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FORCEnet; Capabilities, Tasks, and Attributes

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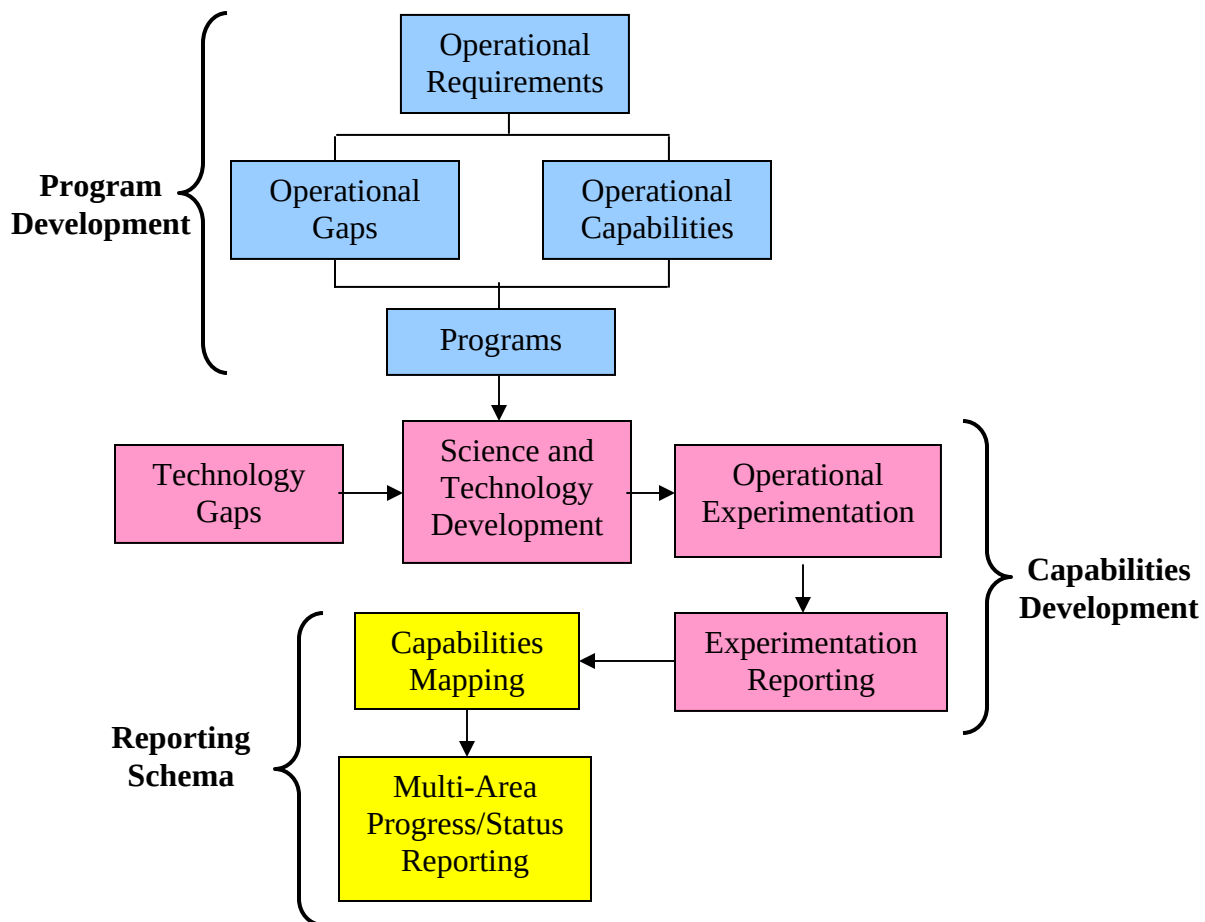
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EXECUTIVE SUMMARY

The relationships between military operational capabilities and the programs responsible for the development of technologies that support those capabilities are complex. This report describes a schema for mapping those relationships. One purpose of the schema is to enable reporting progress in capabilities development across program and capabilities areas, with the ultimate goal to support programmatic decision-making.

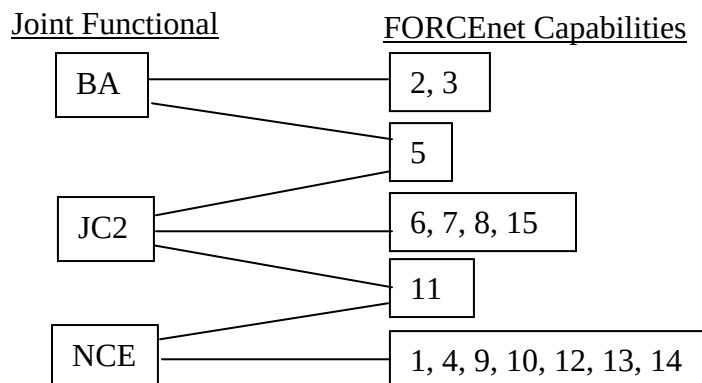
The following figure illustrates, simplistically, the structure of the schema. Capabilities development begins with identification of operational gaps, followed by programs designed to fill those gaps, system and process development, experimentation to test developments, and reporting of progress. The schema provides a structured mapping of the relationships between programs and capability areas and uses this mapping reporting across these areas.



Although not shown, training is an important part of the development process. New capabilities are not realized without training to utilize the new systems and processes.

Contained here are mappings between FORCEnet capabilities and the capabilities described in three JCIDS Functional Concepts: Battlespace Awareness (BA), Command and Control (JC2),

and Net-Centric Environment, (NCE). Capability mapping results are shown in the following diagram.



If the same criteria had been used for defining Joint and FORCEnet capabilities the mapping would be one-to-one. This is not the case and is most often not the case when comparing different domains.

A mapping that can be used for results reporting requires examining levels below capabilities, tasks within those capabilities, and this is shown in the body of the report. Multi-level mapping requires determining those levels that can be used for mapping. For this schema they are:

Functional Capabilities – capabilities required to perform successfully those functions (e.g., Intelligence, Surveillance, and Reconnaissance).

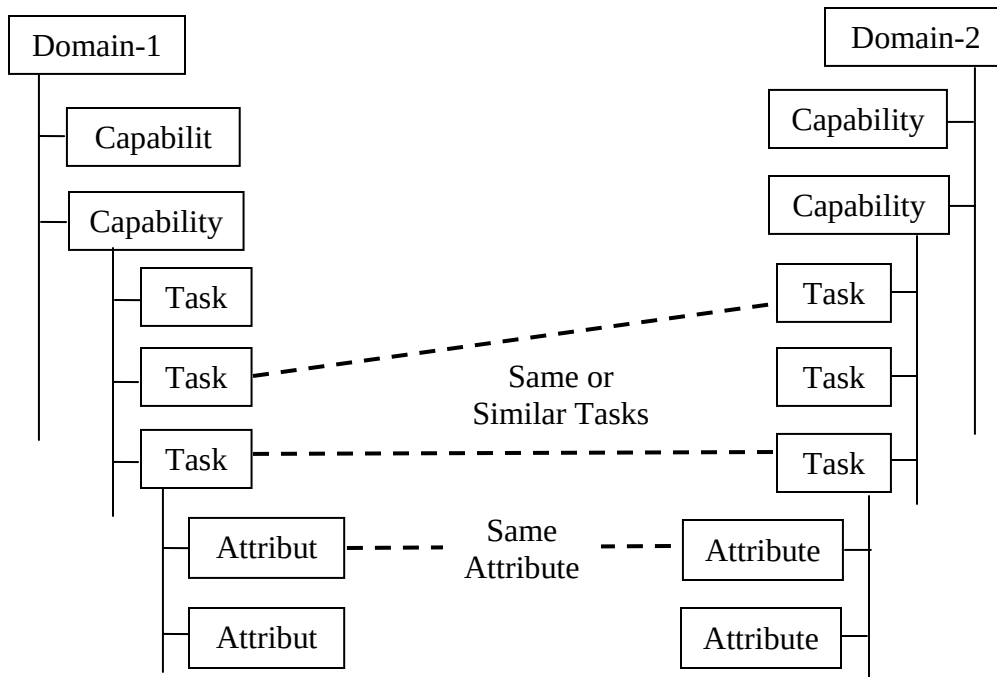
Operational Tasks – tasks performed by operating forces, executing processes that provide those capabilities (e.g., Battle Damage Assessment). There can be several task levels (sub-tasks).

Attributes – quantifiable characteristics of task performance (e.g., Timely).

Measures – specific quantities that provide attribute quantification (e.g., elapsed time, as a timeliness measure, for executing the BDA task).

The structure presented here for mapping between different areas is shown in the following diagram. It is understood that an area will normally contain several capabilities, a capability several tasks (and sub tasks).

The structure reported maps at the task and attribute levels, shown by dotted lines in the following figure. It is understood that mapping may be needed at the sub-task level. The key is that operational tasks must be well defined and sufficiently narrow in scope so that mapping that is essentially one-to-one can be achieved.



It is also necessary to map attributes because results are presented as measures (attribute quantification). For example, a particular task, e.g. planning, may need to be timely and sufficient (the two attributes).

Schema Summary:

It has been found that adequate mapping of Joint to FORCEnet capabilities is accomplished by using tasks and a single sub-task level.

Attributes have been extracted from the three Joint concepts examined and from the capability lists used for Trident Warrior experiments. Attributes have been assigned to the defined FORCEnet tasks and sub-tasks as part of this work and development of the capabilities Annex. Mapping of Joint and FORCEnet attribute has been developed.

These steps have produced a robust schema for relating progress and status between JCIDS and FORCEnet capabilities. The schema can be used for mapping between any areas as long as they contain equivalent or like operational tasks.

Required measures are often produced as results from operational experiments. Applying those results to a given set of capabilities follows essentially the same schema described above. During the experiment planning process, the tasks to be tested are defined, as are their attributes and measures. Mapping of these tasks and attributes to those areas/capabilities to which reporting is to be done is also determined. Once this is done, reporting to the desired venue is essentially automatic.

Mapping from Trident Warrior experiment results to both FORCEnet and JCIDS capabilities has been completed.

A significant advantage of this approach is that reported results, at any level or to any area, are automatically traceable to the data from which they were produced. Such reporting pedigree allows one to assess confidence in the results and even their range of validity.

One difficulty is not discussed here: rollup of results to higher-level attributes and measures. This schema provides a means for relating results across equivalent operational task levels. How to do roll-ups from lower to higher levels is not presented.

1.0 INTRODUCTION

DoD services and joint organizations are in the process of transforming forces to meet the demands of 21st century operations. One foundation of this effort is to develop operational concepts that utilize present and emerging network-centric information processes. Many activities and organizations are developing these concepts and they are only loosely coupled. There are overarching directives, such as CJCSI 3170, which established the policies and procedures of the Joint Capabilities Integration and Development System (JCIDS), but they do not provide sufficient guidance to insure that the many concepts being developed have common methodologies nor that they can be easily integrated.

One of these capabilities development efforts is FORCEnet, which is being carried out by the Navy's Network Centric Warfare Command (NETWARCOM). FORCEnet capabilities are defined and described in the document "FORCEnet, a Functional Concept for the 21st Century", signed out by the Chief of Naval Operations and the Commandant of the Marine Corps. This document presents the needed capabilities and example attributes associated with those capabilities. An Annex to the capabilities document has been prepared that defines tasks associated with the capabilities, attributes for the tasks, and some example measures associated with the attributes.

Three of the Joint Functional Concepts that have been developed under the JCIDS process are closely related to FORCEnet and are described in Section 2 of this report. One of the purposes of the work described in this report is to establish traceable relationships between FORCEnet and these Joint Functional Concepts.

Other relationships between FORCEnet and DoD activities need to be established. One is to the Planning, Programming, Budgeting, and Execution (PBE) process and its implementation by the Navy as the Naval Capabilities Development Process (NCDP). Another is to experimentation. Experimentation is addressed in this report and the NCDP is addressed in an accompanying report.

One goal of concept development, operational capabilities development, systems development, and their supporting experimentation is to provide information that supports the NCDP process. The NCDP focuses on funding support for capabilities to carry out defined operations such as Homeland Security, Strategic Deterrence, Major Combat Operations, and Stability Operations. A basis for assessing these capabilities is development of mission threads (that define operations to be carried out) and architectures for systems and processes (that provide the capabilities to successfully prosecute those threads). Correlation between mission threads and architectures and the schema presented in this report is in development and will be presented in a later report.

This report contains:

- Tasks and sub-tasks that support joint capabilities.
- Tasks and sub-tasks that support FORCEnet capabilities.

- Mapping between these task sets.
- Attribute development and mapping between the areas.
- Task/attribute association.
- A methodology for reporting experimentation results to capabilities and functional areas.

The sum-total of the material in this report provides a robust schema for relating capabilities development and status across functional areas.

This report provides background for the Annex, presenting the methodologies that were used in its development and development material that was not appropriate for inclusion in the Annex. This report does not describe FORCEnet capabilities since those definitions can be found in the functional concept document referred to above. There is considerable overlap, however with the material found in the Annex, because some of that material was developed as part of this project and is needed here for this report to be complete.

2.0 BACKGROUND

For reference purposes, this section provides a limited amount of information on the capabilities described by the Joint and FORCEnet functional concept documents. For complete descriptions, refer to the documents listed below. Also included is some experimentation information to provide the basics of how experiment initiatives are related to these capabilities.

2.1 Joint Functional Areas

The Joint Functional Concepts describe how the future joint force will perform a particular military function. The three that are directly related to FORCEnet are:

- Joint Command and Control (JC2)
- Net-Centric Environment (NCE)
- Battlespace Awareness (BA)

Reference documents used in this project's development are:

- Joint Command and Control Functional Concept, v1.0, Draft, undated
- Net-Centric Environment Joint Functional Concept, Version 0.95, Office of the Joint Chiefs of Staff, December 30, 2004
- Battlespace Awareness Functional Capabilities Board, Functional Area Analysis, 29 March 2004

Each Functional Area is divided into two distinct sets of capabilities:

JC2	Basic C2 Capabilities	Collaborative C2 Capabilities
NCE	Knowledge Area Capabilities	Technical Area Capabilities
BA	Operational Capabilities	Enabling Capabilities

The capability types within these sets are not exactly the same. In general, the first set has an operational flavor while the second is more technical.

One would expect that the three joint areas would contain capabilities of the following types:

- BA** Operational ISR processes.
- JC2** C2 processes in support of operations.

NCE Technical support of C2, situational awareness, information processes, and operations.

Clean distinctions of this type are not made, and this leads to difficulties in mapping capabilities that are discussed in Section 4. One difficulty is that there is considerable overlap between JC2 and NCE, with each including capabilities that rightly belong to the other.

The capabilities listed under each of the three Joint Functional Areas are:

JC2	<u>Basic C2 Capabilities</u> <i>Monitor and Collect Data</i> <i>Develop Situational Understanding</i> <i>Develop Course of Act., Select One</i> <i>Develop a Plan</i> <i>Execute Plan, Direction, & Leadership</i> <i>Monitor Execution & Adapt as Necessary</i>	<u>Collaborative C2 Capabilities</u> <i>Network</i> <i>Share Information</i> <i>Interact</i> <i>Develop Shared Awareness</i> <i>Decide in a Collaborative Environment</i> <i>Synchronize</i>
NCE	<u>Knowledge Area Capabilities</u> <i>Establish Appropriate Org Relationships</i> <i>Collaborate</i> <i>Synchronize Actions</i> <i>Share Situational Awareness</i> <i>Share Situational Understanding</i> <i>Conduct Collab. Decis. Making/Planning</i> <i>Operate Independently</i>	<u>Technical Area Capabilities</u> <i>Create/Produce Information</i> <i>Store/Share/Exchange Information & Data</i> <i>Establish an Information Environment</i> <i>Process Data and Information</i> <i>Employ Geospatial Information</i> <i>Employ Information</i> <i>Find and Consume Information</i> <i>Provide User Access</i> <i>Access Information</i> <i>Validate/Assure</i> <i>Install/Deploy</i> <i>Operate/Maneuver</i> <i>Maintain/Survive</i> <i>Provide Network Services</i>
BA	<u>Operational Capabilities</u> <i>Command and Control of BA Assets</i> <i>Execute Collection</i> <i>Exploitation and Analysis</i> <i>Model, Simulate and Forecast</i> <i>Manage Knowledge</i>	<u>Enabling Capabilities</u> <i>Integrate BA Network</i> <i>Rapidly Infuse Technology</i>

Each of these capabilities has an associated set of tasks. They are listed in Section 4.

2.2 FORCEnet Capabilities

There are 15 FORCEnet capabilities. In numerical order they are:

Fn1. Provide robust, reliable communication to all nodes, based on the varying information requirements and capabilities of those nodes.

Fn2. Provide reliable, accurate and timely location, identity and status information on all friendly forces, units, activities and entities/individuals.

Fn3. Provide reliable, accurate and timely location, identification, tracking and engagement information on environmental, neutral and hostile elements, activities, events, sites, platforms, and individuals.

Fn4. Store, catalogue and retrieve all information produced by any node on the network in a comprehensive, standard repository so that the information is readily accessible to all nodes and compatible with the forms required by any nodes, within security restrictions.

Fn5. Process, sort, analyze, evaluate, and synthesize large amounts of disparate information while still providing direct access to raw data as required.

Fn6. Provide each decision maker the ability to depict situational information in a tailorable, user defined, shareable, primarily visual representation.

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.

Fn8. Automate lower-order command and control sub-processes and use intelligent agents and automated decision aids to assist people in performing higher-order sub-processes, such as gaining situational awareness and devising concepts of operations.

Fn9. Provide information assurance.

Fn10. Function in multiple security domains and multiple security levels within a domain, and manage access dynamically.

Fn11. Interoperate with command and control systems of very different type and level of sophistication.

Fn12. Allow individual nodes to function while temporarily disconnected from the network.

Fn13. Automatically and adaptively monitor and manage the functioning of the command and control system to ensure effective and efficient operation and to diagnose problems and make repairs as needed.

Fn14. Incorporate new capabilities into the system quickly without causing undue disruption to the performance of the system.

Fn15. Provide decision makers the ability to make and implement good decisions quickly under conditions of uncertainty, friction, time, pressure, and other stresses.

A significant portion of this report will deal with various mappings between FORCEnet and Joint Functional Area capabilities. Doing this leads to sorting the FORCEnet capabilities into logical groups that initially map as follows:

JC2 to Fn6 Fn7 Fn8

NCE to Fn1 Fn4 Fn5 Fn9 Fn10 Fn11 Fn12 Fn13 Fn14

BA to Fn2 Fn3

Fn15 is not listed because it is an overarching capability and mapping it to individual joint capabilities is not useful for the purposes of this report. The initial mapping shown above is not sufficient. Improving it requires that Fn5 and Fn11 each be split into two parts, each part corresponding to a particular “domain”. This will be explained in Section 4.

2.3 Trident Warrior Experiment Series

Trident Warrior is a series of yearly experiments specifically designed to develop and test FORCEnet capabilities. Each experiment is carried out using operational naval forces. Systems are tested, within a variety of operational processes, both current and developmental.

The experiments are not explicitly designed to specifically test or provide information for a specific FORCEnet capability. Rather, they are designed toward a set of learning objectives. The experiment planning process proceeds along the following steps:

- Define a set of experiment focus areas that match the overall experiment purposes.
- For each focus area, determine objectives that are to be achieved.
- Objectives require a set of associated goals/questions. Design those goals.
- Determine the experiment conditions required to address each goal.
- Determine attributes.
- Determine measures for each attribute that address the goal.

Following these steps is detailed planning to define events, data capture, personnel assignments, etc. Only the steps listed above are germane to this report.

Results produced by these experiments automatically inform the objectives and focus areas for which they were determined. They do not automatically inform FORCEnet or Joint Functional Area capabilities. In order to do that, the mappings that are presented in this report are required. Section 7 will describe the reporting processes.

2.4 Mission Capability Packages

Informing the Navy NCDP process is an important aspect of reporting experimentation results. Mapping to do this is through the Mission Capability Packages (MCPs). The basic mapping between FORCEnet capabilities, MCPs, and Joint Functional Concepts is shown in Figure 1.

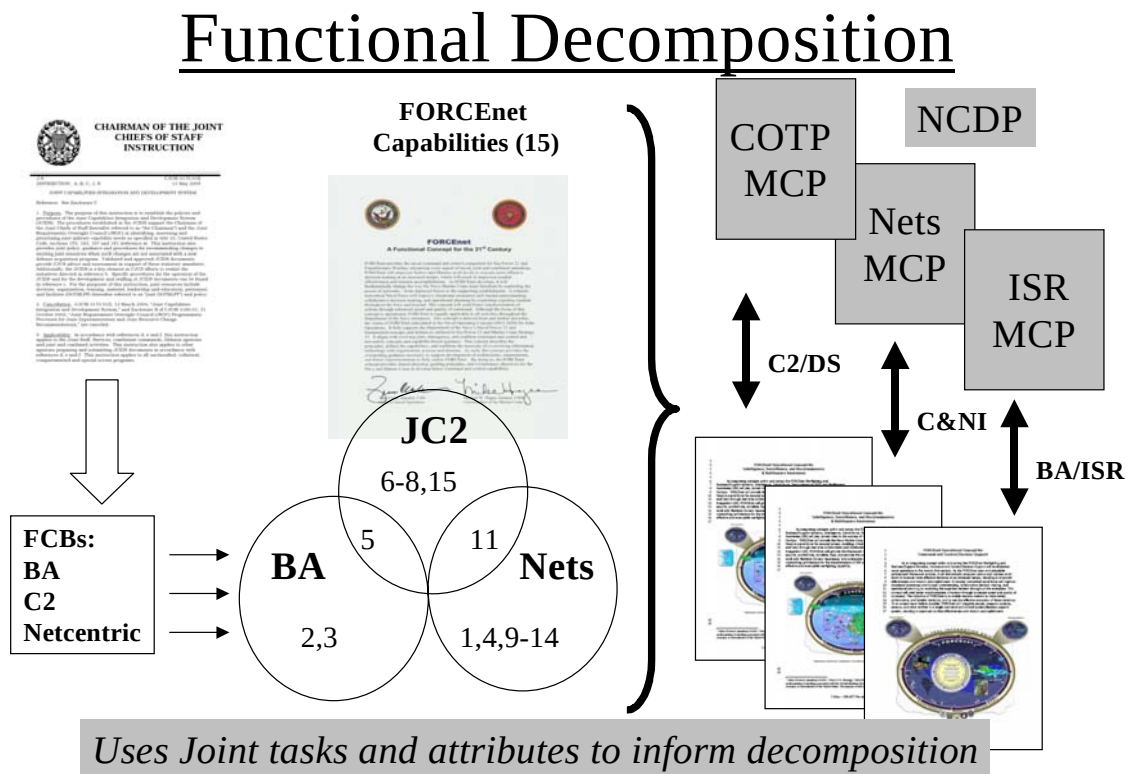


Figure 1. FORCEnet capabilities, MCPs, and Joint Functional Areas Mapping

Mapping to MCPs is not described, only mentioned in this report for completeness. A separate report is being prepared that includes a complete description.

