

## Novel Concepts for the COP of the Future

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### ABSTRACT

*The US DoD has undertaken a significant transformation to implement Net-Centric Warfare. The new interoperability foundation is Net-Centric Enterprise Services (NCES). Rather than sharing the same applications (e.g. GCCS), the US DoD organizations and Allied countries would interoperate using their own applications but adhering to the same sets of Information Technology standards and sharing common services.*

*The COP 21 Portal is a Situation Awareness Knowledge Portal, in line with NCES. COP 21 has a number of COP capabilities that contribute to improve situation awareness:*

- *Single point of access to multiple information sources*
- *Filtering and categorizing information using Portfolio views*
- *Dissemination of information using Portfolios*
- *View of several documents together*
- *Contextual search services*
- *Web-Based Geographic Information System*
- *Integration of application services in the portal*

*The COP 21 Portal has been tried out during JWID 04 with great success, allowing the validation of the current capabilities and the identification of improved COP capabilities.*

### 1.0 INTRODUCTION

“Within NATO, there is a need to coordinate complex operations across nations, theatres, and branches (land, sea, air). A common operational picture (COP) provides shared understanding of the battlespace to improve responsiveness and provide decision dominance. Visualization technology offers a means to establish the COP and should help the commander transition across strategic, operational and tactical levels. The ultimate aim is to obtain an integrated visualization environment where commander and staff can gain a shared understanding of the changing battlefield situation” (IST-043, [1]).

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## Novel Concepts for the COP of the Future

The definition of COP, or associated terms such as Recognized – Maritime, Air, Land – Pictures (RMP, RAP, RLP), has generated strong debates. First it is not clear what is meant by common. Depending on their role, staff officers need to see different pieces of the current situation. The word ‘consistent’ has been suggested as a replacement to ‘common’, reflecting the common set of information sources rather than a common representation. In this ‘consistent’ representation, each commander or staff officer is able to filter and customize his view based on his own needs or task.

The term ‘picture’ is also misleading. For many users, the COP is a picture or more precisely a map showing the disposition of the forces in a military conflict. Although a lot of the required information is geo-referenced and can be superimposed onto a map background, some of this information cannot be depicted on a map or is best represented using non-geospatial representations. Consider information such as Commander’s intent, staff operating procedures, opposing forces doctrine or terrorist threats.

Therefore, we could say: The Common Operational Picture is the integrated capability to receive, correlate and display heterogeneous sources of information in order to provide a consistent view of the battlespace. This definition focuses on the integration capability versus the end product. Moreover, the end product is not simply a picture but an understanding or a common view.

The Canadian Director Joint Force Capabilities (DJFC) has developed a C4ISR Campaign Plan to define the Joint C4ISR development approach to coordinate the drive to Strategy 2020 (Knight [2]). This Campaign Plan presents a Joint C4ISR Target Integration Model that presents the different building blocks. The COP building block presented in the Campaign Plan is consistent with the COP definition given above.

