JC3IEDM-enabled Tactical Collaboration (JTC)

Technical Readiness Plan

Version 30 July 2007

This Page Intentionally Blank

Summary

JC3IEDM-enabled Tactical Collaboration (JTC) is a prototype collaborative work application. It is under development as an instrument and capability intended to support standards-based multinational command and control information sharing and management.

JTC was sheculed to be a Trident Warrior 2007 coalition experimentation initiative, but was postponed when it was recognized that not all experimental objectives would be achieved. The JTC experiment objectives remain the same a originally planned. This document serves as guide to the next step which is a Technical Readiness Assessment (TRA). The TRA is intended to provide familiarity and confidence regarding JTC and its readiness to support maritime command and control experimentation and use.

This Page Intentionally Blank

Table of contents

Summary iii
Table of contents v
Introduction....1
Technical Readiness Assessment (TRA) Objectives....2
TRA Objectives 2
Experiment Objectives....3
Capability Assessment 3
Metrics 3
CWE CONOPS....5
JTC Chart Application Overview....7
TRA Vignettes....10
TRA Level of Support....11
TRA Schedule....11
TRA Data Collection....11
TRA Deployment....12
Annex A Fundamental Transformation Challenge....A-1
Annex B JTC Architecture....B-1
Annex C Multi-User Chat (MUC) Room Configuration....C-1
Annex D Data Collection Plan....D-1
Annex E Examining JC3IEDM concepts and semantics....E-1

This Page Intentionally Blank

Introduction

US FORCEnet[1] Capabilities

FORCEnet Functional Concepts and associated objective capabilities provide US requirements guidance for future maritime command and control and information management capability. Evolving, assessing and refining FORCEnet related concepts and technologies are of particular interest US maritime allies. Of specific interest is:

> FORCEnet Capability #7. Provide distributed groups of decision makers the ability to cooperate in the performance of common command and control activities by means of a collaborative work environments (CWE).

Experiment Background

This experiment was developed as a Trident Warrior 2007 ('07) Command and Control (C2) initiative to explore the maritime use of multinational C2 data standards as a basis for improved CWE. The operational and technical hypothesis is that:

> A shared formal C2 vocabulary (with its lexicon, grammar, protocol and business rules) enables improved CWEs by providing a semantic foundation on which to build interoperable and integrated multi-mission capability.

The Joint Consultation, Command and Control Information Exchange Data Model (JC3IEDM) is a “vocabulary” product of the Multilateral Interoperability Programme (MIP) an important multinational command and control community of interest [comprised of 25 Nations, NATO and Allied Command Transformation]. Semantic interoperability is critical to efficient and precise information sharing, shared understanding and proper automated processing of formal work products (e.g., orders). See Annex A and C for additional information on JC3IEDM.

Technical Approach for Achieving Required Operational Capability

Experiment with the generic concept of “data collaboration” by defining CWE information objects using JC3IEDM data semantics. Collaborating in data is enabled, and constrained, by the scope of shared formal semantics. The JC3IEDM semantics support a very wide range of warfare planning, coordination, resource allocation, and deconfliction collaboration topics. The JTC application provides an initial increment of this CWE capability.

Experiment Assessment Context

This JTC experiment will look at improvements to distributed collaboration planning and coordination in the context of maritime multinational operations, within and across echelons, during future operations planning (FOPS), current operations planning an execution (COPS) and real-time tactical coordination (TAC). To meet these objectives a series of linked assessment vignettes, focusing on operators at the “tactical edge,” will be conducted across organizational, functional and cultural boundaries.

We will establish a WAN CWE architecture on the UNCLASS Internet. Conduct multinational, multi-echelon distributed collaboration FOPS, COPS and TAC planning and coordination in a JC3IEDM-enhanced CWE. Asssess MOE related to Fn Capability #7 and the suitability of JC3IEDM as a semantic for multinational maritime C2 and information management.

This experiment uses two types of CWE application clients; 1) JC3IEDM-enabled Tactical Collaboration (JTC) Chart and 2) Spark, that enable collaboration in data and text respectively. Both client types use extensible messaging and presence protocol (XMPP) for WAN connectivity and archiving.

[1]FORCEnet is the name given to the CNO concept describing the future net-centric Navy.

Technical Readiness Assessment (TRA) Objectives

Background

JC3IEDM-enabled Tactical Collaboration (JTC) is a prototype collaborative work application. It is under development as an instrument and capability intended to support standards-based multinational command and control information sharing and management.

Trident Warrior 2007 offered a coalition experiment venue for JTC-based CWE experimentation. The JTC initiative was postponed when it was recognized that not all experimental objectives would be achieved. The CWE experiment objectives remain and a US led JTC-based experiment will be conducted at a time convenient to participating TTCP nations.

TRA Objectives

This document serves as guide to the JTC / experiment TRA which is intended to provide personnel (TTCP scientists, engineers and military) with:

- familiarity and confidence in the JTC Chart application,
- familiarity and confidence in the Spark chat application (or other XMPP client),
- an understanding of data-centric CWE CONOPs
- confidence in the network impairment configuration and technique
- familiarity with a small set of JC3IEDM semantics
- experience establishing the JTC distributed CWE on the public Internet,
- an opportunity to assess the proposed MOP and MOE measures,
- familiarity with data collection procedures and automated techniques,
- an understanding of military personnel requirements for future experiments,
- information required to support future TTCP experiment planning.

The TRA results will be used to help define the metrics, schedule and participants for future TTCP MAR TP-1 JTC experiments.

Experiment Objectives

Background

During Trident Warrior 2006 (TW06) a CWE based on JTC version 1.0 was used to simplify the development and exchange of plans, orders, and coordination measures. It had two intentionally very narrow and focused objectives:

- Enhance distributed collaboration planning: person to person (P2P), person to machine (P2M), machine to machine (M2M).
- Assess JC3IEDM semantics supporting the maritime-COP, specifically tasking and tracks.

During the TW06 experiment a direct comparison of JTC-based collaborative work and legacy methods (e.g., using PPT to convey military graphics and orders) was conducted. It was found that users not only preferred using structured data and synchronous collaboration techniques but that these methods greatly reduced both the time and bandwidth required to accomplish deliberate and collaborative tasks.

Capability Assessment

The 2007 experiment objectives are similar to those in 2006 but the operational and technical context, participants, and deployment are broader. Additionally, no direct comparison to legacy methods will be made.

This experiment and assessment will focus on net-centric information sharing and interoperability fundamentals – the requirement for standardized command and control semantics. These fundamentals will be applied to FORCEnet Capability 7 (Fn7): “Provide distributed groups of decision makers the ability to cooperate in the performance of common command and control activities by means of a collaborative work environment.” The experiment objectives are:

- Objective 1: Assess the use of JC3IEDM data semantics for maritime domain awareness (MDA) information sharing, planning and coordination.
- Objective 2: Assess data-enhanced distributed collaborative work processes.

We want to better understand how the capability/constraint of collaborating-in-data enables a rich collaboration process (i.e., two or more people or groups with differing perspectives and complementary skills interacting purposefully to produce a shared creation that none would have produced alone)[4]. In turn, we want to understand how JC3IEDM semantics can enable rich collaboration and required FORCEnet capabilities.

Metrics

Table 1 below defines and rolls up a set of weighted Measures of Effectiveness (MOE) linked to the FORCEnet Capability 7 requirements and an associated weighted set of Measures of Effectiveness (MOP). The MOPs are defined in term of efficiency ratios, time distributions and completeness rations. An initial planning objective is to, as a group, assess these weighting factors and percentages. JTC user event logs, chat logs, observer logs, and subject questionnaires will be used to derive MOP / MOE metrics.

JTC Chart has not been explicitly designed to these requirements, even so, the general approach of leveraging C2 semantic data standards and open source collaboration protocols has led to a technology that immediately begins to address many aspects of Fn7.