2.5. NCOW Reference Model

The Network Centric Operations and Warfare Reference Model (NCOW RM) is an important reference for FORCEnet tasks. It was not used directly for this project, but it is playing a major role in the development of an integrated architecture for FORCEnet. The NCOW RM and the FORCEnet Concept Annex each define a hierarchy of capabilities, tasks, or activities. Unfortunately, the correspondences between the two structures are not always between corresponding levels, which complicates the mapping. This will be the subject of a separate project, undertaken with architecture development.

Appendix C presents a spreadsheet showing comparison of NCOW RM activities and tasks to FORCEnet capabilities and tasks. This information was produced by a separate NETWARCOM project and is included here as a reference.

3.0 ATTRIBUTE DEVELOPMENT

An attribute is a quality or characteristic of a process, system, or human. The focus of the work described here is military operations so attributes are those appropriate to determining operational capabilities. Attributes used here are those that describe the ability of processes, systems, and humans to perform their ascribed operational functions. The functions that are performed during military operations are very broad and numerous, as are the applicable attributes.

This section describes the attribute sources that have been used, the process for merging them into a single set, and how mapping between the sources is preserved for use in reporting experimental results.

3.1 Attribute Sources

Attributes have been used from five primary sources:

1. Joint Command and Control Functional Area
2. Network Centric Environment Functional Area
3. Battlespace Awareness Functional Area
4. FORCEnet Capabilities for the 21st Century
5. Trident Warrior Experiment, TW05 initiatives

Additional secondary sources were:

- Silent Hammer experiment report
- FORCEnet MOE Analysis, SAIC, Oct 2004
- FORCEnet Analysis: Status and Plans, Bell, Mar 2003

Sources 4 and 5 were combined into a common FORCEnet source (see Table 1). The secondary sources were used to check the completeness of the FORCEnet source.

3.2 Attribute Semantic Set

The dictionary contains many words that are essentially attributes. Many of them have meanings that are close to being the same, with small nuances being the difference between them. Whether or not these nuances are important depends on the context, or situation, in which they are being used. Our desire here is to have the minimum number of attributes that are needed for describing military operational capabilities. Thus, in those cases where we judge attributes to have essentially the same meaning, we have removed all but one of them from the final list. The final list is designated the “Semantic Set”.

The original attribute numbers are used to trace which attributes have been deleted from the semantic set and also which attribute is used in its place. The scheme is as follows:

- If an attribute from the all attribute set isn't used, it isn't listed in the semantic set and a number appears in its place.
- The number in the semantic set cell is the number of the attribute used in its place.
- When numbers appear in the Synonymous column, they are the numbers of the attributes that have been absorbed into the one indicated.

This numbering scheme provides a map from an attribute in the semantic set back to its source(s). This mapping is one of the components in relating experiment results to the various capabilities to which they apply.

3.3 Attribute Map

Table 1 contains the attributes from all sources, the combined attribute set, and the reduced/semantic set that is the final result of attribute development. The table column titles and their contents are:

Col 1: "FORCEnet All Source" – Attributes obtained from sources 4 and 5 and the secondary sources.

Cols 2, 3, & 4: "JCIDS"; "BA", "JC2", and "NCE" – Attributes obtained from the Joint Functional Area documents.

Col 5: "#" – Sequential number used for attribute numbering and tracking.

Col 6: "All Attributes" – Alphabetical list of attributes obtained from all sources.

Col 7: "Synonymous #" – Indication, by number, of attributes that are judged to be synonymous with each other.

Col 8: "Semantic Set" – Final set of attributes to be used. Synonymous attributes have been collapsed into a single attribute (see explanation in Section 3.3).

Table 1. FORCEnet - JCIDS Attribute Comparison

FORCEnet All Source	JCIDS			#	All Attributes	Synonymous #	Semantic Set
	BA	JC2	NCE				
Accessible		Accessible	Accessible	1	Accessible	13	Accessible
Accurate		Accurate	Accurate	2	Accurate	74	Accurate
Adaptive		Adaptable		3	Adequate		Adequate
Agile	Agile		Agile	4	Adaptable		Adaptable
Ambiguous				5	Agile		45
Applicable				6	Ambiguous		Ambiguous
				7	Applicable		81

Appropriate Assured		Appropriate	Appropriate Assured	8 Appropriate 9 Assured		81 Assured
Automatic Autonomous			Authentic Autonomous Available	10 Authentic 11 Automatic 12 Autonomous 13 Available 14 Capacity	49	Authentic Automatic Autonomous 1
Capacity						Capacity
Clear Compatible Complete Comprehensive		Complete Compliant	Complete Confidential	15 Clear 16 Compatible 17 Complete 18 Compliant 19 Comprehensive 20 Confidential	112 19, 73, 100	Clear Compatible Complete Compliant 17 95
Connected Consistent Continuous		Congruent Consistent SU	 Consistent Controllable	21 Congruent 22 Connected 23 Consistent 24 Continuous 25 Controllable		Congruent Connected Consistent Continuous Controllable
Correlated Coverage Current		Coordinated Correct Current	Correct	26 Coordinated 27 Correct 28 Correlated 29 Coverage 30 Current		Coordinated Correct Correlated 80 Current
		Dispersed C2	Deployable Distributed Diverse	31 Deployable 32 Dispersed 33 Distributed 34 Diverse 35 Duplicative	32	Deployable 33 Distributed Diverse Duplicative
Duplicative						
Economical Efficient		Effective	Dynamic Employable	36 Dynamic 37 Economical 38 Effective 39 Efficient 40 Employable	32, 44, 125	45 39 Effective Efficient 114
Enhanced Fast Fewer Flexible		Superior Decisions Extended Flexible	 Flexible	41 Enhanced 42 Extended 43 Fast 44 Fewer 45 Flexible 46 Frequent	5, 36, 82	Enhanced Extended 69 39 Flexible Frequent
Good Graceful Degr. Independent Innovative		 Innovative	 Innovative	47 Good 48 Graceful Degrad 49 Independent 50 Innovative		66 Graceful Degrad 12 Innovative
Full Integrated Integrity Interoperable Intuitive Latency		Full Spect. Integ.	Integrated Integrity Interoperable	51 Integrated 52 Uncompromized 53 Interoperable 54 Intuitive 55 Latency		Integrated Uncompromized Interoperable Intuitive Latency
Layered Learning Lethal		Maintainable	Maintainable Manageable Maneuverable	56 Layered 57 Learning 58 Lethal 59 Maintainable 60 Manageable 61 Maneuverable		Layered Learning Lethal Maintainable Manageable Maneuverable

Modular		Mobile	Modular	62 Mobile		
Networked			Non-Repudiated	63 Modular		Modular
				64 Networked		Networked
Open System				65 Non-Repudiated		Non-Repudiated
				66 Open System		Open System
Orderly				67 Ordered		Ordered
Permanent				68 Permanent		70
Permissive				69 Permissive		Permissive
Persistent	Persistent			70 Persistent	68	Persistent
Pertinent				71 Pertinent		81
Pervasive				72 Pervasive		Pervasive
Polymorphic				73 Polymorphic		17
Precise	Precise			74 Precise		2
				75 Protected		95
Quality	Quality	Quality	Quality	76 Quality	47	Quality
Quickly				77 Quickly		79
	Range			78 Range		Range
Rapid				79 Rapid	43, 77, 99	Rapid
Reach	Reach	Reach	Reach	80 Reach	29	Reach
		Relevant	Relevant	81 Relevant	7, 8, 71	Relevant
			Reconfigurable	82 Reconfigurable		45
Reliable			Redundant	83 Redundant		Redundant
				84 Reliable		88
			Repairable	85 Repairable		Repairable
Resilient		Resilient	Resilient	86 Resilient		88
Responsive		Respon/Tailor Orgs	Responsive	87 Responsive		Responsive
Robust		Robust Networking	Robust	88 Robust	84, 86, 89, 104	Robust
			Rugged	89 Rugged		88
			Scalable	90 Scalable		Scalable
Seamless				91 Seamless		Seamless
Self-Contained				92 Self-Contained		Self-Contained
Self-Healing				93 Self-Healing		Self-Healing
Self-Organizing				94 Self-Organizing		Self-Organizing
Secure	Secure			95 Secure	20, 75	Secure
Sharable	Sharable	Shared Understand.		96 Sharable		Sharable
		Shared Quality Info				
		Simultan. C2 Proc.		97 Simultaneous		Simultaneous
Sortable				98 Sortable		Sortable
Speed of Decis				99 Speed of Decis		79
Sufficient				100 Sufficient		Sufficient
				101 Superior		Superior
Standard				102 Standard		Standard
Structured				103 Structured		Structured
Survivable		Survivable	Survivable	104 Survivable		88
			Sustainable	105 Sustainable		Sustainable
Synchronous		Flexible Synch.		106 Synchronous	133	Synchronized
Tailorable				107 Tailorable		Tailorable
Timely	Timely	Timely	Timely	108 Timely		Timely
			Traceable	109 Traceable		Traceable
			Transportable	110 Transportable		Transportable
Understandable			Uncompromized	111 Uncompromised		Uncompromised
				112 Understandable		15
		Upgradeable	Upgradeable	113 Upgradeable		Upgradeable
Usable		Usable	Usable	114 Usable	40	Usable

User Defined				115 User Defined	User Defined
User Friendly				116 User Friendly	User Friendly
Value Added				117 Value Added	Value Added
Primarily Visual			Visible	118 Visual	Visual
The following attributes are primarily for human and group capabilities. Above attributes can also be used for humans and groups when appropriate					
Competent			Competent	119 Competent	Competent
Confident			Confident	120 Confident	Confident
Collaborative				121 Collaborative	Collaborative
Compliant				122 Compliant	Compliant
Cooperative				123 Cooperative	Cooperative
Diverse				124 Diverse	34
Efficient				125 Efficient	39
Engaged				126 Engaged	Engaged
Experienced				127 Experienced	Experienced
Interdependent				128 Interdependent	Interdependent
Knowledge Flow				129 Knowledge Flow	Knowledge Flow
Risk Accepting				130 Risk Accepting	Risk Accepting
Size				131 Size	Size
Structured				132 Structured	Structured
Synchronized				133 Synchronized	106
Trusting				134 Trusting	Trusting
Trusted				135 Trusted	Trusted
			Willing	136 Willing	Willing

3.4 Human/Group Attributes

Attributes that apply specifically to human operators and groups of humans or organizations have been separated from the other attributes and are shown at the bottom of Table 1. There are attributes in the main list that can also apply to humans and organizations, but whether they do so is not indicated. This separation of human/organization attributes is done because special care is needed when ascribing characteristics to humans, when judging their performance. Having a well-defined and understood set of attributes that will be used helps in performing adequate judgments.

Those human-system interaction attributes that apply to how well a system meets human needs are not in the human/group list, rather they are contained in the main list.

There is nothing sacrosanct about the attributes presented here. They have been checked by several types of subject-matter-experts, including experts in human factors. But, it is well known that different groups, when faced with the task of defining attributes and/or measures, will often come up with sets that are not identical even though many elements will be the same. This is a result of the richness of human language.

This list is the one that is currently being used for Trident Warrior and that appears in the Annex to the FORCEnet functional concept document. After Trident Warrior 05 the list will be examined in light of lessons-learned from the experiment and modified as necessary.

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4.0 TASK DEVELOPMENT AND MAPPING

4.1 Task Domains

The FORCEnet functional concept document lists six “dimensions”. Dimension is an unfortunate choice of words due to its common use to indicate axes or quantities that define components of a functional relationship or space. The more accepted term “domains” is used here. The listed dimensions are:

- *Physical*: the various platforms, weapons, sensors, and other entities on the operating end of FORCEnet.
- *Information Technology*: the communications and network infrastructure through which these entities interact.
- *Data*: the common structure and protocols for information handling.
- *Cognitive*: human judgment and decision making and the human-computer interfaces that support them.
- *Organizational*: the new force structures and working relationships that will be made possible by FORCEnet.
- *Operating*: the emergent methods and concepts by which forces and other organizations will accomplish their missions due to the capabilities provided by FORCEnet.

This is a cumbersome set to use for this work. Note that physical includes sensors, which are information providers, and are also information technology elements. Human-computer interfaces are included under cognitive and they are part of information technology. Such overlaps make the dimensions set difficult to use. We compress them into four separate domains that make up the essential elements of operations and their network-based support. They are:

- *Physical*: All physical systems, excluding humans, that support the information structure.
- *Informational*: Data and information that is flowing through the physical structure and made available to humans or for machine-to-machine use.
- *Cognitive*: All processes that transform information into awareness and understanding, primarily human processes.
- *Organizational*: Processes performed by groups of humans, the SOP, TTP, and CONOPS that support/define those processes, whether by co-located or distributed groups, including collaboration.

Some discussions of network-centric warfare refer to the fourth domain a social rather than organizationsl. In what follows the labels P, I, C, and O will be used to indicate task domains.

4.2 Joint Functional Concept Tasks

Each of the Joint Functional Concepts documents lists tasks under each capability. These capabilities and tasks are shown in Table 2. Capabilities are in bold, the tasks under them in normal format. The domain of each task is shown.

Table 2. Joint Functional Areas Capabilities and Associated Tasks

NCE Technical Area Capabilities		NCE Knowledge Area Capabilities	
Create/Produce Information		Establish Appropriate Organizational Relationships	
Collect Data	P	Deal with Flexible Authority Relations	O
Transform/Process Data Into Information	I	Maintain Flexible Attitudes to Power & Authority	O
Store/Share/Exchange Information & Data		Obtain/Maintain Understanding of Cdr's Intent	O
Tag Information	I	Flexibly Adapt to Changing Operational Needs	O
Post/Publish Information	I	Collaborate	
Share Stored Information	I	Effectively Collaborate with Other Entities	O
Advertise Information	I	Overcome Orgaz/Cul;tural Limits to Collaboration	O
Stage Content (Smart Store)	I	Establish Trust in Decisionmaking Collaboration	O
Archive	I	Synchronize Actions	
Collaborate	C	Flexibly Adapt Act to Take Advantage of Oppor.	O
Message	I	Flexibly Adapt Act to Minimize Impact of Threats	O
Establish an Information Environment		Share Situational Awareness	
Establish Criteria for Storing and Sharing	C/I	Achieve Situational Awareness	C
Share Access Across Areas	P	Communicate SA to Other Decisionmakers	C
Support Enterprise-Wide and COI-Specific Applications	I	Simultaneously Process Multiple Source Inputs	I
Support Dynamic, Priority-Based Resource Allocation	C	Share Situational Understanding	
Process Data and Information		Use Multiple Methods to Achieve SU	C
Support Mediation/Translation Services	I	Conduct Collab Decisionmaking/Planning	
Correlate and Fuse Information	I	Achieve Higher Quality SU via Multiple Means	C
Process Information	I	Comm Understandings to Other Decisionmakers	C
Employ Geospatial Information		Utilize Virtual Reality Train, Wargaming, & Exerc	O
Link Geographic Info to Underlying Database	C	Make High Quality Decisions	O
Provide Layering and Drill-Down	C	Operate Independently	
Employ Information		Know Tasks and Teams Assigned to Tasks	O
Display Information	I	Know Available Assets Enterprise-Wide	I
Enable Machine-to-Machine Information sharing	I	Interact Effectively with DSTs in a Collab Environ	O
Find and Consume Information		Interact/Accept Inputs from Non-Traditional Cols	O
Train Using Simulation and Mission Rehearsal	C		
Discover/Search	C		
Pull/Retrieve/Access	C		
Subscribe	I		
Perform Intelligent Search/Smart Pull	C		
Consume Information	C		
Provide User Access			
Support Role-Based Access Control	C		
Support Strong Authentication	C		

Access Information	
Supprot Multi-Level Security	I
Share Across Security Areas (Coalition, HLS)	I
Validate/Assure	
Restore/Recover	I
Assure Information	I
Validate Information	I
Determine an Information Pedigree	I
Develop Trust in the Information	C
Install/Deploy	
Rapidly Deploy/Employ Robust Connectivity Froward	P
Tailor to Specific Capabilities	I
Function Under Range of Infrastructure and ROE	I
Dynamically Plan Net Architecture Development Process	C
Operate/Maneuver	
Self-Synchronize	C
ID & Maintain Awarenes all Nodes All Time	I
Wargame the Network	C
Operate Without Geographical Constraints	O
Support all Ops and Transitional States Along the ROMO	O
Manage Assured Access/Denial	C
Provide ad-hoc Copalition Connectivity	P
Manage Continuity and Restoration of Operations	O/P
Provide Timely and Reliable Delivry of Information	I
Maintain/Survive	
Detect and Defend Against logical Attack	C
Dynamically Re-Route Services	C
Degrade Gracefully and Contain Cascade Failures	C
Cpntinue Essential Operations in Degraded Environments	C
Prioritize Data Flows from Key Databases/Backups	C
Acquire Additional Network Resources on Demand	P
Provide Network Services	
Connect with All Assets	P
Connect and Share Info Among Interagency/Coalition/IO/NGO	I
Easily Search, File, Transfer, Comm., Support Net Taxonomy	I/P
Archive Large Amounts of Data	I
Inform/Update Chain-of-Command of Network Status	C
Support Separate Constellations of COIs	C/O
Support Gepgraphically Transitioning Nodes	C/O

Collaborative C2 Capabilities		Basic C2 Capabilities	
Network		Monitor and Collect Data	
Be Networked	O	Develop an Operational Net Assessment	I
Comprehensively Connect the Force	P	Identify and Track Blue/Red/Gray Forces	I
Utilize Secure and Robuse Communications	I	Sassess Countermeasures	C
Employ Network Centric Methods	C/I	Provide Current and Accurate Data	I
Protect Sensors Information & Info Networks	I	Develop Situational Understanding	
Link the Force in Time and Purpose	C	Develop Situational Understanding	C
Conduce Simultaneous C2 Functions	O	Achieve Global Situational Awareness	C
Share Information		Develop Near Real-Time Intelligence	C

Be Decentralized	O	Develop Situational Awareness	C
Be Adaptable	O	Access Immediate Data	I
Access Data from All Relevant Sources	I	Develop Courses of Action and Select One	
Share Collected Information	I	Discern and Follow Commander's Intent	O
Access Horizontaly & Vert Integrated Info	I	Be Creative	C
Interact		Provide the Means to Act on Provided Information	O
Be Decentralized	O	Accurately Predict Events	C
Be Adaptable	O	Have Timely, Relevant, Decisionmaking Info	I
Interact with Interagency & Foreign Entities	O	Develop a Plan	
Interact on a Fully Integrated Syst of Global Coms	O	Develop a Plan Including Pre/Post Conflict Effects	O
Develop Shared Awareness		Dev a Plan Based on Mission Anal & Cdr Intent	O
Be Decentralized	O	Precisely Derive Adversary Courses of Action	C
Be Adaptable	O	Select a CoA Based on Capabilities Assessment	O
Achieve Shared Awareness	C	Execute the Plan, Provide Direct. and Leadership	
Achieve a COP	C/I	Develop and Sustain Unity of Command	O
Develop Shared Understanding		Provide Leadership	O
Be Expeditionary	O	Empower Lower Echelons	O
Be Decentralized	O	Command Throughout Echelonw	O
Be Adaptable	O	Monitor Execution and Adapt as Necessary	
Improve Shared Understanding	C	Assess Changes in Adversary's Systems	C
Maintain Shared Understanding	C	Develop, Maintain Adaptive Command Processes	O
Decide in a Collaborative Environment		Develop "Observables" for Assessment	C
Collaboratively Plan	O	Provide Feedback on Operations	O
Employ Discourse with Subordinates	O	Assess Decisions	O
Employ a Globally Deployed Collab Plan Environ	O	Achieve Desired Effects	O
Orchestrate in a Collaborative Planning Environ	O	Conduct Effects-Based Operations	O
Collaborate on Commander's Intent	O	Re-focus Decisions Based On Adversary Actions	O/C
Synchronize			
Be Expeditionary	?		
Be Decentralized	O		
Be Adaptable	O		
Employ the Appropriate Joint Capabilities	O		
Apply Coalition Resources	O		
Employ Combined Forces	O		
Apply Interagency Resources	O		
Synchronize	O		
Conduct Joint Fires	O		
Self-Synchronize	O		

BA Operational Capabilities		Battlespace Awareness Enabling Capabilities	
Command and Control of BA Assets		Integrate BA Network	
Synchronize ISR with operations	O	Allow for quality BA information flow	I
Task and dynamically re-task assets	C	Allow for timely BA information flow	I
Monitor/track assets & their activities	I	Allow for secure BA information flow	I
Plan	O	Allow for ubiquitous BA information flow	I
Assess	C	Allow for rapidly deployable BA network	P
Execute Collection		Rapidly Infuse Technology	
Gain access	P	Allow for rapid insertion of new technology	I
Surveil broad areas synoptically	I	Allow for rapid restructuring of BA structure	I

Focus/stare on targets of interest	I
Find, identify, and track	I
Employ human resources	?
Employ open source resources	I
Measure & monitor environmental conditions	I
Exploitation and Analysis	
Recognize targets	C
Distribute processing	I
Information fusion	C
Enable analyst collaboration	C
Conduct distributed archive	I
Collaborate between analytic centers	O
ID Red patterns of behavior	C
Defeat denial & deception	C
Model, Simulate and Forecast	
Auto-populate models & simulations	I
ID enemy courses of action	C
Integrate adversary & friendly information	I
Include cultures, social issues, & resources	C
Manage Knowledge	
Smart push/pull information	I
Share plan visibility	I
Allow producer interactions	I
Maintain an open archive	I/P

4.2.1 Joint Capability and Task Irregularities

It would be structurally ideal if the tasks under each capability were all from the same domain. In most cases the tasks are in one domain or span two adjacent domains. In some cases three domains are spanned. When three are found it indicates that the capability should be broken up into two or more so there is more consistency of type for the tasks within a capability.