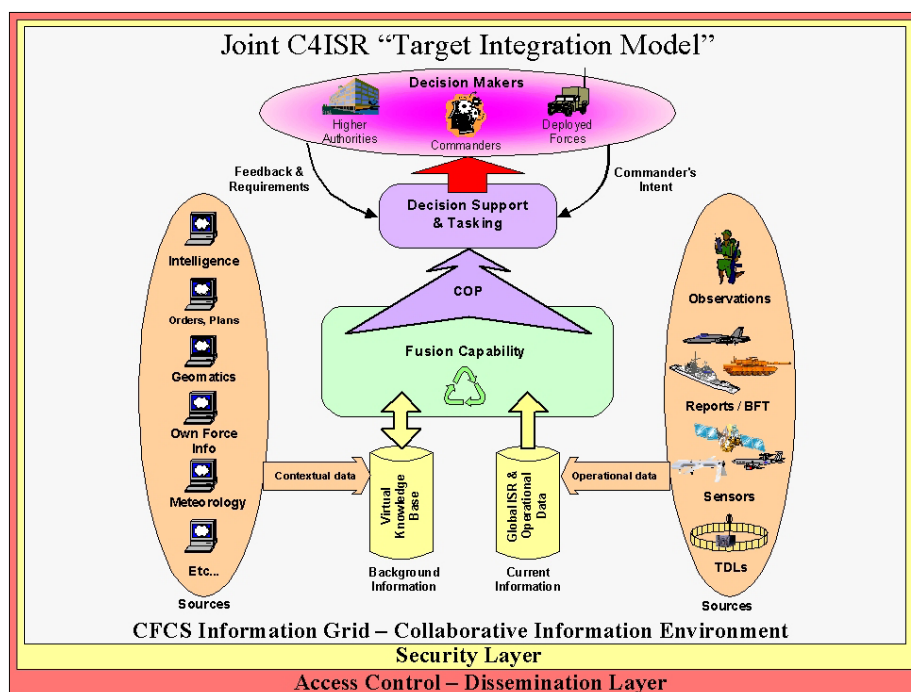


Figure 1: Joint C4ISR Target Integration Model.

The current COP capability of the main allied forces is provided through the use of the US Global Command and Control System (GCCS) (DISA [3]). Although the use of GCCS facilitates interoperability between allies, it does not take into account the nations differences in military structures, resources and doctrine, and limits interoperability with national systems.

Over the last four years, Defence R&D Canada has been exploring the COP capability of the future through the COP 21 Technology Demonstration (COP 21 TD) project. This paper will first examine technological trends on which COP 21 is based, describe the COP 21 Portal capabilities, provide feedback from its trial during the JWID 04 experiment and suggest improved COP capabilities.

## **2.0 US DOD TRANSFORMATION**

Over the last several years, the US Department of Defense and its allies have been going through a major transformation, which exploits all of the power of the Information Age. This transformation focuses on Information Superiority to implement Network Centric Warfare (NCW). In NCW, according to Alberts [4], all elements of the force are robustly networked achieving secure and seamless connectivity and interoperability, providing the capability to share, access and protect information to a degree that it can establish and maintain an information advantage over an adversary, and providing the capability to collaboratively correlate, fuse and analyse the information in order to develop high quality shared awareness.

One of the initiatives to implement NCW is called Net-Centric Enterprise Services (NCES). 'NCES will provide a common set of information capabilities across the Global Information Grid, allowing DoD, the intelligence community, and coalition partners to pull information they want, whenever they need, from wherever they are – within appropriate constraints' (Quagliotti [5]). One approach to implement the NCES is the use of Enterprise Portal technology.

The US DoD acknowledges the limitations of the GCCS: 'At this time, trying to create a GCCS common operational picture (COP) is too labor intensive and it is too late for GCCS to provide requisite shared situation awareness' (Sussman [6]). As part of their transformation initiative, beginning in 2006, the US DoD will be replacing the GCCS by the Joint Command and Control (JC2) system. JC2 will use Web services and fit with DOD's plan for NCES (Temin [7]). The interesting aspect in this is that in order to achieve interoperability, allied nations will no longer need to share the same application (e.g. GGCS). Rather, each nation could have its own application but share some Web services.

## **3.0 ENTERPRISE PORTAL TECHNOLOGY**

Information Portals have become an effective means of enabling organizations to access, share and manage information and knowledge of pertinence to the organizations.

A '*Portal*' refers to a collection of technologies and processes required to locate, retrieve, organize and publish structured and unstructured information in a secure manner and to integrate applications and services embodied in an organization. Portals support the formulation and collaboration of on-line communities (ADGA [8]).

As described in ADGA [8], a portal can provide an organization with the following Web capabilities:

**Table 1: Portal Capabilities**

1.	Personalized access	User can define what they want
2.	Role-based filtering of content	User retrieves information based on role or possibly rank
3.	User-friendly interaction	User can navigate instinctively (they understand what they see)
4.	Multi-system integration	Users directly access the systems they require to complete daily tasks
5.	Scalability	Users experience good online response time with lowest possible hardware investment
6.	Single sign-on	Users require only one password for all systems they use (with validation)
7.	Content management	Users require to find the documents and knowledge-sharing to be effective
8.	Security	Systems and content are accessed by appropriate personnel
9.	Community support	Employees and suppliers can collaborate online
10.	A general development framework	A technology tool kit that can aggregate various internal organizational software

“Seen from a technical point of view, portals are frameworks, which integrate various tools and applications together in a common framework” (RoweBots [9]). Ideally speaking, a single central place to look for everything is the best that you can do, provided that the portal software performance is good. All information can be cross-linked and stored once; updates can be assured and the intellectual capital of the organization protected. A portal like this can offer a complete environment for everyone in the organization to do his or her job, completely and seamlessly integrated with the desktop.

