potentially could be one of the methods that would allow assessment of interoperability issues that would impact certain aspects of DOTML-FP
2. JDEP could allow the metric of interoperability to be assessed to support the user and JROC in making decisions within the services POM cycles (reduces the friction which adds time)
3. JDEP could allow spiral development to occur and maintain the archive that would allow iterative interoperability assessment of issues that can't be solved in one pass

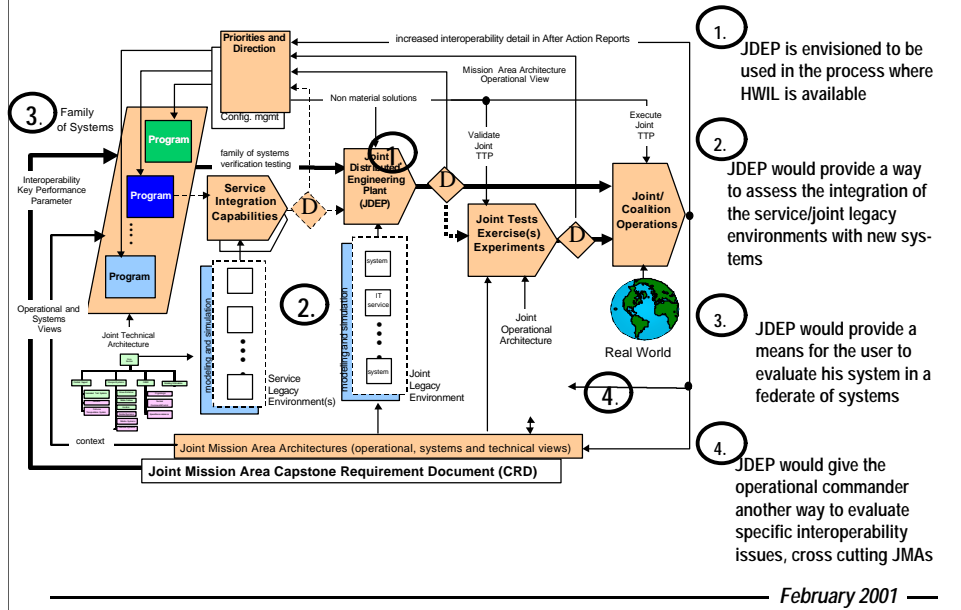
February 2001

Where there is HWIL, JDEP potentially could be one of the methods that would allow assessment of interoperability issues that would impact certain aspects of DOTML-FP. JDEP could allow the metric of interoperability to be assessed to support the user and JROC in making decisions within the services POM cycles (reduces the friction which adds time). JDEP could allow spiral development to occur and maintain the environment that could allow iterative interoperability assessment of issues that can't be solved in one pass. This supports the spiral development concept, and would ensure an assessment environment would not have to be created each evaluation period from scratch. Additionally, a JDEP strategy would fulfill the goal of this process to link the separate service test facilities (labs, ranges, etc.) in the assessment phase of the process.



The DoD Outcome Based Interoperability Based Process was established to insure interoperability is achieved in a family of systems. It is a Service to Joint flow process. The process considers all architectures (system, technical, operational) views. It also considers the legacy and new systems in the DoD environment. Moreover the process evaluates systems in an operational context. Throughout the process it has decision points for field or fix dependent on issues (e.g. interoperability shortfalls). The foundation for this process is the Joint Mission Area Capstone Requirements Document (CRD). This process is a conceptual approach to achieving interoperability in a Family of Systems.

JDEP Relationship To Outcome Based Interoperability Process



JDEP is envisioned in the Outcome Based Interoperability Process to be used where HWIL is available for interoperability evaluation. Moreover, JDEP would provide a way to assess the integration of the service/joint legacy environments with new systems that is central to this outcome based process. It would integrate the sim/stim (M&S) where necessary in a JDEP strategy to provide a method to evaluate systems in a family of systems where the hardware of one system is not necessary (or available) to evaluate the interoperability issue associated with the hardware-in-loop under evaluation in a JDEP CONOPs. JDEP would give the operational commander another way to evaluate specific interoperability issues, cross cutting Joint Mission Areas (JMAs), or for select specific interoperability issues within one JMA.