FORCEnet Capability 7 (Fn7):	Fn #	WF	Measures of Effectiveness (MOE) Definition:	WF	Associated MOPs (Defined below)
Provide distributed groups of decision makers the ability to cooperate in the performance of common command and control activities by means of a collaborative work environment.	7.1	10	Can define, share and visualize planning products and related track information. [P2P, P2M]	20	MOP 1: Access tracks
				15	MOP 2: Access OPTASKs
				35	MOP 3: Define plans
				30	MOP 6, 7, 8: Semantics
	7.2	20	Interaction enables decision makers to reach mutual understanding regarding shared plans, work products and information objects. [P2P]	30	MOP 4: Collaboratively share and discuss work
				20	MOP 5: technology enables fluid interactions
				50	MOP 6, 7, 8: Shared semantics
	7.3	5	Can form distributed collaborative work sessions. [P2P]	100	MOP 4: Easily form collaborative sessions
	7.4	25	Can collaboratively edit planning products. [P2P, M2M]	20	MOP 2: OPTASK Query
				60	MOP 4: Easily form collaborative sessions
				20	MOP 4: Easily form parallel collaborations
	7.5	10	Can form multi-modal collaborative work sessions. [P2P, M2M]	100	MOP 9: Available modalities
	7.6	20	Diverse/multi-mission (functional) planning data incorporated in collaborative work sessions and products. [P2P, M2M]	60	MOP 6, 7, 8: Semantic scope
				40	MOP 10: Cross-community plan integration process
	7.7	10	Manage collaboration sessions and processes. [P2M]	60	Managed collaborations
				40	Parallel collaborations

MOP #	Measures of Performance (MOP) Definition:
1	Track dissemination ratio (# tracks/reply delay): [larger is better]
2	OPTASK query ratio (# OPTASKs returned/reply delay): [larger is better]
3	Deliberate Planning Time Period distribution: [less time is better]
4	Collaborative Planning Time Period distribution: [less time is better]
5	Round-Robin Time Period (all nodes modify an OPTASK sequentially): [less time is better]
6	Maritime Task Concept Ratio (available semantics/needed semantics): [larger is better]
7	Maritime Route Concept Ratio (available semantics/needed semantics): [larger is better]
8	Maritime Region Concept Ratio (available semantics/needed semantics): [larger is better]
9	Collaborative Work Modality Ratio (available modalities/needed modalities): [larger is better]
10	Functional Integration Ratio (supported functional planning/needed functional planning): [larger is better]

Table 1: Draft JTC MOE-MOP definitions

CWE CONOPS

This experiment will examine a generic CWE concept of operations (CONOPS) referred to as "data-centric collaboration." We will explore this concept by defining CWE information objects using JC3IEDM data semantics and conduct representative warfare planning, coordination, resource allocation, and deconfliction collaborative tasks. The JTC Chart application provides the an initial CWE data-centric collaboration capability.

The capability to define and share standards-based work products/information objects is essential for collaboration in a net-centric / network-enabled environment where many different users and systems reside. More generally, machine-readable tasking capability facilitates plan and order generation and is capable of bringing increased automation through the use of coherent semantics for multinational, joint and FORCEnet net-centric information sharing. The result could be improved speed of command, improved man-to-machine communications and automated processing, and simpler more effective distributed collaboration.

JTC Chart brings to the traditional collaborative information environment an ability to generate plans and orders that can be read by both the warfighter and automated processes. JC3IEDM-based information exchange, provided by JTC Chart, is used in combination with unstructured chat, provided by a chat client. These tools enable deliberate planning, collaborative planning and tactical execution monitoring. These capabilities improve shared situational awareness and understanding and simplify the exchange of plans, orders, and coordination measures. Figure 1 shows JTC-enabled distributed CWE CONOPS for three general types of command and control activities.

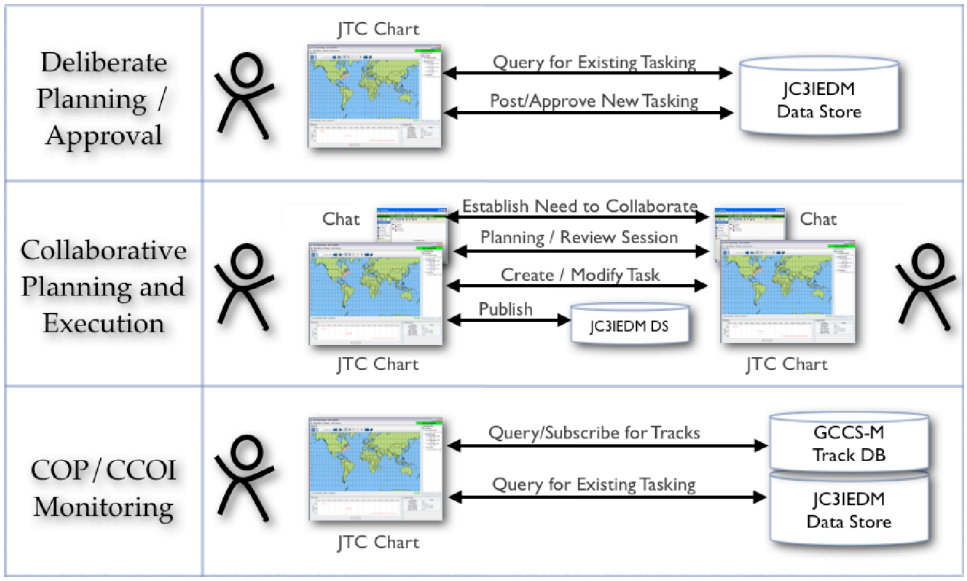


Figure 1: JTC-enabled Distributed Collaborative Work Environment

The CWE CONOPS exploits the JC3IEDM data representation of plans and situation information to enable 1) a process of deliberate planning and publishing, 2) a process for synchronous collaborative planning and execution, and 3) situation monitoring. The JTC-enabled planning process is described in further detail in the JTC Chart User Manual. Figure 2 shows the basic collaboration states and interactions during JTC-enabled planning.

