

Coalition CINC 21 – Leading-Edge Information Technologies to Support Coalition Operations

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Abstract

Over the last decade, the number of coalitions operations has significantly increased, necessitating greater interoperability with our Allies. Several organizational, cultural, system and technological issues need to be addressed to enable synchronization of operations and shared coalition situation awareness. In order to address Coalition Situation Awareness requirements and contribute to interoperability in future coalition operations, a four-nation collaboration known as Coalition CINC 21 (C-CINC 21) has been established between the United States, Australia, Canada and United Kingdom. C-CINC 21 participated in Joint Warrior Interoperability Demonstrations (JWID) in 2001 and 2002, to demonstrate the use of portal technology and distributed collaborative services to share coalition information and to experiment with a coalition-shared infrastructure for geospatial access and with a number of collaborative planning and decision-support tools. This paper addresses a number of interoperability issues associated with coalition operations, describes the C-CINC 21 activities, draws lessons from the collaboration and outlines a way ahead for further collaboration.

1. Introduction

The character of modern military operations has changed significantly. Strategically, we have left a bipolar world and entered one that is more difficult to define. As Canadian Defence Beyond 2010: The Way Ahead succinctly summarizes, "...the future is uncertain and ... international instability, fractured states, asymmetric threats (e.g. Weapons of mass destruction, information operations, international terrorism, international crime, etc) along with the proliferation of conventional military technology have made the world a volatile and unpredictable place" [RMA, 1999].

Coupled with major advances in precision, lethality and weapon miniaturization, military operations have become more complex, demanding and dangerous. Recent operations have illustrated the importance of rapid response and global deployability in addressing conflict and alleviating human suffering. Whether with the United Nations or the North Atlantic Treaty Organization, the number of coalitions operations has increased, necessitating greater interoperability in a number of domains: technological, doctrinal, organizational and cultural

(e.g. language, religion). There is also a growing requirement for co-ordinated efforts between Armed Forces and their respective Government agencies.

Until recently in Canada, the approach to Command and Control (C2) interoperability was to standardise on the US DoD Global Command and Control System (GCCS). Recognizing the differences in Allied organization, systems, equipment and doctrine, the interoperability concept is evolving towards integration capabilities. As [Allsopp et al, 2002] and [Schmorrow, 2002] point out: “In addition to the problems of integrating single-service and Joint capabilities into a coherent force, the nature of Coalition (multi-national) operations implies a need to rapidly configure incompatible, ‘come-as-you-are’ or foreign systems into a cohesive whole, in an open, heterogeneous, diverse and dispersed environment”.

2. Coalition Operation Issues

To enable successful planning and conduct of coalition operations, a number of issues must be addressed: technological, system, organizational and cultural.

- **Commitment/attitude.** Each Coalition partner brings its own level of commitment to the mission, along with National political imperatives, and varying capabilities and resources.
- **Cultural differences.** Language and cultural differences among Coalition partners may result in ambiguity if not addressed appropriately. This is particularly true in the case of UN missions with non-traditional Allies.
- **Military capabilities.** Coalition partners have different military traditions, doctrine, organizational structures, leadership, training and Standard Operating Procedures (SOP).
- **C4I systems.** When Coalition partners deploy with significantly different C4I systems there is an increase in the complexity associated with the exchange of information, shared situation awareness and the ability to work collaboratively.
- **Security.** All Coalition partners will impose restrictions on information access and dissemination in order to protect National security interests. Security enclaves (established within coalition networks) need to be combined with agreed procedures to enable the release of information to coalition partners.
- **Host Nation cultural differences.** Conduct of Coalition Operations also requires an understanding of the history and culture of the ‘Host Nation’ or ‘Theater of Operations’, including social, political, military, religious, and ethnic makeup of the region.
- **Host Nation operational environment.** Coalition partners need to be trained and prepared for the operational environment, including the type of terrain, vegetation, climate and epidemiology.
- **Operations Other Than War (OOTW).** The nature of OOTW, for example Peace Support, non-combatant evacuation (NEO) and disaster relief operations raise additional issues. These operations “are very likely to be based on cooperation of a number of different, quasi-volunteered, vaguely organized groups of people, non-governmental organizations (NGO’s), institutions providing humanitarian aid, but also army troops and official governmental initiatives” [Pichouèk, 2002].