Joint Distributed Engineering Plant (JDEP)

JDEP Strategy

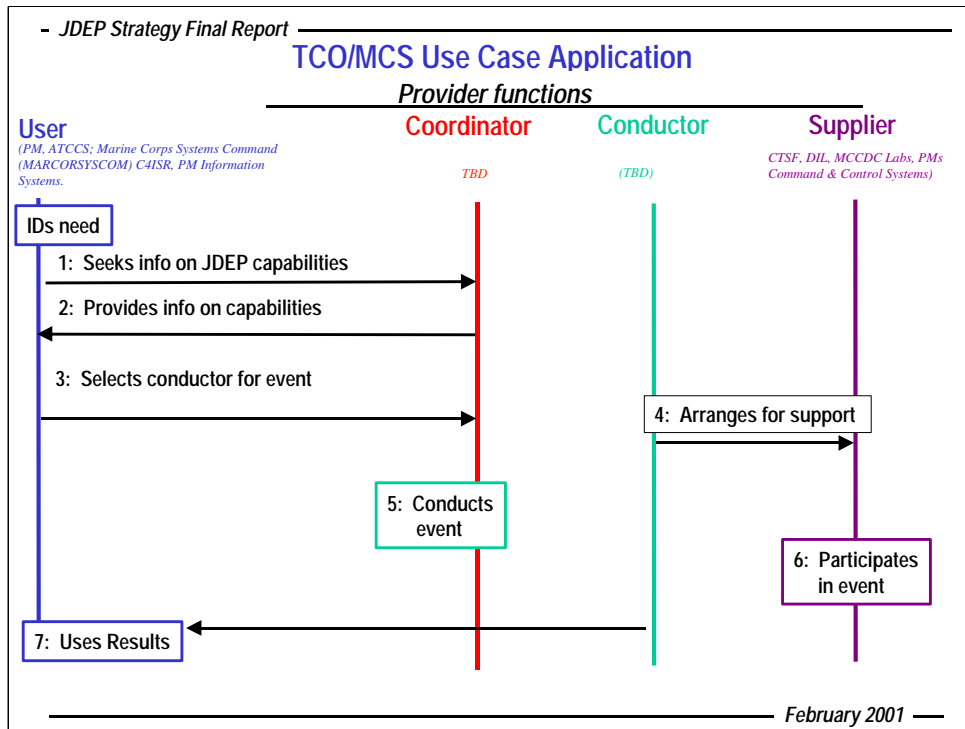
Final Report Supporting Materials

Part 6: Use Cases

JDEP Use Cases

- 1.) Tactical Combat Operations (TCO)/Maneuver Control System (MCS)
- 2.) Joint Strike Fighter (JSF)