The overall benefits are (RoweBots, [9]):

- A single point of sharing and communication in the organization.
- Elimination of duplicate information.
- Reduction in information overload.
- Improved communication with all partners and customers.
- Access to a consistent set of applications with support and backups.
- International and multi-site collaboration without difficulties of shared drives and similar issues.
- Simple cross-functional cross organization communication.
- Creating norms of information sharing and knowledge creation for the organization.
- Communicating new reward systems, which emphasize knowledge sharing.

The value of Portal technology in providing Coalition Situation Awareness still has to be demonstrated but the premises are all present to enable it. However, ‘Portals are all about vision and organizational alignment with technology. The technology is only 20% of the problem. The other 80% is making sure that the technology aligns with the business requirements and delivers true value to the enterprise (ADGA [8]).

#### 4.0 COP 21 SITUATION AWARENESS KNOWLEDGE PORTAL

Using Enterprise Portal technology, the COP 21 TD has implemented a Situation Awareness Knowledge portal (Gouin [10]). The COP 21 portal has been tried out during the JWID 04 experiment. The Portal was assessed from its military utility in terms of enhancing situation awareness and from a technical perspective in terms of providing a single access to multiple sources of information and services, and supporting interoperability across organizations.

Figure 2 is an illustration of the COP 21 Portal as appearing on a two-screen configuration. The following presents the main capabilities provided by COP 21 as well as feedback from JWID 04 users. The COP 21 Software Design Document (xwave [11]) provides more detailed information on the capabilities.

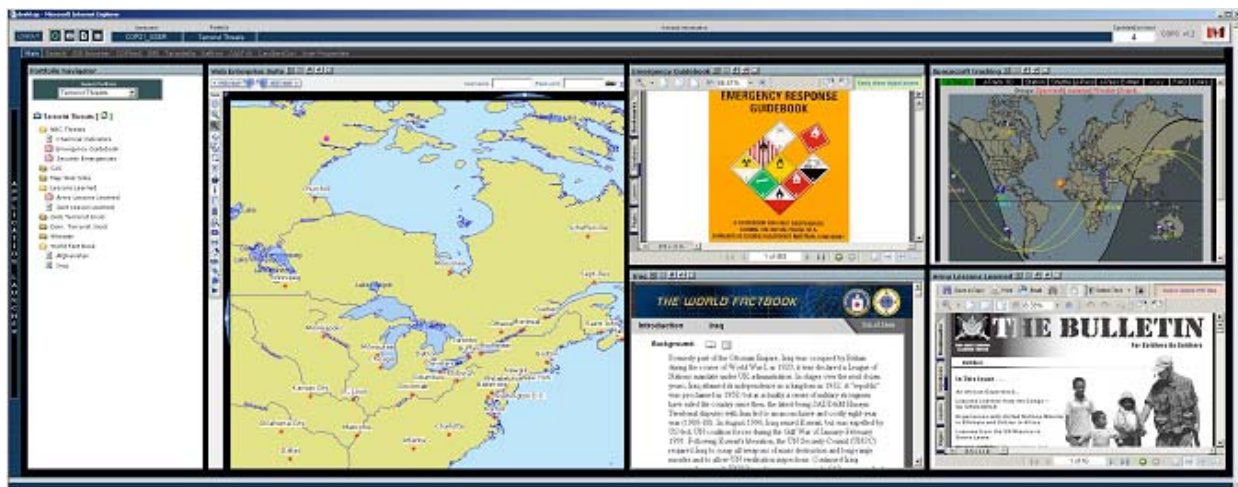


Figure 2: The COP 21 Portal as Represented on a Two-Screen Configuration.