As stated by MGen (Retd) Forand (CA), “a perfect coalition force (extremely difficult to achieve) would have a large common ground to work from, including standards of efficiency and conduct, doctrine, terminology, and organizational structures, and working language(s). Also some degree of Interoperability – both tactical and logistic – would be an obvious benefit” [Forand, 2001].

MGen Forand identified a number of challenges associated with three different types of coalition operations [Forand, 2001]:

- **United Nations operations** tend to be driven by events and public or diplomatic reaction to them. Planning is ad-hoc and consultations informal, depending on the interest and/or capability of states willing to participate. Command and logistic structures are negotiated, ad-hoc, and inevitably late in being approved, resourced, and put in place. The major problem is the lack of a cohesive and functioning staff system, including the intelligence function. The ad-hoc nature of HQs, the “national” agendas that dominate all contingents and the general lack of trust means that there is a tendency for coalition partners to look to their own interests at the expense of the mission.
- **Alliance-based operations** (e.g. NATO, CANUS, or AUKCANUSNZ) have the advantage of planning using existing, practiced staff structures based on a degree of standardization. While alliances are also dependent on consensus building, the mechanisms for doing so are smaller and less fractious and the integration of components easier and more cohesive. A relatively large, cohesive and well-trained staff (i.e. NATO) provides the framework for information sharing and the basis for the creation of integral coalition information functions.
- **Ad-hoc multi-national operations**, based on the Lead Nation concept, are typically US-led as they require Corps and above Corps resources. While a smaller nation may undertake to lead such a coalition, it requires clear and limited objectives, national support and a clear commitment of the necessary resources.

3. Coalition CINC 21

In order to increase their situation awareness capability, many countries have been conducting Advanced Concept Technology Demonstrators (ACTD) and significant R&D activities to enhance information management and to produce an improved Common Operational Picture (COP) to interpret the battlespace. To address Coalition Situation Awareness requirements and contribute to the interoperability of future coalition operations, a four-nation collaboration known as Coalition CINC 21 (C-CINC 21), was established between the United States, Australia, Canada and United Kingdom. This collaboration leverages on the US Commander-in-Chief 21st Century Advanced Concept Technology Demonstrator (CINC 21 ACTD) (see Figure 1), Canada’s Common Operational Picture 21st Century Technology Demonstration (COP 21 TD), UK’s Advanced Research Program on Situation Awareness Methods & Tools and Command Post 21, and Australian TAKARI projects. A TTCP Project Arrangement supports the collaboration.

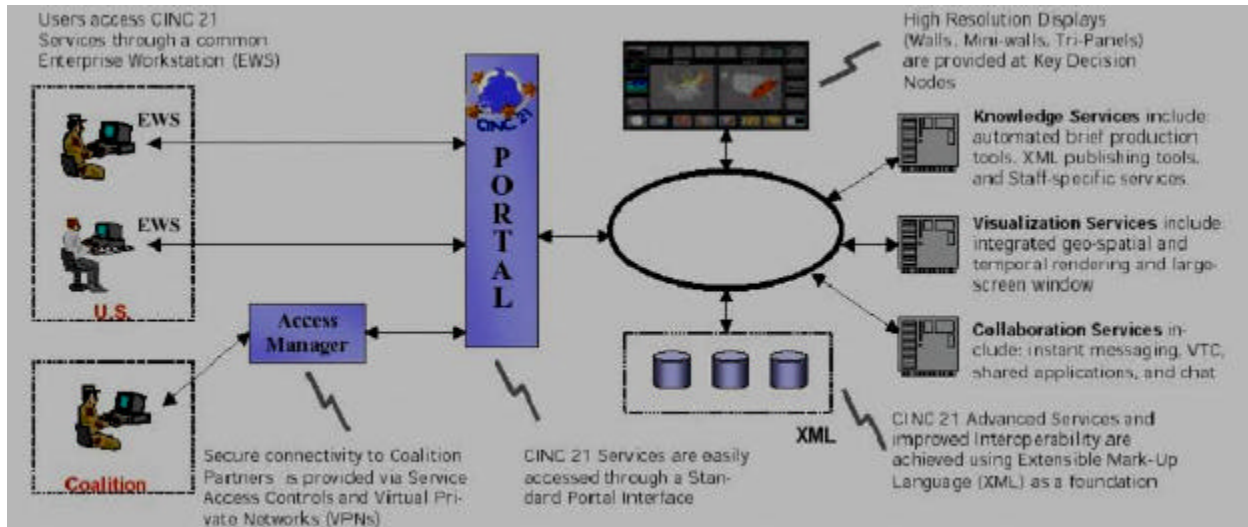


Figure 1 - CINC 21 ACTD Conceptual Description

C-CINC 21 was structured around 6 focus areas:

- **Visualization Services.** Assess the effectiveness of novel visualization tools and techniques in generating a consistent coalition perception of the battlespace.
- **Distributed Collaborative Planning.** Identify requirements for improved coalition interoperability to enable distributed collaborative planning across coalition forces using standards-based formats, protocols, enabling technologies and networking.
- **Knowledge Management.** Using Information Portal technology, understand how national and coalition information can be shared and exploited among coalition partners without compromising national interests.
- **Geospatial and Imagery Information Services.** Create a framework to enable the warfighter to discover, evaluate, access and exploit geospatial and imagery information services to support coalition operations.
- **Ontologies.** Using an appropriate methodology and tools, develop ontologies (vocabulary of basic terms) for selected areas of coalition interoperability.
- **Information Assurance.** Identify the information assurance (confidentiality, integrity and availability) requirements for coalition operations and demonstrate the utility of emerging technologies.

4. Technologies for Interoperability / C-CINC 21 Experimentation

The four participating C-CINC 21 countries have developed a number of promising applications and technological solutions to address the technological dimension of coalition interoperability, information sharing, and distributed collaborative planning. Some of these were developed in the lab (in collaboration with small high-tech firms) whereas others are commercial tools and products that have been integrated to meet the needs of the warfighter. Limited experimentation of some of these technologies was conducted during the Joint Warrior Interoperability Demonstrations (JWID) in 2001 and 2002, where military operators assessed them. C-CINC 21 realised several significant achievements during JWID 02:

- Effectively integrated tools contributed by CA, AS, UK, US into a Coalition portal to support the Operational Planning Process (C2 Portal).
- Provided a coalition mechanism for data and information dissemination to support the decision-making process (COINS).
- Successfully demonstrated the capability to conduct distributed collaborative planning (DCTS, COPlanS, GeCoPlan, Elvin Sticker).
- Successfully demonstrated decision support tools for joint and combined operations (COPlanS).

Some of the principal applications and technologies explored within these focus areas are described hereafter.

4.1 *C2 Portal*

The C-CINC 21 community had the opportunity to follow the development of portal technologies as they emerged from the Core CINC 21 ACTD in its final development year. CINC 21 successfully engaged both serving and retired General officers to capture requirements and develop the concept of 'Decision-Focused Operations'. This concept uses commercial collaboration and portal tools to dynamically build workspaces for the staff and 'decision-ready' visualizations for the Commander, all organized around operations. Within the C2 portal, CINC 21 provides the mechanisms for creating and managing the critical elements of operations: missions, battle rhythm, decision points and CCIRs. Workspaces and 'decision-ready' visualizations can be generated, linked to the appropriate decision points. Commanders have the ability to navigate through the 'Decision Space', depending upon the situation; to review the information associated with decision points of particular interest to them.

In the coalition context, CINC 21 portal technologies and services are being developed to enable coalition partners to achieve better cross-coalition situational awareness by allowing access to each other's web-based displays and services. For JWID 02, a C2 portal was successfully deployed to support C-CINC 21 experimentation and to demonstrate to the wider JWID audience the value of emerging portal technologies and services. Military operators at six sites in four countries, were actively involved in the experimentation and their feedback contributed to a limited military assessment of the C-CINC 21 C2 portal (see Figure 2) and its ability to effectively support Coalition Operations.