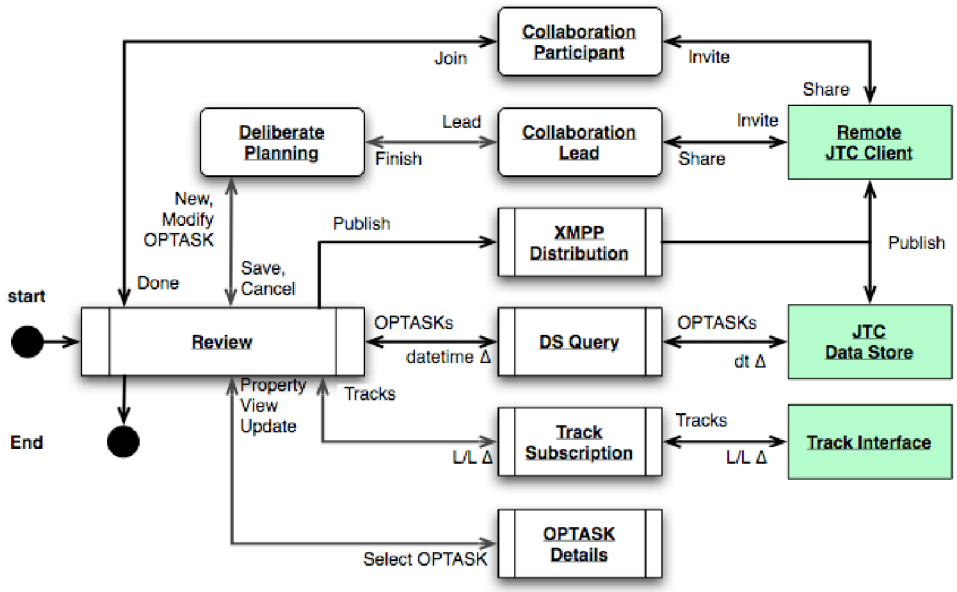
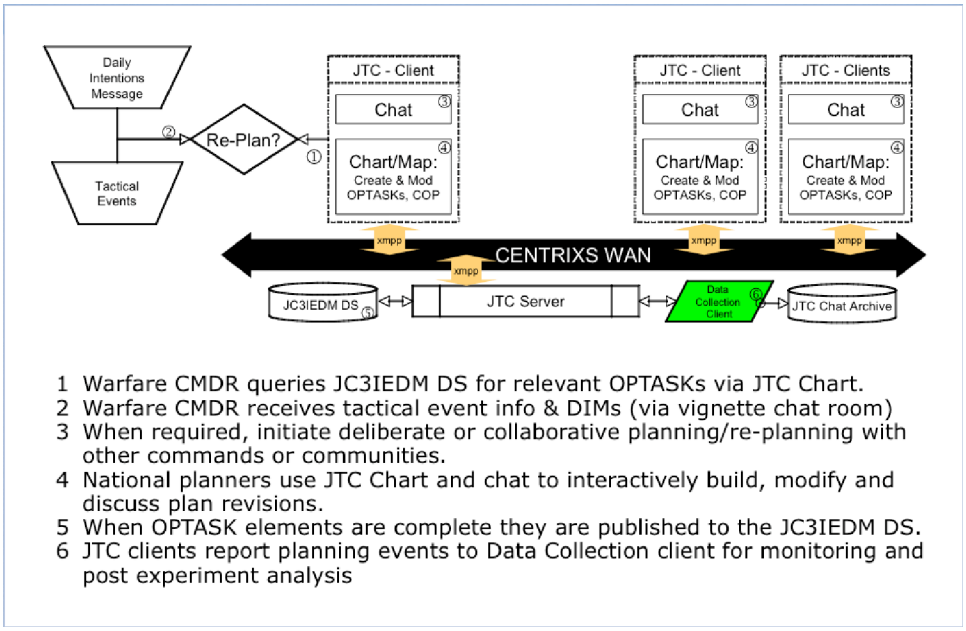


Figure 2: JTC-enabled Collaboration States and Interactions

A typical data-centric deliberate / collaborative planning use case is shown in figure 3.



1 Warfare CMDR queries JC3IEDM DS for relevant OPTASKs via JTC Chart.
2 Warfare CMDR receives tactical event info & DIMs (via vignette chat room)
3 When required, initiate deliberate or collaborative planning/re-planning with other commands or communities.
4 National planners use JTC Chart and chat to interactively build, modify and discuss plan revisions.
5 When OPTASK elements are complete they are published to the JC3IEDM DS.
6 JTC clients report planning events to Data Collection client for monitoring and post experiment analysis

Figure 3: JTC-enabled Data-centric Planning Use Case

JTC Chart Application Overview

JTC Chart provides the user with access two types of information objects, Operational Tasks (a.k.a., OPTASKs) and platform tracks. See Annex E for a fuller description of these information objects. OPTASKs are simple generic Who/What/Where/When type plans/orders that direct a friendly organization or unit to perform a specific military task. OPTASKs can be used to specify tasking at the strategic, operational, and tactical level. JTC Chart enables users to collaborate on the definition and modification of OPTASKs. There are four primary window in JTC Chart, the Summary View to designate which set of OPTASKS are to be shown in the Map View and Gantt View (double clicking on a Summary View OPTASK will toggle its visibility state). The properties of the currently selected OPTASK are shown in the Property View.

The user can query the network JC3IEDM server for published OPTASKs, using a datetime period specification, and the result is subsequently listed in the Summary View section under Operations. OPTASKs completed and stored locally, but not yet published globally, are listed under Summary View > JC3IEDM > Planning. Ongoing OPTASK-specific collaboration sessions are listed under Summary View > JC3IEDM > Collaboration. Globally published OPTASKs are listed under Summary View > JC3IEDM > Operations,

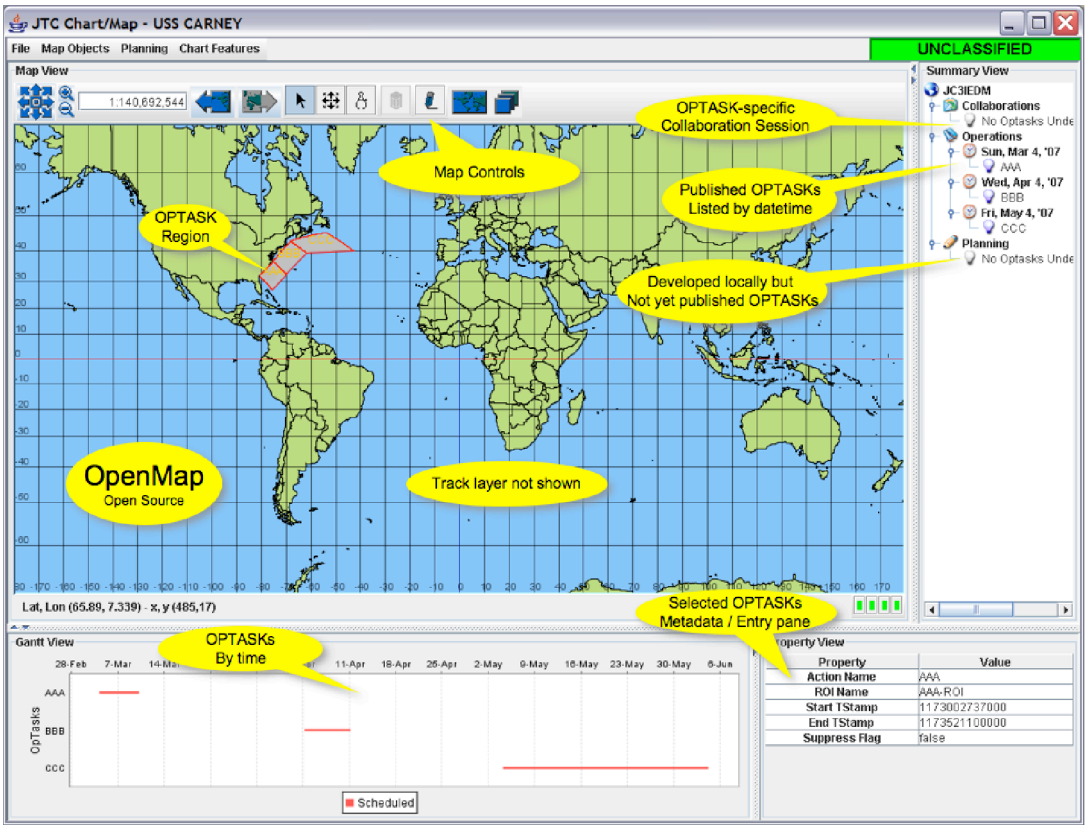


Figure 4 JTC Chart Window GUI with Comments. Track Layer not shown.

The JTC Chart map view enables the user to select a geographic region and subscribe to platform tracks for that region. Independent of the track subscription region, there are map controls that enable the user to pan and zoom, recall previous views, make geographic distance and bearing measurement, and select additional data layers such as "cities".

Operational Task (OPTASK) Specification

OPTASKs are created by specifying the following parameters in a template displayed in the JTC Chart Property View (lower right corner). The Map View is used to define the geographic shape of a region and route. OPTASK who, what, which, where, and when information is represented using JC3IEDM semantics. It is through the creation, collaboration and sharing of OPTASKs that JTC Chart begins to demonstrate and deliver FORCEnet collaborative work capabilities.

