NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

FIELD LEVEL INFORMATION COLLABORATION DURING COMPLEX HUMANITARIAN EMERGENCIES AND PEACE OPERATIONS

by

Hezekiah Barge, Jr.
Mark S. Davis
John T. Schwent, Jr.

June 2003

Co-Advisors: Alex Bordetsky
Glenn Cook

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** June 2003	**3. REPORT TYPE AND DATES COVERED** Master's Thesis
4. TITLE AND SUBTITLE Field Level Information Collaboration During Complex Humanitarian Emergencies and Peace Operations.		**5. FUNDING NUMBERS**
6. AUTHOR (S) Hezekiah Barge, Jr., Mark S. Davis, John T. Schwent, Jr.		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000		**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)		**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the authors and do not reflect the official policy or position of the U.S. Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited	**12b. DISTRIBUTION CODE**

13. ABSTRACT *(maximum 200 words)*

Multinational humanitarian and military efforts such as those seen in Somalia, Kosovo and Afghanistan are known as Complex Humanitarian Emergencies. These types of emergencies are complex and difficult to operate in because they contain political, military and humanitarian considerations. The various actors responding to a CHE can be divided into two distinct groups – military and civilian. Each of these groups needs the other to effectively respond to the crisis. Thus communication, collaboration and coordination are critical. Technology can play a significant role to enable information sharing between the various participants during CHEs. This thesis documents the continued development of a collaborative, Information Technology-based, operation support system designed to facilitate information sharing at the field/tactical level during CHE and Peace Operations. The operational support system was designed in the context of a Tactical Humanitarian Relief Habitat and will undergo a technical evaluation in a simulated CHE/Peace Operations environment. The end state of our research will result in recommendations for continued development of a habitat designed for utilization in the Civil Military Operations Center of a CHE or Peace Operation.

14. SUBJECT TERMS Peer-to-Peer Network, Client-Server Network, Wireless Network, Collaborative Environment, Collaborative Tools, Multi-Agent Architecture, Complex Humanitarian Emergency, Knowledge Portal, Information Sharing, Coordination, Non-Governmental Organizations, International Organizations, Relief Operations, Peace Operations, Peace Keeping			**15. NUMBER OF PAGES** 185
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

NSN 7540-01-280-5500 **Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std. 239-18**

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

FIELD LEVEL INFORMATION COLLABORATION DURING COMPLEX HUMANITARIAN EMERGENCIES AND PEACE OPERATIONS

Hezekiah Barge, Jr.
Major, United States Marine Corps
B.S., Florida A&M University, 1991

Mark S. Davis
Captain, United States Marine Corps
B.A., University of California San Diego, 1995

John T. Schwent, Jr.
Captain, United States Marine Corps
B.A., University of Memphis, 1996
M.B.A., Webster University, 2001

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
June 2003

Authors: Hezekiah Barge, Jr.

Mark S. Davis

John T. Schwent, Jr.

Approved by: Alex Bordetsky
Thesis Co-Advisor

Glenn Cook
Thesis Co-Advisor

Dan C. Boger
Chairman, Department of Information Sciences

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

Multinational humanitarian and military efforts such as those seen in Somalia, Kosovo and Afghanistan are known as Complex Humanitarian Emergencies. These types of emergencies are complex and difficult to operate in because they contain political, military and humanitarian considerations. The various actors responding to a CHE can be divided into two distinct groups – military and civilian. Each of these groups needs the other to effectively respond to the crisis. Thus communication, collaboration and coordination are critical. Technology can play a significant role to enable information sharing between the various participants during CHEs. This thesis documents the continued development of a collaborative, Information Technology-based, operation support system designed to facilitate information sharing at the field/tactical level during CHE and Peace Operations. The operational support system was designed in the context of a Tactical Humanitarian Relief Habitat and will undergo a technical evaluation in a simulated CHE/Peace Operations environment. The end state of our research will result in recommendations for continued development of the habitat designed to be utilized in the Civil Military Operations Center of a CHE or Peace Operation.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I. INTRODUCTION 1
A. AREA OF RESEARCH 1
B. BACKGROUND 1
C. THESIS FOCUS 3
D. STATEMENT OF PROBLEM 4
1. Failing to Share Information 5
2. Organizational and Cultural Divide 6
3. Language Barriers 10
4. Competing Priorities and Perceptions 11
5. Professional and Cultural Norms 12
6. Lack of Trust and Stereotypes 13
E. METHODOLOGY 14
F. ORGANIZATION 15

II. RELATED WORKS 17
A. INTRODUCTION 17
B. ORGANIZATIONAL SOLUTIONS: MILITARY 17
1. The Humanitarian Assistance Coordination Center (HACC) 17
2. The Humanitarian Operations Center (HOC) 18
3. The Civil Military Operations Center (CMOC) 19
4. NATO Civil-Military Cooperation Centers (CIMIC) 22
C. ORGANIZATIONAL SOLUTIONS: UN PERSPECTIVE 24
1. On-Site Operations Coordination Center (OSOCC) 24
2. Humanitarian (Community) Information Center (CIC/HIC) 25
D. TECHNOLOGY SOLUTIONS: OVERVIEW 26
E. TECHNOLOGY INITIATIVES: MILITARY 28
1. The CIMILink Project 28
a. Background *28*
b. Functionality *30*
2. NEO Tracking System 2000 32
a. Background *32*
b. Functionality *33*
3. Virtual Information Center (VIC) 36
a. Background *36*
b. Functionality *37*
4. The Peace Operations Support Tool (POST) 39
a. Background *39*
b. Functionality *40*

F. **TECHNOLOGY SOLUTIONS: CIVILIAN** 42
1. **Relief Web** 42
a. ***Background*** *42*
b. ***Functionality*** *44*
2. **Collaborative Techniques for Coalition Teams (CT2)** 47
a. ***Background*** *47*
b. ***Functionality*** *47*
3. **The Virtual Operations Coordination Center – VOCC** 49
a. ***Background*** *49*
b. ***Functionality*** *51*
G. **SUMMARY** 52

III. **METHODOLOGY** 53
A. **INTRODUCTION** 53
B. **REQUIREMENTS** 53
C. **INFORMATION REQUIREMENTS** 54
1. **Conference on Information Sharing** 54
2. **Interviews from Bosnia** 55
a. ***Problem Statement*** *56*
b. ***Information Requirements*** *56*
c. ***Technical Issues*** *58*
D. **SYSTEM REQUIREMENTS** 59
E. **MODEL DEVELOPMENT** 62
1. **Technological Subsystem** 63
2. **Social/Political Subsystem** 63
3. **Structural Subsystem** 64
4. **Goals and Values Subsystem** 64
5. **Leadership & Management Subsystem** 64
F. **PARTNERSHIP DEVELOPMENT** 64

IV. **ENVIRONMENT** 67
A. **INTRODUCTION** 67
B. **DEFINITION** 67
C. **ORGANIZATIONAL INVOLVEMENT** 68
D. **DIFFERING GOALS** 69
E. **ORGANIZATIONAL STRUCTURES AND CULTURES** 71
1. **Military** 71
2. **International Organizations (IO)** 72
3. **Non-Governmental Organizations (NGO)** 72
F. **CURRENT STATE VERSUS DESIRED STATE** 73
G. **PROBLEM DEFINITION** 74
1. **Military Intervention** 75
2. **System Archetype** 76
3. **Proposed Solution** 77

H. NETWORK-CENTRIC INFRASTRUCTURE FOR COMMAND, CONTROL AND INTELLIGENCE (NICCI) HABITAT CORE CAPABILITIES 79
I. HABITAT COMPONENTS 84
1. Habitat Nodes and Sensors 88
2. Habitat Taxonomy 91
3. Networking Platform 94
J. AGENT TECHNOLOGY PLATFORM 94

V. DEVELOPMENT OF A TECHNICAL EVALUATION 97
A. INTRODUCTION 97
B. COMMUNICATION ARCHITECTURE 98
1. Habitat Components 100
a. Virtual Civil-Military Operations Center (VCMOC) 100
b. Relief Operations Coordination Center (ROCC) 102
c. Situational Awareness Tool 103
d. Collaborative Tool 107
2. NASA Advanced Communications Technology Satellite (ACTS) 110
a. Background 110
b. NASA ACTS Program 112
c. Ground Station Parameters 114
d. Ground Station Architecture 114
3. Network Management 114
a. Network Operations Center 115
C. TECHNICAL EVALUATION OF HABITAT FUNCTIONALITY 119
1. Scope of Evaluation 119
a. Evaluation Approach 119
b. Evaluation Objectives 120
2. Schedule of Events 121
3. Evaluation Scenarios 123