A greater structural difficulty is that there are overlaps at the capability level. The following are the most significant cases:

- The Collaborative C2 Capability “Network” is, as its name states, an NCE capability.
- A significant number of the NCE Knowledge Area Capabilities naturally belong to JC2, such as Collaborate, Share Situational Awareness, Share Situational Understanding, Conduct Collaborative Decision-Making/Planning.
- Some of the Network tasks under Collaborative C2 Capabilities belong to NCE, such as the task Comprehensively Connect the Force.

These structural ambiguities may arise from the overlaps noted previously among the Joint Functional Concepts. Our suggestion that BA be regarded as an operational concept and the others as supporting functions leads to the following:

- NCE capabilities provide physical network and information support to the higher level JC2 and BA capabilities.
- JC2 capabilities deal with processes/tasks that provide collaboration, situation awareness and understanding, planning, decision-making, etc. that support operations.
- BA is an ISR function that is operational in nature. NCE and JC2 provide support to carry out that function.

Such distinct definitions would structurally prevent the overlaps noted above. Section 4.4 shows how these overlaps affect mapping tasks between the Joint Functional Area tasks and FORCEnet tasks.

4.3 FORCEnet Tasks

Table 3 lists the assigned tasks for each of the FORCEnet capabilities. This task list is not the final set presented in the Annex but an earlier version used in this report so that the process of task development can more easily be shown. Shortened versions of the capability titles are used for convenience.

The domain and type of each task are also shown. The domains are those listed previously. Type indicates whether the task is an operational action/activity or a supporting task that enables operational activities.

As is the case for the Joint Functional Concepts, tasks within a FORCEnet capability span one to three domains, but the consistency is better for FORCEnet. The types of tasks included within a capability are much more consistent. In only a few cases does a capability contain both enabling and operational tasks.

Table 3. FORCEnet Task's and their Level and Type

Domain: **P** = Physical **I** = Informational **C** = Cognitive **O** = Organizational

Type: **E** = Enabling (supporting) **A** = Operational Action or Activity

FORCEnet Capabilities and Tasks		Domain	Type
Fn1 Communications all Nodes		P	
Access the Network (Provide)		P	E
Publish presence/identity & services availability		P	E
Publish and subscribe to info on the network		P	E
Produce redundant communication channels		P	E
Identify all nodes on the network		I	E
Ensure network availability and reliability		P	E

Provide sufficient quality-of-service to all nodes	P	E
Fn2 Provide Blue Information	I	
Report own ID, location, intentions, and status	I	A
Update own information on a timely basis	I	A
ID for any node where any other plots location	I	A
ID, calculate, report non-reporting friendly units	I	A
Fn3 Provide Red Information	I	A
Collect/publish everything	I	A
Provide continuous surveillance of everything	I	A
Provide combat assessment	C	A
Provide and task collection assets via network	C	A
Fn4 Store/retrieve all information	I	
Store information	I	E
Establish metadata registries	I	E
Establish data/metadata standards	I	E
Catalogue information	I	E
Ensure storage redundancy	P	E
Retrieve information	I	E
Provide info in compliance with standards	I	E
Fn5 Process, sort, analyze, etc., information	I	
Process data	I	A
Sort information	I	A
Evaluate information	C	A
Analyze information	C	A
Synthesize information	C/I	A
Correlate reports over time	I	A
De-conflict multiple reports	C	A
Produce intelligence from combat info & other sources	C	A
Fn6 Provide decision makers tailorable situation info, primarily visual	I	
Represent information visually	I	E
Represent information aurally	I	E
Correlate elements of visual, aural, other, information	C	A
Create user-defined situational representations from common data	C	A
Represent information temporally	I	E
Fn7 Provide Collaborative environment to distributed decision makers	O	
Share plans and complex information products	O	A
Update information products in real-time	I	E
Integrate/synchronize multiple inputs, modes, media	C	A
Form distributed teams or communities of interest	O	E
Collaboratively create commonly-alterable work products	O	A
Integrate diverse mission-planning systems into single session	O	A
Manage collaborative sessions	O	A
Fn8 Automate Lower-Order C2 Sub-Processes Automated Aids	C	
Search for Desired Information or Patterns as Specified by Users	C	E
Provide automated simulations	C	E
Provide targeting solutions	C	A
Provide alerts based on user-defined thresholds	C	E

Recognize temporal, spatial, content, others, patterns	C	A
Suggest changing user preferences based on usage patterns	C	E
Make assertions about information patterns	C	A
Project movement patterns, trends, and possible outcomes	C	A
Aggregate data into larger groupings	C	E
Generate auto-routing, navigation solutions, etc. for ships and aircraft	C	A
Fn9 Provide Information Assurance	I	
Authenticate all information and sources	I	E
Protect all info systems against disruption, denial, degradation, and destruction	I	E
Identify disruption, denial, degradation, and destruction of information	C	E
Identify disruption, denial, degradation, and destruction of information systems	C	E
Mitigate effects of disruption, denial, degradation, and destruction of information and systems	C/I	E
Fn10 Function in Multiple-Security Domains and Levels, Manage Dynamically	I	
Identify clearance of any network node	I	E
Track classification of all information	I	E
Correlate clearance with classification in any situation	I	E
Control access to information as needed	I	E
Sanitize or downgrade classified info to lower security as appropriate	I	E
Fn11 Interoperate with C2 Systems of Different Types and Sophistication	I/C/O	
Establish C2 systems standards	C	E
Comply with C2 system standards	C	E
Translate between different systems formats and protocols	I	E
Provide system interfaces as network services	P	E
Incorporate non-DoD elements into Joint C2 Processes	C	E
Fn12 Allow Individual Nodes to Function Temporarily Disconnected from Network	I/C/O	
Optimize communications with limited or interrupted throughput	P	E
Prioritize info requirements in order of importance	C	A
Interpolate/extrapolate patterns based on limited data	C	A
Provide to any node the most recent location information	I	E
Fn13 Monitor and Manage the Functioning of the C2 System, Diagnose, Repair	P	
Monitor systems usage and performance	P	E
Allocate and reallocate C2 resources to network services	P	E
Manage network accounts	P	E
Provide and manage core network services	P	E
Reroute info based on load, damage, performance, etc.	P	E
Identify the need to intervene in C2 system performance	C	E
Suffer C2 system degradation gracefully.	P	E
Fn14 Incorporate New Capabilities without Disruption to System Performance	P	
Incorporate new technologies	P/I/O	E
Adopt new doctrine and TTP	C	E
Create new organizations	O	E
Fn15 Provide Decision Makers Ability to Make Quality Decisions Under All Conditions	C/O	
Make sense of complex situations	C	A
Make decisions	C	A
Direct action	O	A
Monitor execution	C	A

4.3.1 *FORCEnet Capability and Task Irregularities*

The irregularities described here are not meant to imply that there is something wrong with the FORCEnet capabilities. We discuss them to indicate how inconsistencies make mapping of tasks from one venue to another difficult.

Fn14 is a good example of the types of inconsistencies encountered. It deals with adoption of new technologies and its included tasks span the full range of domains:

- The task “incorporate new technologies” is somewhat indeterminate;
 - It could be physical, dealing with the physical installation.
 - It could be informational, dealing with the use of those technologies to provide information (that interpretation isn’t as likely).
 - It could be cognitive, dealing with human use of those systems for SA and decision-making.
- “Adopt new doctrine and TTP” is primarily cognitive with an organizational component.
- “Create new organizations” is clearly organizational.

There is nothing inherently wrong with having a range of task domains within a capability. Because this occurs for both the Joint and FORCEnet concepts, however, the mapping between them becomes fairly complex.

Fn5 and Fn11 are difficult cases:

- Fn5 deals with processing information and it needs to be mapped to both NCE and BA.
- Fn11 deals with C2 system interoperability and it needs to be mapped to both NCE and C2.

In order to accomplish mapping, it has been necessary to divide both Fn5 and Fn11 into two parts. This will be shown in the next sections.

4.4 Task Mapping Methodology and Sub-Tasks

The first thing that must be done for task mapping is to adopt common semantics. FORCEnet has 15 tasks and a relatively small number of tasks in each. The counts are:

	<u>Capabilities</u>	<u>Tasks</u>
FORCEnet	15	85

BA, NCE, and JC2 use slightly different semantics, have two each capability categories and the following totals of capabilities and tasks:

	<u>Capability Categories</u>	<u>Capabilities</u>	<u>Tasks</u>
BA	2	7	35
NCE	2	21	85
JC2	2	13	70

There is some overlap between the Joint and FORCEnet sets, and in both sets there are tasks that are not included in the other. In the course of the mapping, tasks from the joint concepts have been incorporated into the FORCEnet set where there was no corresponding FORCEnet task. Tasks that are missing from the joint areas have been identified but are not reported here.

In order to do the mapping, the following adjustments to terms have been used:

<u>Joint</u>	<u>FORCEnet</u>	<u>Terms Used</u>
Capability Category	Capability	> Capability
Capability	Task	> Task
Task		> Sub-Task

Note that almost all additions made to the FORCEnet task list were made at the sub-task level.

As was discussed in Section 2, the starting point for task mapping with the following identifications:

Initial Mapping

- JC2 to Fn6 Fn7 Fn8
- NCE to Fn1 Fn4 Fn5 Fn9 Fn10 Fn11 Fn12 Fn13 Fn14
- BA to Fn2 Fn3

From this starting point, the following steps were used to map all tasks and sub-tasks:

- Identify all tasks that are common between the Joint and FORCEnet concepts.
- Identify all additional Joint tasks (sub-tasks) that should be included in FORCEnet.
- Using the complete FORCEnet task and sub-task set, determine the assignments to FORCEnet capabilities. (As noted above, the initial mapping cannot be used for all assignments. Table 4 shows the results of this “mix-and-match” process.)
 - o Perform the logical segmenting of Fn5 into Fn5-Cognitive and Fn5-Informational; also Fn11 into Fn11-Informational and Fn11-Organizational.
 - o Transfer some NCE Knowledge Area tasks to Basic C2 by assigning them to Fn7.
 - o Transfer some JC2 Collaborative tasks to NCE by assigning them to Fn1.
 - o Transfer some BA Enabling tasks to NCE by assigning them to Fn1 and Fn14.

A summary of this complicated set of steps to accomplish adequate mapping is shown in Table 4 and the full results in Appendix A. Appendix A shows all FORCEnet and Joint tasks and sub-tasks and the mapping at the sub-task level.

4.5 FORCENet Tasks, Sub-Tasks, and Sources

Table 4 contains FORCENet tasks and sub-tasks for all capabilities and identifies their sources. This is not the set that appears in the Annex. The Annex set was derived from this one, with some additions and deletions, as appropriate. For example, the task “execute collection” is appropriate for BA but not for FORCENet. The fact that this is not the final task list is of no consequence because the purpose of this report is to present the mapping process rather than a final result.

Fn15 is not included in Table 4. It is not included in this report because it is an overarching capability, essentially the sum-total of what FORCENet enables. Also, in the Annex some of the purely operational tasks have been transferred from where they appear here to Fn15.

Table 4. FORCENet Capabilities Task and Sub-Task List

Task		Task	
Source	Sub-Task	Source	Sub-Task
Fn1		Fn2	
NCE	Connect with all assets	Fn2	Report Blue ID, location, status...
NCE	Support Role-Based Access Control	Fn2	Report own status
NCE	Support Strong Authentication	Fn2	ID, calc, non-report friendly units
NCE	Rapidly Deploy/Employ Robust Connectivity Fwd	Fn2	ID for any node where other is
NCE	Function Under Range of Infrastructure and ROE	Fn2	Report Blue intent
NCE	Dynamically Plan Net Arch Develop Process	Fn2	Project Blue movement
NCE	Operate Without Geographical Constraints	Fn2	Report Blue FP posture
NCE	Operate Without Geographical Constraints	Fn2	Project Engagements
BA	Comprehensively Connect the Force	Fn2	Project Blue/Red Engagement
NCE	Support Geographically Transitioning Nodes	Fn2	Project Friendly/Red Engagement
NCE	ID & Awareness all Nodes All Time	Fn3	
BA	Rapidly Deploy BA network	BA	Gain access (Physical to airspace)
Fn1	Publish services availability	BA	Employ human resources
Fn1	Publish & subscribe to info	BA	Employ open source resources
NCE	Tailor to Specific Capabilities	BA	Measure & monitor environmental conditions
NCE	Provide Timely and Reliable Delivery of Infor	BA	Assess collection performance
NCE	Easily Search, File, Xfer, Com., Support Net	BA	Develop collection plan
Fn1	Provide redundant comms channels	BA	Provide continuous surveillance
Fn1	Ensure net availability & reliability	BA	Surveil broad areas synoptically
NCE	Manage Continuity and Restoration of Ops	BA	Focus/stare on targets of interest
NCE	Detect and Defend Against logical Attack	BA	Find, identify, and track
NCE	Dynamically Re-Route Services	Fn3	Provide combat assessment
NCE	Degrade Gracefully, Contain Cascade Failures	BA	Synchronize ISR with operations
NCE	Continue Essential Operations in Degraded Env	BA	Task and dynamically re-task assets
BA	Utilize Secure and Robust Communications	BA	Monitor/track assets & their activities
Fn1	Provide sufficient QoS all nodes	Fn5C	
Fn4		Fn5C	Analyze Information
Fn4	Establish Information Environment	Fn5C	Evaluate Information
NCE	Establish Criteria for Storing and Sharing		

NCE	Share Access Across Areas	Fn5C	Synthesize Information
NCE	Support Enterprise-Wide and COI-Specific Appl	Fn5C	De-conflict multiple reports
NCE	Support Dynamic, Priority-Based Resource Alloc	BA	Recognize targets
NCE	Share Stored Information	BA	Information fusion
Fn4	Establish metadata registries	Fn5C	Utilize Simulation for analysis
Fn4	Establish data/metadata standards	BA	Auto-populate models & simulations
NCE	Consume Information	BA	ID enemy courses of action
NCE	Enable Machine-to-Machine Information sharing	BA	Integrate adversary & friendly information
NCE	Train Using Simulation and Mission Rehearsal	BA	Include cultures, social issues, & resources
NCE	Discover/Search	BA	Conduct Distributed analysis
NCE	Pull/Retrieve/Access	BA	Enable analyst collaboration
NCE	Perform Intelligent Search/Smart Pull	BA	Conduct distributed archive
Fn4	Advertise information	BA	Collaborate between analytic centers
NCE	Message	BA	ID Red patterns of behavior
NCE	Display Information	BA	Defeat denial & deception
NCE	Subscribe	BA	Produce Assessments
NCE	Support Multi-Level Security	Fn5C	Distribute Battlespace knowledge
NCE	Share Across Security Areas (Coalition, HLS)	BA	Smart push/pull information
Fn4	Ensure storage redundancy	BA	Share plan visibility
Fn4	Retrieve information	BA	Maintain an open archive
Fn4	Provide info compliant with standards	BA	Allow for quality BA information flow
		BA	Allow for timely BA information flow
		BA	Allow for secure BA information flow
		BA	Allow for ubiquitous BA information flow
Fn5I		Fn6	
NCE	Transform/Process Data Into Info	JC2	Develop an Operational Net Assess
NCE	Collect Data	Fn6	Correlate information elements
NCE	Process Information	Fn6	Access & manage info repository
NCE	Support Mediation/Translation Services	JC2	Update info products real time
NCE	Correlate and Fuse Information	JC2	Provide Current and Accurate Data
Fn5I	Sort Information	JC2	Achieve a COP
NCE	Link Geographic Info to Underlying Database	Fn6	Present Blue/Red/Grey Situation info
NCE	Provide Layering and Drill-Down	Fn6	Represent info visually
Fn5I	Correlate reports over time	Fn6	Represent info aurally
NCE	Simulate Process Multiple Source Inputs	Fn6	Create user-defined representations
Fn5I	Catalog Information	Fn6	Share user-defined visualizations
Fn5I	Archive	JC2	Identify and Track Blue/Red/Gray Forces
NCE	Tag Information	JC2	Develop "Observables" for Assessment
NCE	Archive	JC2	Provide Feedback on Operations
		Fn6	Represent info temporally
		JC2	Assess Countermeasures
Fn7		Fn8	
JC2	Develop common situation understanding	Fn8	User specified search for info
Fn7	Share plans & info products	Fn8	Provide automated simulations
Fn7	Collaboratively create alterable work products	Fn8	Provide targeting solutions
Fn7	Integrate/sync inputs, modes, media	Fn8	User-defined threshold alerts

JC2	Achieve Global Situational Awareness	Fn8	Recognize patterns
JC2	Develop Situational Awareness	Fn8	Suggest changes to user preferences
JC2	Assess Changes in Adversary's Systems	Fn8	Make info patterns assertions
NC	Achieve Shared Awareness	JC2	Project movement, trends, outcomes
JC2	Improve Shared Understanding	Fn8	Aggregate data into larger groups
JC2	Maintain Shared Understanding	Fn8	Generate auto-routing, navigation solutions
NCE	Achieve Situational Awareness		
NCE	Use Multiple Methods to Achieve SU	Fn9	
NCE	Achieve Higher Quality SU via Multiple Means	Fn9	Authenticate all info and sources
JC2	Discern and Follow Commander's Intent	Fn9	Protect all information
JC2	Collaborate on Commander's Intent	BA	Protect Sensors Information & Info Networks
NCE	Communicate Understand to Other decision makers	NCE	Assure Information
NCE	Communicate SA to Other Decision-makers	NCE	Validate Information
JC2	Be Networked (organizationally)	NCE	Determine an Information Pedigree
JC2	Employ Network Centric Methods	Fn9	ID info disruption, denial, destruction
JC2	Link the Force in Time and Purpose	Fn9	ID system disruption, denial, destruction
JC2	Conduct Simultaneous C2 Functions	NCE	Develop Trust in the Information
JC2	Develop and Sustain Unity of Command	NCE	Restore/Recover
JC2	Provide Leadership	NCE	Assure Information
JC2	Empower Lower Echelons		
JC2	Command Throughout Echelons	Fn10	
JC2	Develop, Maintain Adaptive Command Processes	Fn10	ID clearance of network nodes
JC2	Dev Plan Based on Miss Anal & Cdr Intent	Fn10	Track classification all info
JC2	Assess Decisions	Fn10	Correlate clearance with classification
JC2	Develop a Plan Including Pre/Post Conflict Effects	Fn10	Control access to information
JC2	Precisely Derive Adversary Courses of Action	Fn10	Sanitize or downgrade as appropriate
JC2	Select a CoA Based on Capabilities Assessment		
Fn7	Integrate diverse miss planning	Fn11-O	
JC2	Provide a Collaborative Environment	Fn11	Incorporate non-DoD into JC2
Fn7	Form distributed teams, Cols	JC2	Be Adaptable
JC2	Provide the Means to Act on Provided Information	JC2	Employ the Appropriate Joint Capabilities
NCE	Overcome Organization/Cultural Limits to Collaboration	JC2	Apply Coalition Resources
NCE	Establish Trust in Decision-making Collaboration	JC2	Employ Combined Forces
JC2	Conduct Effects-Based Operations	JC2	Apply Interagency Resources
JC2	Achieve Desired Effects	JC2	Synchronize
JC2	Re-focus Decisions Based On Adversary Actions	JC2	Self-Synchronize
JC2	Collaboratively Plan	JC2	Be Expeditionary
JC2	Interact with Interagency & Foreign Entities	JC2	Be Decentralized
JC2	Employ Discourse with Subordinates	JC2	Be Adaptable
JC2	Employ a Globally Deployed Collab Plan Environ	JC2	Conduct Joint Fires
JC2	Orchestrate in a Collaborative Planning Environ	JC2	Access Data from All Relevant Sources
NCE	Make High Quality Decisions	JC2	Share Collected Information
		JC2	Access Horizontally & Vertically Integrated Info
		JC2	Interact on Fully Integrate System Global Comms
Fn11-I		Fn12	
Fn11	Establish C2 Systems Standards	Fn12	Optimize communications with limited throughput
Fn11	Comply with C2 Systems Standards	NCE	Know Tasks and Teams Assigned to Tasks

NCE	Access Immediate Data	NCE	Interact Effectively with DSTs in a Collab Environ
NCE	Have Timely, Relevant, Decision-making Info	NCE	Interact/Accept Inputs from Non-Traditional Cols
Fn11	Translate system, formats, protocols	Fn12	Prioritize info requirements
Fn11	Provide system interface services	Fn12	Interpolate/extrapolate patterns
		NCE	Know Available Assets Enterprise-Wide
		Fn12	Provide recent location info
Fn13		Fn14	
Fn13	Monitor system usage & performance	Fn14	Incorporate new technologies
Fn13	Allocate/reallocate C2 resources	NCE	Flexibly Adapt to Changing Operational Needs
NCE	Wargame the Network	NCE	Deal with Flexible Authority Relations
Fn13	Manage network accounts	NCE	Maintain Flexible Attitudes to Power & Authority
NCE	Support Ops and Transit States Along ROMO	Fn14	Adopt new doctrine & TTP
NCE	Manage Assured Access/Denial	BA	Rapid restructuring of BA structure
Fn13	Provide/manage network services	NCE	Flexibly Adapt Act to Take Adv of Opportunities.
NCE	Prioritize Data Flows from Databases/Backups	NCE	Flexibly Adapt Act to Min Impact of Threats
NCE	Acquire Additional Network Resources on Demand	Fn14	Create new organizations
Fn13	ID need to intervene in C2 systems		
NCE	Inform/Update Chain-of-Command Net Status		

5.0 ASSIGNING ATTRIBUTES

5.1 Attribute Groups

Attributes are often assigned to tasks a-priori as a means to more fully describe the tasks. This provides a means for describing those aspects of tasks that are important for the operations they support. In order to keep these assignments from becoming too voluminous, we make assignments only at the task level, not at the sub-task level. Assignments at the sub-task level are done when a specific project is being undertaken, such as an experiment.

It is not useful for a-priori attribute assignments to utilize all of the 100-plus attributes. The nuances represented by the full set are needed only when specific measures are to be defined, such as for an experiment. Simplification is accomplished by assigning similar/related attributes to groups. Thirteen groups are created in this way and they are shown in Table 5. The titles of these groups are used for the a-priori assignments, reducing the number of possible assignments from 100 to 13.