Field	Meaning	Interpretation
Name	Name of the operational task.	Descriptive task name
Objective:		
Entity	The specific entity that is the objective of the task	Which entity (track or friendly organization?)
Route	Name of the geographic route specified	The name of Route Along Which the Task to be performed
Route Type	A list of route types to further describe the objective route	Select the route type required for the task based on the provided JC3IEDM definition.
Region	Name of the geographic region specified	The name of Objective Region Where is the Task to be performed
Control Feature Type	A list of control feature types to further describe the Objective Region	Select the region type required for the task based on the provided JC3IEDM definition.
Begin Date/Time	The begin date/time of the task.	When does the Task begin
End Date/Time	The end date/time of the task.	When does the Task end
Performer	The friendly unit that is to perform the task.	Who is to perform the Task
Task	The specific military task that is to be performed.	What military Task is to be performed
Task Status	The assignment status of ACTION-TASK	Is the Task Planned or Ordered
Definition (provided in hard-copy form for reference)	Either, the Route-Type, Control-Feature-Type or Task definition depending which of these fields is selected.	Used to understand the meaning of the selected option

Table 2: OPTASK Specification (Semantic) Parameters:

JTC imposes the following OPTASK rules and procedures to facilitate the collaborative work process:

- An OPTASK is “owned” by the organization associated with the JTC Client that creates it, e.g., OPTASKs created by JTC Client US_MOC_1 and US_MOC_2 are both owned by US_MOC.
- A user may create, modify or collaborate on only one OPTASK at a time. Thus, any such ongoing operation must be cancelled or completed before moving to another OPTASK operation.
- Only JTC clients associated with the OPTASK owner can modify the original OPTASK. A modified OPTASK will retain the same name for continuity with the addition of revision #). If the originator modifies an OPTASK name then the OPTASK will, by definition, be saved

as a new OPTASK. Note, if renaming was done in error then cancel the modification and reselect the OPTASK, Modify and Save.

- Any user may modify any OPTASK by choosing to "Save As" which then results in a new OPTASK with that user as the owner/originator.
- Any user may initiate collaboration session on a new or existing OPTASK. That client is then the collaboration leader for that session.
- Any users may assist with modifying an OPTASK during a collaborative session. Only the collaboration leader may save the results and end the collaboration.
- When the original OPTASK owner is the collaboration leader, the group effort may lead to a modified OPTASK, or a new OPTASK, at the owner's discretion. Data Collection Plan

TRA Vignettes

The TRA will demonstrate JTC Chart readiness as a data-centric collaborative work tool. It will familiarize TTCP personnel with JTC Chart, the XMPP chat client, the experimental CWE and procedures for performing:

- deliberate planning and publishing
- synchronous collaborative planning, and
- situation monitoring.

Figure 5 shows user - vignette-type association and the corresponding TRA and experiment planning and coordination contexts, namely:

- future operations planning conducted among the various joint, maritime, and naval operations centers
- current operations planning conducted between the national operations centers and the various tactical platforms, and
- tactical execution conducted among the various tactical platforms.

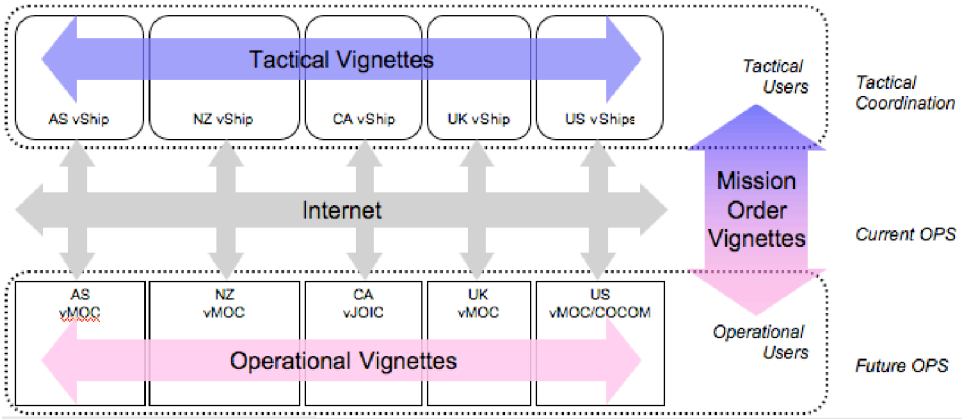


Figure 5: JTC Vignette and Associated Planning Contexts

The functional context for the TRA and experiment vignettes will be typical maritime:

- National port MIO planning then interdiction (TRA and Exp)
- Coordinated multi-national port MIO planning then interdiction (TRA and Exp)
- Coordinated multi-national ASW planning and execution (TRA and Exp)
- Coordinated multi-national Strike planning and execution (Exp)
- Coordinated multi-national humanitarian planning and execution (Exp)
- Naval Gunfire Support planning and execution (Exp)
- Routine ship operations planning and execution (Exp)
- Amphibious Operations planning (Exp)

Conducting TRA vignettes

The US will coordinate with each participating nation to define a convenient time period for TRA familiarization and testing. TRA vignettes will be addressed in increasing CWE complexity starting with national vignettes, then two nation vignettes, and then more than two nations simultaneously. The vignettes will likewise move from future operations planning, to current operations planning, to tactical coordination.

A typical four hour session:

1) [-1:00] US verify JTC Server configuration and communications
2) [-0:30] National clients establish chat communications on MUC “radio_check” and MUC “Command_XXX”. Report issue and readiness.
3) [-0:30] National clients on-line and established communication with JTC Server (i.e., successful boot)
4) [0:00+] US initialize COP replay (at appropriate time)
5) [0:00 – 1:30] Conduct vignette
6) [1:30 – 2:00] Vignette assessment, comments, and on-line review.
7) [1:30 – 2:00] US archive MUCs and DB reset if required.
8) [2:00+] US initialize COP replay (at appropriate time)
9) [2:00 – 3:30] Conduct vignette
10) [3:30 – 4:00] Vignette assessment, comments, on-line review, survey completion.
11) [3:30 – 4:00] US archive MUCs and DB reset if required.

TRA Level of Support

Requested level of support for this TRA is:

1) Internet access / Firewall configuration / JTC install (x2) – 8 hours (likely the most time consuming factor is opening XMPP firewall settings)

2) Assessment: two four hour periods: pairwise training and trial multinational vignette

3) Feedback: your thoughts and recommendations

TRA Schedule

The TRA is tentatively scheduled for the week of 13 August 2007. The US will work normal working hours for participating countries. National represetatives are requested to identify preferred schedules and to whom the US should directly include on future planning emails.

TRA Data Collection

Annex D describes TRA data collection plans and techniques. While the primary purpose of the TRA is to develop familiarity and confidence with JTC, this includes the data collection methodology. The manually created observer logs provide a part of the collection results.

The automated event logging will provide a time coded view of the operational (trainning use of JTC and more generally a data-centric CWE. These log will be analyzed after the fact to provide some of the timing metrics required for MOP assessment.

TRA Deployment

Background

The JTC TRA deployment architecture, application, and methodology will mirror that of the expected future JTC experiment deployment. The TRA has as a secondary objective establishing and demonstrating the suitablity of an unclassified distributed experimentation environment on the Internet.

Logical Architecture

JTC was to be deployed during Trident Warrior '07 on Combined Enterprise Regional Information Exchange System (CENTRIXS) Cooperative Maritime Force Pacific (CMFP). The delayed execution of the JTC experiment has meant that the TRA and initiative have moved to the public Internet WAN and shifted to UNCLASSIFIED processing. Additionally, GCCS-M platform tracks will be provided from a recorded UNCLASSIFIED simulation scenario instead of a live release-to-coalition track feed. The JTC capability is composed of a collection of distributed server and client components integrated using XMPP protocols and JC3IEDM semantics. Figure 6 shows the notional replanned JTC TRA architecture. The national point(s) of presence (POP) are as required by the participating nations.