VI. TECHNICAL EVALUATION RESULTS AND RECOMMENDATIONS FOR FURTHER RESEARCH 125
A. RESULTS OF TECHNICAL EVALUATION 125
1. NASA ACTS System 125
2. Technical Evaluation Results of Scenarios 128
B. FUTURE RESEARCH 145
1. Future ROCC/VCMOC Development 146
a. Personalization 146
b. Operations 147
c. Organizations 147
d. Displaced Persons 147
e. Points of Contact 148
f. Camp Management 148
g. Requirements 149

2. General Development 149
a. Database Verification 149
b. Satellite Communication 150
c. Modularity 151
C. THESIS CONCLUSION 153

APPENDIX A. SATELLITE ACQUISITION INSTRUCTIONS STANDARD OPERATING PROCEDURES 155

APPENDIX B. TECHNICAL EVALUATION SCENARIO 1 159

APPENDIX C. TECHNICAL EVALUATION SCENARIO 2 161

LIST OF REFERENCES 163

INITIAL DISTRIBUTION LIST 167

LIST OF FIGURES

Figure 2.1. CHE Virtual Information Tools....................27
Figure 2.2. CIMILink Project.................................31
Figure 2.3. NTS 2000 System..................................35
Figure 2.4. Examples of the VIC Functionality................38
Figure 2.5. Peace Operations Support Tool....................42
Figure 2.6. Relief Web.......................................46
Figure 2.7. CT2..50
Figure 2.8. Virtual Operations Coordination Center..........52
Figure 3.1 Kast & Rosenzweig.................................63
Figure 4.1. Archetype Model..................................76
Figure 5.1. Basic CHE Communication Architecture.............99
Figure 5.2. Groove Home Page................................108
Figure 5.3. Groove User Workspace...........................109
Figure 5.4. View of All SSIDs with MAC Address..............118
Figure 6.1. Chart of Frame Speed by Channel.................131
Figure 6.2. GPS Poster Program..............................132
Figure 6.3. CHE SA Tool Display within Groove...............133
Figure 6.4. CHE SA Tool Display with Message Line...........134
Figure 6.5. Alert Information on Posted Icon................135
Figure 6.6. Habitat Member Profile..........................136
Figure 6.7. Habitat Member Profile with Embedded MS NetMeeting Application..........................137
Figure 6.8. Displaced Person Alert..........................138
Figure 6.9. Node Listing 2 with Detail Information by Node.141
Figure 6.10. Node Listing 3 with Detail Information by Node.141
Figure 6.11. SSID Listing...................................142
Figure 6.12. Channel Listing................................142
Figure 6.13. Performance Display............................143
Figure 6.14. Chart of Frame Types...........................143
Figure 6.15. Chart of Frame Speed by Node...................144
Figure 6.16. Diagnostic of a Node...........................144

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1.1. NGO and Military Cultures Contrasted............10
Table 2.1. Relief Web Resources.............................45

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGEMENTS

We wish to thank our advisors, Dr. Alex Bordetsky and LCDR Glenn Cook for sharing their vision, keen insight and passion for this field of study. Their guidance and direction was critical and their zeal was contagious.

We would also like to recognize Eugene Bourakov. His ability to turn concepts into tangible products contributed immensely to our ability to continue the second phase of this project.

Finally, as a group we are sincerely grateful to the academics, humanitarians and military personnel whose unabashed input determined the functionality of the final product.

Major Hezekiah Barge Jr.:

First, I want to give all the honor and praise to God. I would like to take this opportunity to thank my family for their continued support of my career and interests, particularly for their support of the time associated with this project. My wife, Dawn and my kids (Zeke, Hannah, Faith, Samuel, Eli) are critical to any success that I have. I would also like to thank my teammates and my advisors for their work and guidance. Their efforts have been invaluable.

Captain Mark S. Davis:

Foremost, my wholehearted thanks goes to Jesus Christ, my savior and Lord, who has made life possible for me.

Thank you to my son, Keegan, who has truly been a blessing and an example for any young man to follow. He provided me with continued inspiration and motivation for success. To my daughter, Krystal, I thank for providing a balance in the family. She truly possesses a great heart for mercy and compassion. My wife, Diana, I thank for all the support that she provided in all areas of our family. She kept the home front in a state of organization when all things could have easily been otherwise. Without her, my career successes are hollow. I would like to thank my thesis partners for their hard work, patience and dedication throughout this project. Thank you for putting up with my 'Spurring.'

Captain John T. Schwent Jr.:

My most sincere expression of gratitude is to my Lord and Savior, Jesus Christ. I am eternally thankful for all he's done in my life and the opportunities that have made this a reality.

I am so thankful for the wonderful family God has blessed me with and I would also like to express my sincere appreciation to you. To my lovely bride Melissa, I want to thank you for your love, patience and wisdom in support of my career. Also to my three wonderful children (Jernigan, Kristen, and Morgan), I give thanks for your understanding and support when I could not always be there for you. You are a constant source of joy and the reasons why I do what I do. Finally, I want to give thanks to my thesis partners for their tireless efforts and Christian fellowship throughout this process. May glory be to GOD!

I. INTRODUCTION

A. AREA OF RESEARCH

The purpose of this study is to further explore information requirements and technology solutions that would enable information sharing and collaboration at the field/tactical level during Complex Humanitarian Emergencies (CHE) and Peace Operations.

Based on a favorable proof of concept, step two develops the information architecture and its requirements. Field experiments are conducted to test the interface and usability of the system platform using decision support systems and collaborative technologies.

B. BACKGROUND

This study is a continuation of the thesis, "Communication During Complex Humanitarian Emergencies: Using Technology to Bridge the Gap" (1). The purpose of the previous research project was to explore the use of technology to enhance collaboration and coordination among participants in a Complex Humanitarian Emergency. To this end, a web server application was developed to serve as a proof of concept and test bed for current off-the-shelf technologies. The authors detailed the process of the project by providing a background of the problems and difficulties associated with collaboration and coordination among the organizations participating in a CHE. Additionally, the authors addressed the sharing of information, technical requirements and the design solution of a proof-of-concept for the focus and scale of their thesis. The previous thesis provides an overview of past and current tools to aid participants of a CHE, group structures and decision-making models, information collection and dissemination, and technical capabilities which have the potential to enhance the coordination and information flow among culturally disparate and geographically separated groups.

The technical solution that the previous thesis group developed in the form of a proof-of-concept application is titled the Relief Operations Coordination Center (ROCC). It is a dynamic HTML-based application that can be used terrestrially or wirelessly and is targeted at field-level personnel. Its core functionality is a web-enabled relational database that networked users can use to easily access and view information, present it in a number of different formats, and update it as required. The ROCC database and the web pages that interface with it are held on a server to allow greater access and are passed to the client via normal Internet protocols. The web interface provides a common access point and one that is readily recognizable to many users and does not require much training, equipment or software to employ.

The "ROCC" thesis team envisioned the applicability of this system to be used by civilian and military actors with the functionality required at the tactical/field level of operations during the initial chaotic stages of a CHE. System requirements stress that the ROCC must be highly mobile, rapidly deployable, and able to interface with a larger more robust system once the CHE reaches a mature stage. The previous thesis established the proof of concept. The first phase of their thesis defines the problems associated with information sharing during CHEs, develops user requirements, examines alternative technological solutions and finally establishes a software-based proof of concept.

C. THESIS FOCUS

The ROCC provides knowledge management capability but it is only one part of the total solution. In order to be most effective, it must be combined and integrated with collaborative capabilities. When you combine the capabilities of the ROCC and a collaborative tool, a shared situational awareness environment is created. This allows users of the ROCC to have knowledge of other users working in the application. Thus creating an environment in which users can self organize to accomplish task without a central governing authority – the essence of knowledge management. This thesis will focus on continued development of a collaborative, Information Technology-based, operational support system designed to facilitate information sharing at the field/tactical level during CHE and Peace Operations. This will not be an in depth study on the business practices or methodologies particular to IOs or NGOs. The bulk of this thesis will look at capitalizing on existing technology and applying it to the problems that exits regarding the sharing of information between organizations involved in the CHE or Peace Operation. This project will also design and conduct a test of some of the system functionalities in a simulated CHE/Peace Operations environment. The end state of our research will result in recommendations for continued development of a system designed to be utilized in the Civil Military Operations Center of a CHE or Peace Operation

D. STATEMENT OF PROBLEM

Within the last decade the world community has responded to a number of complicated, large-scale human tragedies. Following the Persian Gulf War, over 30 nations and 21,000 troops participated in Operation Provide Comfort. One year later in the Horn of Africa, Operation Restore Hope brought together more than 10,000 coalition forces from 24 nations in an effort to help relieve the suffering from famine in war-torn Somalia. In 1999, hundreds of relief agencies and various militaries under NATO’s command responded to the needs of refugees in Kosovo. Today, literally hundreds of groups and organizations are assisting the people of Afghanistan to recover from serious drought and warfare. All of these multi-participant efforts are in response to what have become known as Complex Humanitarian Emergencies.