Table 5. Attribute Groups

Accessible	Assured	Capable	Compatible
Accessible	Accurate	Capable	Collaborative
Automatic	Assured	Competent	Compatible
Integrated	Authentic	Confident	Congruent
Networked	Compliant	Cooperative	Connected
Ordered	Consistent	Engaged	Coordinated
	Correct	Experienced	Correlated
	Non-Repudiated	Learning	Interdependent
	Persistent	Trusted	Interoperable
	Precise	Trusting	Sharable
	Secure	Willing	
	Traceable		
	Uncompromised		
Effective	Extensive	Flexible	Manageable
Effective	Capacity	Adaptable	Controllable
Efficient	Distributed	Flexible	Deployable
Enhanced	Diverse	Innovative	Manageable
Lethal	Extensive	Permissive	Maneuverable
Relevant	Pervasive	Responsive	Sortable
Self-Organizing	Range	Risk Accepting	Transportable
Size	Reach	Scalable	
Superior		Tailorable	
Value Added		Upgradeable	

Robust	Structured	Sufficient	Timely
Autonomous	Layered	Complete	Continuous
Duplicative	Modular	Sufficient	Current
Graceful Degradation	Open System		Frequent
Maintainable	Standard		Synchronized
Redundant	Structured		Timely
Repairable			
Robust			
Self-Healing			
Survivable			
Usable			
Clear			
Intuitive			
Seamless			
Unambiguous			
Usable			
User Defined			
User Friendly			
Visual			

5.2 FORCEnet Attribute Assignments

Attributes have been assigned to each of the tasks associated with the FORCEnet capabilities. These assignments are shown in Table 6. The dark cells show the assignments.

Table 6. FORCEnet Attribute to Task Assignments

	Accessible	Assured	Capable	Compatible	Effective	Extensive	Flexible	Manageable	Robust	Structured	Sufficient	Timely	Usable
Fn1													
1.1 Connect with all assets													
1.2 ID & Awareness all Nodes All Time													
1.3 Rapidly Deploy BA network													
1.4 Publish services availability													
1.5 Publish & subscribe to info													
1.6 Provide redundant communications channels													
1.7 Ensure net availability & reliability													
1.8 Provide sufficient Quality of Service to all nodes													
Fn2													
2.1 Report Blue ID, location, status...													
2.2 Report Blue intent													
2.3 Project Blue movement													
2.4 Report Blue FP posture													
2.5 Project Engagements													
Fn3													
3.1 Gain access (Physical to airspace)													
3.2 Employ human resources													
3.3 Employ open source resources													
3.4 Measure & monitor environmental conditions													
3.5 Assess collection performance													
3.6 Develop collection plan													
3.7 Provide continuous surveillance													
3.8 Provide combat assessment													
3.9 Synchronize ISR with operations													
3.10 Task and dynamically re-task assets													
3.11 Monitor/track assets & their activities													
Fn4													
4.1 Establish Information Environment													
4.2 Share Stored Information													
4.3 Establish metadata registries													
4.4 Consume Information													
4.5 Advertise information													
4.6 Subscribe													
4.7 Ensure storage redundancy													
4.8 Retrieve information													
4.9 Provide info compliant with standards													

		Accessible	Assured	Capable	Compatible	Effective	Extensive	Flexible	Manageable	Robust	Structured	Sufficient	Timely	Usable
	Fn5C													
5.1	Analyze Information													
5.2	Utilize Simulation for analysis													
5.3	Conduct Distributed analysis													
5.4	ID Red patterns of behavior													
5.5	Defeat denial & deception													
5.6	Produce Assessments													
5.7	Distribute Battlespace knowledge													
	Fn5I													
5.8	Transform/Process Data Into Info													
5.9	Support Mediation/Translation Services													
5.10	Sort Information													
5.12	Correlate reports over time													
5.13	Simulate Process Multiple Source Inputs													
5.14	Catalog Information													
5.15	Archive													
	Fn6													
6.1	Develop an Operational Net Assess													
6.2	Achieve a COP													
6.3	Represent info temporally													
6.4	Assess Countermeasures													
	Fn7													
7.1	Develop common situation understanding													
7.2	Discern and Follow Commander's Intent													
7.3	Communicate Understand to Other decision makers													
7.4	Be Networked (organizationally)													
7.5	Develop and Sustain Unity of Command													
7.6	Dev Plan Based on Miss Anal & Cdr Intent													
7.7	Integrate diverse mission planning													
7.8	Provide a Collaborative Environment													
7.9	Conduct Effects-Based Operations													
7.10	Collaboratively Plan													
7.11	Make High Quality Decisions													
	Fn8													
8.1	User specified search for info													
8.2	Provide automated simulations													
8.3	Provide targeting solutions													
8.4	User-defined threshold alerts													
8.5	Recognize patterns													
8.6	Suggest changes to user preferences													
8.7	Make info patterns assertions													
8.8	Project movement, trends, outcomes													
8.9	Aggregate data into larger groups													
8.10	Generate auto-routing, navigation solutions													

	Accessible Assured Capable	Compatible Effective Extensive	Flexible Manageable Robust	Structured Sufficient	Timely Usable
Fn9					
9.1 Authenticate all info and sources	■				
9.2 Protect all information	■		■		
9.3 <u>Assure Information</u>	■				
9.4 ID info disruption, denial, destruction			■		
9.5 <u>ID system disruption, denial, destruction</u>			■		
9.6 Develop Trust in the Information	■		■		■
9.7 Restore/Recover			■		■
Fn10					
10.1 ID clearance of network nodes		■	■		
10.2 Track classification all info		■	■		
10.3 <u>Correlate clearance with classification</u>		■	■		
10.4 Control access to information		■	■		
10.5 Sanitize or downgrade as appropriate			■		
Fn11I					
11.1 Establish C2 Systems Standards				■	
11.2 Comply with C2 Systems Standards				■	
11.3 <u>Access Immediate Data</u>	■				■
11.4 Translate system, formats, protocols		■	■		
11.5 Provide system interface services		■	■		
Fn11O					
11.7 Incorporate non-DoD into JC2	■		■		
11.8 Synchronize		■	■		■
11.9 <u>Be Expeditionary</u>			■		
11.10 Conduct Joint Fires	■	■	■		■
11.12 <u>Access Data from All Relevant Sources</u>	■	■	■		
11.13 Share Collected Information	■	■	■		
11.14 Interact on Fully Integrated System Global Coms	■	■	■		
Fn12					
12.1 Optimize coms with limited throughput	■	■		■	■
12.2 Know Tasks and Teams Assigned to Tasks		■		■	
12.3 Interact Effectively with DSTs in a Collab Environ		■	■		
12.4 Interact/Accept Inputs from Non-Traditional Cols		■	■		
12.5 Prioritize info requirements	■		■	■	
12.6 Interpolate/extrapolate patterns					
12.7 Know Available Assets Enterprise-Wide					

	Accessible	Assured	Capable	Compatible	Effective	Extensive	Flexible	Manageable	Robust	Structured	Sufficient	Timely	Usable
Fn13													
13.1 Monitor system usage & performance													
13.2 Allocate/reallocate C2 resources													
13.3 Wargame the Network													
13.4 Manage network accounts													
13.5 Provide/manage network services													
13.6 Acquire Additional Network Resources on Demand													
13.7 ID need to intervene in C2 systems													
13.8 Inform/Update Chain-of-Command on Network Status													
Fn14													
14.1 Incorporate new technologies													
14.2 Flexibly Adapt to Changing Operational Needs													
14.3 Adopt new doctrine & TTP													
14.4 Rapid restructuring of BA structure													
14.5 Flexibly Adapt Act to Take Adv of Opportunities													
14.6 Flexibly Adapt Act to Min Impact of Threats													
14.7 Create new organizations													

6.0 MEASURES

There is a substantial body of literature that deals with measures/metrics. There is a fair amount of semantic and conceptual diversity in this literature. In this report we take a simple and straightforward approach, concentrating on measures that support production of results through experimentation. That approach is described in this section. The next section will describe how the approach is applied to reporting experiment results.

We have based our work on material found in the “Command and Control Effectiveness Handbook”, published by the US Army TRADOC Research and Analysis Center. This handbook is based on the “Modular Command and Control Evaluation Structure (MCES)” produced by a series of workshops sponsored by the Military Operational Research Society. The following figure is from the MCES document.

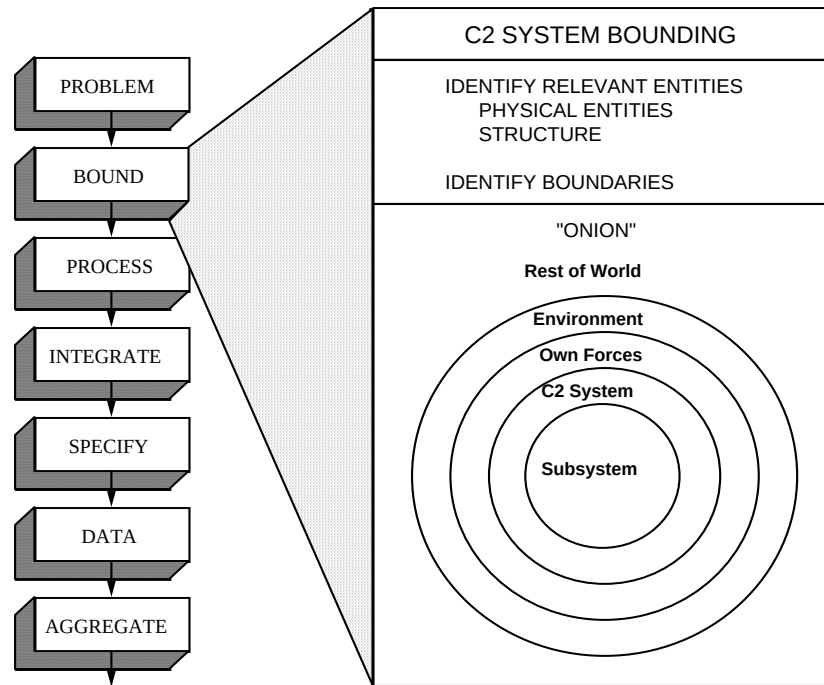


Figure 2. MCES C2 System Bounding

Figure 2 provides a useful perspective with respect to measures. Measures can be defined for any of the levels shown in the “Onion Skin” diagram. Until one specifies the problem, and the bounds associated with the problem, it is not possible to identify measures as being Measures of Effectiveness (MOE) or Measures of Performance (MOP). What one considers an MOE or MOP depends on where the boundaries are drawn. This is described in sub-section 6.1.

6.1 Use of MOPs and MOEs

Whether a particular measure is called an MOE or an MOP is context dependent, so doing a-priori assignments can be misleading. In this report we present no MOPs or MOEs for the 15 FORCEnet Capabilities or their tasks. The following discussion illustrates the situation.

Assume an experiment is to be conducted with the purpose of developing or testing mission planning capabilities. Assume there is a specific Objective for the mission planning capability, and three Goals for that Objective. It is natural to have an MOE associated with the capability.

	<u>MOE</u>	<u>MOP</u>
Capability: Mission Planning	Planning Quality	Tool-set Quality

The experiment objective could be to develop a planning tool-set. There will be a natural MOE associated with the effectiveness of the set.

	<u>MOE</u>	<u>MOP</u>
Objective: Develop planning tools.	Tool-set Quality	Tools Quality

Lower-level objectives could be to develop/test three tools in the tool-set, with goals that each have specific attributes.

	<u>Attribute</u>	<u>MOP</u>	<u>Measures</u>
Goal 1 – Provide	rapid reach-back	Timeliness	Not Specified
Goal 2 – Provide	complete information	Completeness	“
Goal 3 – Provide	consistent COP	Consistency	“

FORCEnet Attributes associated with the Goals are shown in bold. The three MOPs listed for the Goals are not complete because actual measures aren't specified. The problem can be bounded at any of the levels shown above.

The example shows that the MOP and MOE specifications are not definite. With the three measures associated with the Goals as MOPs, a specified measure for quality of the planning tool-set would be an MOE and it would be an aggregate of the MOPs. However, it is also possible, and correct, to have tool-set quality be an MOP, along with other like-level MOPs, under the mission planning MOE. Thus, tool-set quality can be either an MOP or MOE.

At the lower end, one can also introduce other levels, such as breaking down reach-back into component MOPs associated with the reach-back systems and processes, resulting in reach-back timeliness being an MOE.

Using only the term measures, as is done in this report, is preferable to attempting to define a-priori MOPs and MOEs. What one calls effectiveness and performance depends on how one wishes to express results, that is, where one wishes to place the effectiveness-performance boundary.

6.2 Objective and Subjective Measures, Quantification, Rollups

For systems testing one most often utilizes objective measures. Direct quantitative measurements are made of parameters such as bandwidth, processing times, capacity. Measures that address operational capabilities are often subjective. It is appropriate to refer to information gathered during the course of investigations as data regardless of whether it is subjective or objective.

A type of data on the boundary of objective and subjective is event-capture by observers. The observer notes events that occur at a specific time, providing time-marked data. The event can be an occurrence that is definite, such as information appearing on the COP, which clearly falls in the objective category. An observation can be less definite such as noting the time at which an operator becomes overloaded, possibly lowering his efficiency. That observation is somewhat subjective because whether or not the operator is overloaded may be a matter of opinion.

Subjective measures are most often the opinions of subject-matter-experts, including operators who are performing tasks during the time needed data is to be captured. Their opinion is sought about whether or not a process is effective, whether information is useful, whether a particular system makes a process more efficient, etc. How much weight one places on purely subjective data depends on the observer's level of expertise and experiment parameters such as how representative were the conditions under which the expert was performing the task.

As was noted earlier in this report, measures are the quantification of attributes. This means that measures need to be quantified in order to most useful. Objective data is automatically quantified. Subjective data is most often quantified by obtaining several pieces and performing some sort of processing, such as averaging, or by having the data provided on a specified scale. Discussing the accuracy of quantification techniques is beyond the scope of this report.

The examples in sub-section 6.1 provide illustrations of the above measures discussions:

- Timeliness for rapid reach-back is objective presuming that time stamps are provided for request and receipt.
- Information completeness can be either objective if a count is made of numbers required and provided or subjective if an opinion is obtained as to whether all the information is available to get the task done.
- Rollups: Tool-set quality can also be either subjective or objective. In order to provide an objective, or any type of quantitative, tool-set quality measure, a means is need to combine the individual tool quality measures. This is essentially a rollup from MOPs to an MOE.

Rollups to higher-level measures are often difficult to define in a way that provides an adequate determination of the higher-level attribute. It is an art that is beyond the scope of this report.

6.3 Example Measures

A table containing example measures for all FORCEnet tasks, for each of their attributes, is presented in Appendix B.

These measures are not meant to answer every need for quantification, but are examples of the types of measures that could be used. As has been noted, actual measures will depend on the situation being addressed.

7.0. REPORTING EXPERIMENT RESULTS

7.1 FORCEnet Experiment Structure

FORCEnet experiments involve networks, information, the decision processes they support, and the humans making the decisions. The following figure illustrates this system.

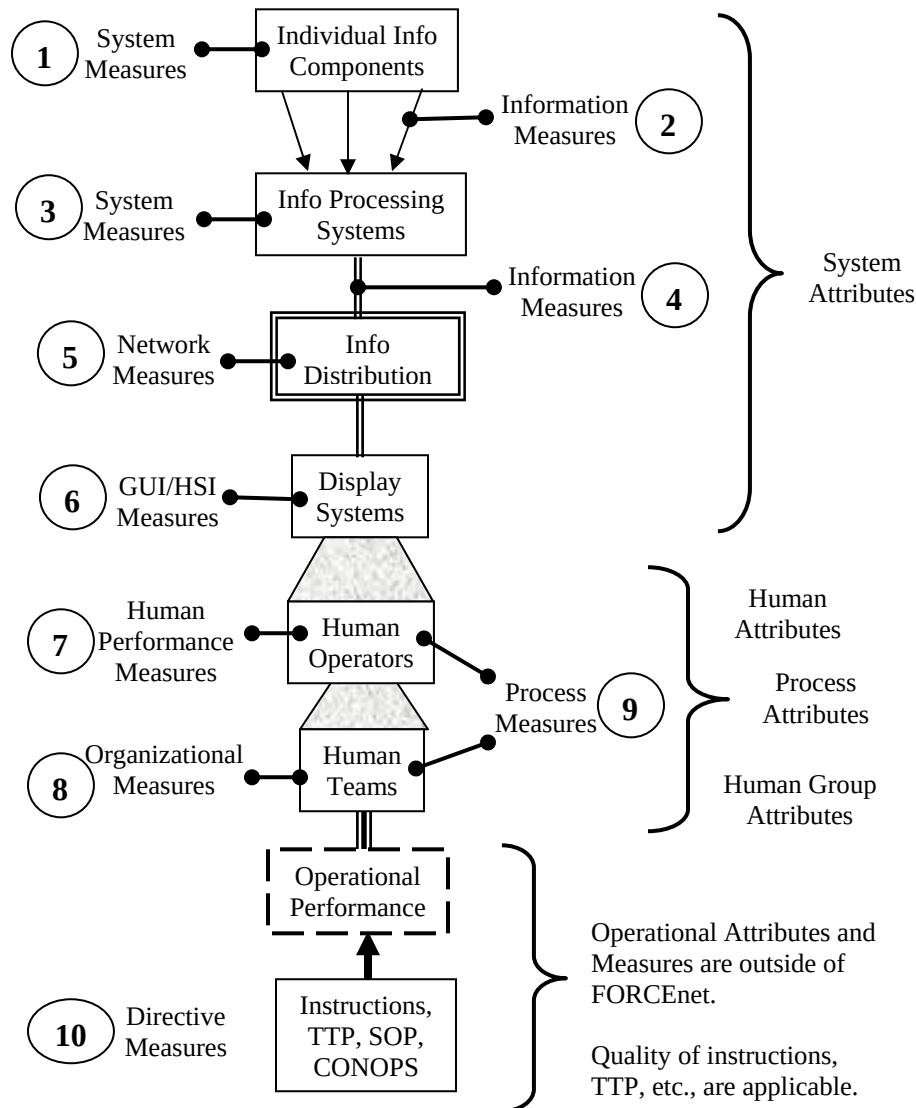


Figure 3. FORCEnet Experiment Components, Attributes, and Measures.

These are the components that are involved in task performance. Components included are systems, the processes/tasks that are performed by humans and teams, and the various directives that guide task performance and decision-making.

It is useful to group attributes and measures into types when planning experimentation and/or studies. Type categories are not absolute, but useful sets for FORCEnet experimentation are:

Attribute types:

- System
- Process
- Human
- Human Group

Measure types:

- System
- Network
- Human-System Interaction
- Human
- Organizational
- Directive

These attribute and measure types and their relations to FORCEnet components are shown in the figure, with the measure types numbered.

Human operators can be part of any system or process node. When they are part of a system, measures can be obtained for both human-system interaction and human performance. When they are participating in a process, measures can be obtained for both process quality and human performance.

Specific measures to be used are highly dependent on the situation. The steps one takes in developing measures, e.g. for an experiment, are:

1. Decide which FORCEnet component will be examined.
2. Decide which specific system or process will be examined.
3. Decide what aspect of the component will be examined, that is, which attribute.
4. Develop the specific question to be asked or the examination goal.
5. Specify the measure(s) to be determined to address the question/goal.
6. Assure that the attribute, question, and measure(s) are congruent.

Example measures are presented in Appendix 2. .

7.2 Experiment Planning, Mapping to FORCEnet Capabilities

During experiment planning the structure is set up that enables reporting results to the appropriate capabilities and tasks. For FORCEnet experiments, the initial phases of planning proceed as shown in Figure 4.

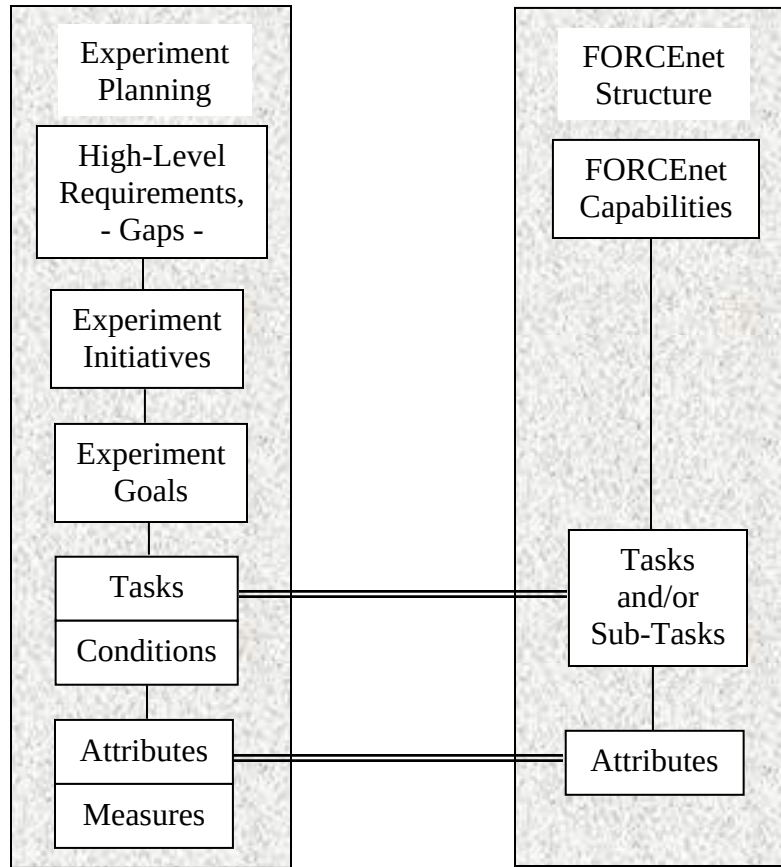


Figure 4. Matching Experiment to FORCEnet Structure

Experiment planning proceeds from high-level requirements. The overarching objective is often to develop C2 systems and processes that will fill capabilities gaps. It is not normally the case that the initiatives and goals are designed to produce FORCEnet capabilities.

During the planning process, specific goals are developed. These goals are related to specific operational tasks and conditions under which those tasks are to be performed. It is always the case that attributes and measures are associated with determining whether goals have been achieved.