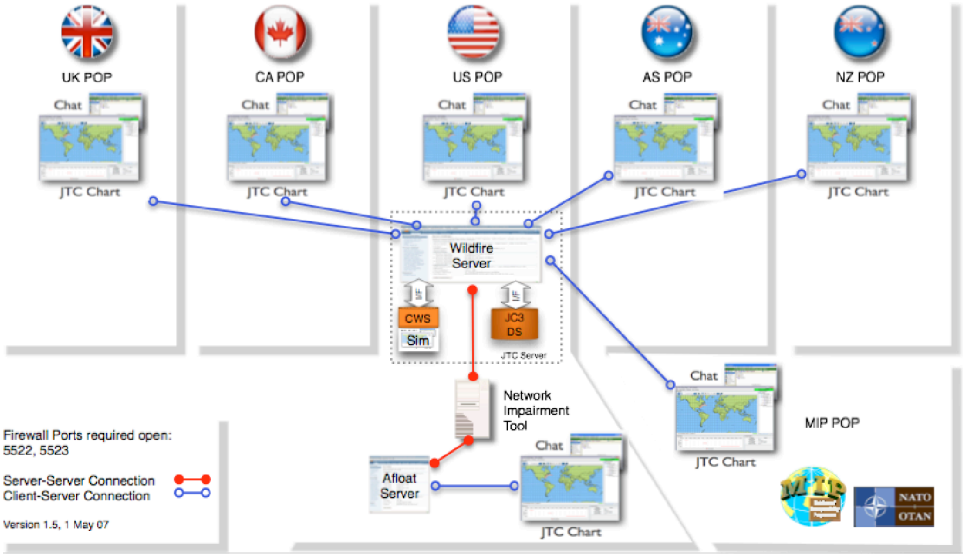


Figure 6: JTC TRA Deployment Node Architecture

Notes	Comment
JTC Wildfire XMPP Server	Hosted at US Naval Postgraguate School (NPS), Monterey, CA
Client-Server Connections	All non-US clients are connected directly to the central JTC Server at NPS
GCCS-M CWS feed	UNCLASS GCCS-M simulator generated track histories will be accessed via CWS. No GCCS-M on-line/on the Internet.
Network Impairment Tool	Supports bandwidth and latency impairment testing/simulation. Can be used to create global effects on collaboration MUCs.

XMPP Architecture

JTC components are integrated through the use of the Internet Engineering Task Force open standard extensible messaging and presence protocol (XMPP). The JTC CWE processes use the following XMPP multiuser chat (MUC) rooms for text and data passing. Additionally, the experimental procedures use additional MUC for coordination and data collection.

JTC Design and Implementation

Annex B provides the details of JTC implementation. Annex C describes the XMPP MUC configuration for the TRA.

Firewall Configurations

Organization / Internet firewall ports 5222 and 5223 must be open for the XMPP protocol to properly function. Nations are requested to assist with the completion of Annex B, Table B-1: JTC Operational Node Network Description, by providing the Internet IP address for participating JTC client systems.

Annex A Fundamental Transformation Challenge

> "Communities of interest (COI) - A collaborative group of users who must exchange information in pursuit of their shared goals, interests, missions, or business processes and who therefore must have shared vocabulary for the information they exchange."
> Source: DOD Net-Centric Data Strategy, DOD Chief Information Officer, 9 May 2003

All communities of interest (COI) require a range of agreements amongst participants enabling them to interoperate in a robust and confident manner. Necessarily this includes a shared understanding of community concepts (e.g., doctrine, TTP), "business" processes, communication architectures, and importantly information/data semantics (that includes lexicon, grammar, syntax, and business rules - collectively simplified to the notion of a "vocabulary"). Each military community expends significant funds to train personnel in order to effectively making them proficient members of their community. All communities have an explicit "vocabulary" that includes aspects of command and control (C2). More importantly, each community must be able to share C2 knowledge in order to coordinate with other communities and to effectively work for the operational commander. Translating between unique, or even similar, vocabularies is expensive and usually introduces uncertainty, ambiguity, loss of precision, loss of information, or loss of context - all of which have negative impacts on decision-making.

> Thus, a truly netted force must have a shared C2 vocabulary (with its lexicon, grammar, protocol and business rules) that eliminates translation and serves as the practical foundation on which to build interoperable and integrated multi-mission capability.

The Multilateral Interoperability Programme (MIP) is an important and unique multinational C2 community of interest that has been working to achieve precisely this integrated C2 foundation. It is driven by shared operational requirements and has achieved consensus in the technical and data standards area. 25 Nations, NATO and Allied Command Transformation are part of the MIP's ongoing process of improvement and testing. The MIP's primary "vocabulary" product is the Joint Consultation Command and Control Information Exchange Data Model (JC3IEDM).

The JC3IEDM is a product of almost 20 years of effort by hundreds of people[2] to define and document the information multinational commanders need to exchange, machine-to-machine, to conduct effective coordinated operations. This data model / knowledgebase has been adopted by the US Army and US Marine Corp as the Service standard for net-centric command and control transformation and integration. It is also the NATO corporate data model, recently ratified as NATO STANAG 5525. The scope of the MIP model is impressive, more than 1370 attributes[3] carefully integrated into a relational model. The JC3IEDM is neutral with respect to country, Service, system, technology and vendor. In other words, the JC3IEDM presents an extensible generalized non-proprietary, open source/standard framework. Like all standards it requires a dedicated effort to learn and properly implement. Regardless of the JC3IEDM pedigree, design attributes, and scope of content, simple adoption and extension is not easy or quick.

The net-centric transformation requires significant operational, process and technical change to achieve significant improvement. Deconstructing the many stove-piped processes and systems requires more than network and web service technology, it requires a strategy addressing alignment of fundamental enterprise information sharing requirements, a strategy that builds on a multinational and joint C2 "vocabulary". Achieving this operational objective will demand a different engineering paradigm. The perceived risk to existing programs makes this type of

[2] The MIP meets quarterly for two weeks. Most countries are always represented. In total approximately 120 people attend these meetings, with 40+ specifically supporting the data modeling working group.

[3] The JC3IEDM has reused ADatP3 (i.e., USMTF) and other classic military authoritative semantics whenever practical.

transformation difficult, but the enterprise risk of building new technology stovepipes must be addressed.

JTC experimentation during Trident Warrior 06 showed that JC3IEDM enabled rapid and efficient machine-to-machine communications. Importantly, collaboration in data also significantly improved person-to-person and person-to-machine information exchanges when compared to widely used unstructured collaborative techniques based on chat, email and PowerPoint. The ability to collaboratively plan, in real-time, with military data (aided by text chat) was considered a significant, useful and efficient improvement - reducing both time and bandwidth.

Trident Warrior 07 (TW07) continues assessing the JC3IEDM, its application in the maritime security domain, and the impact of formal modeled semantics on command and control collaborative capabilities required by FORCEnet.

Annex B JTC Architecture

JTC Architecture Components

JTC has two types of components, server and client. The JTC Server provide three basic functions, 1) XMPP server functions that integrate the various XMPP clients and provide communications persistence and archiving for chat and JC3IEDM XML messaging, 2) JC3IEDM data storage and query services, and 3) receives an external feed of tactical track data from GCCS-M Command, Control, Communications, Computers, Intelligence (C4I) Web Service (CWS). When experimenting on the Internet the tactical track data will be read from an UNCLASSIFIED track file by the Track Interface (Track I/F). Communications are from client to server and from server to server. All JTC clients will use NTP services to ensure proper time annotation.

For the JTC TRA each JTC client must have an appropriate identity. There are three variations of the JTC Client configuration typically connect as shown in figure B-1. The Ashore Client and Simple Client consist of only application clients. During the TRA all non-US clients will be configured as Ashore JTC Clients (see green boundary).