In the post-Cold War era, the term Complex Humanitarian Emergency or CHE has been coined to describe man-made, or man-exacerbated disasters. CHEs describe today's violent conflicts often involving intra-state struggles that have regional implications. These types of emergencies can result in massive numbers of refugees and internally displaced persons, gross violations of human rights and large-scale disruption of people's livelihoods. Complex Humanitarian Emergencies also can include an international response that extends beyond the mandate or capacity of any one agency or nation and requires a military element for purposes of civilian safety, relief security or logistical expertise. (2) The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) currently documents more than 22 on-going Complex Humanitarian Emergencies around the globe. (3)

Because of their extreme volatility and complexity, CHEs are very difficult to respond to and organize. Unlike natural disasters such as earthquakes or floods, the human component during CHEs is usually layered with political, military, religious, ideological and ethnic considerations. For example, during the earliest stages, basic relief in the form of food, water and shelter are a priority. Yet the distribution of these necessities can be hampered because of the lack of security and infrastructure (4).

Those who respond to CHEs in an effort to alleviate human suffering must overcome a number of difficult issues. One of the most important is access and the ability to share critical information. With so many organizations and agencies operating simultaneously in theater, each with their own organizational agendas, priorities and structure, it is difficult to keep information accessible and transparent, especially at the field level. Communication among participants often has led to shortfalls, friction and redundancy of effort (5).

1. Failing to Share Information

Failure to share information among CHE participants can be attributed to many factors: an organizational and cultural divide; language differences; competing priorities and perceptions; different profession and cultural norms; and the lack of common horizontal and inter-organizational network support. All of these factors can lead to a lack of trust and stereotyping among the participants.

2. Organizational and Cultural Divide

To understand information sharing during CHEs it is important to understand the people who use the information. During a Complex Humanitarian Emergency, the actors can be generally separated into two broad categories – civilian and military participants. These two groups are distinct in the way they think, plan and operate. However, they both play a key role and in some ways are mutually dependent during a CHE.

The civilian component is largely composed of humanitarian relief organizations or HROs. During a CHE, HROs from all over the world can take part. In Afghanistan for example, the Afghanistan Information Management Service's (AIMS) Directory of Organizations Working For Afghanistan has over twenty-six pages listing various HROs currently providing some sort of assistance. (6)

The first to respond can be local or host-nation agencies. These agencies provide on-site expertise and natural familiarity with the affected region. Often the region affected will not have the governmental or social infrastructure to provide the necessary relief making the relief effort even more complicated.

Other responding groups take the form of International Organizations (IOs). These are organizations with international mandates and global influence such as the UN and the International Committee of the Red Cross. They provide a global perspective and international awareness when they respond to a regional CHE. (4), (7)

Non-Governmental Organizations or NGOs are another pivotal group of humanitarian agencies that bring needed assistance and expertise to the region. NGOs are non-profit organizations that are not accountable to governments or profit-making enterprises. However, they work with governments and serve as channels for government assistance during relief efforts. (IBID)

All of the above organizations can enter into a region in an effort to comply with resolutions or fulfill humanitarian mandates. They form a complex patchwork of different efforts working towards a common goal - the alleviation of human suffering.

HROs are generally organized to operate effectively in austere environments. Because of their unique mandates, humanitarian relief organizations tend to be autonomous and decentralized. Their operational focus is at the field level where decisions and assessments are made often under severe conditions. These organizations value the principles of humanity, impartiality and neutrality. (2) They believe that human suffering should be relieved without regard to nationality, political or ideological beliefs, race, religion, sex, or ethnicity. They believe they must remain impartial as best they can in order to be effective.

Neutrality plays a principle role. It requires the provision of humanitarian relief without bias toward or against one or more of the parties involved in the controversy that has given rise to the Complex Humanitarian Emergency. To this end, humanitarian agencies avoid the perception of taking sides in a conflict. This often means purposely distancing themselves from the second major group – the military.

From a military perspective, participation in Complex Humanitarian Emergencies falls under the category of Military Operations Other Than War (MOOTW). The Joint Doctrine for Military Operations Other Than War provides a general definition for MOOTW as follows: "MOOTW encompass a broad range of military operations and support a variety of purposes: supporting national objectives, deterring war, returning to a state of peace, promoting peace, keeping day-to-day tensions between nations below the threshold of armed conflict, maintaining US influence in foreign lands, and supporting US civil authorities consistent with applicable law. Support of these objectives is achieved by providing military forces and resources to accomplish a wide range of missions other than warfighting." (8)

During CHEs, military forces can fulfill a variety of Military Operations Other then War that include Peacekeeping, Peace-enforcement and Humanitarian Assistance. The general focus of this research will be on those issues associated with Humanitarian Assistance operations. Humanitarian Assistance (HA) is different in nature from Peace Operations. US Military forces execute HA missions when directed by cognizant legal authority. By definition HA includes programs conducted to relieve or reduce the results of natural or man-made disasters or other endemic conditions such as human pain, disease, hunger, or privation that might present a threat to life or result in great damage or loss of property. (4)

As illustrated in Somalia and the Former Republic of Yugoslavia, HA can be conducted simultaneously with Peace Operations. In the case of Kosovo's Albanian refugees, HA was conducted at the same time NATO was executing Combat

Operations against the Serbs. It is important to make the distinction that HA operations are designed to support the host nation or agencies that might have the primary focus of providing humanitarian assistance. The military assumes a supporting role of providing security and stability to enable humanitarian assistance.

Complex Humanitarian Emergencies are more likely to fall under multinational HA operations. During these types of operations the military will be working within the structure of an alliance or coalition and operate within a Multinational Task Force. Supporting US forces will structure themselves as a Joint Task Force (JTF). This task force will be made up of different units to include combat units, service support units and specialized units such as Civil Affairs. (IBID)

When one looks at these two groups of people, considering their organizational mandates and cultures, it becomes easy to see how information sharing can become difficult during CHEs. In general, the humanitarian community is made up of professionals who are motivated and results-oriented. People who are attracted to humanitarian work are often single-minded with a strong moral imperative. (9) The field worker in particular is accustomed to functioning under adverse conditions. They are adept last minute planners, able to execute on the fly and more prone to function through consensus rather than tasking from higher headquarters. (10) Humanitarians operate with a "do no harm" attitude looking at all facets of relief from aid dependence to prevention. The average service person participating in a Humanitarian Assistance Operation can be described as task and mission driven.

Military participants understand the importance of hierarchy within the organization and place a strong emphasis on advance planning and systematic execution.

In comparison, when tasked with HA Operations, military commanders consider the objectives and the principles of unity of effort, perseverance, security, restraint and legitimacy. These provide a general guideline to help the Joint Task Force Commander maximize the effectiveness of force employment in an effort to provide mission focus and prevent mission creep. (8) From a military perspective, a high degree of importance is placed on the protection of forces and operational security.

The following table produced by the Center for Disaster Management and Humanitarian Assistance illustrates the differences between the military and NGO cultures: (11)

The NGO and Military Cultures Contrasted	
NGO	**Military**
Independent	Highly Disciplined
Decentralized Authority	Hierarchical Command
On the job Training	Extensive Branch Training
Few Field Manuals	Doctrinal Publications
Long-term Perspective	“End State” Approach
Field Experience	Combat Experience

Table 1.1. NGO and Military Cultures Contrasted

3. Language Barriers

Another obstacle to information sharing during multinational CHEs is language. This may not only mean French as opposed to English, but also the vernacular used by different organizations. What a humanitarian might call a “response” a service person would call an “operation”. The humanitarian responds through C3A - Cooperation, Coordination Consensus and Assessment. The Military conducts an operation using C3I - Command, Control, Communications and Intelligence. Even the use of the word collaborator can mean two vary different things depending on your organizational mental model. Humanitarians view collaboration as a good thing, while the military uses the word collaborator with negative connotations. (12)

Barriers are also formed because of the different cultures and operating procedures within the various agencies and military organizations. For example the U.S. military may do things vary differently than a Canadian force, and World Vision may have operating procedures that differ from Irish Catholic Relief.