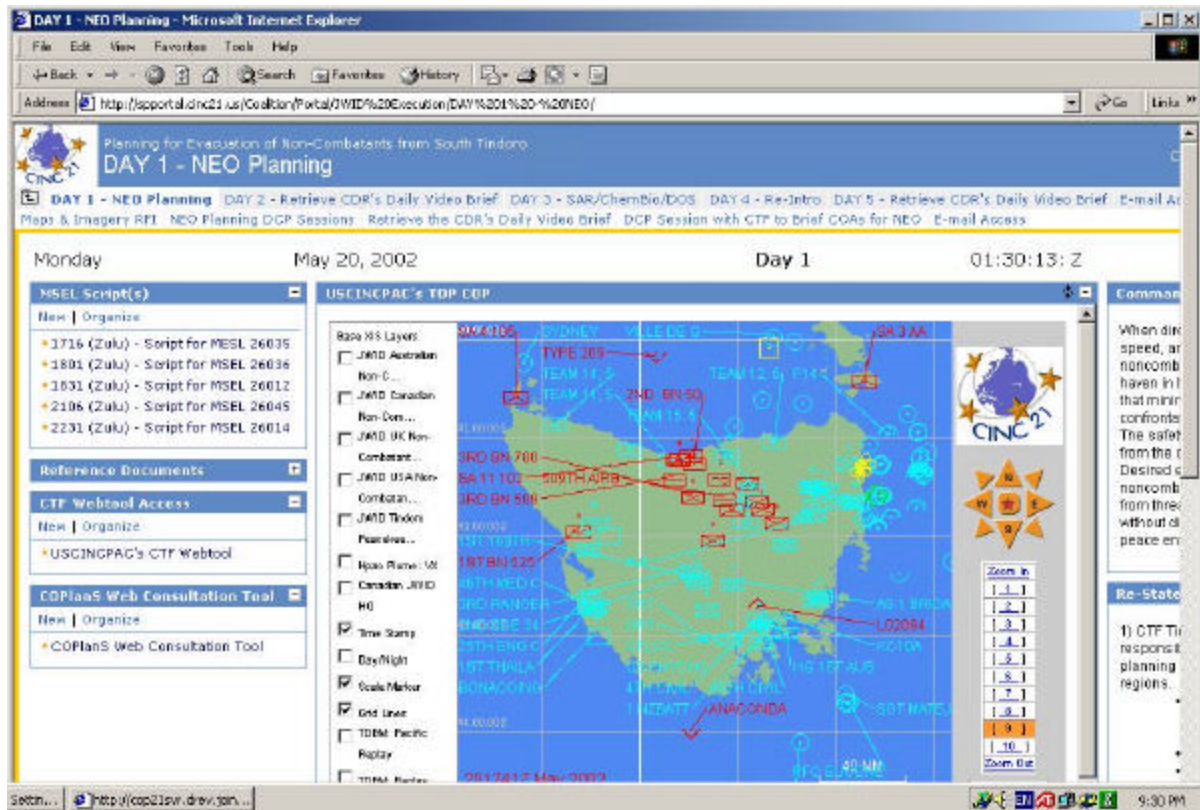


Figure 2 – CINC 21 C2 Portal

4.2 Coalition Information Service (COINS)

As described in Section 2, security concerns bring information management, dissemination and access constraints. Coalition nations will most likely only share a portion of their information to their partners. “This may often mean protecting intelligence sources and methods, information gathering capabilities, and battlefield capabilities as well as specific situation assessment or plan products, while making some of those information elements available to coalition command to drive the command and control process” [Edwards et al., 2002].

The National COINS (COalition INformation Services) was an instantiation of a coalition warfighter capability designed to address a critical warfighter need to discover and share information provided to the Coalition and based on collaboratively developed ontologies. The lead nation (US) provided the Coalition COINS, a single service point that federates all the National COINS (Web portal and server) (see Figure 3). The connectivity between COINS was successfully demonstrated from a technical point of view. COINS provided federated query and retrieval services to enable information sharing across the Coalition. Testing of the web-based connectivity using a limited set of agreed exchange formats and services were successfully demonstrated. The exchange infrastructure is re-usable to provide more advanced knowledge management services between the COINS.

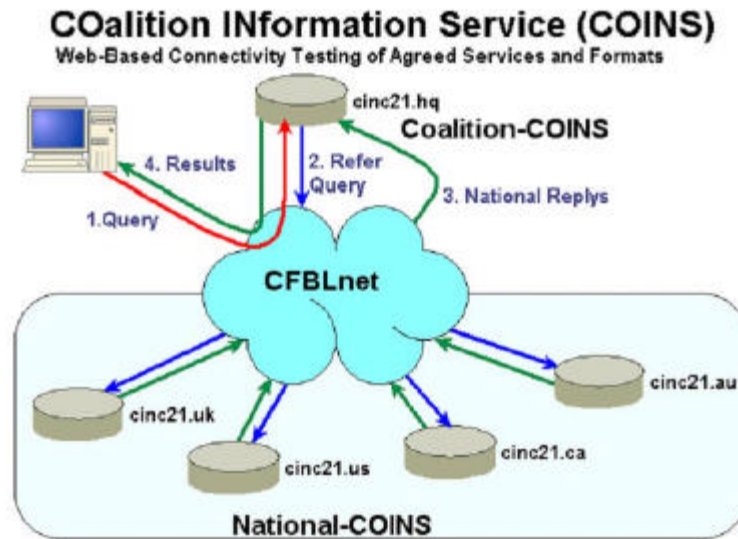


Figure 3 - Exploitation of Coalition-Wide Information to Enable Shared Situation Awareness

COINS has been developed using Internet Standards

- XML for representing coalition information
- XML Schemas to represent ontologies
- XQuery to represent queries
- HTTP protocol to transport queries
- Servlets are executed by the web server to do the queries and the servlets are using the JAVA classes of QUIP to answer the queries.