#### 4.1 Single Point of Access to Multiple Information Sources

COP 21 is an integration platform. It does not replace existing applications. Rather it allows a user to access a variety of sources of information and a variety of services from a single workstation. The user has no longer to move from one workstation to another to consult information and interact with applications. As the COP 21 portal is implemented upon the J2EE (Java 2 Enterprise Edition) architecture using BEA Web Logic [12], integration of new sources of information and of Web services can be easily performed.

Comments from the JWID 04 experimentation are the following:

“COP21 is ideal for loading a large amount of data from multiple sources, as proved by the scenarios run.”

“Being able to access all pertinent info from one workstation has increased my efficiency 10 fold!”

## 4.2 Filtering and Categorizing Information using Portfolio Views

One particular concept of COP 21 is the provision of portfolios where the information can be filtered and categorized based on interventions (e.g. military operations) and on the user identity and tasks (e.g. monitoring, planning). This is a first implementation of the C-O-P Trilogly (Gauvin [13] and [14], also see Section 6.1). Each authenticated user has access to a number of portfolios, depending on their roles.

The data stored in the portal consists of portfolios, folders and entries. The definition and description of each data component is as follows: A portfolio is a top-level container of organized data. Each portfolio may contain an unlimited number of folders and entries. A folder is a container of organized data and each folder may contain an unlimited number of other folders or entries. An entry is a connection or link to a piece of data. This piece of data can be any accessible file such as a web page, Word/text document, spreadsheet, message, image, video clip, map, or any document created using applications integrated in the Portal.

The portfolio manager component provides authenticated users with the ability to create, modify and delete ‘portfolios’, ‘folders’ and ‘entries’ through a user interface. The portfolio navigator component also provides users with the ability to browse and view the portfolio data through a user interface. Users may select a working portfolio, expand or collapse folders within that portfolio and select entries to display from portfolios/folders. Users are also able to view a portfolio summary as well as the metadata corresponding to each data entry. Figure 3 shows a view of some folders and entries contained in a portfolio.



**Figure 3: Portfolio Navigator Showing Portfolio Folders and Entries.**

Comments from the JWID 04 experimentation are the following:

“It’s an effective way to share, file, organize info.”

“Having all the apps in one place – not needing to know where documents are stored – just that they are related to a portfolio is a bonus.”

## 4.3 Disseminating Information using Portfolios and Notification Services

Portfolios can be shared amongst users and as portfolios point to information, there is no duplication of information or version control issues. As new information is added or updated in a portfolio, the information

becomes available to all users registered to that portfolio. Users are automatically notified of the new information through the scrolling of a message at the bottom of their screen using Elvin/Sticker, an event notification tool with a 'ticker-tape' interface. Via the Alert Icon, the user can also consult the portfolio entries that have changed since the last time he consulted them.

Comments from the JWID 04 experimentation are the following:

“Posting to portfolios is an appropriate and effective means of info dissemination.”

“The portfolio method to disseminate information is certainly better than trying to guess who to send info to – i.e. need to know who needs to know by email (HUH?). It is partially a push and partially a pull environment.”

“I liked the fact that the sticker automatically informed others that I had changed anything in the portfolio.”

#### **4.4 Multiple Collated Windows to View Several Documents Together**

In the COP 21 portal, the information available in a portfolio can be displayed in a number of windows, called portlets. Rather than seeing one piece of information at a time, the user is able to consult several documents. For instance, a user can see together the Commander's intent, the Blue and Red (Friendly and Enemy) forces situation map, the Orders of Battle, the Weather Report and so on. This presentation of multiple pieces of information contributes to achieve improved situation awareness. The user can easily switch from one portfolio to another, in which case the information as last viewed is presented.

The user is able to run the COP 21 portal on a single or multiple displays. A single-screen implementation will provide three portlets whereas a two-screen configuration will allow five portlets. Figure 2 is an example of the COP 21 Portal on a two-screen configuration.

Comments from the JWID 04 experimentation are the following:

“I like the 5 windows that gave us the opportunity to see more info at the same time. Ex incident report with the map showing the exact grid.”

“With the 5 screens in full operation you get a better picture of what's going on in any of the portfolios you have open. It also remembers what you had open.”

#### **4.5 Contextual Search Services**

COP 21 provides contextual search capabilities. Using Autonomy [15], a second-generation search engine, searches can be made in a document repository, portfolios, e-mails, chat sessions, and databases. The query allows users to find documents via a natural language or keyword centric specification. However, the searches are performed based on concepts, taking into account frequency of keywords and associations between these keywords.