4. Competing Priorities and Perceptions

As complex humanitarian participants enter into the region they each bring different priorities and perceptions. In a CHE aligning mission and goals becomes more challenging with so many different partners. Each participant can have different approaches and operational points of view. The military has a mission mind-set that usually considers security at the top of their priority list, while humanitarians tend to be focused on providing relief. Thus, complex emergencies often become mired in a morass of competing priorities and plans.

Effectively establishing priorities is how missions are accomplished. This is especially true during CHEs. Each organization struggles to fulfill its mandate or mission and the pressures can sometimes be overwhelming. NGOs naturally set their priorities based on donor support. Donor support is usually limited which in turn can create competition among NGOs. In order to demonstrate effectiveness and ensure the necessary flow of financial support, NGOS jockey for recognition and resources. These competitive pressures often inhibit information sharing among NGOs and other entities that are viewed as a threat to mission viability and success. (10)

The military arrives with its own set of priorities and interests. Those priorities reflect what is important to the Joint Task Force Commander in order to ensure mission success. Typically, the military will be concerned with establishing priorities, measures of effectiveness (MOEs) and developing an exit strategy for each mission. The need to share information is contingent upon the priorities established and the requirements of the overall effort. Ultimately, from a military perspective, information sharing depends on an entity's "need to know." (IBID)

5. Professional and Cultural Norms

When it comes to sharing information, professional and cultural barriers are issues that arise particularly in the civilian-military relationship. As mentioned above the two cultures are made up of people with very different personal motives, professional backgrounds, and organizational structures. The NGO views information sharing with the military as a violation of its nonpartisan/nonaligned status. Humanitarians want to protect their neutrality. In the humanitarian’s view it is often the military forces that have had a hand in creating the CHE in the first place. (10) Northern Iraq and Kosovo are examples. NGOs also view the military as quick to take information yet slow to give it. They see the military collect and then unnecessarily classify data shared by NGOs, thus preventing free distribution to all involved at the field level. (2)

On the other hand, the military is concerned with security and force protection. The challenges they face during a CHE involve developing force structure, defining rules of engagement and interpreting national and international law. They are wary of information shared by NGOs for fear that it is purposely inflated or twisted to support their particular mandate or agenda. The information provided by the NGO might be presented in a way that dramatizes a given situation in an effort to rally donor support. The information can also be difficult to substantiate because it is not generated within the military intelligence system.

6. Lack of Trust and Stereotypes

As a result of the above-mentioned difficulties, a lack of trust can develop among CHE participants. Lack of trust in turn can lead to stereotyping. NGOs sometimes perceive the military as responsible for the destruction of homes, crops and livestock and guilty of serious offenses such as rape, torture, genocide and violations of human rights. And when the conflict does end, they see the military leaving behind unexploded ordnance and landmines that cause long-term human damage.

From the military side, NGOs are often viewed as difficult to work with during CHEs. They want support yet they demand autonomy. NGOs will not respond to orders given by the military even if their personal safety is at stake. The military see NGOs as resistant to the changes the military brings and unwilling to collaborate in support of military intelligence. NGOs on one hand will openly criticize the military, while at the same time request logistics, communications and transportation support from those same military forces. (10, 11)

Based on these views of the other, neither group is able to appreciate that each one provides a vital component for mission success. The humanitarian has local experience and provides professional expertise. He is independent and able to respond quickly. The military provides security, logistics and opens up a protected space for humanitarian assistance to occur. Neither the military nor the civilian can function effectively without the other. They are interdependent during a CHE, making information sharing essential for mission accomplishment.

E. METHODOLOGY

The first stage of this thesis will be to acquire an understanding of the proof of concept developed by our predecessors, Major Todd Ford, Major Jim Hogan and Major Mike Perry.(1) They conducted a thorough analysis of military Peace Operations and Humanitarian Assistance Operations. Furthermore, they conducted a study of the technology barriers that exist in the CHE environment. We will use the results of their research to assist in determining information requirements for both civilian and military participants. The second stage will focus on establishing partnerships with prospective sponsors. These partnerships will help to further future development, assist in testing of a prototype in a CHE environment, and provide financial assistance for continued research. The third stage of this thesis will be to develop a small-scale prototype that will validate the information requirements.

This prototype will focus on web-based technologies, agent architecture utilizing the DARPA CoAbs grid and wireless networking in an austere environment. Finally, we will test some of the functionalities of our proposed habitat.

F. ORGANIZATION

Chapter I provides background information on Complex Humanitarian Emergencies. We examine the various reasons why information sharing during Complex Humanitarian Emergencies is difficult and state the scope and ultimate goals for this thesis. Chapter II provides a review of the current related organizational and technological prototypes that are in development. Chapter III generates the information and system requirements for the prototype. Chapter IV describes the environment within which the final product will be used. Chapter V outlines the structure of the test bed. Finally, chapter VI concludes our thesis by summarizing the research and makes recommendations for further development.

THIS PAGE INTENTIONALLY LEFT BLANK

II. RELATED WORKS

A. INTRODUCTION

This chapter reviews two on going general solutions to the problem of information sharing and coordination during CHEs. The first addresses the organizational arrangements that have been developed in recent years to improve communications among participating organizations. We briefly review those developed by the military and the UN, indicating some of their successes and limitations. The second general solution focuses on other developments in information technology that may facilitate information sharing during CHEs and is deserving of some attention.

B. ORGANIZATIONAL SOLUTIONS: MILITARY

Organizational solutions represent a range of coordination mechanisms that have been developed by various participating entities in a CHE. The list below is not meant to be exhaustive, but it identifies the major arrangements that have been devised by military organizations to overcome information-sharing difficulties.

1. The Humanitarian Assistance Coordination Center (HACC)

The HACC plays an important role during the early stages of a large humanitarian crisis as seen in a Complex Humanitarian Emergency. A US combatant's command can organize a HACC in order to open communication lines among other US government agencies, NGOs and IOs. According to Joint Doctrine, the HACC is considered to be a planning and coordinating body that defines the strategy and develops an early assessment of a Humanitarian Operation. (13) However, in Operation Uphold Democracy, the HACC functioned more as a clearinghouse for organizations requesting assistance (25), normally done by the Humanitarian Operations Center or the Civil Military Coordination Center.

2. The Humanitarian Operations Center (HOC)

According to joint doctrine, "the HOC is primarily an international and interagency policy making and coordinating body." (13) The HOC is not a command and control agency. The primary goal for the HOC is to coordinate the overall relief strategy, to focus resources and maximize the combined effort of all agencies involved. A large part of what the HOC strives to do is to focus the combined efforts of all involved by identifying and prioritizing humanitarian logistics and support requirements.

The HOC can be established by one of three entities: The host nation government, the UN, or if a US-led unilateral operation, the Office of Foreign Disaster Assistance (OFDA). The Host Nation government can establish a HOC in an effort to maximize the coordination of the humanitarian aid effort. If the host nation government is functioning, then the HOC will most likely operate closely with some sort of Emergency Operations Center. In essence, the HOC provides a host nation with a way to coordinate and prioritize assistance from international agencies and militaries.

In many CHEs, the government of the affected region is no longer functioning. In these cases the UN will take responsibility to establish a HOC. NGOs, IOs and military representatives will use the HOC as a multi-agency organizational design tool to ensure coordination and a unified effort. An example of an UN-established HOC can be seen in Somalia during Operation Restore Hope. The southern portion of Somalia was divided into eight separate regions called Humanitarian Relief Sectors. A HOC was established within each sector to facilitate coordination. (14)

Although there is no formal membership for the HOC, it generally consists of representatives from critical agencies and organizations involved in the relief effort. They can include the host nation, NGOs, International Organizations, representatives from the US Embassy or consulate and the UN.

In order to coordinate military support for the various humanitarian agencies, the HOC maintains close connections with another critical agency during CHEs known as the Civilian Military Operations Center.

3. The Civil Military Operations Center (CMOC)

The CMOC functions more as an executive agency during CHEs. It performs the liaison and coordination between the military support structure, NGOs and PVOs, other agencies, and local authorities. (15) This coordination is vital for the simple fact that NGOs and PVOs have valid missions and concerns, which at many times may complicate the mission of US forces. The CMOC is the place where things get done. It is the day-to-day nerve center and critical point of coordination for civilian and military agencies. The interaction within the CMOC establishes the tone for the operation. To quote Roy Williams, former Director of OFDA, Bureau for Humanitarian Response, USAID, "the CMOC is not a structure, but a relationship." That relationship between the military and civilian component is key to mission success.