Mapping of experiment to FORCEnet capabilities is done utilizing the task-to-task and attribute-to-attribute correlations.

Mapping experiment results to report their contribution to FORCEnet capabilities is easily done using the above structure. Results are expressed as the measures that have been determined. These measures are attribute quantifications. The tasks and values for the attributes are directly related FORCEnet tasks and attributes. Figure 4 illustrates the process,

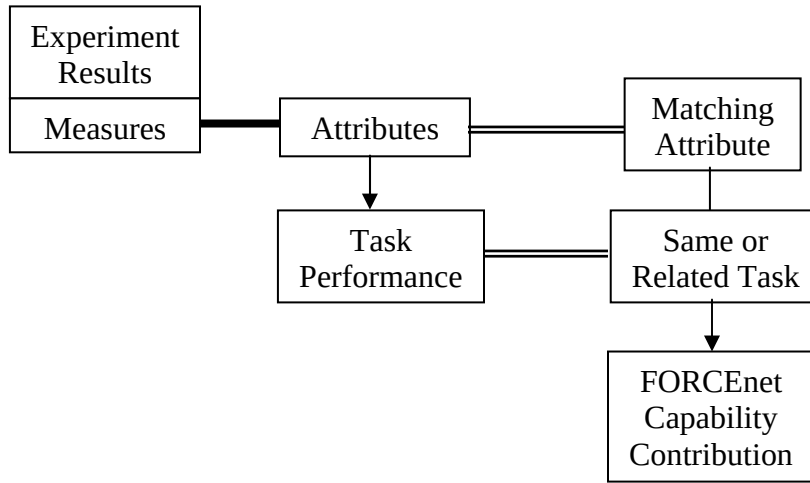


Figure 5. Translating Results to FORCEnet Capabilities

7.3 Utilizing the Full Attribute Set

It may be the case that, in the course of experiment planning, the 13 attribute that specify the attribute groups are not sufficiently precise to be used for some of the goals. When this is the case, the planner will utilize an attribute within a group. Mapping from this attribute to FORCEnet is easily done through the group attribute, which is what is used in the FORCEnet structure.

7.4 Mapping Results to Other Venues

Mapping results to other venues requires that they first be mapped to FORCEnet capabilities and tasks, then the mapping from FORCEnet to the other venue is utilized. Figure 6 illustrates the process.

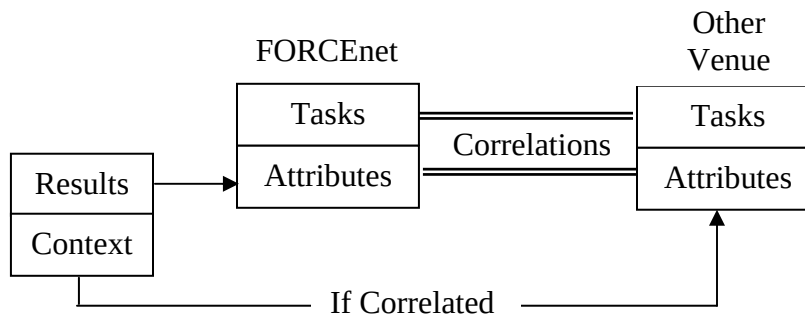


Figure 6. Translating Results to Other Venues.

There is no guarantee that the tasks/processes used in the experiment will be exactly the same as stated in the other venue (or even exactly the same as FORCEnet capability tasks). This is why we use the term “translating” in the title of Figure 6. Whether or not some modification of the results is needed depends on how closely related the tasks are. If they are not fairly close, it will not be possible to translate the results.

Context is important and must be carried forward with the result. It may be that the result is only valid for particular situations, using particular systems, or while utilizing particular processes. These types of context are part of the result.

7.5 Reporting and Results Pedigree

It is often the case that it is difficult to determine results pedigrees once they are reported at levels higher than the experiment itself. The schema reported here for mapping results to structures other than that of the experiment’s makes it possible to do so.

The schema in this report is being implemented in the Naval Postgraduate School’s knowledge management system, FORCEnet Innovation and Research Enterprise, FIRE. All of the links shown in Figures 3 and 4 are being implemented in the system. This will make it possible to drill down from a result at any level to the supporting data, and also obtain the conditions under which the data were acquired.

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Appendix A. Sub-Task Level Mapping

This appendix contains the spreadsheets that show the methods used to map Joint Functional Concept tasks and sub-tasks to FORCEnet capabilities and the mapping results. The spreadsheets contain a large amount of diverse information and the following explanations are a guide to understanding the structure.

The spreadsheets are large so they are presented in sections. Lines in the sheets are used to segment sections and to make it easier to trace rows and columns. Most task and sub-task names are abbreviated.

As was stated in the bulk of this report, the basic mapping from Joint Functional Concepts (JFCs) to FORCEnet capabilities is as follows:

Battlespace Awareness	to	FORCEnet Capabilities 2, 3, and 5-C
Joint Command & Control	to	FORCEnet Capabilities 6, 7, 8, and 11-O
Net-Centric Environment	to	FORCEnet Capabilities 1, 4, 5-I, 9, 10, 11-I, 12-14

The spreadsheet rows and columns are:

- JFC capabilities, tasks, and sub-tasks are in the rows at the left.
- The domain of each task and sub-task is in the column following the task name.
- FORCEnet capability numbers and short titles head a set of columns that contain their tasks and sub-tasks.
- Whether a particular column is a task (T) or sub-task (S) is indicated below the title.
- The domains of FORCEnet tasks and sub-tasks are indicated below the title.

Which are FORCEnet tasks and sub-tasks is indicated as noted above. Their placement indicates which sub-tasks belong to which tasks:

- A sub-task is shown immediately to the right of the task to which it belongs.

The interiors of the spreadsheets show associations between Joint Functional Concepts and FORCEnet and also show task to sub-task associations.

- “T” in a cell indicates that the Joint and FORCEnet tasks are essentially the same.
- “S” in a cell indicates that the Joint sub-task listed is a sub-task of the FORCEnet task heading the column.

The result of this spreadsheet structure is that complete set of FORCEnet tasks and sub-tasks are shown by:

- All FORCEnet tasks are shown at the top of the sheet and indicated by the “T” below them.
- All FORCEnet sub-tasks are shown by:
 - at the top of the sheet with an “S” and placed to the right of the task to which it belongs,
 - within the sheet with an “S” in the cell and placed below the task to which it belongs.

Table A. JCIDS to FORCEnet Sub-Task Level Mapping

Domain ----->		Fn2 Blue Info										Fn3 Red Info										
		I	I	I	I	C	I	I	C	C	C	P	I	I	I	C	C	I	C	C	C	C
Tasks Map for BA to Fn2, 3, 5-C - Levels: P = Physical I = Informational C = Cognitive O = Organizational		Report Blue ID, location, status...	Report own status	ID, calc, non-report friendlyies	ID for any node where other is	Report Blue intent	Project Blue movement	Report Blue FP posture	Project Engagements	Project Blue/Red Engagement	Project Friendly/Red Engagement	Gain access (Physical to airspace)	Employ human resources	Employ open source resources	Measure & monitor environm cond	Assess collection performance	Develop collection plan	Provide continuous surveillance	Provide combat assessment	Synchronize ISR with operations	Task and dynamically re-task assets	Monitor/track assets & their activities
Task (T) or Subtask (S) ----->		T	S	S	S	T	T	T	T	S	S	T	T	T	T	T	T	T	T	T	T	T
BA Operational Capabilities																						
Command and Control of BA Assets																						
Synchronize ISR with operations	O																					
Task and dynamically re-task assets	C																					
Monitor/track assets & their activities	I																					
Plan	O																					
Assess	C																					
Execute Collection																						
Gain access (Physical to airspace)	P																					
Surveil broad areas synoptically	I																					
Focus/stare on targets of interest	I																					
Find, identify, and track	I																					
Employ human resources	I																					
Employ open source resources	I																					
Measure & monitor environmental conditions	I																					
Exploitation and Analysis																						
Recognize targets	C																					
Distribute processing	I																					
Information fusion	C																					
Enable analyst collaboration	C																					
Conduct distributed archive	I																					

Collaborate between analytic centers	O		
ID Red patterns of behavior	C		
Defeat denial & deception	C		
Model, Simulate and Forecast			
Auto-populate models & simulations	I		
ID enemy courses of action	C		
Integrate adversary & friendly information	I		
Include cultures, social issues, & resources	C		
Manage Knowledge			
Smart push/pull information	I		
Share plan visibility	I		
Allow producer interactions	I		
Maintain an open archive	I/P		
Battlespace Awareness Enabling Capabilities			
Integrate BA Network			
Allow for quality BA information flow	I		
Allow for timely BA information flow	I		
Allow for secure BA information flow	I		
Allow for ubiquitous BA information flow	I		
Allow for rapidly deployable BA network	P	Transfer to Fn1	
Rapidly Infuse Technology			
Allow for rapid insertion of new technology	I	Transfer to Fn14	
Allow for rapid restructuring of BA structure	I	Transfer to Fn14	

Domain - - - - >		Process...Sort...Info									
Task (T) or Subtask (S) - - - - >		C	C	C	C	C	C	C	C	C	C
Tasks Map for BA to Fn2, 3, 5-C ----- - Levels: P = Physical I = Informational C = Cognitive O = Organizational		Analyze Information	Evaluate Information	Synthesize Information	Deconflict multiple reports	Utilize Simulation for analysis	Conduct Distributed analysis	ID Red patterns of behavior	Defeat denial & deception	Produce Assessments	Distribute Battlespace knowledge
		T	S	S	S	T	T	T	T	T	T
BA Operational Capabilities											
Command and Control of BA Assets											
Synchronize ISR with operations	O										
Task and dynamically re-task assets	C										
Monitor/track assets & their activities	I										
Plan	O										
Assess	C										
Execute Collection											
Gain access (Physical to airspace)	P										
Surveil broad areas synoptically	I										
Focus/stare on targets of interest	I										
Find, identify, and track	I										

Employ human resources	I					
Employ open source resources	I					
Measure & monitor environmental conditions	I					
Exploitation and Analysis						
Recognize targets	C	S				
Distribute processing	I				T	
Information fusion	C	S				
Enable analyst collaboration	C				S	
Conduct distributed archive	I				S	
Collaborate between analytic centers	O				S	
ID Red patterns of behavior	C				T	
Defeat denial & deception	C					T
Model, Simulate and Forecast						
Auto-populate models & simulations	I			S		
ID enemy courses of action	C			S		
Integrate adversary & friendly information	I			S		
Include cultures, social issues, & resources	C			S		
Manage Knowledge						
Smart push/pull information	I					S
Share plan visibility	I					S
Allow producer interactions	I				T	
Maintain an open archive	I/P					S
Battlespace Awareness Enabling Capabilities						
Integrate BA Network						
Allow for quality BA information flow	I					S
Allow for timely BA information flow	I					S
Allow for secure BA information flow	I					S
Allow for ubiquitous BA information flow	I					S
Allow for rapidly deployable BA network	P					
Rapidly Infuse Technology						
Allow for rapid insertion of new technology	I					
Allow for rapid restructuring of BA structure	I					

Domain - - - - >	Fn6 COP/UDOP										Fn8 Automate lower-order C2						
	I	I	I	I	I	I	I	I	I	C	C	C	C	C	C	C	C
Tasks Map: C2 to Fn6, 7, 8, 11-O	Develop an Operational Net Assess	Correlate information elements	Access & manage info repository	Update info products real time	Achieve a COP	Present Blu/Reg/Grey Situation info	Represent info visually	Represent info aurally	Create user-defined representations	Share user-defined visualizations	Represent info temporally	Assess Countermeasures	User specified search for info	Provide automated simulations	Provide targeting solutions	User-defined threshold alerts	Recognize patterns
Levels: P = Physical I = Informational C = Cognitive O = Organizational																	
Task(T) or Subtask (S) - - - - >	T	S	S	S	T	S	S	S	S	S	T	T	T	T	T	T	T
Basic C2 Capabilities																	
Monitor and Collect Data																	
Develop an Operational Net Assessment	I	T															
Identify and Track Blue/Red/Gray Forces	I				S												
Assess Countermeasures	C										T						

Provide Current and Accurate Data	I	S			
Develop Situational Understanding					
Develop Situational Understanding	C				
Achieve Global Situational Awareness	C				
Develop Near Real-Time Intelligence	C		T		
Develop Situational Awareness	C				
Access Immediate Data	I	Transfer to F11-I			
Develop Courses of Action and Select One					
Discern and Follow Commander's Intent	O				
Be Creative	C				
Provide the Means to Act on Provided Info	O				
Accurately Predict Events	C				T
Have Timely, Relevant, Decision-making Info	I	Transfer to F11-I			
FROM NCE					
Effectively Collaborate with Other Entities	O				
Overcome Orgaz/Cultural Limits to Collab	O				
Establish Trust in Decision-making Collab	O				
Achieve Situational Awareness	C				
Communicate SA to Other Decision-makers	C				
Use Multiple Methods to Achieve SU	C				
Achieve Higher Quality SU via Mult Means	C				
Comm Understand to Other Decision-makers	C				
Make High Quality Decisions	O				
Develop a Plan					
Dev Plan Including Pre/Post Conflict Effects	O				
Dev Plan Based on Mission Anal & Cdr Intent	O				
Precisely Derive Adversary CoAs	C				
Select CoA Based on Capabilities Assmnt	O				
Execute Plan, Provide Direction and Leadership					
Develop and Sustain Unity of Command	O				
Provide Leadership	O				
Empower Lower Echelons	O				
Command Throughout Echelons	O				
Monitor Execution and Adapt as Necessary					
Assess Changes in Adversary's Systems	C				
Develop, Maintain Adaptive Cmnd Proc	O				
Develop "Observables" for Assessment	C		S		
Provide Feedback on Operations	O		S		
Assess Decisions	O				
Achieve Desired Effects	O				
Conduct Effects-Based Operations	O				
Re-focus Decisions On Adversary Actions	O/C				
Collaborative C2 Capabilities					
Network					
Be Networked (organizationally)	O				
Comprehensively Connect the Force	P	Transfer to Fn1			
Utilize Secure and Robust Communications	I	Transfer to Fn1			
Employ Network Centric Methods	C/I				
Protect Sensors Info & Info Networks	I	Transfer to Fn9			
Link the Force in Time and Purpose	C				
Conduct Simultaneous C2 Functions	O				
Share Information					
Be Decentralized	O				
Be Adaptable	O				
Access Data from All Relevant Sources	I				
Share Collected Information	I				
Access Horizontally & Vert Integrated Info	I				
Interact					
Be Decentralized	O				

Be Adaptable	O			
Interact with Interagency & Foreign Entities	O			
Interact on Integrated Syst of Global Coms	O			
Develop Shared Awareness				
Be Decentralized	O			
Be Adaptable	O			
Achieve Shared Awareness	C			
Achieve a COP	C/I		T	
Develop Shared Understanding				
Be Expeditionary	O			
Be Decentralized	O			
Be Adaptable	O			
Improve Shared Understanding	C			
Maintain Shared Understanding	C			
Decide in a Collaborative Environment				
Collaboratively Plan	O			
Employ Discourse with Subordinates	O			
Employ Globally Deployed Collab Plan Envir	O			
Orchestrate in Collaborative Planning Envir	O			
Collaborate on Commander's Intent	O			
Synchronize				
Be Expeditionary	?			
Be Decentralized	O			
Be Adaptable	O			
Employ the Appropriate Joint Capabilities	O			
Apply Coalition Resources	O			
Employ Combined Forces	O			
Apply Interagency Resources	O			
Synchronize	O			
Conduct Joint Fires	O			
Self-Synchronize	O			

		Fn7 Provide Collaborative Environment														Fn11-O C2 Interoperability									
Domain ----->		O	I	C	I	C	C	O	O	C	O	O	O	O	O	O	C	C	C	I	O	I	I	P	
Tasks Map: C2 to Fn6, 7, 8, 11-O		understanding	Share plans & info products	Collab create alterable work products	Integrate/sync inputs, modes, media	Discern and Follow Cmdr's Intent	makers	Be Networked (organizationally)	Command	Dev Plan Based on Miss Anal & Cdr Int	Assess Decisions	Integrate diverse miss planning	Provide a Collaborative Environment	Form distributed teams, Col	Conduct Effects-Based Operations	Collaboratively Plan	Make High Quality Decisions	Incorporate non-DoD into JC2	Synchronize	Be Expeditionary	Access Immediate Data	Conduct Joint Fires	Access Data from All Relevant Sources	Share Collected Information	Coms
	----->																								
Levels:																									
P = Physical																									
I = Informational																									
C = Cognitive																									
O = Organizational																									
Task(T) or Subtask (S) ----->		T	S	S	S	T	T	T	T	T	S	T	T	S	T	T	T	T	T	T	T	T	T	T	
Basic C2 Capabilities																									
Monitor and Collect Data																									

[illegible]

[illegible]

Deal with Flexible Authority Relations	O							
Maintain Flexible Attitudes to Power & Auth	O							
Obtain/Maintain Understanding of Cdr's Int	O	Transfer to Fn7						
Flexibly Adapt to Changing Ops Needs	O							
Collaborate								
Effectively Collaborate with Other Entities	O	Transfer to Fn7						
Overcome Orgaz/Cultural Limits to Collab	O	Transfer to Fn7						
Establish Trust in Decision-making Collab	O	Transfer to Fn7						
Synchronize Actions								
Flexibly Adapt Act to Take Advan. of Oppor	O							
Flexibly Adapt Act to Min. Impact of Threats	O							
Share Situational Awareness								
Achieve Situational Awareness	C	Transfer to Fn7						
Communicate SA to Other Decision-makers	C	Transfer to Fn7						
Simultaneously Process Mult Source Inputs	I							
Share Situational Understanding								
Use Multiple Methods to Achieve SU	C	Transfer to Fn7						
Conduct Collab Decision-making/Planning								
Achieve Higher Quality SU via Mult Means	C	Transfer to Fn7						
Com Understand to Other Decision-makers	C	Transfer to Fn7						
Utilize Virtl Reality Train, Wargaming, Exerc	O							
Make High Quality Decisions	O	Transfer to Fn7						
Operate Independently								
Know Tasks & Teams Assigned to Tasks	O							
Know Available Assets Enterprise-Wide	I							
Interact Effly with DSTs in Collab Environ	O							
Interact/Accept Inputs from Non-Tradit Cols	O							
NCE Technical Area Capabilities								
Create/Produce Information								
Collect Data	P							
Transform/Process Data Into Information	I							
Have Timely, Relevant, Decision-making Info	I							
Access Immediate Data	I							
Store/Share/Exchange Information & Data								
Tag Information	I							
Post/Publish Information	I					S		
Share Stored Information	I					T		
Advertise Information	I					S		
Stage Content (Smart Store)	I					S		
Archive	I							
Collaborate	C						S	
Message	I						S	
Establish an Information Environment								
Establish Criteria for Storing and Sharing	C/I					S		
Share Access Across Areas	P					S		
Support Ent-Wide and COI-Specific Appl	I					S		
Support Dyn, Priortiy-Based Resource Alloc	C					S		
Process Data and Information								
Support Mediation/Translation Services	I							
Correlate and Fuse Information	I							
Process Information	I							

Employ Geospatial Information							
Link Geograph Info to Underlying Database	C						
Provide Layering and Drill-Down	C						
Employ Information							
Display Information	I					S	
Enable Machine-to-Machine Info sharing	I					S	
Find and Consume Information							
Train Using Sims and Mission Rehearsal	C					S	
Discover/Search	C					S	
Pull/Retrieve/Access	C					S	
Subscribe	I						T
Perform Intelligent Search/Smart Pull	C					S	
Consume Information	C					T	
Provide User Access							
Support Role-Based Access Control	C	S					
Support Strong Authentication	C	S					
Access Information							
Support Multi-Level Security	I					S	
Share Across Security Areas (Coal., HLS)	I					S	
Validate/Assure							
Restore/Recover	I						
Assure Information	I						
Validate Information	I						
Determine an Information Pedigree	I						
Develop Trust in the Information	C						
Install/Deploy							
Rapidly Deploy/Empl. Robust Connect Fwd	P	S					
Rapidly Deploy BA network	P		T				
Tailor to Specific Capabilities	I				S		
Function Under Range of Infrastruct & ROE	I	S					
Dynamic. Plan Net Arch Develop Process	C	S					
Operate/Maneuver							
Self-Synchronize	C						
ID & Maintain Awareness all Nodes All Time	I		T				
Wargame the Network	C						
Operate Without Geographical Constraints	O	S					
Support Ops and Transit States on ROMO	O						
Manage Assured Access/Denial	C						
Operate Without Geographical Constraints	P	S					
Manage Continuity and Restoration of Ops	C				S		
Provide Timely and Reliable Delivery of Info	I			S			
Maintain/Survive							
Detect and Defend Against logical Attack	C				S		
Dynamically Re-Route Services	C				S		
Degrade Gracefully, Contain Cascade Fail	C				S		
Continue Essential Ops in Degraded Env	C				S		
Prioritize Data Flows from DB/Backups	C						
Acq Additional Net Resources on Demand	P						
Provide Network Services							
Connect with All Assets	P	T					
Connect, Share Info, Interagency/Coalition/NGO	I				S		
Easily Search, File, Xfer, Comm., Sprt Net	I			S			
Archive Large Amounts of Data	I						
Comprehensively Connect the Force	P	S					
Utilize Secure and Robust Communications	I			S			
Protect Sensors Info & Info Networks	I						
Rapid restructuring of BA structure (BA)	I						

Inform/Update Chain-of-Cmd of Net Status	I		
Support Separate Constellations of COIs	P		S
Support Geograph Transitioning Nodes	P	S	