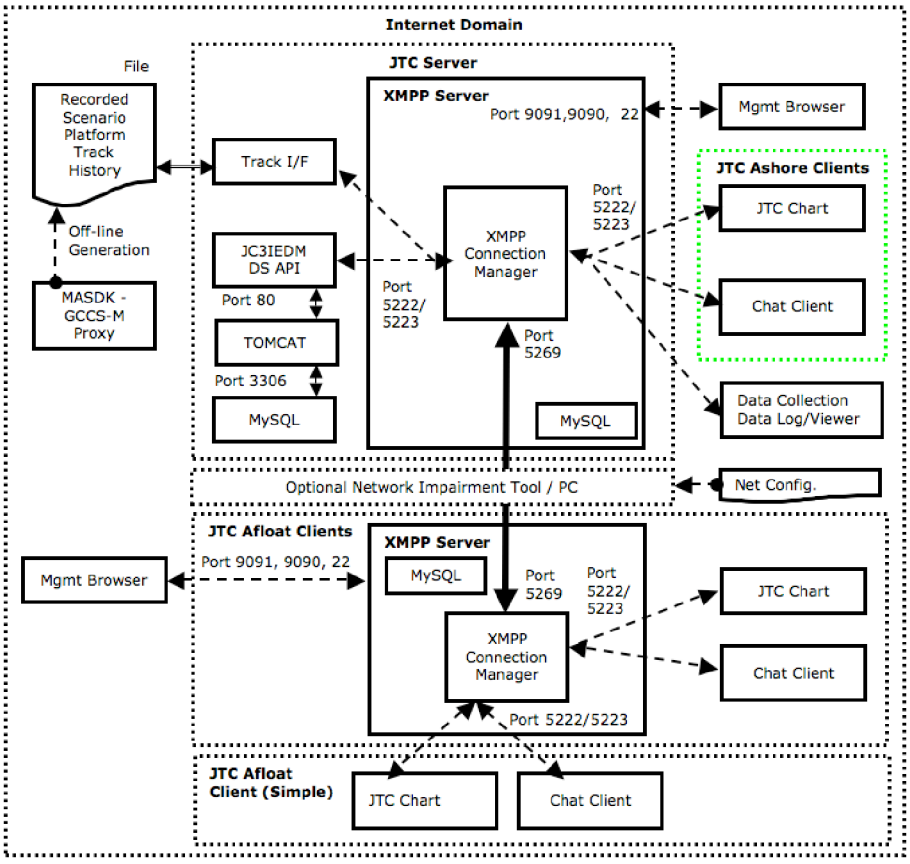


Figure B-1: JTC Typical Client-Server Architecture

Operational Nodes for the TRA

JTC Client / Server AF= Afloat, AS=Ashore, S=Simple	Internet	DNS Entry
JTC Server		
NPS, XMPP Server		
Clients		
AS_CTG_1 AS_Gallipoli_1 CA_MOC_1 CA_Charlettetown_1 NZ_MOC_1 NZ_MOC_2 NZ_MOC_3 NZ_Endeavor_1 NZ_TeKaha_1 UK_MOC_1 UK_MOC_2 US_MOC_1 US_MOC_2 US_MOC_3 US_HueCity_1 US_Carney_1 US_PACOM		

Table B-1: JTC Operational Node Network Description

Network Impairment Simulation

National communications bearer systems would provide connectivity on multinational networks such as CENTRIXS CMFP. As a result, end-to-end network performance will vary according to the combined performance of the national bearer systems supporting the information exchange. Accordingly, JTC will be expected to operate in both very low and high bandwidth conditions. Additionally, severe latency conditions could occur (e.g., routing over subnet relay and HF-IP).

The Internet will be used for multinational connectivity during the TRA and an least some future experiments. Internet connection baseline performance will be characterized within the architecture. It is recognized that this performance will likely change over time and is not under the control of the TRA or experiment controllers. Similarly, consistent quality of service is not today guaranteed on classified networks.

Limited (bandwidth and latency) communications conditions can be simulated using a network impairment tool (NIT). The architecture and NIT configuration shown in Figure E-1 enables constrained performance for OPTASK publishing, real-time OPTASK collaboration and chat for all clients. Additionally, track update performance for US clients can be restricted. Table B-2 shows expected best bandwidth performance for specific link types. Latency will not exceed values required for acceptable XMPP API. TRA will start with unconstrained NIT configurations to ensure accomplishing the primary TRA JTC readiness and familiarization objectives. As time permits, impairment can be applied to multinational events. Testing of the range of conditions shown in Table B-2 will be conducted by US nodes.

	SHF	INMARSAT	SNR Shared	HF IP Shared	Simulated SATCOM	Landline or Pierside
Comms Path BW (kbps)	256	32 - 128	77	19.2	128	T1-10240

Table B-2: Nominal Communications Path Bandwidth

Equipment

Each nation has provided its own hardware to host JTC capability. JTC Client configurations and the JTC Server components are to be hosted on new or existing nationally accredited PC and Server Commercial-Off-Shelf (COTS) hardware. There is no unique JTC security-specific hardware required. The preferred general type of host hardware and OS requirement for each type of JTC component Server of Client is shown in the Table B-3 below.

JTC Hardware Function	Intel Proc	RAM (MB)	HDD (GB)	JVM (Operating System)
Server	P/4	2000	36	Win2003 Server
Afloat	P/4	1000	1	JVM 1.5.0_11 (OS X-10.4x, Linux, WinXP)
Ashore & Simple	P/3	512	1	JVM 1.5.0_11 (OS X-10.4x, Linux, WinXP)

Table B-3: JTC Minimum Hardware Requirements

Client Software

There is one JTC Server installation for the TRA at Naval Postgraduate School, Monterey. All other installations are JTC Clients. JTC Client software is delivered as a package that requires selective installation and configuration based on the JTC node type and identity. All non-US JTC clients will be installed as Ashore Clients during the TRA. Minor version changes to the software listed could be expected as a result of bug fixes, application tuning required to address interoperability and performance issues discovered during the TRA. The software includes:

JTC Client Type	WildFire XMPP Server [version 3.1.1]	JTC Chart [Version 2.2]	Spark [version 2.5.4]
Afloat Client	X	X	X
Ashore Client		X	X
Simple Client		X	X

Table B-4: JTC Minimum Hardware Requirements

Multiuser Chat Rooms

The JTC Server and clients use a set of MUC rooms for text chatting between users, data dissemination and inter-application communications which are summarized in Annex C.

Modelling and simulation

Simulated platform tracks will used during TRA and the subsequent experiment to provide context for the experiment vignette. The Global Command and Control System - Maritime (GCCS-M) Mission Application Software Development Kit (MASDK) and its three applications, the C4I Team Training System and Replay have been used to develop vignette specific track feeds for JTC TRA and experimentation.

C4I Team Training System (C4ITTS) Description

The C4I Team Training System (C4ITTS), or sometimes referred to as the Mission Editor, is an application which allows users to quickly build, edit and replay scenarios within GCCS. Users create a scenario by adding tracks and assigning attributes to those tracks. Users then create a Path of Intended Movement (PIM) for each track using a point and click interface built into the GCCS System Chart. Once completed, the scenario can be replayed at 1:1 or faster speed through GCCS.

Replay

Replay is a lightweight application that is used to play Mission Editor created scenarios or archived scenario files. Once scenarios were adequately defined, they were replayed causing the data to be presented at the C4I web service (CWS) interface. A JTC CWS Track Interface was developed that can both:

- Read CWS in real-time (at a defined rate) and publish in response to JTC client geo-subscriptions, or
- Archive to file a scenario worth of time-stamped CWS reports. The CWS Track Interface can then playback with proper timing the scenario from the file record. This enables the UNCLASS scenario to be replayed without GCCS-M or MASDK present. This was required in order to avoid placing GCCS-M and CWS C4I software on a computer operating on the Internet.