The JTF commander can establish a CMOC in an effort to coordinate Humanitarian Assistance needs and match them with military support capabilities. These needs can range from transportation request to providing security for supply convoys. Joint Publication 3-08 makes the following statement on the establishment of CMOCs: "A commander at any echelon may establish a CMOC to facilitate coordination with other agencies, departments, organizations, and the host nation. In fact, more than one CMOC may be established in an AOR or JOA, and each is task-organized based on the mission." (16)

In order to better understand the dynamics of a CMOC, we need to look at who operates within it. From the military perspective, the membership of a CMOC should consist of individuals with the authority to act on the needs of the NGO community. Membership outside the Joint Task Force consists of resident experts and knowledgeable agency representatives. The following is a list of possible CMOC participants:

Military

- Operations personnel
- Civil Affairs
- Communications
- Medical
- HOST Nation or participating forces

Civilian

- Host Country or local government representatives
- Representatives from NGOs and IOs
- Liaisons from service and functional components such as airfields and ports
- USAID/OFDA and DART representation
- Department of State and other US government agencies

Although there is a suggested organization and membership highlighted within Joint Doctrine, it is important to remember the CMOC is a flexible and mission specific concept. "The CMOC can be anywhere from a tent to a tree, a place to meet all the operators who have power to make decisions." (10) In other words, no two CMOCs will necessarily look or function exactly the same. This is a natural consequence given the dynamic nature of CHEs. What was needed during relief operations in Somalia might not be needed in Afghanistan or Iraq.

The CMOC seems to function more like a political committee than a structured command system. The military is not in charge. There is no power to direct or enforce. The CMOC strives to develop consensus, ensure focus of effort and maximize available assets through situational awareness. Constituted in this way, the CMOC becomes the primary tactical/field level communication, coordination and information sharing system. The information push-and-pull requirements are monumental and often conducted under austere conditions. The following list of CMOC functions taken from Joint Publication 3-57 highlights the wide range of information requirements:

- Providing nonmilitary agencies with a focal point for activities and matters that are civilian related
- Coordinating relief efforts with US and/or multinational commands, United Nations, host nation, and other nonmilitary agencies
- Providing interface with the US Information Service, US Agency for International Development (USAID), and the Country Team
- Assisting in the transfer of operational responsibility to nonmilitary agencies
- Facilitating and coordinating activities of the joint force, other on-scene agencies, and higher echelons in the military chain of command
- Receiving, validating, coordinating, and monitoring requests from humanitarian organizations for routine and emergency military support
- Coordinating the response to requests for military support with Service components
- Coordinating requests to nonmilitary agencies for their support
- Coordinating with Disaster Assistance Response Team deployed by USAID/Office of Foreign Disaster Assistance
- Convening ad hoc mission planning groups to address complex military missions that support nonmilitary requirements, such as convoy escort, and management and security of refugee camps and feeding centers
- Convening follow-on assessment groups

4. NATO Civil-Military Cooperation Centers (CIMIC)

NATO defines the CIMIC as the co-ordination and co-operation, in support of the mission, between the NATO Commander and civil actors, including the national population and local authorities, as well as international,

national and non-governmental organizations and agencies. US forces usually refer to this as Civil Military Operations (CMO). (17)

CIMC functions range from sustaining life to restoring governments. A dedicated staff working at the headquarters level develops CIMIC operations. Their main goal is to ensure effective civil-military cooperation in execution of the allied commander's CIMIC plan. The tasks are then executed by the CIMIC group. The CIMIC group is comprised of specialists in the following fields:

- Public Affairs
- Civil Infrastructure
- Humanitarian Aid
- Economic and Commercial Structures and
- Judicial matters

In recognition of the importance of fostering an open dialog between military and civilian participants, NATO forces will set up a dedicated means of communications. This is accomplished when the CIMIC staff establishes a CIMIC Center.

As seen in Bosnia-Herzegovina, NATO forces established a CIMIC Center to provide a location where NGOs, IOs and military personnel could coordinate and share information. In essence, it provided much of the same functionality as a HOC or CMOC.

Any level of command can establish a CIMIC in order to facilitate coordination among agencies. Preferably, CIMICs are located outside the military compound and in closed proximity to other major agencies. This promotes ease of access to all participants and recognizes the concerns humanitarians have of remaining separate from the military. The functions of the CIMIC Center include:

- Provide initial points of contact
- Provide a focal point for liaison
- Facilitate information exchange
- Provide advice on the availability and mechanics of military assistance to civilian organizations and
- Re-enforce the legitimacy of the Force in the eyes of the local population

C. ORGANIZATIONAL SOLUTIONS: UN PERSPECTIVE

When the UN spearheads humanitarian operations, coordinating systems take on different names but essentially provide the same functions as the military. The UN mechanisms for coordinating between humanitarian participants, official entities and agencies are the On-site Operations Coordination Center (OSOCC) and the Humanitarian (Community) Information Center (HIC/HCIC).

1. On-Site Operations Coordination Center (OSOCC)

The OSOCC is a mechanism used by the UN Office for the Coordination of Humanitarian Affairs (OCHA) to do many of the same functions the HOC or CMOC accomplishes. The OSOCC provides a rapid assessment and coordination capability during the initial stages of a disaster. As mentioned in chapter one, humanitarian agencies are often operating within an affected region well before the military component of a Complex Humanitarian Emergency. The OSOCC is one of the early coordination tools used by the UN. (18)

The UN establishes the OSOCC for the use of the United Nations Disaster Assessment Coordination (UNDAC) team. The UNDAC team is a stand-by team of voluntary disaster management professionals that can be deployed within hours to carry out rapid assessment and help local authorities in cases of environmental emergencies and natural disasters such as floods and earthquakes. UNDAC members are considered specialist within their field and are under the direction of the United Nations, Office for the Coordination of Humanitarian Affairs. (IBID)

2. Humanitarian (Community) Information Center (CIC/HIC)

The HIC works to guarantee an on-going exchange of information concerning security, humanitarian activities, communications, sector assessments, requests for humanitarian aid assistance, and requests for the use of UN assets. The HIC serves as a physical place where organizations involved in implementing the humanitarian response can come together. The center strives to provide humanitarians with an overall view of the situation. This serves to focus individual efforts where they are needed most. HICs provide the vital function of collecting, analyzing and disseminating information.

The HCIC model was seen in Kosovo. It was established in part by the UN Office for the Coordination of Humanitarian Affairs (OCHA) to assist in the UN-led repatriation effort of Kosovar Albanians. The HCIC functioned as a one-stop coordination and information source for NGOs and IOs. The primary role of the HCIC in Pristina, Kosovo was to promote and facilitate coordination by serving as an information focal point for local and international NGOs, UN and other inter-governmental agencies, donors and KFOR. (19) This was accomplished in part by providing contact lists, local maps and organizing daily briefings for the humanitarian community. The HCIC was also instrumental in standardizing data formats and developing protocols to ensure the widest dissemination of vital information.

D. TECHNOLOGY SOLUTIONS: OVERVIEW

Each of the organizational arrangements described in the above section offers an example of how to coordinate and share information during CHEs. They have provided some relief, but organizational duplication and the potential for confusion still exists. As LTC Michael M. Smith, CMO/PSYOP Policy Branch Chief, USSOCOM - "it's an alphabet soup" of different terms and systems describing much of the same things." Despite the progress that has been made, coordination problems to a large extent still remain. Thus, many organizations are turning to information technology to deal with their collaboration problems. In large measure, this has been due to the affects of Moore's Law and the rapid development and expansion of the Internet. Today, satellite and Internet technology is being used in such places as Central Asia and the Middle East to help in complex humanitarian efforts. Military and civilian organizations alike have recognized the benefits of developing and using virtual networks and software tools to enable information sharing and facilitate collaboration, communication and coordination.

Figure 2.1 is a graphic representation of key information technology systems that in some way support information sharing during CHEs. The graphic illustrates the timeline and ownership a number of technical initiatives, both military and civilian that are currently underway.