When the query completes, the portlet displays the results meeting the search criteria. Each result includes the following information:

- The title, source & size of the document.
- A contextual summary of the document that provides a synopsis of the document as it relates to the query that was performed.

Users can view the contents of any document in the results as html, text, highlighted text or as a conceptual summary. Users may also request to add any document to a portfolio or to refine their query manually or via the ‘suggest similar’ option. The ‘suggest similar’ option allows the user to select one or more documents from the result list for which they would like to see other documents of a similar nature.

Persistent queries in the form of agents can be pre-configured to automatically find documents relating to a particular concept of interest. The Agent Management portlet allows the user to create/edit/delete, retrieve information from and retrain agents.

### **4.6 Web-Based Geographic Information System**

COP 21 integrates a Web-based Geographic Information System (GIS) allowing the user to access remote geospatial datasets remotely and exploit geospatial services. The GIS Browser used is Web Enterprise Suite Map Manager from CompuSult [16], which is conforming to the OGC (Open GIS Consortium) protocols. The GIS Browser provides capabilities to display standard raster and vector products, customize the map rendering, display STANAG 2525B symbols originating from C2PC and save contextual views in COP 21 portfolios. The GIS Browser can be seen in one of the portlets shown in Figure 2.

### **4.7 Integration of Application Services in the Portal**

Various applications can be accessed through the COP 21 Portal allowing users not only to connect to information sources but to execute applications on their COP 21 workstations as well. The COP 21 portal not only integrates various sources of information but also integrates a variety of services such as an Incident Management System, a Request for Information service and a number of information visualization and decision support applications. These applications have been integrated into the portal in a loosely coupled or tightly coupled manner. The loosely coupled applications are those accessed through the COP 21 Application Launcher. In this case, the applications simply run over the Portal with limited interaction with it. Tighter integration has allowed running applications within the COP 21 portal, through one of the Application Tabs. Some of these applications have also been configured to run within a portlet and upload or display information into/from portfolios.

## **5.0 IMPROVED COP 21 CAPABILITIES**

A partial vision of a Situation Awareness Knowledge Portal has been implemented so far as part of the Technology Demonstration. Moreover, the JWID 04 experiment has allowed the identifying and validating of functional requirements. Following is a number of the improved capabilities foreseen for the COP 21 Portal.

### **5.1 Full C-O-P Trilogy implementation**

The COP 21 team has put together the vision of a User-centric, mission-oriented knowledge portal (Gauvin [13] and [14]). The approach lays on three intertwined fundamental concepts, namely Context, Ontology and Portfolio. These are defined as:

- Portfolio: A user’s (or group’s) working space to perform the work related to long-term task-oriented activities in relation to a domain of interest (operations, interventions, exercises).
- Context: The set of all elements (internal or external) surrounding the work performed in a portfolio that contributes to bring light on its meaning and its value.



- Ontology: An organized and shared set of definitions of the elements pertaining to organizational domains and portal universes.

The delimitation of the work into well-scoped working spaces, called portfolios, allows to a certain extent to confine and to grasp the knowledge and know-how that is handled to a certain extent. The use of knowledge content and structure, using appropriate domain ontologies, might prove a great help. It could provide contextual assistance in offering the right tools and giving access to the right sources of information.

The full implementation of the C-O-P Trilogy represents a great challenge. Conversely, Gauvin [14] provides an incremental implementation strategy that could be useful to improve the COP 21 Portal.

## **5.2 Information Management**

Although participants in JWID 04 have expressed positive feedback on the use of Portfolios to manage information, significant feedback has been provided on some of the limitations with the current implementation of COP 21 from an Information Management perspective:

“There is no Information Manager. Therefore, there was no owner of portfolios so there was no one to control the contents of the folders. By the end of Day 4 the portfolios had duplicate files and a lot of obsolete info.”

“I have concerns about the management of files by multiple users. Having seen the accumulation of files over one week in JWID, the SA and amount of info available for each portfolio continued to increase over the week. However, when does the info become outdated and no longer relevant? Will there be someone who can decide that info is no longer required for decision-making? At what point does SA become compromised by the overwhelming number of documents available?”