4.3 *Distributed Collaborative Tool Suite*

For distributed collaboration, the Coalition CINC 21 has used thoroughly the Distributed Collaborative Tool Suite (DCTS) both in JWID 01 and 02. Following a meeting room paradigm, DCTS provides an audio/video whiteboard, chat, document repositories and application sharing capabilities. DCTS includes the following tools:

- Digital Dashboard
- SharePoint
- CuSeeMe Server
- Microsoft NetMeeting

4.4 *Elvin/Sticker*

Elvin is a notification/messaging service provided by Australia for the C-CINC 21 collaboration. It is coupled with Sticker which provides a “ticker tape” interface (Figure 4) and runs on a wide range of platforms.

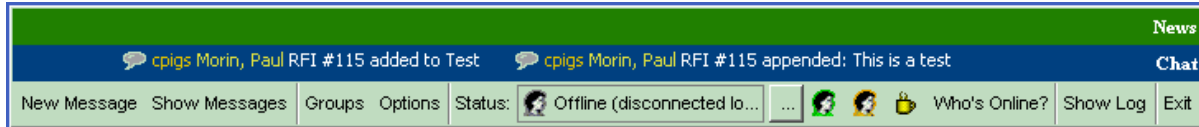


Figure 4 - Sticker Client

Features include:

- Ticker is for short transient messages
- In addition to user messages it adds the ability for any application to easily post messages
- Sticker works by subscribing to a number of ticker groups
- Incoming messages appear on a ticker tape and begin scrolling across the screen
- Users can just read the messages as they scroll across the ticker
- Messages with a URL attachment have a paperclip icon
- Sticker also supports a degree of virtual presence, to show who is out there and their activity

During JWID 01, “Sticker was very good for exchanging information such as Requests For Information (RFI), rapid notifications and short messages. The users also felt that Sticker is an essential tool for co-ordination and circuit restoration” [Arseneau, 2001].

4.5 *Distributed Collaborative Planning*

The JWID 02 C-CINC 21 experiment successfully demonstrated the capability to conduct distributed collaborative planning. Warfighters in CA, US, UK, AS used planning tools contributed by three nations to plan the evacuation of non-combatants. (CoPlanS, GeCoPlan, Tempo). The DCTS (US) and Elvin / Sticker (AS) effectively complemented these planning tools.

COPlanS is an integrated flexible suite of planning, decision-aid and workflow management tools specially designed to support different Military Operations Processes (e.g. Operations Planning Process) (Figure 5 and Figure 6). COPlanS offers capabilities to:

- Support a Joint or Combined staff in the planning of operations
- Handle multi-level and multiple team workflows and sub-workflows to support synchronizing work, products and collaboration
- Document the decision-making process and create an organizational memory
- Rationalize the process, improve the decision tempo, and rapidly produce documents to support the commanders
- Support Course of Action (COA) development and analysis
- Enable COA comparison and decision analysis to enhance decisions-making and manage risk
- Generate PowerPoint briefings automatically