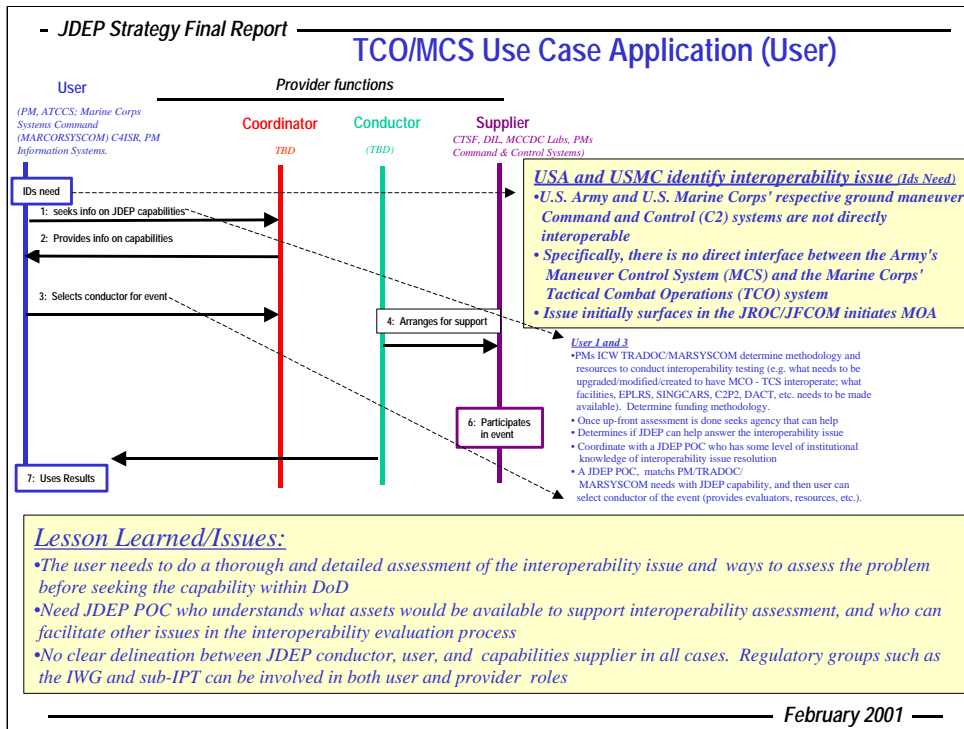
To better define the issues surrounding a JDEP strategy and its implementation, two use cases were evaluated during the course of the study. As the JDEP strategy matured, a number of iterative passes applying the strategy to the use cases were used to develop, and refine issues highlighted in the strategy. The two primary use cases were the Tactical Combat System/Maneuver Control System (TCO/MCS) and Joint Strike Fighter (JSF). These programs were diverse enough to gain appreciably different insights, and at the same time some similarities as the use cases were applied. The JSF program office has a joint lead among the Navy and Air Force, and is relatively early in system development and acquisition. The program is also being developed when policy, regulations, and documentation requirements for system interoperability and family of systems assessment/testing are starting to be fully codified and implemented within the Department. On the other hand, the TCO and MCS are the command and control (C2) systems for the Marine and Army respectively. These C2 systems have been fielded and are actually being used in an operational environment. However, the users identified an interoperability deficiency between the two systems, and certain agencies and commands are in the process of planning for ways to fix the deficiency and after implementation of the solution conduct an interoperability assessment of the results. These two use case walkthroughs served to better articulate the roles and responsibilities of key players in the JDEP strategy. The use case construct will serve to refine and adjust the strategy and provide bases for organizational and business model aspects of the strategy.



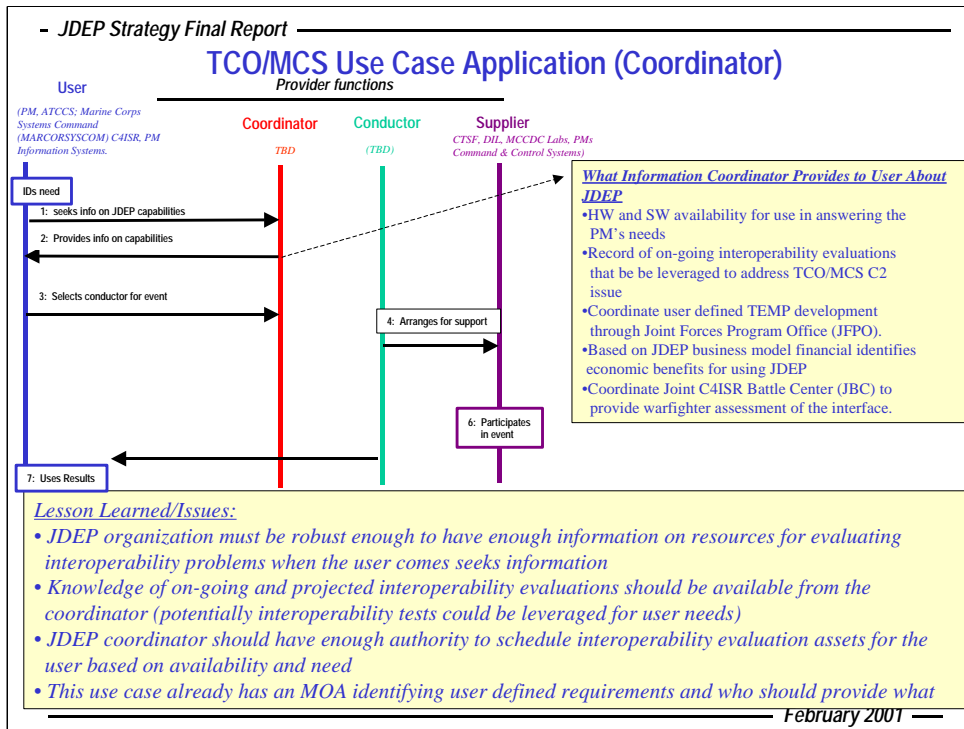
This depicts the current view of how TCO/MCS JDEP events would be created and executed. The organizations placed in the construct are:

1. The TCO/MCS User and/or user organization identifies a need for SoS HW/SWIL integration or test as a result of noting an interoperability problem in their C2 system.
2. TCO/MCS User 'goes to' Coordinator (TBD) for information on availability of assets to needed to assess an interoperability issue after corrective measures are developed to address the C2 interoperability issue.
3. Coordinator (TBD) provides list of system specific and common components to address needs (including names of suppliers and profiles of capabilities, locations, availability, cost), and provides information on needed systems not yet JDEP 'capable, and what it might take to make them work in a JDEP configuration
4. User selects 'conductor (in this due to the capabilities available - the JITC and Joint Battle Center (JBC) were selected) who works with suppliers to develop plan, conduct event, collect and analyze data to meet users need, providing direction to the conductor and suppliers for their services in the conduct of the event
5. Conductor (JITC/JBC proposed) organizes and conducts the event
6. Suppliers (Army and Marine Corps test facilities) participate in event
7. Users take results and apply them to their process

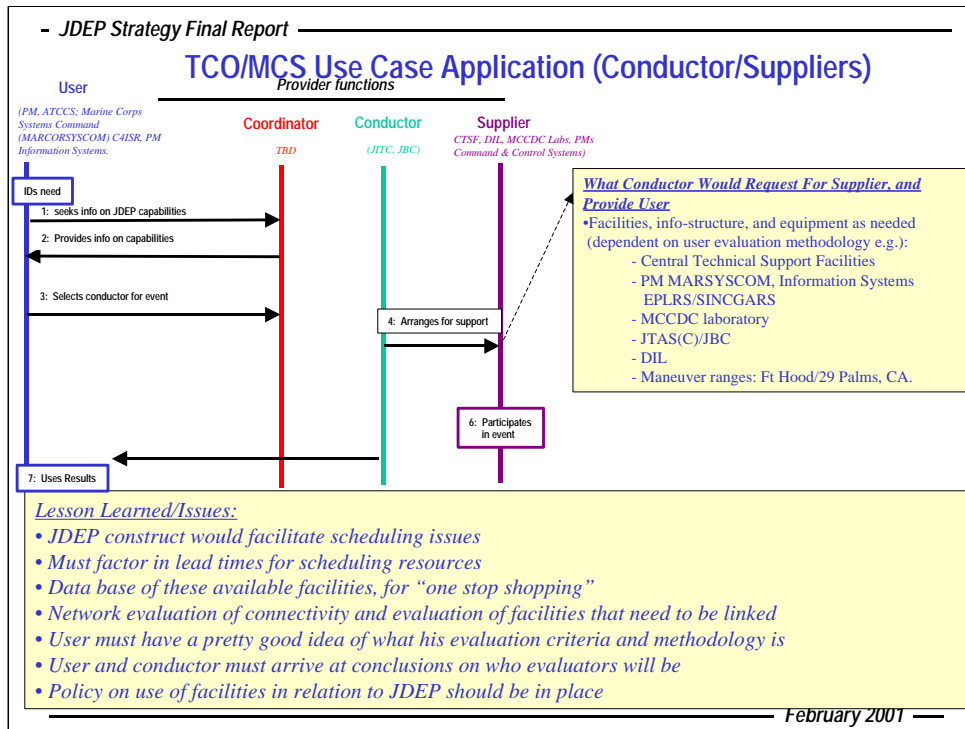
This construct will be followed in the next charts to depict associated issues in applying the JDEP strategy to this use case. Other organizations might have the capability to fulfill the conductor and supplier roles; however the organizations identified above were chosen because they seemed the most logical fit in terms of ongoing work involved with TCO/MCS. Note here also that one organization might have multiple roles (e.g. separate offices in one agency as the coordinator and conductor roles). This was one lesson learned from this use case.