Domain - - - - >	Fn5-I Proc, Anal... Info						Fn9 Info Assurance					Fn10 MLS				
	I	I	I	I	I	I	I	I	I	C	C	C	I	I	I	I
	Transform/Process Data Into Info	Support Mediation/Translation Services	Sort Information	Correlate reports over time	Simul Process Multiple Source Inputs	Catalog Information	Archive	Authenticate all info and sources	Protect all information	Assure Information	ID info disruption, denial, destruction	ID syst disruption, denial, destruction	Develop Trust in the Information	Restore/Recover	ID clearance of netwok nodes	Track classification all info
Task (T) or Subtask (S) - - - - ->	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
NCE Knowledge Area Capabilities																
Establish Appropriate Organizational Relationships																
Deal with Flexible Authority Relations	O															
Maintain Flexible Attitudes to Power & Auth	O															
Obtain/Maintain Understanding of Cdr's Int	O	Transfer to Fn7														
Flexibly Adapt to Changing Ops Needs	O															
Collaborate																
Effectively Collaborate with Other Entities	O	Transfer to Fn7														
Overcome Orgaz/Cultural Limits to Collab	O	Transfer to Fn7														
Establish Trust in Decision-making Collab	O	Transfer to Fn7														
Synchronize Actions																
Flexibly Adapt Act to Take Advan. of Oppor	O															
Flexibly Adapt Act to Min. Impact of Threats	O															
Share Situational Awareness																
Achieve Situational Awareness	C	Transfer to Fn7														
Communicate SA to Other Decision-makers	C	Transfer to Fn7														
Simultaneously Process Mult Source Inputs	I															
Share Situational Understanding																
Use Multiple Methods to Achieve SU	C	Transfer to Fn7														
Conduct Collab Decision-making/Planning																
Achieve Higher Quality SU via Mult Means	C	Transfer to Fn7														
Com Understand to Other Decision-makers	C	Transfer to Fn7														
Utilize Virtl Reality Train, Wargaming, Exerc	O															
Make High Quality Decisions	O	Transfer to Fn7														
Operate Independently																
Know Tasks & Teams Assigned to Tasks	O															

Know Available Assets Enterprise-Wide	I					
Interact Effly with DSTs in Collab Environ	O					
Interact/Accept Inputs from Non-Tradit Cols	O					
NCE Technical Area Capabilities						
Create/Produce Information						
Collect Data	P	S				
Transform/Process Data Into Information	I	T				
Have Timely, Relevant, Decision-making Info	I					
Access Immediate Data	I					
Store/Share/Exchange Information & Data						
Tag Information	I		S			
Post/Publish Information	I					
Share Stored Information	I					
Advertise Information	I					
Stage Content (Smart Store)	I					
Archive	I		S			
Collaborate	C					
Message	I					
Establish an Information Environment						
Establish Criteria for Storing and Sharing	C/I					
Share Access Across Areas	P					
Support Ent-Wide and COI-Specific Appl	I					
Support Dyn, Priority-Based Resource Alloc	C					
Process Data and Information						
Support Mediation/Translation Services	I		T			
Correlate and Fuse Information	I		S			
Process Information	I	S				
Employ Geospatial Information						
Link Geograph Info to Underlying Database	C		S			
Provide Layering and Drill-Down	C		S			
Employ Information						
Display Information	I					
Enable Machine-to-Machine Info sharing	I					
Find and Consume Information						
Train Using Sims and Mission Rehearsal	C					
Discover/Search	C					
Pull/Retrieve/Access	C					
Subscribe	I					
Perform Intelligent Search/Smart Pull	C					
Consume Information	C					
Provide User Access						
Support Role-Based Access Control	C					
Support Strong Authentication	C					
Access Information						
Support Multi-Level Security	I					
Share Across Security Areas (Coal., HLS)	I					
Validate/Assure						
Restore/Recover	I					T
Assure Information	I		T			S
Validate Information	I		S			
Determine an Information Pedigree	I		S			
Develop Trust in the Information	C				T	
Install/Deploy						
Rapidly Deploy/Empl. Robust Connect Fwd	P					
Rapidly Deploy BA network	P					
Tailor to Specific Capabilities	I					
Function Under Range of Infrastruct & ROE	I					
Dynamic. Plan Net Arch Develop Process	C					
Operate/Maneuver						

Self-Synchronize	C			
ID & Maintain Awareness all Nodes All Time	I			
Wargame the Network	C			
Operate Without Geographical Constraints	O			
Support Ops and Transit States on ROMO	O			
Manage Assured Access/Denial	C			
Operate Without Geographical Constraints	P			
Manage Continuity and Restoration of Ops	C			
Provide Timely and Reliable Delivery of Info	I			
Maintain/Survive				
Detect and Defend Against logical Attack	C			
Dynamically Re-Route Services	C			
Degrade Gracefully, Contain Cascade Fail	C			
Continue Essential Ops in Degraded Env	C			
Prioritize Data Flows from DB/Backups	C			
Acq Additional Net Resources on Demand	P			
Provide Network Services				
Connect with All Assets	P			
Connect, Share Info, Interagency/Coalition/NGO	I			
Easily Search, File, Xfer, Comm., Sprt Net	I			
Archive Large Amounts of Data	I		T	
Comprehensively Connect the Force	P			
Utilize Secure and Robust Communications	I			S
Protect Sensors Info & Info Networks	I			
Rapid restructuring of BA structure (BA)	I			
Inform/Update Chain-of-Cmd of Net Status	I			
Support Separate Constellations of COIs	P			
Support Geograph Transitioning Nodes	P			

Domain - - - - >		Fn11-I C2 Interop					Fn12 Autonomous Nodes				
		I	I	I	I	P	P	C	C	C	C
Tasks Map for NCE to Fn1, Fn4, Fn8, 5-I, 9-14		Establish C2 Systems Standards	Comply with c2 systems standards	Access Immediate Data	Translate syst, formats, protocols	Provide system interface services	Optimize coms with limited thruhp	Collab Environ	Traditional Cols	Prioritize info requirements	Interpolate/extrapolate patterns
Levels:											
P = Physical											
I = Informational											
C = Cognitive											
O = Organizational											
Task (T) or Subtask (S) - - - - >		T	T	T	T	T	T	T	T	T	S
NCE Knowledge Area Capabilities											
Establish Appropriate Organizational Relationships											
Deal with Flexible Authority Relations	O										
Maintain Flexible Attitudes to Power & Auth	O										
Obtain/Maintain Understanding of Cdr's Int	O	Transfer to Fn7									
Flexibly Adapt to Changing Ops Needs	O										
Collaborate											
Effectively Collaborate with Other Entities	O	Transfer to Fn7									
Overcome Orgaz/Cultural Limits to Collab	O	Transfer to Fn7									

Establish Trust in Decision-making Collab	O	Transfer to Fn7				
Synchronize Actions						
Flexibly Adapt Act to Take Advan. of Oppor	O					
Flexibly Adapt Act to Min. Impact of Threats	O					
Share Situational Awareness						
Achieve Situational Awareness	C	Transfer to Fn7				
Communicate SA to Other Decision-makers	C	Transfer to Fn7				
Simultaneously Process Mult Source Inputs	I					
Share Situational Understanding						
Use Multiple Methods to Achieve SU	C	Transfer to Fn7				
Conduct Collab Decision-making/Planning						
Achieve Higher Quality SU via Mult Means	C	Transfer to Fn7				
Com Understand to Other Decision-makers	C	Transfer to Fn7				
Utilize Virtl Reality Train, Wargaming, Exerc	O					
Make High Quality Decisions	O	Transfer to Fn7				
Operate Independently						
Know Tasks & Teams Assigned to Tasks	O			T		
Know Available Assets Enterprise-Wide	I					T
Interact Effly with DSTs in Collab Environ	O			T		
Interact/Accept Inputs from Non-Tradit Cols	O				T	
NCE Technical Area Capabilities						
Create/Produce Information						
Collect Data	P					
Transform/Process Data Into Information	I					
Have Timely, Relevant, Decision-making Info	I		S			
Access Immediate Data	I		T			
Store/Share/Exchange Information & Data						
Tag Information	I					
Post/Publish Information	I					
Share Stored Information	I					
Advertise Information	I					
Stage Content (Smart Store)	I					
Archive	I					
Collaborate	C					
Message	I					
Establish an Information Environment						
Establish Criteria for Storing and Sharing	C/I					
Share Access Across Areas	P					
Support Ent-Wide and COI-Specific Appl	I					
Support Dyn, Priortiy-Based Resource Alloc	C					
Process Data and Information						
Support Mediation/Translation Services	I					
Correlate and Fuse Information	I					
Process Information	I					
Employ Geospatial Information						
Link Geograph Info to Underlying Database	C					
Provide Layering and Drill-Down	C					
Employ Information						
Display Information	I					
Enable Machine-to-Machine Info sharing	I					
Find and Consume Information						
Train Using Sims and Mission Rehearsal	C					
Discover/Search	C					
Pull/Retrieve/Access	C					
Subscribe	I					
Perform Intelligent Search/Smart Pull	C					

Consume Information	C		
Provide User Access			
Support Role-Based Access Control	C		
Support Strong Authentication	C		
Access Information			
Support Multi-Level Security	I		
Share Across Security Areas (Coal., HLS)	I		
Validate/Assure			
Restore/Recover	I		
Assure Information	I		
Validate Information	I		
Determine an Information Pedigree	I		
Develop Trust in the Information	C		
Install/Deploy			
Rapidly Deploy/Empl. Robust Connect Fwd	P		
Rapidly Deploy BA network	P		
Tailor to Specific Capabilities	I		
Function Under Range of Infrastruct & ROE	I		
Dynamic. Plan Net Arch Develop Process	C		
Operate/Maneuver			
Self-Synchronize	C		
ID & Maintain Awareness all Nodes All Time	I		
Wargame the Network	C		
Operate Without Geographical Constraints	O		
Support Ops and Transit States on ROMO	O		
Manage Assured Access/Denial	C		
Operate Without Geographical Constraints	P		
Manage Continuity and Restoration of Ops	C		
Provide Timely and Reliable Delivery of Info	I		
Maintain/Survive			
Detect and Defend Against logical Attack	C		
Dynamically Re-Route Services	C		
Degrade Gracefully, Contain Cascade Fail	C		
Continue Essential Ops in Degraded Env	C		
Prioritize Data Flows from DB/Backups	C		
Acq Additional Net Resources on Demand	P		
Provide Network Services			
Connect with All Assets	P		
Connect, Share Info, Interagency/Coalition/NGO	I		
Easily Search, File, Xfer, Comm., Support Net	I		
Archive Large Amounts of Data	I		
Comprehensively Connect the Force	P		
Utilize Secure and Robust Communications	I		
Protect Sensors Info & Info Networks	I		
Rapid restructuring of BA structure (BA)	I		
Inform/Update Chain-of-Cmd of Net Status	I		
Support Separate Constellations of COIs	P		
Support Geographic Transitioning Nodes	P		

Domain - - - - >

Fn13									Fn14					
Network Manag									New Capabilities					
P	P	C	P	P	P	C	P		P	O	C	O	O	O

Tasks Map for NCE to Fn1, Fn4, Fn8, 5-I, 9-14 Levels: P = Physical I = Informational C = Cognitive O = Organizational		Monitor system usage & performance	Allocate/reallocate C2 resources	Wargame the Network	Manage network accounts	Provide/manage network services on Demand	ID need to intervene in C2 systems	Status	Incorporate new technologies	Needs	Adopt new doctrine & TTP	Rapid restructuring of BA structure	Opportunities	Threats	Create new organizations
Task (T) or Subtask (S) - - - - ->		T	T	T	T	T	T	T	T	T	T	T	T	T	T
NCE Knowledge Area Capabilities															
Establish Appropriate Organizational Relationships															
Deal with Flexible Authority Relations	O									S					
Maintain Flexible Attitudes to Power & Auth	O									S					
Obtain/Maintain Understanding of Cdr's Int	O	Transfer to Fn7													
Flexibly Adapt to Changing Ops Needs	O									T					
Collaborate															
Effectively Collaborate with Other Entities	O	Transfer to Fn7													
Overcome Orgaz/Cultural Limits to Collab	O	Transfer to Fn7													
Establish Trust in Decision-making Collab	O	Transfer to Fn7													
Synchronize Actions															
Flexibly Adapt Act to Take Advan. of Oppor	O												T		
Flexibly Adapt Act to Min. Impact of Threats	O													T	
Share Situational Awareness															
Achieve Situational Awareness	C	Transfer to Fn7													
Communicate SA to Other Decision-makers	C	Transfer to Fn7													
Simultaneously Process Mult Source Inputs	I														
Share Situational Understanding															
Use Multiple Methods to Achieve SU	C	Transfer to Fn7													
Conduct Collab Decision-making/Planning															
Achieve Higher Quality SU via Mult Means	C	Transfer to Fn7													
Com Understand to Other Decision-makers	C	Transfer to Fn7													
Utilize Virtl Reality Train, Wargaming, Exerc	O														
Make High Quality Decisions	O	Transfer to Fn7													
Operate Independently															
Know Tasks & Teams Assigned to Tasks	O														
Know Available Assets Enterprise-Wide	I														
Interact Effly with DSTs in Collab Environ	O														
Interact/Accept Inputs from Non-Tradit Cols	O														
NCE Technical Area Capabilities															
Create/Produce Information															
Collect Data	P														
Transform/Process Data Into Information	I														
Have Timely, Relevant, Decision-making Info	I														
Access Immediate Data	I														
Store/Share/Exchange Information & Data															
Tag Information	I														
Post/Publish Information	I														
Share Stored Information	I														
Advertise Information	I														

Stage Content (Smart Store)	I					
Archive	I					
Collaborate	C					
Message	I					
Establish an Information Environment						
Establish Criteria for Storing and Sharing	C/I					
Share Access Across Areas	P					
Support Ent-Wide and COI-Specific Appl	I					
Support Dyn, Priortiy-Based Resource Alloc	C					
Process Data and Information						
Support Mediation/Translation Services	I					
Correlate and Fuse Information	I					
Process Information	I					
Employ Geospatial Information						
Link Geograph Info to Underlying Database	C					
Provide Layering and Drill-Down	C					
Employ Information						
Display Information	I					
Enable Machine-to-Machine Info sharing	I					
Find and Consume Information						
Train Using Sims and Mission Rehearsal	C					
Discover/Search	C					
Pull/Retrieve/Access	C					
Subscribe	I					
Perform Intelligent Search/Smart Pull	C					
Consume Information	C					
Provide User Access						
Support Role-Based Access Control	C					
Support Strong Authentication	C					
Access Information						
Support Multi-Level Security	I					
Share Across Security Areas (Coal., HLS)	I					
Validate/Assure						
Restore/Recover	I					
Assure Information	I					
Validate Information	I					
Determine an Information Pedigree	I					
Develop Trust in the Information	C					
Install/Deploy						
Rapidly Deploy/Empl. Robust Connect Fwd	P					
Rapidly Deploy BA network	P					
Tailor to Specific Capabilities	I					
Function Under Range of Infrastruct & ROE	I					
Dynamic. Plan Net Arch Develop Process	C					
Operate/Maneuver						
Self-Synchronize	C					
ID & Maintain Awareness all Nodes All Time	I					
Wargame the Network	C		T			
Operate Without Geographical Constraints	O					
Support Ops and Transit States on ROMO	O			S		
Manage Assured Access/Denial	C			S		
Operate Without Geographical Constraints	P					
Manage Continuity and Restoration of Ops	C					
Provide Timely and Reliable Delivery of Info	I					
Maintain/Survive						
Detect and Defend Against logical Attack	C					
Dynamically Re-Route Services	C					
Degrade Gracefully, Contain Cascade Fail	C					
Continue Essential Ops in Degraded Env	C					

Prioritize Data Flows from DB/Backups	C	S			
Acq Additional Net Resources on Demand	P	T			
Provide Network Services					
Connect with All Assets	P				
Connect, Share Info, Interagency/Coalition/NGO	I				
Easily Search, File, Xfer, Comm., Sprt Net	I				
Archive Large Amounts of Data	I				
Comprehensively Connect the Force	P				
Utilize Secure and Robust Communications	I				
Protect Sensors Info & Info Networks	I				
Rapid restructuring of BA structure (BA)	I			T	
Inform/Update Chain-of-Cmd of Net Status	I		T		
Support Separate Constellations of COIs	P				
Support Geograph Transitioning Nodes	P				

Appendix B. FORCEnet Task-Level Attributes and Example Measures Table

The following table presents attributes and example measures for FORCEnet tasks.

Table B. FORCEnet Task-Level Attributes and Example Measures

Major Tasks	Attributes	Example Measures
1.1 Establish the network	Extensive	<i>Number</i> of nodes served by the network.
	Sufficient	<i>Fraction</i> of nodes requesting service that receive it.
	Timely	<i>Time</i> difference between network services required and provided (min).
1.2 All nodes access the network	Accessible	<i>Number</i> of steps required to log on network
		<i>Amount of time</i> required to log in and have access to the network.
		<i>Percent</i> of time communications channels are available.
	Compatible	<i>Percent</i> of nodes able to authenticate identity.
	Extensive	<i>Percent</i> of required nodes able to access network.
		<i>Number</i> of different types of nodes that can access the network.
		<i>Percent</i> of nodes that can communicate using desired access mode, information format, applications.
		<i>Number</i> of nodes that can be provided acceptable service at same time.
1.3. All nodes publish their presence, identity and available services	Accessible	<i>Percent</i> of nodes able to publish presence/identity and offer available services.
		<i>Percent</i> of provided services available, by requesting node.
	Manageable	<i>Time</i> required to make services available after request, by service.
1.4. Maintain a dynamic directory of all nodes that is available to all nodes	Sufficient	<i>Percent</i> of required services available on the network.
	Accessible	<i>Percent</i> of nodes whose identity can be queried and established.
		<i>Seconds</i> required to identify any node on the network.
		<i>Seconds</i> required to publish presence/identity, offer available services.
1.5. All nodes publish information or requests for information to the network.	Manageable	<i>Percent</i> of nodes identifiable to any node.
	Accessible	<i>Percent</i> of nodes able to publish/subscribe.
		<i>Percent</i> saturation of communication channels.
	Compatible	<i>Number</i> of types of nodes able to publish/subscribe.
		<i>Number</i> of different types of nodes that publish or subscribe information.
	Sufficient	<i>Percentage</i> of collected information that is posted/transmitted/received.
		<i>Percent</i> of number of data packets requested that are delivered.
		Maximum data <i>throughput</i> (bits/sec).
	Usable	<i>Time</i> required to publish or subscribe information, by node.
		<i>Number</i> of different types of nodes that publish or subscribe information.
1.6. All nodes subscribe to desired information from the network.	Accessible	<i>Percent</i> of nodes able to publish/subscribe.
		<i>Percent</i> saturation of communication channels.
	Compatible	<i>Number</i> of types of nodes able to publish/subscribe.
		<i>Number</i> of different types of nodes that publish or subscribe information.
	Sufficient	<i>Percentage</i> of collected information that is posted/transmitted/received.
		<i>Percent</i> of number of data packets requested that are delivered.
		Maximum data <i>throughput</i> (bits/sec).
	Usable	<i>Time</i> required to publish or subscribe information, by node.
		<i>Number</i> of different types of nodes that publish or subscribe information.

1.7. Push selected information directly to nodes that have not subscribed to it.	Compatible	<i>Fraction</i> of the information required by a node required for its operation that is pushed without intervention.
	Flexible	<i>Number</i> of different information profiles that can be pushed.
		Push/pull of information integrated to achieve timelines (yes, no).

2.1 Each node publish extensive operational/mission-oriented information on itself—such as location, status, plans or intentions.	Assured	Horizontal and vertical geolocation <i>accuracy</i> in <i>feet</i> .
		<i>Percent</i> of reports for which unit identity can be confirmed as correct.
		<i>Percent</i> of nodes that have accurate, current location information.
	Sufficient	<i>Number</i> of different types of nodes reporting.
		<i>Number</i> of different status dimensions reported by any node.
		<i>Percent</i> of units reporting.
2.2 Identify, calculate, report and update positions of friendly units, elements or entities that are not able to function as direct nodes on the network.	Assured	<i>Percent</i> of non-reporting units for which position and status reports is determined to be correct.
		Subjective determination that status determination of non-reporting units is accurate enough to be operationally useful (useful, marginal, not useful).
	Capable	<i>Number</i> of units that can be tracked without their reporting.
	Timely	Amount of time required to determine non-reporting units characteristics.
		<i>Percent</i> of non-reporting units for which a position is maintained within a given period of time.
		Average in <i>minutes/hours</i> within which a given non-reporting friendly location is updated.

3.1. Deploy/maneuver collection assets into position as necessary to collect against a designated target (e.g., penetrate hostile airspace, penetrate a communications network, infiltrate an organization).	Timely	<i>Time</i> from request to asset in position for surveillance.
	Sufficient	<i>Fraction</i> of required airspace available for surveillance.
		<i>Fraction</i> of requested area that can be surveilled.
3.2. Persistently collect information on designated targets.	Assured	<i>Percent</i> of AO without reconnaissance and surveillance.
		<i>Percent</i> of reconnaissance/surveillance missions conducted in accordance with assigned parameters.
	Sufficient	<i>Rate</i> of area surveillance (square km/hr).
		<i>Percentage</i> of targets located within allocated on-location time.
	Manageable	<i>Number</i> of means available to obtain required information, by info type.
		<i>Fraction</i> of information types for which capture means are available and can be tasked.
	Timely	<i>Minutes</i> since latest information collected/published.
		Gaps in coverage of a given target in <i>seconds/minutes</i> .
		<i>Time</i> required to locate target area.
		<i>Time</i> required to locate target once sensor scans appropriate area.
		<i>Minutes</i> since meteorological data updated.

3.3. Publish information on environmental, neutral, unknown and hostile elements, locations, networks, activities, events, sites, platforms, facilities and individuals.		<i>Hours</i> since oceanographic data updated.
		<i>Months</i> since geospatial data updated.
	Assured	Horizontal and vertical geolocation accuracy in <i>feet</i> .
		<i>Percent</i> level of assuredness of location.
		<i>Percent</i> of tracks with correct ids.
		<i>Percent</i> of quality scores on quality/utility assessments that fall within average.
	Sufficient	<i>Number</i> of targets/day detected, classified, identified.
		<i>Percent</i> of targets/day accurately located, classified/identified.
		<i>Percent</i> of PIRs satisfied.
		<i>Percent</i> of outstanding PIRs.
		<i>Percent</i> of enemy offensive actions for which warning provided.
		<i>Percent</i> of nodes receiving indications and warning.
		<i>Percent</i> of time-critical targets engaged successfully.
		<i>Instances</i> of failure to respond to RFI.
		<i>Percent</i> of PIRs with more than one collection source.
	Timely	<i>Hours</i> to satisfy RFI.
		<i>Seconds/minutes/hours/days</i> from collection to publishing.
		<i>Percent</i> of manned reconnaissance missions requiring current intelligence that have it before execution.
		<i>Seconds/minutes/hours</i> to convert in situ measurements into environmental profiles.