Annex C Multi-User Chat (MUC) Room Configuration

The JTC initiative collaborative work environment and processes will be established in the following MUC rooms. For TW07 multinational JTC client nodes on various ships and at various ashore sites. For the JTC TRA each JTC client must have an appropriate identity. The TW07 client identities have been retained for the TRA. This will enable role approriate names for the trianning and assessment vignettes.

MUC Use	MUC ID	TransVerse Text		Data channel
Exper. Coord.	radio_check			
Observation	jtc_comments			jtc_events
Command	Command_PAC	Command_Global		Command_LANT
Track Services	geographic_filter	XXXXX_track@		
JC3 DB Services	jc3iedm_private			

JTC Node Name Mapping		DNS Reference
[Ship/Country_Station_ Collab]	[Site_Station]	
Collaboration Leader MUC Room	Chat Contact Nickname	
AS_CTG_1_Collab	AS_CTG_1	
AS_Gallipoli_1_Collab	AS_Gallipoli_1	
CA_MOC_1_Collab	CA_MOC_1	
CA_Charlettetown_1_Collab	CA_Charlettetown_1	
NZ_MOC_1_Collab	NZ_MOC_1	
NZ_MOC_2_Collab	NZ_MOC_2	
NZ_MOC_3_Collab	NZ_MOC_3	
NZ_Endeavor_1_Collab	NZ_Endeavor_1	
NZ_TeKaha_1_Collab	NZ_TeKaha_1	
UK_MOC_1_Collab	UK_MOC_1	
UK_MOC_2_Collab	UK_MOC_2	
US_MOC_1_Collab	US_MOC_1	
US_MOC_2_Collab	US_MOC_2	
US_MOC_3_Collab	US_MOC_3	
US_HueCity_1_Collab	US_HueCity_1	
US_Carney_1_Collab	US_Carney_1	
US_PACOM _Collab	US_PACOM	

Table C-1: JTC Chart Chat and Data MUC Rooms

Table D-2 below provides additional details regarding the MUC rooms used by JTC for data and text exchange and Table D-3 gives the general TW07 chat room setup.

TransVerse Chat Room Name	MUC Type	Purpose
Radio_Check	Public	24/7 all stations monitor / establish comms
Command_Global	Public	Global command & coordination (includes global vignettes)
Command_PAC	Public	Pacific command & coordination (includes Pacific vignettes)
Command_ LANT	Public	Atlantic command & coordination (includes Atlantic vignettes)
Country_ Organization_Station_ Collab	Public	Client specific public text MUC rooms for OPTASK collaboration. Each client uses their associated MUC for collaborations that they lead. When advertised in the "List View" for collaboration both the advertising client name and OPTASK name are shown, e.g.,"NZ_MOC_1/MIO1". Other clients wishing to join this collaboration will select the OPTASK and join the corresponding TransVerse MUC (NZ_MOC_1/_collab) for text dialog.
jtc-observer	Public	Common text channel coordinating JTC experiment activities and for reporting and archiving JTC observations
MUC Room Name	**Content & Type**	**Purpose - note: each client has a unique jtc-wkst-x.xxx address**
jtc_de	Data & Public	Data-exchange MUC used by all JTC Chart apps to notify each other when OPTASK collaborations start and end. All JTC Chart clients globally publish OTASKS using this MUC. Clients publish geo-subscription request to the track interface on this MUC. Additionally, Client collaboration state changes are passed on this channel to manage collaborative sessions.
Country_ Organization_Station_ track	Data & Private	Used to by the Track Interface to publish to JTC Chart client “Country_ Organization_Station” (NZ_MOC_1)
jtc_events	Data & Private	Used by all JTC clients for reporting and archiving JTC client events

Table C-2: JTC Chart and Data MUC Room Details

Annex D Data Collection Plan

During the TRA those undergoing the familiarization training will be asked to assess, compare and contrast the experimental data-centric collaboration methodology and its JC3IEDM semantics with other planning and collaboration capabilities with which they are familiar. Perception of the users, and observer will be captured by the survey instruments and by comments captured using the public jtc_observer MUC. Formal workload assessment methods will not be undertaken during the TRA and subsequent experimentation.

Observer

The TRA will provide an opportunity to familiarize observers with the training and direction needed for future experiments. TRA participants will be asked to complete surveys and review the JC3IEDM enumerated codes for maritime semantics.

Personnel

National nodes should collect the information shown in Table E-1 regarding TRA personnel.

Data Field	Description
Last name	Family surname
First name	Given name
Occupation Type	Values {Military, Government Civilian, Contractor}
Rank/Rate	Typical values {Mr., LCDR, PO1, IT2}
Experiment Role	Values {JTC observer, subject, TW07 observer technical support}
Service Affiliation	Values {Navy, Joint, DHS, USCG}
Country Affiliation	Country values {AS, CA, NS, UK, US}
Organization Name	Name of the organization for which person normally works
JTC Instance	Values {UK_MOC, NZ_Te Kaha, US_C2F}
Comment initials	Name initials underscore Country Affiliation {e.g. , EC_US}
Completed on-line surveys	Yes/No
JTC use start datetime GMT	When did you start using JTC during the experiment?
JTC use end datetime GMT	When did you complete using JTC?
email address	Email address where you can be reached for follow-up questions?

Table D-1: TRA Personnel Information

Experiment Control

Overall TRADITIONAL control will be managed by the Naval Undersea Warfare Center, Division Newport. In case of loss of communications or other difficulties that require voice communications contact the WSPF laboratory +1 401 832-2111 and/or chaume@npt.nuwc.navy.mil and burkleyfg@npt.nuwc.navy.mil.

Lessons Learned

TRA participants will have an opportunity to enter comments and lessons learned in the "jtc_comments" Spark MUC room. Similarly, comment can be made in the collaboration chat rooms during an ongoing planning activity. In order to make the analysis easier a code should prefix each comment. The code syntax is "#XYY AA_BB:" where "#" and an "X" code value are mandatory, each instance of Y is optional, and AA is the commentator's initials_BB country affiliation. Thus, "#JTC EC_US" would code / denote a comment by Erik Chaum of the US about

JTC timing in the collaborative planning mode, e.g., "#JTC EC_US: wow, JTC is faster than sharing PPT files".

X Code	X Meaning
O	Office-based Planning
J	JTC-based Planning
B	Chat client
M	Mail
E	Event Logging
C	Configuration
N	Network/Comms
G	General

Y Code	Y meaning
B	Bandwidth
T	Time
A	Application
S	Planning Semantic
D	Deliberate Planning
C	Collaborative Planning
L	Learning
R	Recommendation
P	Problem

Table D-2: Coded Comments

Paricipants are also encouraged to make comment annotations in the OPTASK specific collaboration MUC rooms, enabling a correlation of the real-time comments to specific OPTASKs and collaboration sessions. Comments should be entered into the chat room in the manner called out in the lessons learned section, i.e., the code syntax is "#XYY AA_BB: Comment text."

Event Recording

JTC Chart, Track Interface, and OCXS components implement selective event reporting to the jtc_events MUC in order to collect state, timing and bandwidth data correlated to user and OPTASK. An assessment of ease, speed and clarity will be made from the timing, bandwidth, information exchange record, and events data recorded.