First the organizations identified above identified the interoperability issue. The U.S. Army and U.S. Marine Corps' respective ground maneuver Command and Control (C2) systems were determined to be not directly interoperable. Specifically, there is no direct interface between the Army's Maneuver Control System (MCS) and the Marine Corps' Tactical Combat Operations (TCO) system. The issue initially surfaces in the JROC and JFCOM initiates MOA proposing a plan to fix and assess the fix. In steps 1 and 3 of the strategy the PMs ICW TRADOC/MARSYSCOM determine methodology and resources to conduct interoperability testing (e.g. what needs to be upgraded/modified/created to have MCO - TCS interoperate; what facilities, EPLRS, SINGCARS, C2P2, DACT, etc. needs to be made available). Determine funding methodology. Once an up-front assessment is done the user seeks an agency that can help. The user then evaluates to determine if JDEP can help answer the interoperability issue. If so the user interfaces with a JDEP POC who has some level of institutional knowledge of interoperability issue resolution, then the coordinator can match PM/TRADOC/MARSYSCOM needs with JDEP capability, and possible conductors of the event. Lessons learned from iterating this use case showed that the user has to do a thorough up-front assessment of assessment methodology so he can judge if JDEP will provide the capability he needs. There has to be a JDEP POC who has the institutional knowledge required to "counsel" the user, also has knowledge of the common items needed to conduct such an interoperability assessment (i.e. scenarios, database assets, etc). This use case shows that there can be some overlap (different offices in the same agency) that potentially fill multiple roles (coordinator, conductor, etc.).



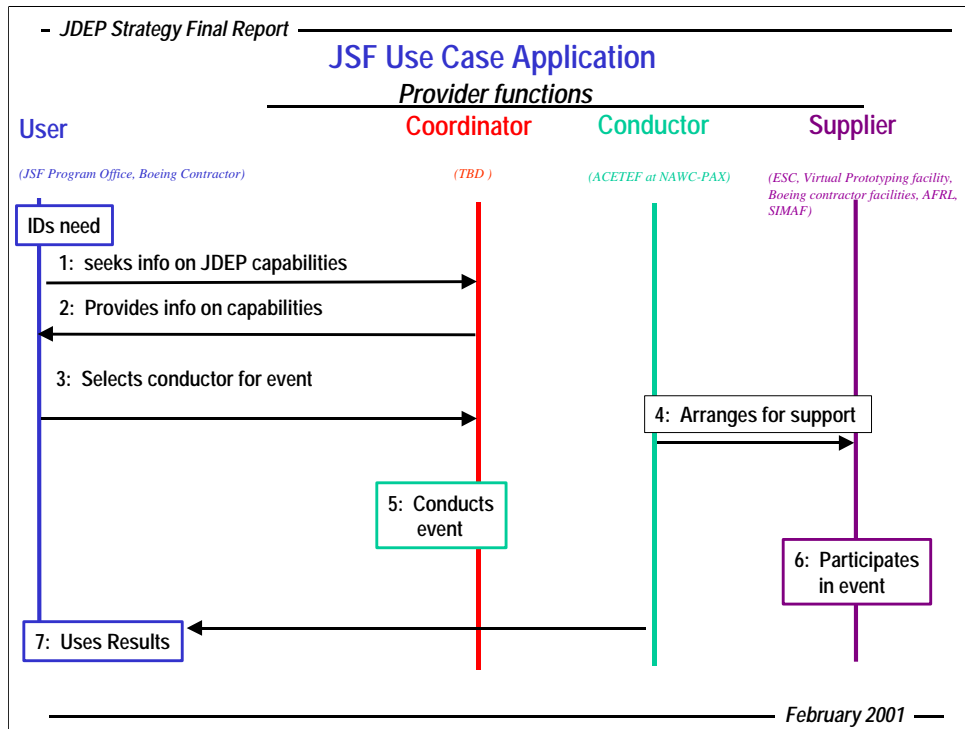
Step 2 is what information the coordinator provides to user about JDEP. In this use case the HW and SW availability (e.g. SINCGARS (radio), any sim/stim capabilities) for use in answering the PM's needs, and the common assets required (environmental contest as necessary). Provide a record of on-going interoperability evaluations that be be leveraged to address TCO/MCS C2 issue. Coordinate the user defined TEMP development through Joint Forces Program Office (JFPO). Based on JDEP business model financial identifies economic benefits for using JDEP to the user (for example the JDEP can do it more economically because it has the common stimulators in a C2 network that the PM might have to build to stimulate the C2 network). Coordinates with Joint C4ISR Battle Center (JBC) to provide warfighter assessment of the interface, and provides the user some idea of assets available for evaluation. Lesson Learned/Issues: JDEP organization must be robust enough to have enough information on resources for evaluating interoperability problems when the user comes seeks information. The JDEP coordinator must have a Knowledge of on-going and projected interoperability evaluations should be available from the coordinator (potentially interoperability tests could be leveraged for user needs) JDEP coordinator should have enough authority to schedule interoperability evaluation assets for the user based on availability and need. In this use case there was already a Memorandum of Agreement identifying user defined requirements and who should provide what assets for testing.