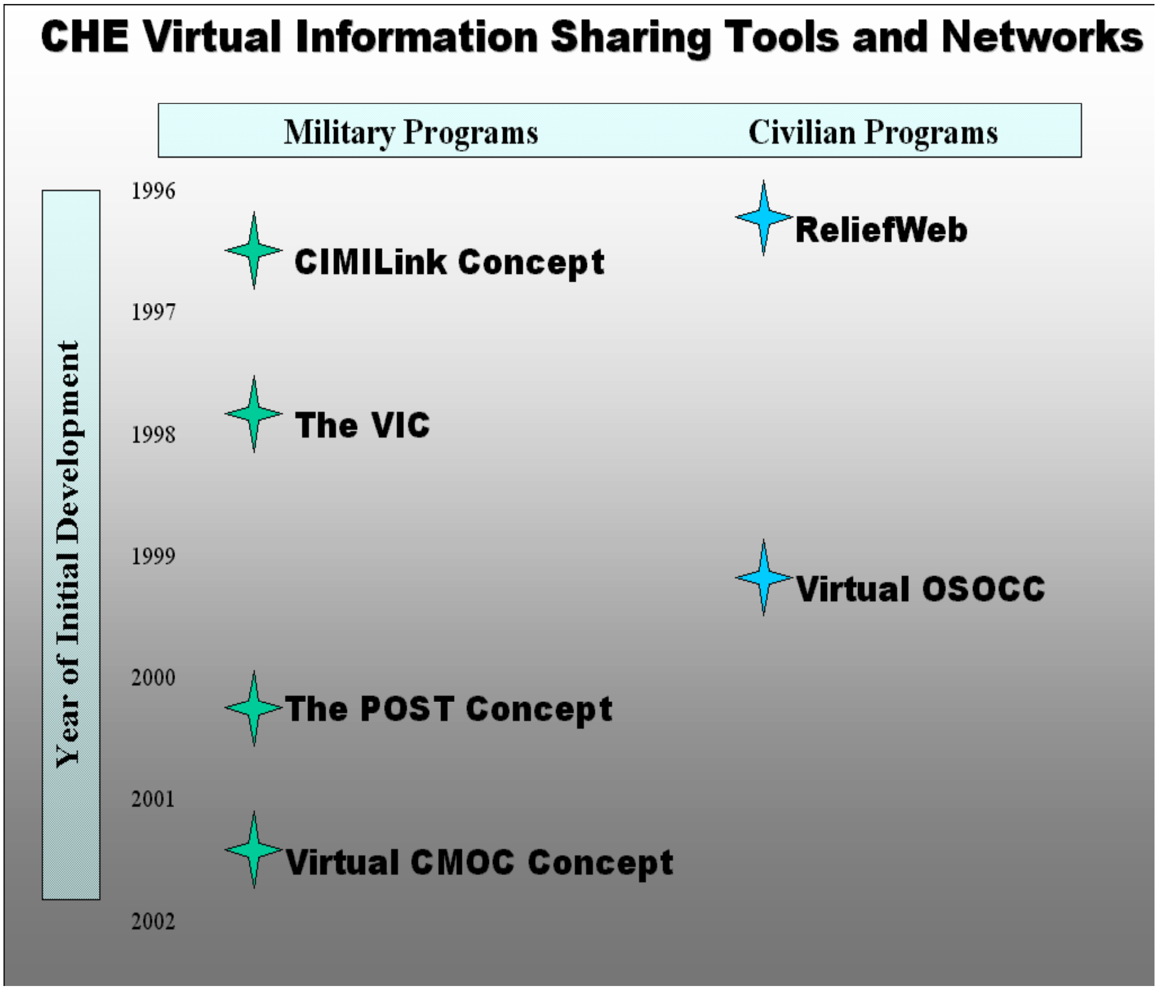


Figure 2.1. CHE Virtual Information Tools

In the sections that follow, we examine the background and functionality of these programs represented in Figure 2.1. Although not meant to be an exhaustive presentation of humanitarian assistance or disaster related websites, this figure highlights key projects and concepts related to this thesis and serves as the framework for the remainder of this chapter. Our focus is on virtual/web-based applications and networks that provide not just news and information, but tap into one or more of the following:

- Virtual collaboration tools
- Web-based operational analysis
- Current planning data
- Synchronous and Asynchronous applications and
- Critical/timely information sharing

E. TECHNOLOGY INITIATIVES: MILITARY

1. The CIMILink Project

a. Background

As far back as 1996 the Department of Defense recognized the key role technology could play in the effort to improve communication between NGOs and the military in humanitarian and peace operations. After Complex Humanitarian Emergencies such as those in Northern Iraq, Somalia and Haiti, the National Defense University's (NDU) Institute for National Strategic Studies (INSS) Directorate for Advanced Concepts, Technologies, and Information Strategies (ACTIS) attempted to capitalize on lessons learned. As a result of these efforts a subsequent technological research effort developed and became known as the CIMILink Project. (20)

The CIMILink project began as a result of a series of workshops held in April of 1996 by the Directorate for Advanced Concepts, Technologies, and Information Strategies (ACTIS). These workshops were entitled -- Humanitarian and Peace Operations: The

NGO/Interagency Interface. They were conducted in order to specifically focus on the civilian – military interface during peace operations.

ACTIS brought together a number of key players from different humanitarian and military communities. They highlighted the problems of communication and coordination during all phases of humanitarian operations and looked into the feasibility of "improving communications between the two communities and within the NGO community itself by developing a networking mechanism to share information, possibly using computer technology." (21)

As a result of this workshop, ACTIS began support for the research, development and fielding of an information system that was "low-cost, user-friendly, responsive to the information needs of the Government and the NGO community, and compatible with the needs of the military." (IBID) The DoD Command and Control Research Program (CCRP) began sponsorship of the Civil Affairs/Coalition Forces Decision Aids prototype/CIMILink Project.

The goal of this project was to develop a set of software tools designed to support the exchange of information and the creation of a common perception of the situation among participants responding to a CHE. The development process used workshops and small focus groups to refine requirements. Based on this data, a set of computer-based tools was developed to facilitate information sharing and support the integrated planning and execution of relief missions. These tools were to be incorporated into a field ready prototype. The U.S. Army Communications-Electronics Command (CECOM) would spearhead the technical aspects of the prototype, while Evidence Based Research Inc, (EBR) a defense contractor focused on the content, overall design, data development, and testing and evaluation.

The CIMILink initial prototype was demonstrated to a number of agencies with favorable response. After presenting the project to Volunteers in Technical Assistance (VITA), EBR learned of a similar research effort underway sponsored by the UN. A partnership was proposed involving VITA, the UN, EBR/NDU, and CECOM to combine efforts. The resulting design would be fielded in support of a World Bank/World Food Program project with the government of Sierra Leone's Ministry of National Reconstruction, Resettlement, and Rehabilitation (MNRR).

The MNRR established the Integrated Information Center (IIC) where coordination and monitoring of programs was conducted and critical information shared. The CIMILink prototype would be used within the IIC to facilitate information sharing. (21)

b. Functionality

The initial core of the system was known as the "CiMiLink Electronic CMOC". The Electronic CMOC was built around Bulletin Board System (BBS) technology that was customized to reflect the needs of CHE actors. The bulletin board would contain various categories of information, accessible either within a CMOC/HOC/OSOCC/CIMIC Center, or remotely through cell phone, HF radio, or telnet.