4.1 Store Information	Assured	<i>Percent</i> of information for which source cannot be identified.
		<i>Percent</i> of time storage media are available.
	Flexible	<i>Number</i> of paths/entry points available to access information.
		Number of formats available.
		Number of types of information that can be stored.
	Robust	<i>Number</i> of different locations a datum can be located.
		<i>Percent</i> of all data stored in redundant databases.
	Structured	Subjective determination of ease of navigating paths to locate desired data (easy, adequate, difficult).
		<i>Existence</i> of a catalog that provides map to data location (yes, no).
	Sufficient	<i>Percent</i> of all created information that is stored.
4.2 Archive information	Assured	<i>Percent</i> of information for which source cannot be identified.
		<i>Percent</i> of time storage media are available.
	Flexible	<i>Number</i> of paths/entry points available to access information.
		Number of formats available.
		Number of types of information that can be stored.
	Robust	<i>Number</i> of different locations a datum can be located.
		<i>Percent</i> of all data stored in redundant databases.
	Structured	Subjective determination of ease of navigating paths to locate desired data (easy, adequate, difficult).
		<i>Existence</i> of a catalog that provides map to data location (yes, no).

	Sufficient	Percent of all created information that is stored.
4.3. Import into network storage and translate information from external sources not subject to DOD information standards.	Structured	Structure conforms with established standards (yes, no).
	Assured	Percent of data that is correctly translated.
	Capable	Number of systems information that can be translated.
	Effective	Percent of data that is translated.
	Flexible	Number of different systems information that can be translated from/to, by information type.
		Number of formats accommodated.
		Translation between formats available (yes, no).
	Timely	Seconds/minutes/hours to translate data (from receipt of request).
	Usable	Subjective determination of <i>usability</i> of information after translation (fully, marginal, unusable)
Number of errors generated during translation.		
4.4. Establish and maintain metadata registries defining the structure, format and definitions of data.	Sufficient	Percent of available data formats described by the registry.
		Subjective determination of <i>adequacy</i> of the registry for describing contained data (1 to 5 scale; 1 fully adequate, 5 inadequate).
4.5. Catalog information according to the structure provided in metadata registries.	Structured	Average number of categories of metadata for all data.
	Sufficient	Percent of all information that is catalogued.
		Percent of derived information linked to source data.
		Percent of information that is prioritized.
	Usable	Subjective determination of <i>adequacy</i> of the catalog for describing and locating data (1 to 5 scale; 1 fully adequate, 5 inadequate).
Percent of all information that is catalogued properly by subject, source, geolocation, priority and users/modifiers of information.		
4.6. Search for and retrieve information.	Accessible	Percent of all information that can be retrieved by any node.
		Number of steps required to retrieve information.
		Percent of all nodes that can retrieve information.
	Timely	Time elapsed from information request to receipt.
	Usable	Seconds required to retrieve any information.
		Number of required data fields that are blank.
Percent of retrieved information that corresponds to information sought.		

5.1. Ensure access to source data before and after any processing.	Accessible	Percent of information that is linked to its source data.
5.2. Process source data into information.	Assured	Percent of data that is correctly processed.
	Capable	Number of systems information that can be processed.
	Effective	Percent of data that is processed.
	Flexible	Number of different systems information that can be processed, by information type.
		Number of information system types.
	Timely	Seconds/minutes/hours to process data (from receipt).
	Usable	Subjective determination of <i>usability</i> of information after processing (fully, marginal, unusable)

		Number of requests for clarification of information, by information type.
5.3. Sort information (refers to arranging information according to categories or classes of metadata—e.g., by source, time, subject, etc.).	Assured	Number of instances of information placed in wrong category.
	Capable	Number of types of information that can be sorted.
	Effective	Percent of data that is sorted.
	Flexible	Number of information types that can be sorted from different systems, by information type and system.
	Timely	Seconds/minutes/hours to translate data (from receipt of request).
	Usable	Subjective determination of <i>usability</i> of information after sorting (fully, marginal, unusable) Number of errors generated during translation.
5.4. Correlate information (refers to the sequencing of multiple inputs on the same object).	Assured	Number of instances of losing information pedigree after correlation.
		Percent of instances correlated tracks preserve original ID.
	Capable	Number of types of information/tracks that can be correlated.
	Effective	Subjective determination of <i>value</i> of correlated information (high, medium, low).
	Flexible	Number of different presentations that can be accomplished with correlated information.
	Timely	Seconds/minutes/hours to correlate information.
5.5. Deconflict multiple source inputs on a single object.	Assured	Number/percent of redundant data (tracks) that can be eliminated through correlations
		Percent of resultant tracks that have correct ID after deconfliction.
	Capable	Number of types of information/tracks that can be deconflicted.
	Effective	Percent of cases that can be deconflicted.
	Flexible	Number of different presentations that can be accomplished with deconflicted information.
	Sufficient	Percent of multiple sources deconflicted.
	Timely	Seconds/minutes/hours to deconflict multiple reports.
	Usable	Subjective determination of <i>usability</i> of deconflicted information (fully, marginal, unusable) Number of tracks that have lost needed information during deconfliction.
5.6. Analyze information (refers to studying or determining the nature of a subject, usually by breaking it down into its constituent parts and then describing their relationships to each other and the whole).	Assured	Percentage of analyzed information that correctly describes object.
		Percentage of analysis cases that provide correct object ID.
	Capable	Number of types of objects/information that can be analyzed.
		Number of types of analyses that can be performed.
	Sufficient	Fraction of requested analyses that can be performed.
	Flexible	Number of different aspects of an object that can be described.
		Number of ways/paths by which an analysis can be reported.
	Timely	Minutes/hours/days to analyze information.
	Usable	Subjective determination of analysis <i>usability</i> (fully, marginal, unusable)
		Fraction of analyses, by type, that contain all requested information.
		Number of requested information packets missing from analysis, by analysis type.

5.7. Evaluate information (a form of analysis that refers to judging the significance, worth, condition, reliability, etc. of information)	Assured	Subjective determination of level of <i>confidence</i> in evaluation's correctness (1-5 scale; 1 fully confident, 5 no confidence).
		<i>Number</i> of cases where incorrect information is judged reliable.
	Flexible	<i>Number</i> of types of evaluation that can be accomplished.
	Sufficient	Subjective determination of whether evaluation contains <i>all</i> needed information (yes, no).
		<i>Number</i> of requested components of evaluation that are missing.
	Timely	<i>Minutes/hours/days</i> to evaluate information.
5.8. Identify and predict activity or other patterns.	Assured	<i>Confidence value</i> of evaluated data/information
		Subjective determination of <i>correlation</i> between prediction and observed situations or outcomes (high, partial, none).
5.9. Synthesize information (refers to the cognitive process of combining elements of information and knowledge to form a more complex whole)	Assured	<i>Confidence value</i> of synthesized data/information.
		<i>Number</i> of cases where synthesis loses basis of information.
	Capable	<i>Number</i> of types of information that can be accessed and synthesized.
	Effective	<i>Percent</i> of information sources that refer to the same situation/object that can be synthesized.
	Flexible	<i>Number</i> of different presentations that can be accomplished with synthesized information.
	Sufficient	<i>Percent</i> of available multiple information types/sources synthesized.
		<i>Percent</i> of required syntheses that can be performed.
	Timely	<i>Minutes/hours/days</i> to synthesize information.
	Usable	Subjective determination of <i>usability</i> of synthesized information (fully, marginal, unusable)

6.1 Represent information visually, i.e., imagery, graphical, textual, tabular, schematic, geospatial or some other visible form.	Compatible	<i>Number</i> of required data elements missing in a representation, by visual representation type.
		Subjective determination of degree to which a visual representation <i>meets the requirements</i> of each user, by user (1-5 scale: 1 fully, 5 unmet)
	Flexible	<i>Number</i> of different visual modes or forms in which any piece of information can be represented.
		<i>Number</i> of visual representations that can be displayed at one time.
		<i>Number</i> of different user specialized representations that can be met.
	Usable	<i>Number</i> of requests for clarification of a visual representation, by representation type.
		<i>Number</i> of steps required to switch from one representation to another.
6.2 Represent information aurally	Compatible	Ability to correlate aural with other sources of the same information (transparent, can do, difficult).
	Flexible	<i>Percent</i> of aural source data represented aurally
	Sufficient	<i>Fraction</i> needed alerts that are provided aurally.
		<i>Aural</i> alert is of sufficient volume/quality that attention is captured (yes, no).
	Usable	<i>Fidelity</i> of aural presentation (high, medium, low).
		Subjective view of understandability (high, medium, low).

6.3 Represent information in multiple sensory modes as appropriate.	Compatible	Number of required data elements missing in a representation, by representation type.
		Subjective determination of degree to which each representation <i>meets the requirements</i> of each user, by user (1-5 scale: 1 fully, 5 unmet)
	Flexible	Number of different modes or forms in which any piece of information can be represented.
		Number of different user specialized representations that can be met.
	Usable	Number of requests for clarification of a representation, by representation type.
		Number of steps required to switch from one representation to another.
6.4 Correlate elements of visual, aural and other information.	Compatible	Subjective determination of degree to which representations are correlated (1-5 scale: 1 fully, 5 unmet)
	Flexible	Number of different elements of information that can be correlated.
		Number of data elements within each representation that can be correlated.
	Usable	Subjective determination of ease of relating new representation to the former when switching from one representation to another (easy, study required, difficult)
		Number of times switching between representations to determine correlation between information elements.
6.5 Represent temporal and spatial object relationships.	Assured	Mean Accuracy of object location for a sequence of location reports for a moving object (meters).
		Maximum reported location error for all reported locations (meters).
	Timely	Rate of information updates (number/min).
		Time delay between location determination and presentation.
	Sufficient	Number of locations presented per mile of object motion.
		Distance object moves before last position report is posted.
6.6 Integrate friendly, enemy, environmental and other information into a single representation as desired.	Effective	Subjective determination of ease of understanding relationship between Red and Blue forces in the representation (1-5 scale: 1 easy, 5 difficult).
		Subjective determination of <i>ability</i> to predict red and Blue movements and their interactions with the representation (1-5 scale: 1 easy, 5 difficult).
	Flexible	Number of different icon representations that can be used to designate units.
		Number of different force representations that can be presented: red only; blue only; red, blue, white; etc.
	Usable	Ability to highlight individual units and drill down to their information with point and click (yes, no).
6.7 From a common set of available data, any node create and update a unique, user-defined representation of the situation as it applies to that node, including any plans, guidance, control measures, etc. as may apply.	Flexible	Number of different modes or forms of information that can be incorporated into a single situational representation.
	Timely	Seconds/minutes/hours lag between real-world situation and situational representation.
		Time lapse between request and production of user representation.
	Usable	Percent of user requested representations that can be produced.
		Subjective determination of degree of <i>completeness</i> for the representation meeting their requirements (fully, partially, largely unmet).
7.1 Each node share	Accessible	Number of steps required for a node to access a product, by product.

user-defined plans, visualizations, work products or other information objects with other nodes.		Percent of on-line nodes that can post and share their products.
		Number of nodes that can share an information product at one time.
	Extensive	Percentage of information products that can be shared among nodes.
		Number of types of information products that can be shared among nodes.
		Number of nodes that can share an information product at one time.
	Manageable	Ability present to visually relate information in products from different nodes (yes, no)
		Ability present to visually highlight the information product from a node for use in the collaboration (yes, no)
	Structured	Information packages can be visually related to the node that provided them (yes, no)
7.2. Provide the means for decision makers to interact in the comparison and assessment of shared plans, visualizations, work products or other information objects in order to reach mutual understanding.	Assured	Fraction of information products provided for collaboration that include their source and validity.
		Log of sources used and development history available for products (yes, no).
		Collaboration products include visual ID of their contributors (yes, no).
	Flexible	Number of nodes that can synchronously or asynchronously contribute to the creation of a work product.
		Number of types of products that can be used in collaborative sessions.
	Timely	Fraction of work products that are available to other users in time to meet their deadlines.
		Latency between product posting and availability for collaboration (sec).
7.3. Provide the capability for nodes readily to form communities of interest based on access to desired services and expertise available on the network.	Accessible	Percent of units wishing to join groups that are able to do so.
		Number of steps required to join desired group.
	Capable	Instances of new groups established after initial organization.
		Instances of new nodes incorporated into existing groups after initial organization.
	Extensive	Percent of required augmentees identified and incorporated into existing groups.
		Percent of distributed groups composed on non-organic/non-military/non-US nodes.
		Number of groups formed.
	Manageable	Number of groups a unit can join and maintain cognizance of situations.
		Number of groups that can be operating at a time and be supplied with required information.
	Structured	Groups formed in accordance with required COIs (yes, no).
		Fraction of groups supplied with correct information for their tasks.
7.4. Provide the means collaboratively to create commonly-alterable work products or information objects—such as plans, orders, graphics, analyses, estimates	Assured	Number of collaboration products that can't be traced to their source.
		Collaboration products include visual ID of their source (yes, no).
	Flexible	Number of nodes that can synchronously or asynchronously contribute to the creation of a work product.
		Number of types of products that can be produced collaboratively.
	Timely	Fraction of work products that are available to other users in time to meet their deadlines.
		Latency between product posting and availability for collaboration (sec).
7.5. Incorporate	Accessible	Number of steps required to access synthesized products.

multiple input modes or media—such as voice, text, sketch, graphics, mapping, imagery, live feeds, etc.—into a single collaboration session.	Extensive	Percentage of information products that can be synthesized.
		Number of syntheses that can be displayed simultaneously.
		Number of types of syntheses that can be produced.
	Manageable	Ease of producing new syntheses upon request (easy, moderate, difficult)
		Number of steps required to produce a new synthesis.
	Structured	Synthesized information products can be visually related to each other (yes, no)
		Synthesized information products can be visually related to their source information (yes, no)
7.6. Incorporate diverse, mission-specific planning applications into a single collaboration session.	Accessible	Fraction of collaboration units that can access all planning systems
	Assured	Fraction of planning-system information that contain a system ID.
		System provided planning products can be traced to their source information (yes, no).
	Flexible	Number of different mission-planning technologies that can be incorporated into a single collaboration session.
		Percent of information that cannot be shared between technologies during a collaboration session.
7.7. Manage collaboration sessions and processes—such as scheduling, establishing objectives and procedures, and assigning permissions and authorities, etc.	Extensive	Number of types of collaboration issues that have preset management procedures.
		Number of collaboration sessions that can be accommodated while meeting required response times.
		Percent of nodes that can be included in arriving at the solution of a management issue.
	Manageable	Percent of instances that collaboration service is available upon request.
		Adequacy of provided SOP to form collaboration units and for conduct of collaboration sessions (1-5scale: 1 adequate, 5 inadequate).
		Number of steps required to solve management issues, by issue type.
	Structured	Number of collaboration structures that are available preset.
		Adequacy of map of collaboration structure to guide sessions to join and how to access (1-5 scale: 1 adequate, 5 inadequate).
		Collaboration structure map and topical indexes available to guide collaborators to appropriate sessions (yes, no).
	Timely	Seconds required to establish a collaboration session.
		Seconds to broadcast an application.
		Seconds to transfer a file to other nodes.
		Seconds to create a virtual space.

8.1 Search for desired information or patterns of information as specified by users	Assured	Percent of patterns that are delivered with information pedigree specified.
	Flexible	Number of different recognizable patterns.
		Number of different sources that can be used to build patterns.
	Structured	Percent of useful categories/classes defined.
		User specified patterns archived and cataloged for reuse (yes. no).
	Timely	Seconds to locate desired information or pattern of information.
		Seconds to build pattern assessment from source information.
8.2 Suggest changing	Capable	Percent of suggested changes adopted by users.

human-computer-interface preferences based on individual usage patterns.	Flexible	Number of preference profiles that can be used/stored for a user.
		Number of user profiles that can be implemented at one time.
8.3. Provide alerts based on user-defined thresholds, such as dipping below specified supply thresholds or a report received pertaining to a specific priority information requirement.	Flexible	Number of means with which an alert can be delivered.
		Number of defined thresholds for an alert.
	Structured	Percent of alerts that have defined operational responses/SOP.
		Number of alert levels that have defined, quantitative, operational parameters for each component of the alert assessment.
	Timely	Latency of alert with respect to alert conditions met.
		Update rates of information required to produce alerts.
8.4. Aggregate data elements into larger groupings, such as tracking overall logistical status by aggregating status of reporting nodes.	Assured	Percent of aggregation cases that misrepresent one or more included data elements.
		Percent of aggregations that provide access to included data.
	Flexible	Number of different types of aggregations that can be calculated.
		Number of different types of data that can be used in preparing an aggregation.
	Structured	Percent of aggregations that satisfy a prescribed operational information requirement.
		Existence of a catalog of available aggregations (yes, no).
8.5. Provide multi-source correlation and fusion of data.	Flexible	Number of different types of data that can be fused.
	Structured	Provisions for identifying sources in fused data (yes, no)
	Timely	Time required to fuse new data with existing, by data type (sec).
8.6. Recognize and predict temporal, spatial, economical, political, cultural or other patterns.	Capable	Number of cross-correlations programmed into the system.
		Number of pattern triggers built into the system that prompt changes in situation assessment.
		Percent of assertions that prove true, based on statistical data.
		Number of assertions that lead to requests for information updates by users.
	Flexible	Number of different dimensions (temporal, spatial, content, etc.) in which patterns can be recognized.
		Number/types of assertions that can be made about information.
		Number of information patterns that are programmed for recognition.
		Number of information pattern types for which automated alerts are provided.
	Timely	Number of different recognizable patterns.
		Time to alert to a pattern change after receiving a change in input parameters of situation prompt.
8.7 Provide automated simulations to support course-of-action evaluation or other purposes.	Assured	Time between pattern change recognition and change assessment transmission/receipt.
		Percent of simulation output that is delivered with relevant model assumptions/parameters provided.
	Effective	Percent of simulation output that is delivered with simulation run context provided.
		Percent of predicted outcomes that prove true, based on statistical data for any given simulation.
	Structured	Percent of all operational/enterprise dynamics defined that can be simulated.

		Percent of simulation output that correspond to operational parameters of interest.
	Usable	<i>Level of complexity</i> of dynamics that can be simulated.
		Degree of correspondence of simulation run to situation of interest (high, partial, uncorrelated).
	Assured	<i>Percent</i> of solutions that utilize operationally current information.
8.8. Provide automated solutions to computational problems, such as targeting, logistics, or navigation solutions, etc.—especially time-critical functions that exceed human capacity (e.g., “Auto Special” mode in Aegis).	Assured	<i>Percent</i> of solutions that provide references to information pedigree used for the assessment.
	Effective	<i>Percent</i> of targets accurately located, classified/identified.
	Timely	<i>Seconds/hours/ days</i> to produce a targeting solution for any target.
		Latency of assessment with respect to operational parameter updates.
8.9. Recommend management decisions based on optimization—such as changing distribution priorities or production schedules.	Assured	<i>Fraction</i> of available supply-chain data used in providing schedules.
		<i>Fraction</i> of schedules that provide link to underlying data to establish schedule validity.
	Capable	<i>Number</i> of possible schedules considered/prepared from which choice was made.
		Subjective assessment of <i>correlation</i> between schedule and favorable supply outcomes (1-5 scale: 1 highly, 5 poorly correlated).
	Timely	<i>Minutes</i> to generate complete schedules.
		<i>Latency</i> between situation change and new solution (min, hours).
		<i>Latency</i> between situation change and alert to management (min).
		<i>Percent</i> of solutions provided within planning timelines.
	Usable	<i>Number/percent</i> of executable schedules generated.
		<i>Number</i> of schedules generated that are sent back for rework.
8.10. Recommend potential options in support of human decision makers exercising judgment, e.g., as in the development of courses of action.	Assured	<i>Fraction</i> of available operational information used in providing Cols.
		<i>Fraction</i> of options that provide link to underlying information to establish option validity.
	Capable	<i>Number</i> of options considered/presented from which choice was made.
		Subjective assessment of <i>correlation</i> between Col and favorable operational outcome (1-5 scale: 1 highly, 5 poorly correlated).
	Timely	<i>Minutes/Hours</i> to generate individual Col.
		<i>Percent</i> of Col presentations developed within planning timelines.
	Usable	<i>Number/percent</i> of executable Cols generated.
		<i>Number</i> of Cols generated that are sent back for rework.

9.1 Control access to networked resources (hardware and software) and data (both in storage and in transit) through authentication services.	Assured	<i>Percent</i> of information/information sources authenticated.
		<i>Percent</i> of information/network users with valid access.
	Effective	<i>Instances</i> of mistaken authorization.
	Flexible	<i>Number</i> of authentication types available.
		Ability to add new authentication profiles (yes, no).
	Manageable	<i>Instances</i> of mistakenly rejected authorization.
		<i>Number</i> of steps required to add a new user and grant access.

		Number of steps required to add a new authenticatin profile.
		Number of steps required to change a users access.
9.2 Ensure confidentiality by preventing unauthorized disclosure of data (both in storage and in transit), including network data such as passwords, routing tables, etc.	Assured	Management system <i>conforms</i> to network security standards (yes, no).
		Frequency password changes.
	Effective	Number of instances of unauthorized disclosure.
		Number of instances of compromised passwords.
9.3 Ensure information integrity by preventing unauthorized modification of data, detecting and reporting unauthorized modification of data, and recording all changes to data.	Assured	Percent of information systems protected by firewalls, virus detection software or other appropriate defensive IO measures.
		Responsible commands perform risk assessment of potential threats and take appropriate action to respond to those risks meeting appropriate criteria—Yes/No.
		Percent of operational information system hardware and software components with replacement components to replace them if they fail or are corrupted.
		Responsible commands have IA or defensive IO memorandums of understanding with commercial communications providers who support information systems—Yes/No.
	Effective	Number of instances of operational information systems being disabled, corrupted or compromised through identified adversary IO actions, criminal mischief or other cause.
		Percent of time information systems are disrupted, degraded or out of service.
		Percent of disrupted, denied, degraded or destroyed information identified.
		Number of instances of disruption, denial, degradation or destruction of information systems identified (due to hostile IO, criminal mischief or other cause).
9.4 Optimize availability to ensure timely, reliable access to data and information services for authorized users by providing protection from attack, protection from unauthorized use, and resistance to routine failure.	Accessible	Number of steps required for a user to gain access to data and information services.
	Assured	Percent of information systems protected by firewalls, virus detection software or other appropriate defensive IO measures.
		Responsible commands perform risk assessment of potential threats and take appropriate action to respond to those risks meeting appropriate criteria—Yes/No.
		Responsible commands have IA or defensive IO memorandums of understanding with commercial communications providers who support information systems—Yes/No.
	Effective	Number of instances of operational information systems being disabled, corrupted or compromised through identified adversary IO actions, criminal mischief or other cause.
		Percent of time information systems are disrupted, degraded or out of service.
		Percent of disrupted, denied, degraded or destroyed information identified.
		Number of instances of disruption, denial, degradation or destruction of information systems identified (due to hostile IO, criminal mischief or other cause).