Step 4 is what the conductor would request from supplier, and provide to user. The conductor would provide evaluators, facilities, info-structure, and equipment as needed (dependent on user evaluation methodology e.g.): In this use case there might be need for a distributed network between the labs. For example between the Central Support Technical Facility (CTSF) for the Army, and the Marine Corps Labs at MCCDC, other resources and ranges might encompass the following:

- Central Technical Support Facilities (CTSF)
- PM MARSYSCOM, Information Systems
- EPLRS/SINGARS
- MCCDC laboratory
- JTAS(C)/JBC
- DIL
- Maneuver ranges: Ft Hood/29 Palms, CA.

Lesson Learned/Issues: A JDEP strategy would facilitate scheduling issues. Must plan for lead times for scheduling resources. A data base of these available facilities, for “one stop shopping” would be very helpful. Network evaluation of connectivity and evaluation of facilities that need to be linked (certification by services possibly). The user must have a thorough plan of what his evaluation criteria and methodology is. The user and conductor must jointly arrive at conclusions on who evaluators will be. An MOA for JDEP for use of facilities in relation to JDEP should be in place.

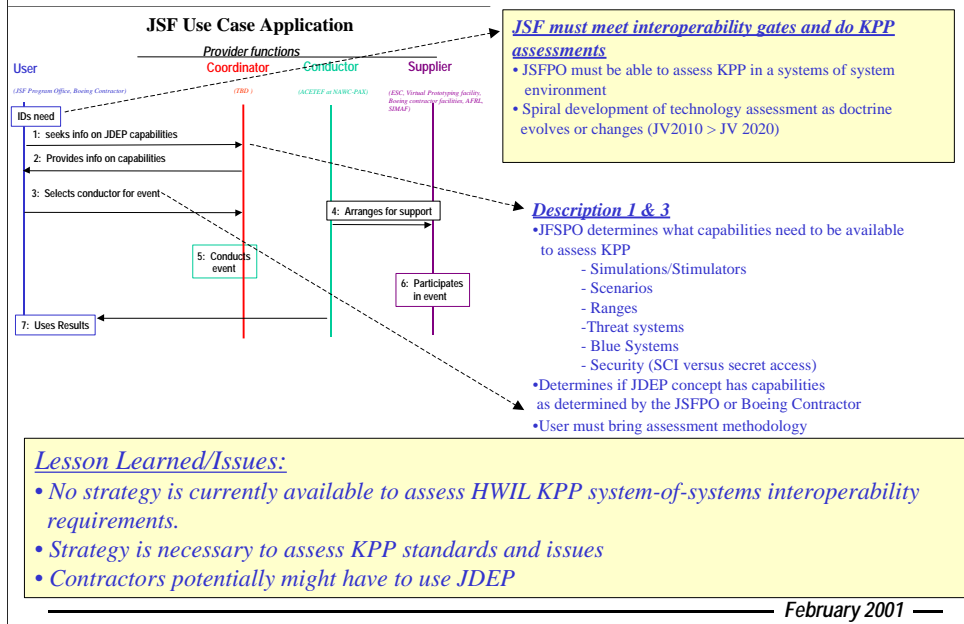


This depicts the current view of how JSF JDEP events would be created and executed. The organizations placed in the construct are:

1. *The JSF User and/or user organization* identifies a need for SoS HW/SWIL integration or test as a result of noting a interoperability problem in their JSF system.
2. *JSF User 'goes to' Coordinator (TBD)* for information on availability of assets to needed to assess an interoperability issue for JSF.
3. *Coordinator (TBD)* provides list of system specific and common components to address needs (including names of suppliers and profiles of capabilities, locations, availability, cost), and provides information on needed systems not yet JDEP 'capable, and what it might take to make them work in a JDEP configuration
4. User selects 'conductor (In this case the Air combat Environment Test and Evaluation Facility (ACETEF) and Naval Air Weapons Center Pax River (NAWC-PAX)) who works with suppliers to develop plan, conduct event, collect and analyze data to meet users need, providing direction to the conductor and suppliers for their services in the conduct of the event
5. *Conductor (ACETEF and NAWC-PAX)* organizes and conducts the event
6. *Suppliers (AF Electronic Systems Command, Boeing facilities, Air Force Research Lab (AFRL) and Simulation and Analysis Facility (USAF))* participate in event
7. *Users* take results and apply them to their process

This construct will be followed in the next charts to depict associated issues in applying the JDEP strategy to this use case. Other organizations might have the capability to fulfill the coordinator and conductor roles; however the organizations identified above were chosen because they seemed the most logical fit in terms of ongoing work involved with JSF.

JSF Use Case Application (User)

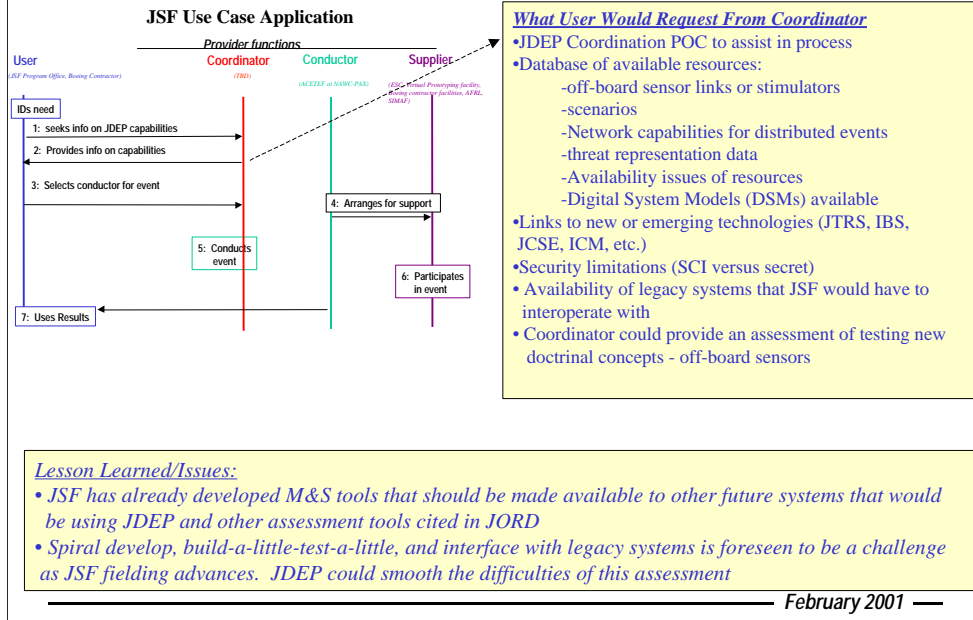


The JSF determines a user need for interoperability assessment. For example the JSF must meet interoperability gates and do KPP assessments. Additionally the JFSPO must be able to assess KPPs in a systems of system environment. The JFSPO must also accommodate spiral development of technology assessment as doctrine evolves or changes (JV2010 > JV 2020). In steps one and three of a JDEP strategy: The JFSPO determines what capabilities need to be available to assess KPP for example;

- Simulations/Stimulators
- Scenarios
- Ranges
- Threat systems
- Blue Systems
- Security (SCI versus secret access)

After this assessment is done a determination is made to see if JDEP strategy has the capabilities as determined by the JSFPO or Boeing Contractor. The JDEP POC discusses the available common tools for assessment. The user must bring the assessment methodology (identifying resources, evaluation requirements, network requirements, scenario/threat requirements). The user in consultation with the JDEP POC selects a conductor for the event. In applying this use case and in discussions with the JSFPO the following lesson learned were noted: There currently is not a strategy available to assess HWIL KPP system-of-systems interoperability requirements fully. There was a perceived need of a strategy to assess KPP standards and issues. Additionally, contractors potentially might have to use JDEP.