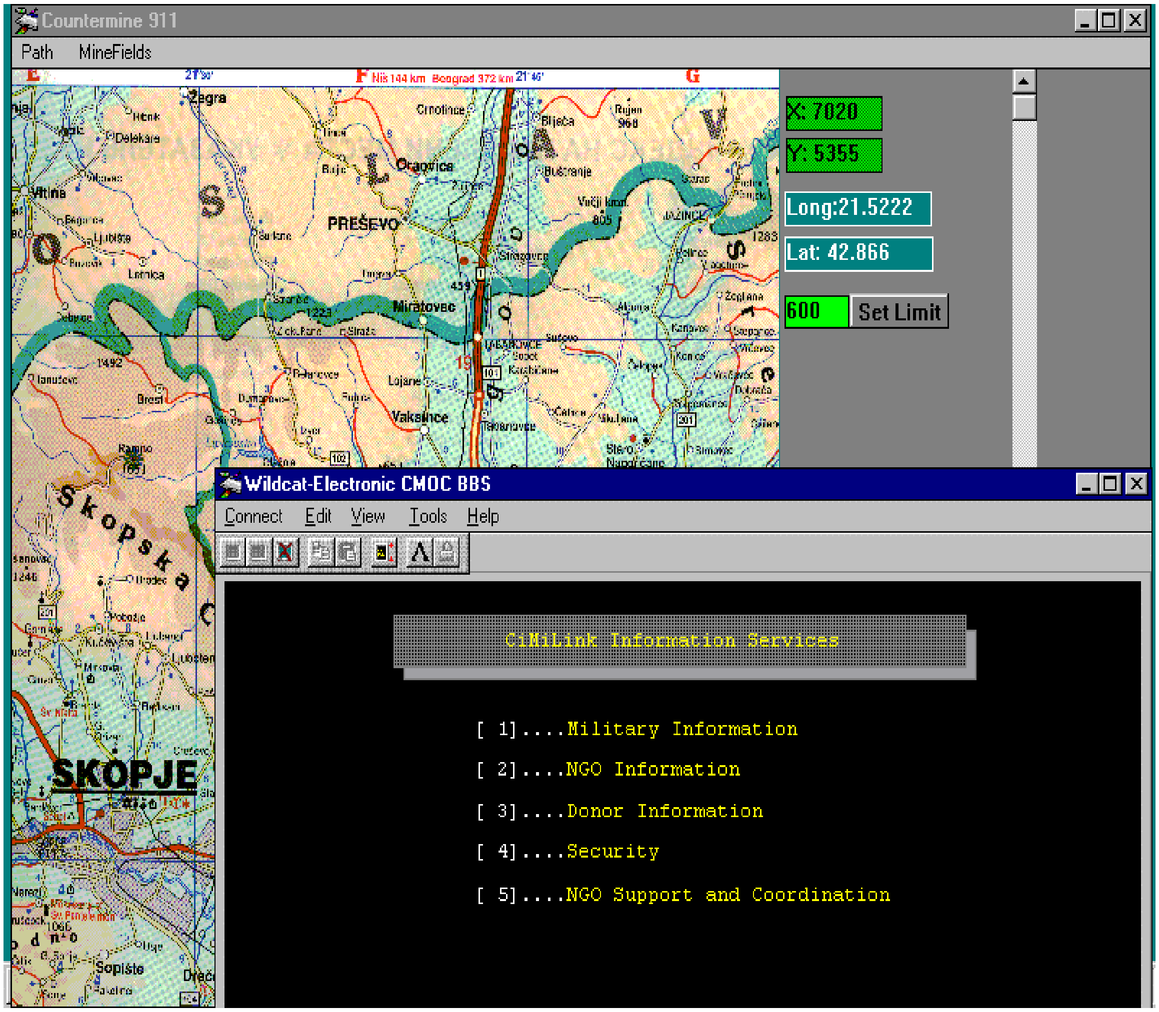


Figure 2.2. CIMILink Project

Figure 2.2 shows the basic mapping capabilities as well as the DOS based user interface for the Electronic COMOC.

The system was intentionally designed around low-tech solutions to allow greater access by those with limited bandwidth capabilities. The baseline design was developed with the capability to be accessed with a 2400-baud modem on a 286 computer.

CIMILink was subsequently fielded with the following capabilities:

- Email when Internet access was available
- File transfer capability
- Topic areas with critical information
- Remote connectivity for database access and online queries
- Digital mapping systems with country datasets

The CiMiLink program went on to form the backbone of the Sierra Leone Integrated Information Center (IIC). The system was field tested over a six-month period with a United Nations organization having a direct impact on the dissemination of data and providing information services within the IIC. Although VITA subsequently provided EBR with valuable feedback and design recommendations, the CIMILink project did not progress on after 1997. (20)

2. NEO Tracking System 2000

a. Background

One of the key military operations other than war (MOOTW) missions that the Marine expeditionary unit (MEU) special operations capable (SOC) training program prepares deploying MEUs to execute is the noncombatant evacuation operation (NEO). NEOs are generally defined as missions conducted to support DoS in evacuating noncombatant and nonessential military personnel from a host foreign nation to an appropriate safe haven and/or the U.S. (24)

Throughout the history of our expeditionary force, this mission has been routinely executed with examples ranging from the actions in the 18th and 19th centuries to more recent ones listed below:

- *Nobel Response*, Kenya and Tanzania (August 1998)
- *Shepard Venture*, Guinea Bissau (July 1998)
- US Embassy; Asamara, Eritrea (June 1998)
- *Silver Wake*, Albania (4 June - 14 July, 1997)
- *Nobel Obelisk*, Sierra Leone (27 May - 6 June, 1997)
- *Guardian Retrieval*, Zaire (2 May - 5 June, 1997)
- *Assured Response*, Monrovia, Liberia (1996)
- Sierra Leone (May 1992)
- *Quick Lift*, Kinshasha, Zaire (September - October 1991)
- *Fiery Vigil*, Clark Air Force Base, Philippines (June 1991)
- *Eastern Exit*, Mogadishu, Somalia (2-11 January, 1991)
- *Sharp Edge*, Monrovia, Liberia (May 1990 - January 1991)
- *Eagle Pull*, Phnom Penh, Cambodia (1975)
- *Power Pack*, Dominican Republic (1965-66)

Processing and maintaining accountability of evacuees throughout the entire evacuation process, from the evacuation coordination center (ECC) to the Amphibious Ready Group/Marine Expeditionary Unit (ARG/MEU) or airfield or safe haven continues to hinder our military forces. New technologies have been developed that enables our US forces to improve NEO mission execution.

b. Functionality

The question of evacuee tracking and accountability is not answered by Marine Corps doctrine. JP 3-07.5 does not address the issue of how to track evacuees throughout the process. Instead, an answer may be found in some of today's existing technologies.

An evacuee, or POW/EPW/refugee for that matter, presents a passport, a scanner scans it, and the information entered into a database. Now take that same computer and place it within a computer network with a server. It can now talk with another computer station doing the same thing and create a database of all evacuees being processed. The server could use the Internet or phone lines to relay this information to the ship or higher headquarters if necessary. Now the ship/higher can track all evacuees throughout the entire process. Couple several evacuee-processing stations equipped with digital scanners, linked by wireless modems to a common server, and match the server with a satellite phone, and you now have an answer to the MEU's evacuee accountability problem. The marriage of existing, off-the-shelf technologies has resulted in the NEO Tracking System 2000. (24)

In the fall of 2000, 26th MEU (SOC) acquired an NTS 2000 system through the European Command to conduct initial training and experimentation. Figure 2.3 shows the system in its current configuration. It should be placed within the processing station of an ECC and utilizes bar code technology. For example, an evacuee enters the ECC and proceeds to "A" processing. He presents his passport, which is scanned by a passport reader. His information is now available and entered automatically into the database. He is now given a bar code bracelet, which is also scanned, that can be used to identify him at any stage of the evacuation. He proceeds through the ECC and is staged for evacuation. The arriving helo is given a computer printed roster with the stick's info, but the miniserver is also sending this info via satellite phone directly to the ARG/MEU.

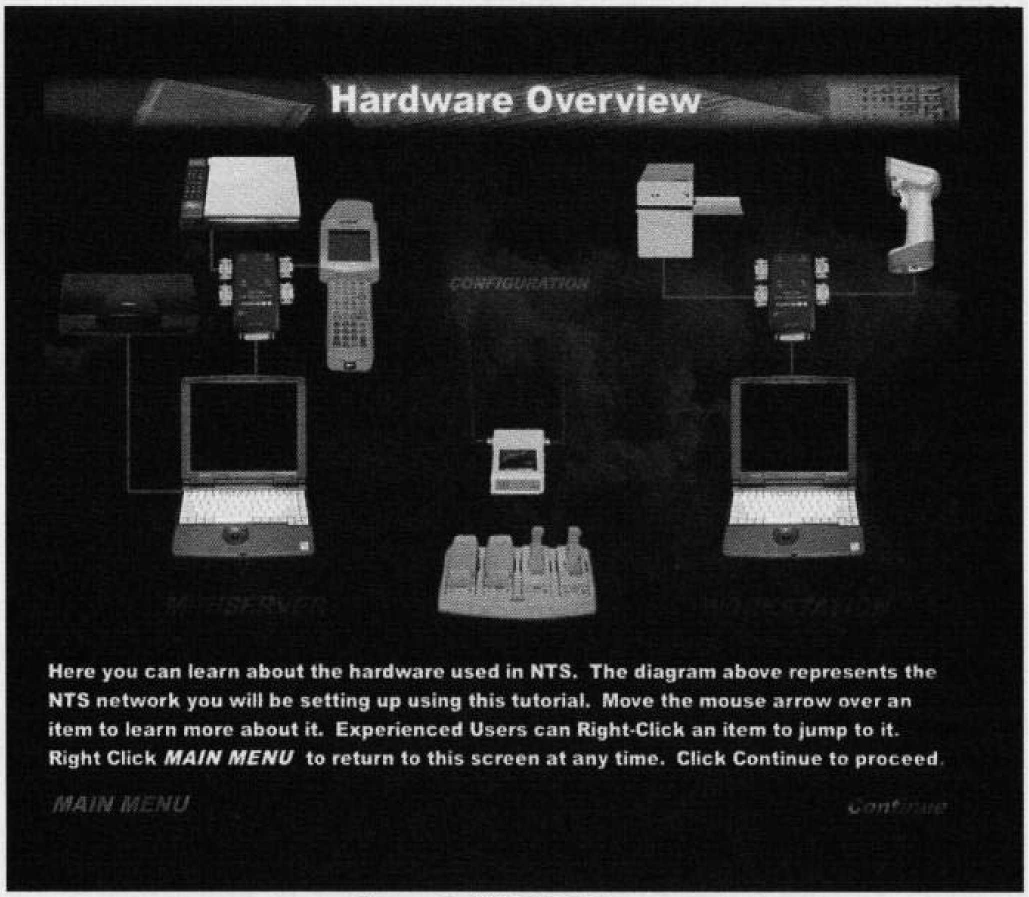


Figure 2. NTS 2000 System.