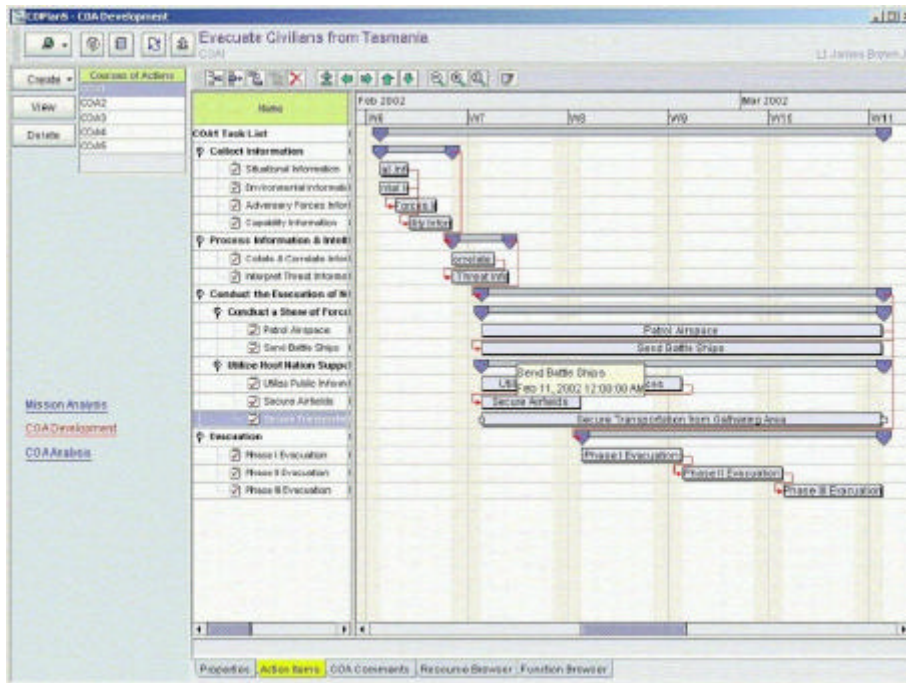


Figure 5 - COPlanS Scheduling Tool



Figure 6 - COPlanS Criteria Management Tool

4.6 Coalition Portal for Imagery and Geospatial Services

The Coalition Portal for Imagery and Geospatial Services (CPIGS) is an Internet-based suite of applications that enables warfighters to search, discover, evaluate and access imagery and geospatial information stored in distributed servers throughout the network. Using the client

interfaces, users generate queries into metadata servers, evaluate the results and either display the results or access the data for use in their own applications.

CPIGS support the following capabilities:

- Managing large & complex databases
- Data cataloging & archiving
- On-line ordering & delivery of data
- Data analysis & data product creation
- Data maintenance & dissemination over wide area networks, especially the Internet
- Linkages to commercial GIS & data analysis packages
- E-Commerce processing
- Customer profile maintenance and configuration
- Processing subscription orders and standing requests

The CPIGS provides a common access point to all clients to access the Geospatial Gateway Services Portal via customized interfaces. This portal can in turn access the Geospatial & Imagery databases from the different Coalition partners. Figure 7 represents a conceptual view of CPIGS.

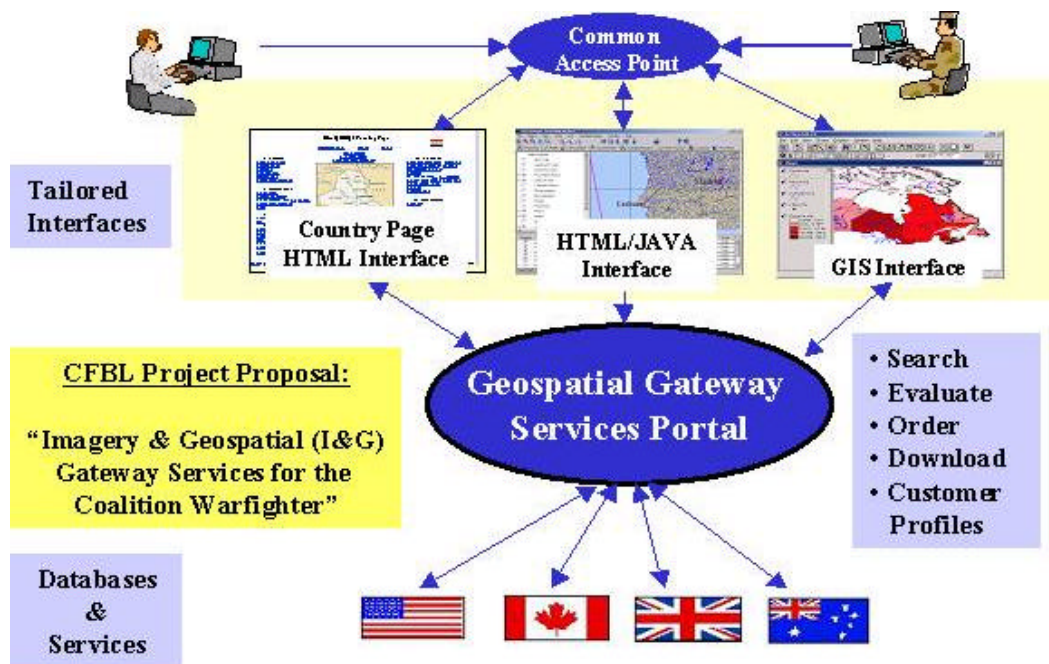


Figure 7 - Coalition Portal for Imagery and Geospatial Information

The current implementation of CPIGS consists of:

- CompuSult's Web Enterprise Suite (Map Manager, Meta Manager, Percipio, Service Registry, Meta Miner)
- Metadata servers located in the United States, Canada, Australia, and United Kingdom
- CubeWerx CubeSTOR data warehouse (CA)
- Bentley Model Image Server (CA)

- Raster Roam (US)
- Vector Roam (US)
- ESRI ARC IMS (US, AS, UK)
- GeoMedia WebMap Enterprise (US)
- Image Product Library (US, UK)

5. Collaboration Benefits

The Coalition CINC 21 has led to tangible benefits to the Coalition partners, including successful coalition experimentations achieved during JWID 01 and JWID 02.

5.1 *Exposure to emerging Allied technology*

C-CINC 21 allowed the four participating allied countries to gain better exposure to the military R&D conducted in each of the countries. It also provided a privileged exposure to emerging allied technology and an opportunity to share software for experimentation. In particular, it gave visibility to the following:

- Enterprise Portal technologies (US CINC 21 Portal, CA/US/AS/UK CPIGS)
- Security (AS Starlight / Tenix, US Multi-Domain Dissemination Server)
- Collaborative tools (US DCTS, US Groove, AS Elvin/Sticker)
- Distributed collaborative planning (UK/AS PlanMan, CA COPlanS, UK GeCoPlan)
- Visualization and display technology (UK Electronic Bird's Table, US Knowledge Wall)
- Architecture / Integration technologies (US Extensible Information System – XIS)

5.2 *Address Technical Interoperability Requirements*

At the heart of the collaboration was the need to address coalition requirements. Although several of the Coalition Operations issues listed in Section 2 still need to be explored further, the collaboration enabled experimentation with new interoperability technologies: Enterprise portal solutions and Network-centric enterprise services. As such, the collaboration addressed:

- Effective coalition information architecture based on heterogeneous systems
- Experimentation with interoperable architecture services
- Development of Ontologies (common understanding)
- Development of Coalition Information Services (COINS)

5.3 *Visibility to the warfighter and military stakeholders*

CINC 21 being an ACTD, the collaboration had a significant warfighter focus and the resources required to conduct a military utility assessment. Because CINC 21 is likely influence the 'next generation GCCS', the collaboration generated considerable interest from military stakeholders in the allied nations. The collaboration also provided the allies with a unique opportunity to showcase their own technologies. Early involvement in a Coalition collaboration of this type creates unique opportunities for the identification of coalition requirements, that could subsequently be addressed in the design and development of future US DoD CCIS.

6. Way Ahead

As the US CINC 21 ACTD will begin its transition phase in October 2002, continued collaboration is being explored as the Allied countries realize the importance of addressing Coalition issues. At least three initiatives are being considered:

6.1 *Secret-High Coalition VPN*

The C-CINC 21 nations have made a commitment to continue their collaboration, using a Virtual Private Network (VPN) as a platform for experimentation. The Secret-High Coalition VPN is an approved Combined Federated Battle Lab (CFBL) experiment that will enable further exploration of the information required to support coalition operations and to develop procedures to share that information within “standing” or “ad hoc” coalitions. To the greatest extent possible, lessons learned will be unclassified and will be shared with the larger CFBL community.

The VPN will provide a Secret enclave on the CFBL network for development and experimentation purposes only, using real data to discover and resolve issues related to legacy systems, protocols and formats, ontologies, database replication and network encryption. It will be deployed to multiple sites within Canada, US, UK and Australia with a number of core services to be provided by the US AITS-JPO: Directory Name Services (DNS), Microsoft (MS) Exchange, Internet Protocol (IP) Call Manager, CuSeeMe Server and Sharepoint Server. The Secret High Coalition VPN will be available to both the scientific and operational communities in the four participating nations and will provide a unique prototyping environment for realistic modelling of operational scenarios.

6.2 *inCOGNITo ACTD*

‘inCOGNITo’ is a promising new ACTD that will be proposed for an October 03 start and is presently in its definition phase. The C-CINC 21 community will further investigate the potential for collaboration with the inCOGNITo ACTD, given that it will explore elements of interest to the four allied nations.