JSF Use Case Application (Coordinator)



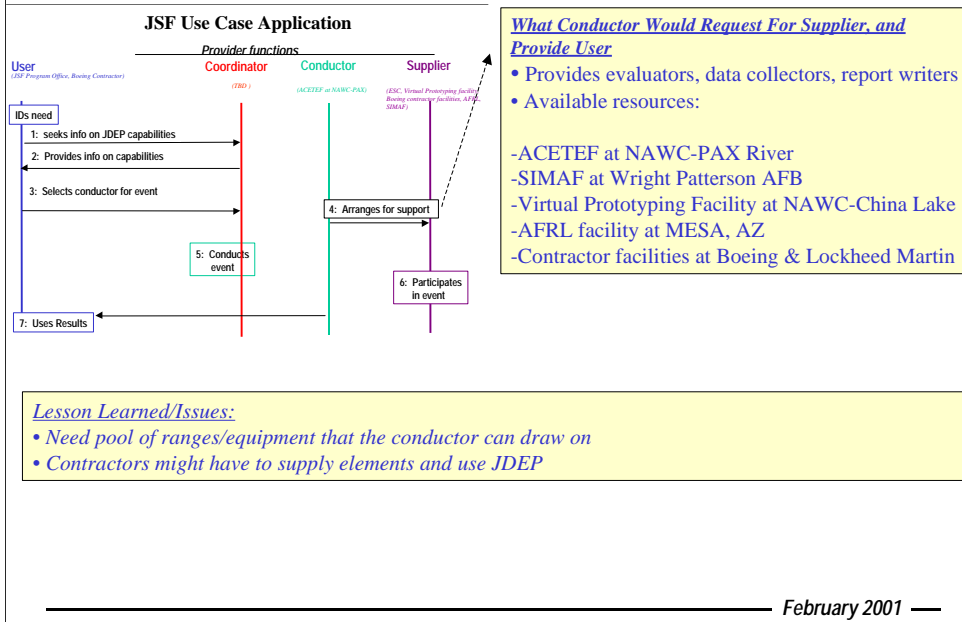
In Step 2 the coordinator would request information on capabilities. In this case a JDEP Coordination POC to assist in process to identify the following common to JDEP or unique for interoperability evaluation requirements.

Database of available resources, and common assets:

- off-board sensor links or stimulators
- scenarios
- Network capabilities for distributed events
- threat representation data
- Availability issues of resources
- Digital System Models (DSMs) available

Links to new or emerging technologies (JTRS, IBS, JCSE, ICM, etc.). Security limitations (SCI versus secret). Availability of legacy systems that JSF would have to interoperate with the JSF system. A coordinator could provide an assessment of testing new doctrinal concepts - off-board sensors. Critical lessons learned in applying the use case are as follows: JSF has already developed M&S tools that should be made available to other future systems that would be using JDEP (e.g. SAWE) and other assessment tools cited in JORD. Spiral develop, build-a-little-test-a-little, and interface with legacy systems is foreseen to be a challenge as JSF fielding advances. JDEP could smooth the difficulties of this assessment.

JSF Use Case Application (Conductor/Suppliers)



February 2001

Step 4: Conductor would arrange for support. In this use case the following assets and resources could be needed: Provides evaluators, data collectors, report writers, potential resources are

- ACETEF at NAWC-PAX River
- SIMAF at Wright Patterson AFB
- Virtual Prototyping Facility at NAWC-China Lake
- AFRL facility at MESA, AZ
- Contractor facilities at Boeing & Lockheed Martin

In some cases the facilities would be distributed and networked based on the JSFPO evaluation methodology.

Significant lessons learned are that:

Need pool of ranges/equipment that the conductor can draw on (this would require MOAs archived with the JDEP POC or JDEP management structure, and the policy for use and scheduling of requested resources).

Additionally the JSFPO has an open door policy with contractors; therefore a contractor might have to supply elements and be allowed use of a JDEP capability based on interoperability assessment needs.