Event Description	These Fields constitute the Event Message Content (CSV)						
Client on-line	COL	Client ID	GMT				
Client shutting down	CSD	Client ID	GMT				
Client error [e.g., ntp, CWS, Chart]	CER	Client ID	GMT	Error #			
User Log-on	ULO	Client ID	GMT	Name	Rank	Organiz.	
User Log-off	ULF	Client ID	GMT	Name	Rank	Organiz.	
Track update [on new subscription, resize ROI, new CWS report]. For new CWS report one Track update for each client subscription.	TUD	Client ID	GMT of Client Track update report	GMT of ref CWS report	GeoSub-scription Upper Left Lat:Long	GeoSub-scription Lower Right Lat:Long	Number of tracks in track update msg
OPTASK Query [Client DB use]	DBQ	Client ID [from]	GMT of Client Query	Period Start [Date-Time]	Period End [Date-Time]		
OPTASK Response [JC3 DB performance and load]	DBR	Client ID [to]	GMT of reply to Client	GMT of Client Query	Number of OPTASKs in Reply		
New OPTASK [user starts new OPTASK definition]	NOP	Client ID	GMT	OPTASK ID			
Save OPTASK [user saves OPTASK on local Client]	SOP	Client ID	GMT	OPTASK ID	OPTASK Name		
Post OPTASK [user send OPTASK to JC3 DS]	POP	Client ID	GMT of Client Post	OPTASK ID Set	Ack RT time [sec]		
Modify OPTASK [user starts to modify an existing OPTASK]	MOP	Client ID	GMT	OPTASK ID			
Cancel OPTASK [for both New or Modify OPTASK]	XOP	Client ID	GMT	OPTASK ID			
Initiate OPTASK Collaboration [new or existing OPTASK]	IOC	Client ID	GMT	OPTASK ID			
Join OPTASK Collaboration	JOC	Client ID	GMT	OPTASK ID			
Leave OPTASK Collaboration	LOC	Client ID	GMT	OPTASK ID			
End Collaboration [Only initiator can end collaborator]	EOC	Client ID :Initiator	GMT	OPTASK ID			

Figure D-3: Client and Server Event Logging

Annex E Examining JC3IEDM concepts and semantics

The JC3IEDM has a very rich capability to express both operational and tactical context. Much more than a simple tactical picture, the MIP's operational analysis process has defined a set of information exchange requirements that support the commander across a spectrum of types of operations and activities (e.g., planning, coordination, execution, observing, and decision making). Figure E-1 shows a high-level independent entity-relationship view of the JC3IEDM. The C2IEDM and JC3IEDM have the essential community characteristic of being generic (i.e., not derived directly from system specific implementations) and extensible (i.e., suitable as a core to which functional extension can be added).

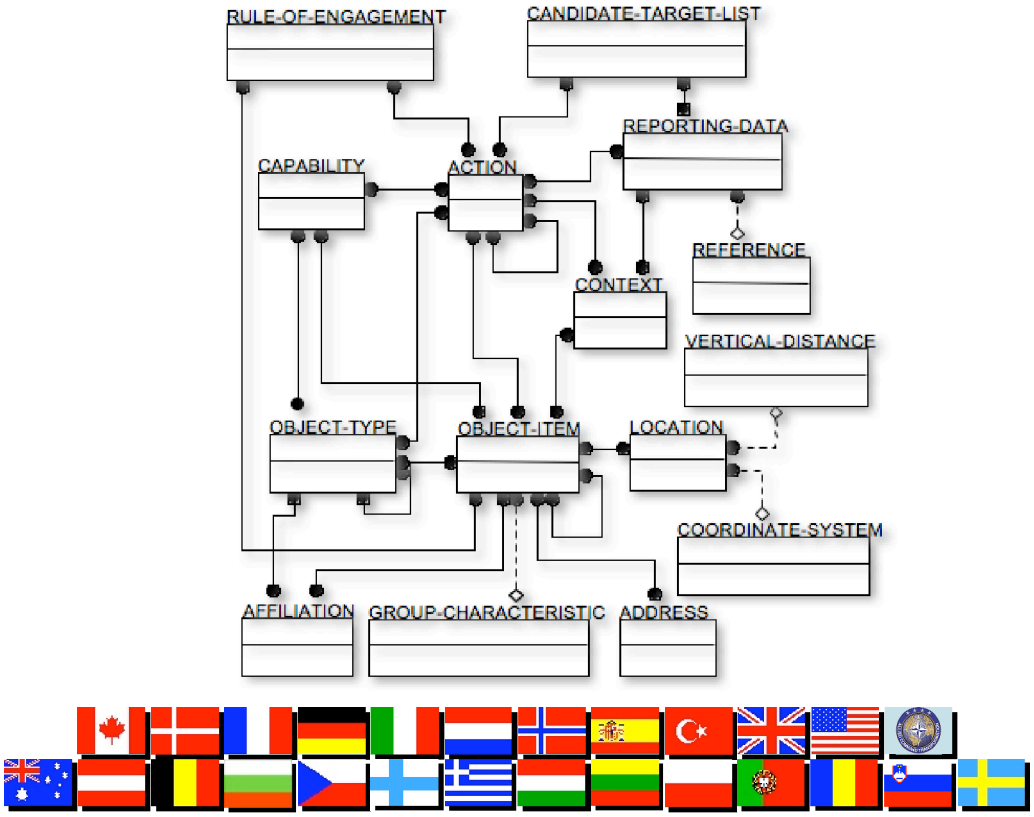


Figure E-1: JC3IEDM 3.0 Independent Entities (IDEF1x)

The JC3IEDM was developed with the objective of enabling liaison and automated C2 interface exchange mechanism. The consensus process has resulted in agreement on a common vocabulary consisting of 240 information categories that include over 1000 content elements. The JC3IEDM is country, system, Service, application, process, technology, vendor neutral supporting war operations, crisis response operations and joint operations. As such, it forms a semantic core for any functional area.

JTC is using two simple data objects that can be derived as views on the JC3IEDM data model. The first is a Track data object and the second is the OPTASK data object. Views of these two views on the JC3IEDM are shown below in figures E-2 and E-3 respectively. Fig

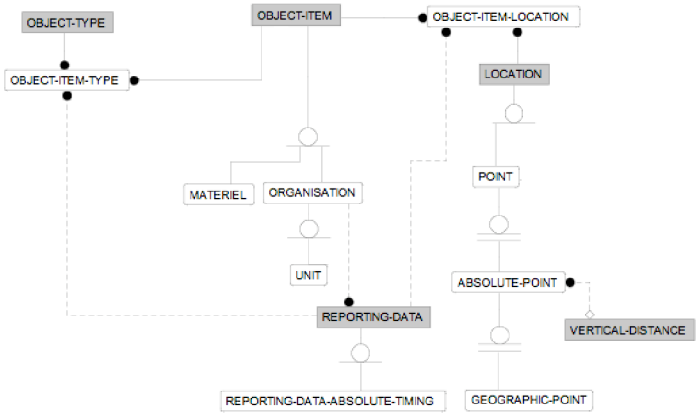


Figure E-2: Track View

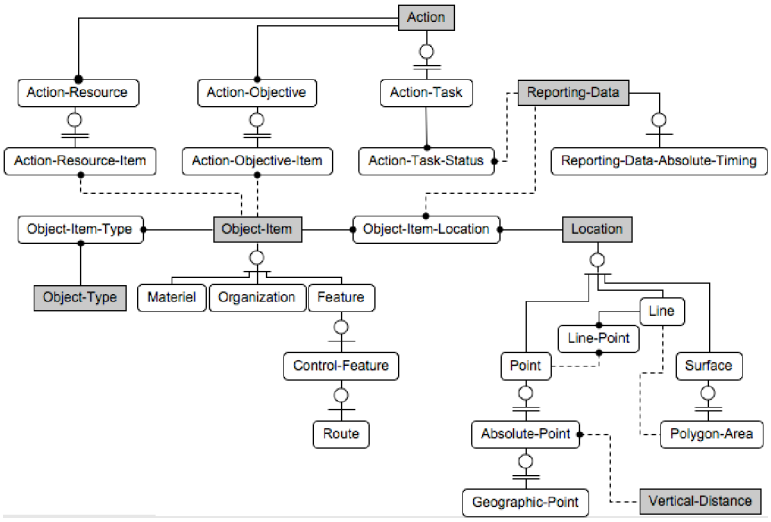


Figure E-3: OPTASK View