- Enterprise Portal technology
- Cognitive display techniques
- Quality of decisions
- Network-centric enterprise services

6.3 *TTCP C3I TP 2*

The new TTCP Panel: C3I Technical Panel 2 - Command Information Interfaces, may also be a suitable vehicle for a multi-nation collaboration. The objective of this panel is to explore approaches for improving situation understanding and decision-making through the effective application of advanced human information interfacing technologies for future command environments, particularly in support of coalition operations.

7. Facilitating Collaboration

International collaboration brings issues similar to those applicable to military coalition operations (see Section 2). In particular, the establishment and execution of these collaborations are made more complex by organizational differences between the participants. As new collaborations are established, the following issues should be carefully addressed:

- **Programmatic.** Each country has a variety of military programs and significant differences exist between ACTDs and R&D projects. For example, ACTDs have important development and transition prerogatives.
- **Timelines.** Collaboration is made easier if all partners have similar timelines for their respective collaborating programs.
- **Funding / resource.** US funding and resources are significantly bigger than those from the other three allied countries. This has significant impact in terms of managing expectations and establishing an appropriate common program of work and schedule.
- **National C4I baseline.** Although there is some degree of standardization on GCCS variants, the Coalition partners essentially have different C4I baseline systems; a reality that needs to be taken into account when developing solutions.

The C-CINC 21 experience has shown the importance of the following collaboration enablers:

- **Objectives.** Establish clear objectives and program of work.
- **Project Arrangement.** TTCP umbrella can be used to develop a project arrangement to support the collaboration, including the exchange of software.
- **Workshops.** Regular workshops should take place throughout the collaboration in order for the program managers, scientists, engineers and warfighters to share ideas, develop solutions and address experimentation.
- **VTCs and Teleconferences.** Regular video / tele-conferences should take place to maintain continued momentum and obtain successful results.
- **Collaborative Tools.** Once the CFBLNet and/or Secret-High Coalition VPN are deployed on a permanent basis, engineers / scientists should be able to collaborate effectively using distributed collaboration tools.
- **Coalition Web site.** A coalition Web site is a valuable tool for sharing documents and synchronizing activities.

8. Conclusion

Coalition operations will continue to face complex interoperability challenges for the foreseeable future: technological, system, organizational and cultural. A truly interoperable coalition force is extremely difficult and perhaps impossible to achieve, whether in a UN, NATO, or US-led mission. We move closer towards that objective when we establish multi-national collaborations that enable the warfighter to experiment with novel technologies using coalition scenarios. Coalition CINC 21 is an example of what four nations: Canada, UK, US and Australia were able to achieve; bringing new technologies out of multiple labs and integrating them for experimentation in Joint Warrior Interoperability Demonstrations.

From a technological perspective, interoperability strategies are moving away ‘standardization’ on common applications and systems (e.g. common use of GCCS / DII COE, moving towards enterprise portals and network-centric enterprise services. The C-CINC 21 JWID 02 experiments were designed to validate a number of these novel solutions

- C-CINC 21 demonstrated a successful integration of heterogeneous technologies, such as Enterprise portal, XML queries, web services, and distributed collaboration tools.
- C-CINC 21 also provided a coalition mechanism for data and information dissemination to support the decision-making process.
- Coalition (US) and National COINS (COalition INformation Services) provided federated query and retrieval services to enable information sharing across the Coalition.
- The C2 Portal (US) provided an integrated access to Coalition information and DCTS collaboration web parts were effectively integrated within the CINC 21 portal.
- Elvin Sticker (AS) proved to be an extremely effective and persistent notification service across the Coalition.
- Using tools contributed by the four participating nations, C-CINC 21 provided warfighters enhanced capability to conduct distributed collaborative planning and to support decision support for joint and combined operations.
- C-CINC 21 demonstrated the use of a Coalition Portal to enable warfighters to efficiently access imagery and geospatial information stored in distributed servers throughout the Coalition network.

The Coalition CINC 21 collaboration was an extremely challenging but tremendously rewarding initiative. It required a significant effort in terms of coordination, time and resources; not unlike the challenges faced by military operators in any coalition operations. The lessons learned will be drawn upon to enhance future multi-nation collaborations, as coalition partners continue to develop solutions to the interoperability challenges associated with coalition operations.

9. Acknowledgements

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