	Timely	<i>Minutes/hours</i> for appropriate computer emergency response teams (CERTs) to respond, identify and correct operational information system failures attributed to adversary IO action or criminal mischief.
9.5 Provide non-repudiation services for all network data information exchanges.	Assured	<i>Percent</i> of information exchanges that identify source and user of data.
		Existence of an archive log of all information exchanges (yes, no)

10.1 Identify clearance of any network node.	Assured	<i>Number</i> of instances of mistaken clearance.
	Extensive	<i>Number</i> of nodes for which clearance is maintained.
	Manageable	<i>Number</i> of steps required to ID clearance of a node.
		<i>Number</i> of people/systems required to maintain clearance ID.
10.2 Track classification of all information.	Assured	<i>Number</i> of instances of mistaken classification.
		<i>Number</i> of Instances of changed classification that are not tracked.
	Extensive	<i>Percent</i> of all information that is provided a security classification.
	Manageable	<i>Number</i> of people/systems required to track information classification.
10.3 Correlate clearance with classification in any situation.	Assured	<i>Number</i> of instances in which clearance should have been denied but was not.
		<i>Number</i> of Instances in which clearance was denied by should not have been.
	Extensive	<i>Number</i> of steps required to ID clearance of a node.
		<i>Number</i> of people/systems required to maintain clearance ID.
10.4 Control access to information as needed.	Assured	<i>Number</i> of people/systems required to maintain clearance ID.
		<i>Number</i> of instances of access improperly denied
	Extensive	<i>Number</i> of access requests processed per hour.
	Manageable	<i>Number</i> of people/systems required to control access to information.
10.5 Sanitize or downgrade classified information to lower security classifications as appropriate.	Manageable	<i>Number</i> of steps required and permissions needed to downgrade classification of a piece of information.
		<i>Number</i> of people required to execute needed declassifications.

11.1 Interface with different system formats and protocols	Effective	<i>Percent</i> of published information not retrieved due to lack of equipment or other interoperability.
		<i>Percent</i> of information generated by non-DOD elements not posted to the network.
	Manageable	<i>Instances</i> of coordination with non-DOD elements significantly delayed.
		<i>Percent</i> of translations that require human intervention.
11.2 Incorporate non-DOD elements into joint command and control processes	Accessible	<i>Percent</i> of non-DOD support requirements filled at time of execution.
		<i>Percent</i> of non-DOD elements that have reviewed plans prior to publication.
	Flexible	<i>Percent</i> of total network nodes are non-DOD elements.
		<i>Days</i> to integrate non-DOD doctrinal differences.
		<i>Minutes/hours</i> to establish coordination with State Department, coalition partners and other non-DOD agencies (after establishment of joint force)
11.3 Communicate	Extensive	<i>Number</i> of nodes that can participate in managing execution.

Commander's Intent and manage execution across a dynamic and diverse range of potential mission partners		Number of types of activity that can be monitored by each node, by node.
		Number of reach-back nodes that participate in execution management.
	Flexible	Number of types of nodes that can participate in managing execution.
		Number of means by which Commander's Intent can be delivered.
	Effective	Collective execution management decisions improve execution (1-5 scale, 1 major improvement, 5 degradation).
	Timely	Latency of delivery of execution information (min).
		Subjective determination of whether execution management directions are delivered in <i>time</i> to modify execution (expedient, time late).

12.1 Maintain in any node the ability to perform essential functions autonomously (i.e., without dependence on services provided by other nodes).	Effective	Number of required operations that cannot be carried out with local services.
		Percent of required functions that can be performed autonomously.
		Time increase in performing required functions autonomously, by function.
	Sufficient	Percent of required capabilities available autonomously.
	Usable	Latency in producing required products with respect to meeting decision timelines.
		Increase in <i>manhours</i> needed to produce products.
12.2 Optimize communication with limited or interrupted throughput.	Accessible	Percent of local nodes that can switch to locally provided communications.
	Effective	Percent of information compression
		Number of channels that can be used for communications.
	Sufficient	Percent of required communications that can be accomplished. .
	Usable	Latency in required communications with respect to meeting due times.
		Percent of communications that require manpower intensive utilization.
12.3 Prioritize information requirements so that information is communicated in order of importance when throughput is limited or connectivity is restored	Assured	Instances in which lower-priority information is communicated before higher-priority information.
		Assigned priorities are <i>congruent</i> with operational requirements (yes, no).
		Instances in which high-priority information is delayed/not received because other information is communicated first
	Flexible	Number of priorities that can be managed.
		Ability to modify priorities depending on the operational situation (yes, no).
	Sufficient	Number of available priorities meets operational requirements (yes, no).

13.1 Monitor network usage and performance	Accessible	Number of system performance parameters that can be automatically and periodically monitored.
	Extensive	Percent of systems for which fraction of time each system is being used can be monitored.
		Percent of nodes using the network that can be monitored.
	Manageable	Frequency of network status reports (number/hour).
		Automatic monitoring and status problem alerts (yes, no).
13.2 Manage network services and accounts	Accessible	Percent of network accounts that allow access for management.
	Flexible	Number of types of network accounts that can be managed.

		<i>Number of account parameters that can be managed.</i>
	Manageable	<i>Number of steps required to make account changes, by account type.</i>
13.3 Identify and diagnose problems in network functioning	Capable	<i>Number of instances of network problems not detected.</i>
		<i>Number of instances of incorret diagnoses of network problems.</i>
		<i>Fraction of instances in which need to intervene in system performance is identified automatically.</i>
	Manageable	<i>Fraction of network functions that have automatic monitoring and status alerts.</i>
	Timely	<i>Seconds/minutes/hours to identify need to intervene in system performance.</i>
13.4 Make necessary repairs to ensure effective and efficient network functioning	Capable	<i>Number of instances for which needed network repairs cannot be made.</i>
	Manageable	<i>Percent of instances for which repairs restore services sufficiently to carry out operations in a timely manner.</i>
		<i>Number of instances for which human intervention in system performance is required and provided.</i>
		<i>Percent of instances for which repair restores full service in a timely manner.</i>
	Timely	<i>Seconds/minutes/hours needed to repair system.</i>

14.1 Incorporate new technologies	Flexible	<i>Number/percent</i> of new technologies or modifications that cannot be introduced without requiring modifications or new interfaces to existing technologies.
	Usable	<i>Dollar costs</i> in integrating new technologies with existing systems.
		Number of capabilities gained with introduction of the new technology.
		Number of capabilities lost with introduction of the new technology.
14.2 Adopt new doctrine, tactics, techniques and procedures	Capable	<i>Efficacy</i> of new doctrine, tactics, techniques and procedures, based on judgment of users (full, partial, degraded).
		Subjective determination of enhancement of operational capabilities with the new procedures (1-5 scale: 1 significant, 5 degraded).
	Flexible	<i>Days/weeks/months</i> to introduce new doctrine, tactics, techniques and procedures.
		<i>Manhours</i> of training required to utilize effectively the new procedures.
14.3 Modify organizational structure, to accept creation of established and expedient communities of interest's	Capable	<i>Number</i> of new organizations introduced.
		<i>Time</i> required to establish a new organizational structure.
	Effective	Subjective determination of enhancement of operations with introduction of the new organization (improved, no change, degraded).
	Flexible	<i>Number</i> of structures considered/tested.
14.4. Develop decision makers at all levels that have the skills and temperament necessary to perform effectively in the command and control environment developed by FORCEnet.	Effective	Subjective roll-up of personnel capability measures subsequent to FORCEnet specific training (1 to 5 scale; 1 fully caable, 5 incapable).
		Individual comfort level with FORCEnet processes subsequent to training (fully, moderate, uncomfortable).
	Capable	<i>Time</i> required for individuals to complete FORCEnet related tasks.
		<i>Number</i> of steps in a process timeline with which an individual is unfamiliar.
		Individual can log on to network, enter collaboration session, without assistance (yes,no).

15.1 Make sense of often-complex situations	Assured	<i>Fraction</i> of available information used in the assessment.
		<i>Number</i> of pieces of information used in the assessment that come from non-verified sources.
	Flexible	<i>Number</i> of assessments of the situation considered.
		<i>Number</i> of assessments of the situation presented to higher authority.
	Sufficient	<i>Fraction</i> of operationally relevant variables included in the assessment.
		<i>Instances</i> of commander surprised by critical events.
		<i>Percent</i> of intelligence judged accurate in light of actual event.
	Timely	<i>Minutes/hours</i> to assess new information on area/situation.
		<i>Minutes/hours</i> since update of situation.
		<i>Minutes/hours/days</i> to identify key variables/factors in a situation.
		<i>Minutes/hours/days</i> to develop working hypothesis about situation systemic dynamics.
		<i>Minutes/hours</i> from receipt of information to complete assessment of situation.
15.2 Make or recommend decisions	Usable	Degree to which assessment matches decision maker's needs (fully, partially, insufficient).
		<i>Fraction</i> of parameters required for the briefing that are provided.
	Assured	<i>Percent</i> of presented options that were considered.
		<i>Number</i> of SMEs consulted in decision-making.
	Flexible	<i>Percent</i> of plans having branches and sequels available.
		<i>Percent</i> of courses of action wargamed against projected threats.
		<i>Number</i> of options considered.
	Sufficient	<i>Fraction</i> of forces needed for the operation that are provided direction.
		Completeness of ROI and order-of-battle descriptions (complete, partially, insufficient).
	Timely	<i>Minutes/hours/days</i> to conceive course(s) of action from time of warning/tasking.
		<i>Minutes/hours/days</i> to approve a course of action from time of conception.
15.3 Direct or authorize execution action	Usable	<i>Latency</i> of decision with respect to current force deployment.
	Assured	<i>Percent</i> of units in sufficient contact for timely direction and response.
		<i>Percent</i> of staff availability to provide needed directions.
	Flexible	<i>Number</i> of units available that can be re-tasked or re-directed.
		<i>Fraction</i> of staff that can provide direction to different unit types.
	Sufficient	<i>Days/hours/minutes/seconds</i> to respond to requests for guidance.
		<i>Percent</i> of addressees receiving direction/guidance.
		<i>Percent</i> of available planning time allotted for subordinate planning.
	Timely	<i>Hours/minutes/seconds</i> to publish changes to orders.
		<i>Seconds/minutes</i> for order to be retrieved world-wide.
15.4 Monitor and supervise execution	Assured	Level of verification for reported information (high, medium, low).
	Sufficient	<i>Amount</i> of information about each unit that can be displayed/assimilated at a time.
		<i>Fraction</i> of units for which timely reporting is available.
	Timely	<i>Latency</i> of information in <i>seconds/minutes/hours</i> .

		<i>Seconds/minutes/hours/days to determine a plan will not achieve the required results.</i>
15.5 All nodes self-synchronize individual actions based on actions of other nodes in consonance with higher intentions.	Sufficient	<i>Number of instances of conflict between unit actions.</i>
		<i>Number of instances of poor synchronization between unit actions.</i>
	Timely	<i>Rate of synchronization updates between units (number/hour).</i>
		<i>Time lapse between information updates between units.</i>

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Appendix C. FORCEnet Capabilities to NCOW RM Correlations

Table C. FORCEnet Capabilities and Tasks Comparison to NCOW RM

Associated NCOW RM Activities	Major Tasks	Associated NCOW RM Tasks
Fn1. Provide robust, reliable communication to all nodes, based on the varying information requirements and capabilities of those nodes.		
A4 Resource Service Requests: Providing the computing, communication and media resources needed to satisfy user requests.	1.1 Access the network	A11 Request Access to information Environment A13 Create/Maintain User/entity profile A33223 Authorize Service/ Capability Access A54 Manage Accounts The NCOW defines "communications" much more narrowly than the Fnet concept. See NCOW A42 - provide communication resources.
	1.2 Identify all nodes on the network	This task is not listed anywhere in the NCOW RM No good correlation to the NCOW RM
	1.3 Publish presence/identity and availability of services on the network	
	1.4 Publish and subscribe to information on the network	A5323 Manage Publish and Subscribe Resources. A5344 Manage COI Subscription
	1.5 Ensure network availability and reliability	A3326 Perform Availability Activities A52 Manage Systems & Network Configurations
	1.6 Provide sufficient quality of service to all nodes	A52 Manage Systems & Network Configurations Various sub-activities to this apply to providing sufficient quality of service to all nodes.
Fn2. Provide reliable, accurate and timely location, identity and status information on all friendly forces, units, activities and entities/individuals.		
A3142 Support Operational Situational Awareness	2.1 Report own identity, location, intentions and status on a timely basis	A3142 Support Operational Situational Awareness A31321 Provide Tactical Information Exchange
	2.2 Identify, calculate, report and update positions of non-reporting friendly units	A3142 Support Operational Situational Awareness

Fn3. Provide reliable, accurate and timely location, identification, tracking and engagement information on environmental, neutral and hostile elements, activities, events, sites, platforms, and individuals.		
A3142 Support Operational Situational Awareness	3.1 Gain access (Physical to airspace)	
	3.2 Collect/publish information on environmental, neutral and hostile elements, networks, activities, events, sites, platforms, facilities and individuals	A3142 Support Operational Situational Awareness A31321 Provide Tactical Information Exchange There are 6 subactivities to this listed in the NCOW RM that further define what Supporting Op Situational Awareness is. However, a few other sub-activities under A31-Provide Core Services could relate to this.
	3.3 Provide continuous surveillance of environmental, neutral and hostile elements, networks, activities, events, sites, platforms, facilities and individuals	In the NCOW reference model these ISR functions would be considered inputs to the network and not services performed by the network
	3.4 Provide combat assessment	In the NCOW reference model this ISR function would be considered an input to the network and not a service performed by the network
	3.5 Task and dynamically re-task collection assets via the network	.
Fn4. Store, catalogue and retrieve all information produced by any node on the network in a comprehensive, standard repository so that the information is readily accessible to all nodes and compatible with the forms required by any nodes, within security restrictions		
A31-Provide Core Services and A54 Manage Core Enterprise Services	4.1 Store Information	A5321 Manage Content Placement
	4.2 Archive information	A5321 Manage Content Placement
	4.3 Establish data/metadata standards	A53244 Manage Metadata Repositories
	4.4 Establish metadata registries describing structure, format and definitions of data	
	4.5 Catalogue information	A5322 Manage Catalog/Directory Services
	4.6 Retrieve information	A5321 Manage Content Placement <i>In the NCOW the sub-activity A315 Provide Information Storage Services also references this.</i>
	4.7 All nodes provide information in compliance with standards established in metadata registries	

Fn5. Process, sort, analyze, evaluate, and synthesize large amounts of disparate information while still providing direct access to raw data as required.

A31-Provide Core Services Parts of this Capability is covered under NCOW RM A314-Provide Information Mediation Services. This refers to information transformation processing, situational awareness support, negotiation and publishing.	5.1 Ensure access to raw data before and after any processing	
	5.2 Process data into information (Refers to operating on data using established, routine, and often rote procedures)	A3141 Transform Information
	5.3 Translate information between different systems	A3132 Provide Synchronous Information Exchange A3141 Provide Negotiation Services
	5.4 Sort information (Refers to arranging information according to categories or classes, including metadata)	A311 Perform Discovery Services
	5.5 Correlate information over time (A form of sorting referring to chronological sequencing of multiple inputs on the same object)	
	5.6 Deconflict multiple source inputs on single object (A form of sorting that refers to determining whether multiple inputs refer to a single object)	A31421 Correlate Information
	5.7 Analyze information (Refers to studying or determining the nature of a subject, usually by breaking it down into its constituent parts and then describing their relationships each other and the whole)	A314 Perform Information Mediation Services
	5.8 Evaluate information (A form of analysis that refers to judging the significance, worth, condition or reliability of information)	A314 Perform Information Mediation Services
	5.9 Identify and predict activity or other patterns	
	5.10 Synthesize information (Refers to combining information elements to form a more complex product)	A314 Perform Information Mediation Services

Fn6. Provide each decision maker the ability to depict situational information in a tailorable, user defined, shareable, primarily visual representation.

A31-Provide Core Services	6.1 Represent information visually .i.e. imagery, graphical, textual, tabular, schematic, geo-spatial or other form	
	6.2 Represent information aurally	<i>These tasks are much more specific than the NCOW RM. However, most can be lumped under the activity A3142-Support Operation Situational Awareness.</i>
	6.3 Correlate elements of visual, aural and other information	A31421 Correlate Information.
	6.4 Represent information temporally	

	6.5 Integrate friendly, enemy and other information into a single representation	A31421 Correlate Information A31422 Fuse Information
	6.6 From a common, universal database, create unique, user-defined situational representations	
	6.7 Develop situation awareness about current conditions, status, implications and plans	A3142 Support Operational Situational Awareness
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.		
A312 Provide Collaboration Services and A535 Manage Collaboration Resources	7.1 Share user-defined plans, visualizations, work products or other complex information products with other nodes, and relate information to others' information representations	
	7.2 Update information products in real time	
	7.3 Integrate/synchronize multiple input modes or media – voice, text, sketch, graphics, geolocation icon, imagery, live feeds, etc. – into a single collaborations session	
	7.4 Provide capability to form distributed teams or communities of interest	A312 Provide Collaboration Services
	7.5 Provide means to collaboratively create commonly-alterable work products or artifacts, such as orders, plans, graphics, analyses, estimates, etc	
	7.6 Integrate diverse mission-planning systems into a single collaborative session	
	7.7 Manage collaboration issues	A312 Provide Collaboration Services A535 Manage Collaboration Resources
	7.8 Develop a common understanding of the situation and the command and control work products among distributed groups.	
Fn8. Automate lower-order command and control sub-processes and use intelligent agents and automated decision aids to assist people in performing higher-order sub-processes, such as gaining situational awareness and devising concepts of operations		
No equivalent in the NCOW RM		
Fn9. Provide information assurance (IA).		
A33 Perform	9.1 Control access to networked	A331 Provide Infrastructure Control

Environment Control Services and several portions of A5-Manage Net-Centric Information Environment	resources (hardware and software) and data (both in storage and in transit) through authentication services.	Services A332 Enforce Net-Centric environmental policy A52 Manage System & Network Configs
	9.2 Ensure confidentiality by preventing unauthorized disclosure of data (both in storage and in transit), including network data such as passwords, routing tables, etc.	
	9.3 Ensure information integrity by preventing unauthorized modification of data, detecting and reporting unauthorized modification of data, and recording all changes to data.	
	9.4 Optimize availability to ensure timely, reliable access to data and information services for authorized users by providing protection from attack, protection from unauthorized use, and resistance to routine failure.	
	9.5 Provide non-repudiation services for all network data information exchanges.	
Fn10. Function in multiple security domains and multiple security levels within a domain, and manage access dynamically.		
Not addressed much in NCOW but is mentioned in A33-Perform Environmental Control Services	10.1 Identify clearance of any network node. Authentication.	<i>Cross domain issues are barely addressed in the NCOW RM. The only references are in A33213-Authenticate Cross-Domain Invocations (this activity only refers to the narrow issues of PKI authentication of Digital signatures) And A5445-Establish Cross-Domain authentication.</i> A3321 Authenticate
	10.2 Track classification of all information. Confidentiality/Integrity.	
	10.3 Correlate clearance with classification in any situation. Authentication.	A33232 Authorize Data Release
	10.4 Control access to information as needed. Authentication.	A3323 Control Information Flow
	10.5 Sanitize or downgrade classified information to lower security	A33233 Authorize Import/Export of Information

	classifications as appropriate. Confidentiality.	A33234 Sanitize Data
Fn11. Interoperate with command and control systems of very different type and level of sophistication.		
Hardly discussed in the NCOW RM but alluded to in A31 Provide Core Servies	11.1 Establish command and control system standards	A3132 Provide Synchronous Exchange Capabilities A31321 Provide Tactical Information Exchange
	11.2 Comply with command and control system standards	
	11.3 Translate between different system formats and protocols	A314 Perform Information Mediation Services
	11.4 Incorporate non-DOD elements into joint command and control processes	
Fn12. Allow individual nodes to function while temporarily disconnected from the network.		
Not really addressed in the NCOW RM	12.1 Optimize communication with limited or interrupted throughput	
	12.2 Prioritize information requirements so that information is communicated in order of importance when throughput is limited or connectivity is restored	
	12.3 Interpolate/extrapolate patterns based on limited numbers of data inputs	
	12.4 Maintain in any node the ability to perform essential functions autonomously (i.e., without dependence on services provided by other nodes).	
Fn13. Automatically and adaptively monitor and manage the functioning of the command and control system to ensure effective and efficient operation and to diagnose problems and make repairs as needed.		
A52 Manage System & Network Configurations and N53 Manage Core Enterprise Services	13.1 Monitor system usage and performance	A331 Provide infrastructure control services
	13.2 Allocate and reallocate command and control resources to network services	A33242 Allocate Network Resources
	13.3 Manage network accounts	A54 Manage Accounts
	13.4 Provide and manage core network services	A31 Provide Core Services A53 Manage Core Enterprise services
	13.5 Reroute information based on load, damage, performance, etc.	
	13.6 Identify the need to intervene in command and control system performance	

	13.7 Diagnose problems in network functioning	
	13.8 Make necessary repairs to ensure effective and efficient network functioning	A524 Recover from incident
Fn14. Incorporate new capabilities into the system quickly without causing undue disruption to the performance of the system.		
Not addressed in the NCOW RM.		
Fn15. Provide decision makers the ability to make and implement good decisions quickly under conditions of uncertainty, friction, time, pressure, and other stresses.		
Not addressed in the NCOW RM.		

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