“How do you control the placement of documents into correct folders without restricting the portfolio to only people who understand the filing mechanisms? How does a regular warfighter know which folder to post something when there are 10 folders in the list?”

Considering the vast amount of information provided by Net-Centric Warfare, good information management is necessary. In the context of the COP 21 Portal, the supporting approaches are both technological and organizational:

- Information ownership along with access privileges (Read, Write, Delete) should be associated with portfolios, folders and information entries.
- Information aging attributes should be associated with the information entries, together with capabilities to automatically archive outdated information.
- Automated information management capabilities should be developed to look for the duplication of information.
- Standard Operating Procedures (SOPs) should be defined for managing the information in Portfolios. This would include specifying Portfolio templates (table of contents) with default folders.
- An Information Manager should be appointed to overlook the use of the Portal and enforce SOPs.

## **5.3 Improved Search Capability and Classification**

Although the search capabilities in the COP 21 are already impressive, they could be improved by exploiting the latest information technology trends. First, interactive search capabilities could be provided to guide the

user through the process. The search capabilities could exploit structures such as semantic networks, ontologies, and meta-data to establish links between domain models and information sources, and help users find relevant information. Automated document classification and knowledge-object capture techniques could be provided to efficiently support situation analysis. These capabilities would allow to examine document content and derive the Who, What, When and Where. The search capabilities would be multi-lingual, exploiting translation services.

### **5.4 Data Aware Portlets**

One of the advantages of the COP 21 Portal is that multiple pieces of information can be viewed at a time. However, currently these pieces of information are only visually linked. Linking them programmatically and having data aware portlets would improve Situation Awareness. For instance, selecting information in one portlet would select the same objects in the other portlets. Drag and drop operations would be possible to move information from one portlet to another. When doing so, the information would be represented in the proper format: for example, unit symbols on a map-based portlet would be represented showing the unit fields in a spreadsheet portlet.

### **5.5 Information Visualization**

Advances in Information Visualization should be exploited in order to maximize the value of the information received, at the same time reducing cognitive overload. Key to achieving SA will be the ability to analyse a situation 'in context' over time: past ... present ... as well as the ability to forecast its evolution in the future.

Most of the COP information being geo-referenced, novel map-based representations, incorporating 2D, 3D and playback capabilities, and geo-intelligence technologies should be evaluated through experimentation and proof-of-concept demonstrations. Information Visualization techniques and products, map-based or not, should also be investigated in the context of the new nature of military operations, including global warfare, peacekeeping, urban and information operations, and asymmetric threats (Gouin [17]).

### **5.6 Standards and Protocols**

The COP 21 Portal is already based on open standards and protocols such as the J2EE (Java 2 Enterprise Edition), the OGC (Open GIS Consortium) specifications and the Dublin Core Document Meta-data standard. Additional standards and protocols should be adhered to, such as: ontology standards, the Command and Control Information Exchange Model (C2IEDM) and HCI (Human-Computer Interface) guidelines. They should be defined so that application Web services could be easily and tightly integrated into the portal as well as other portal environments, in line with the Net-Centric Enterprise Services approach.

## **6.0 CONCLUSION**

In the age of Information Warfare, the warfighters and staff officers can easily be overwhelmed with information and lack proper situation awareness. Network Centric Warfare and Network Centric Enterprise Services have been proposed as a way ahead for the command and control systems of the future. Enterprise Portal Technology constitutes an effective means of enabling organizations to access, share and manage information and knowledge of pertinence and therefore a good foundation to implement Network Centric Enterprise Services.

Defence R&D Canada has developed a Situation Awareness Knowledge Portal. It leverages on the new trends in Information Technology and provides a number of Common Operational Picture capabilities that have been successfully demonstrated during JWID 04. The COP 21 Portal has showed its value as an integrated capability to receive, correlate and display heterogeneous sources of information in order to provide a consistent view of the battlespace. This paper has highlighted the main COP 21 capabilities and suggested a number of improvements.

DRDC together with its military sponsor, DJFC (Directorate Joint Force Development) is addressing the COP 21 transition.

## **7.0 ACKNOWLEDGEMENTS**

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