Figure 2.3. NTS 2000 System

Aboard ARG shipping, the ARG and MEU commanders can use this system to give them real-time information regarding evacuee statistics. This makes reporting a great deal easier and more accurate than counting manifests. Additionally, if the helo, for example is diverted and the evacuees end up at another location or even are broken up into other groups for transportation, a scanning of their bar code bracelets would easily reorganize them and regain accountability.

3. Virtual Information Center (VIC)

a. Background

In 1997, the U.S. Pacific Command (USPACOM) participated in a Command and Control Research Program (CCRP) sponsored workshop entitled: Humanitarian Assistance and Disaster Relief in the Next Century. (25) The focus of the workshop was to use new concepts to apply information superiority to future Humanitarian and Disaster Relief HA/DR operations. The workshop's goal was to somehow match the unprecedented increase in information technology with the mission needs of Humanitarian Assistance/Disaster Relief, (HA/DR) type operations.

The various groups within the workshop recognized the need to establish a collaborative environment and they felt the military could play a key role. This environment would be designed to support HA/DR information needs and promote unity of effort among the diverse participants. New technologies would create the backbone and support this collaborative network. The proposed title for this Network of networks was the Virtual Information Center (VIC).

Taken from the workshop Report the initial idea behind the VIC was documented as follows:

The VIC would support both military and NGO/PVO/IO communities' participation in an HA/DR operation. It would be netted in the field with reach-back to home organizations for information support and material tracking. The military would be a participant in this net, but through a plug-in interface that protects it from intrusion but provides standardized data translation that can be shared with controllable subsets of the participants. The network itself would be commercially provided and the VIC interface function would probably be provided as a UN service package by a selected NGO. (26)

The VIC concept went further to provide mapping, weather, imagery, and other sensor and GIS services from commercial sources. The general goal was for the VIC to "stimulate the pooling of data, coordinate source selection for information and fusion, provide data translation, and promulgate data standards." (IBID)

b. Functionality

Today, The VIC Program, although not true to original form, currently supports the Commander, Pacific Command (COMPACOM) by providing situational awareness in the form of a fused Picture, developed through open source means. (27)

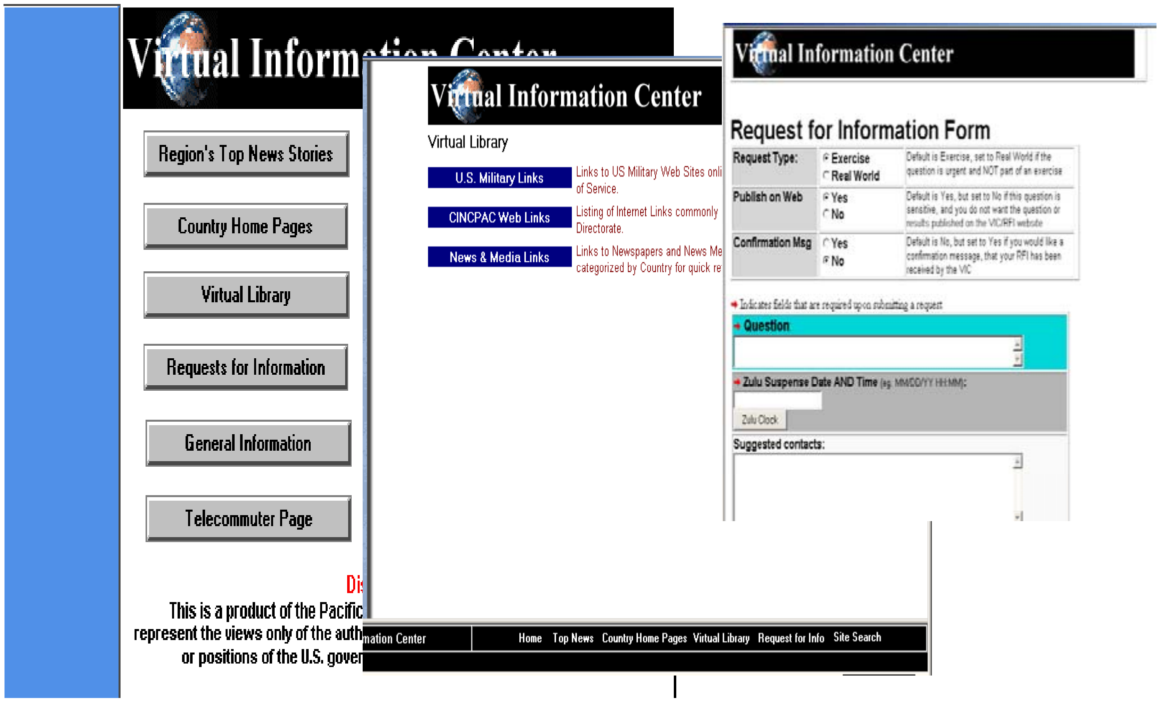


Figure 2.4. Examples of the VIC Functionality

The VIC provides access to a large amount of information regarding a wide range of security and humanitarian issues throughout the Pacific Theater. In essence, the VIC provides the COMBATANT COMMANDER and others with an unclassified, synthesized view of a given situation. The VIC staff accomplishes this by scouring open source information and relying on unclassified contributions from supporting agencies. Figure 2.4 shows examples of The VIC's user interface when providing functionality such as Virtual Library access and Requests For Information.

A key component of the VIC is its close collaboration with other agencies. The VIC's "Information Partners" include other Pacific Command resources such as the Center of Excellence In Disaster Management and Humanitarian Assistance and the Pacific Disaster Center.

The VIC’s functionality involves the ability to search, collaborate, analyze, validate, integrate and disseminate information generated in-house and through its collaborative relationships. (IBID)

4. The Peace Operations Support Tool (POST)

a. Background

In December of 2000, a proposal from J081, U.S. Pacific Command was submitted to prototype a tool that would assist in collaboration and information sharing during CHEs and Peace Operations. This tool would be user friendly, intuitive and multi-platform capable. The goal of this tool would be to “tie together a framework model of complex humanitarian emergencies and peace operations, related databases and other information sources.” (25) This information would be categorized and accessible through a web-based system. The entire system would function as a collection of tools designed to support Complex Humanitarian contingencies.

The system would be built around George Mason Universities Conceptual Model of Peace Operations (CMPO) developed by Professor D. F. Davis. The CMPO organizes the results of extensive development in a collaborative environment with representatives involved in CHEs and peace operations. It is a structured hierarchy that models the functions involved within the areas of peace operations under three branches: Peace Making, Peace Building, and Peace Support. Within these branches functions are broken into sub functions down to six layers maximum. (28) The model provides a solid organization of mission and information needs and structural foundation for POST.

The POST project has gained recognition for its value added potential during the planning and execution phases of CHEs. Partnering with US Pacific Command (PACOM) in this project are the Center of Excellence in Disaster Management and Humanitarian Assistance, George Mason University's School of Policy Program on Peacekeeping Policy, Australia's Defense Science and Technology Organization and the Institute for Defense Analysis.

b. Functionality

The POST provides CHE participants with access to a wide range of information sources as well as a number of technological tools. These have been presented in six broad categories within POST. (29)

(1) Responding Organizations. Provides information on responding organizations in different categories, with COE tracking actual organizations as they respond to a crisis.

(2) Lessons Learned: COE maintains a repository of various lessons learned by a number of organizations made available to users through the system.

(3) Subject Matter Experts: A complete listing of experts within the fields associated with the universe of CHE and Peace Operations. The system will provide access of point of contact information.

(4) Analytical Tools: POST will provide over 100 analytical tools developed by PACOM, U. S. Army's CAA, TRAC-Lee and Australia's DSTO that pertain to CHE and Peace Operations.

(5) Training, Readiness and Operational Capability Requirements. A compilation of requirements garnered through work with International Association of Peacekeeping Training Centers.

(6) Measures of Effectiveness and Measures of Performance. The POST will provide access to approved MOEs and MOPs developed by International Organizations and compiled by COE.

Figure 2.5 shows the index page and the subject expert functionality of the POST Prototype.

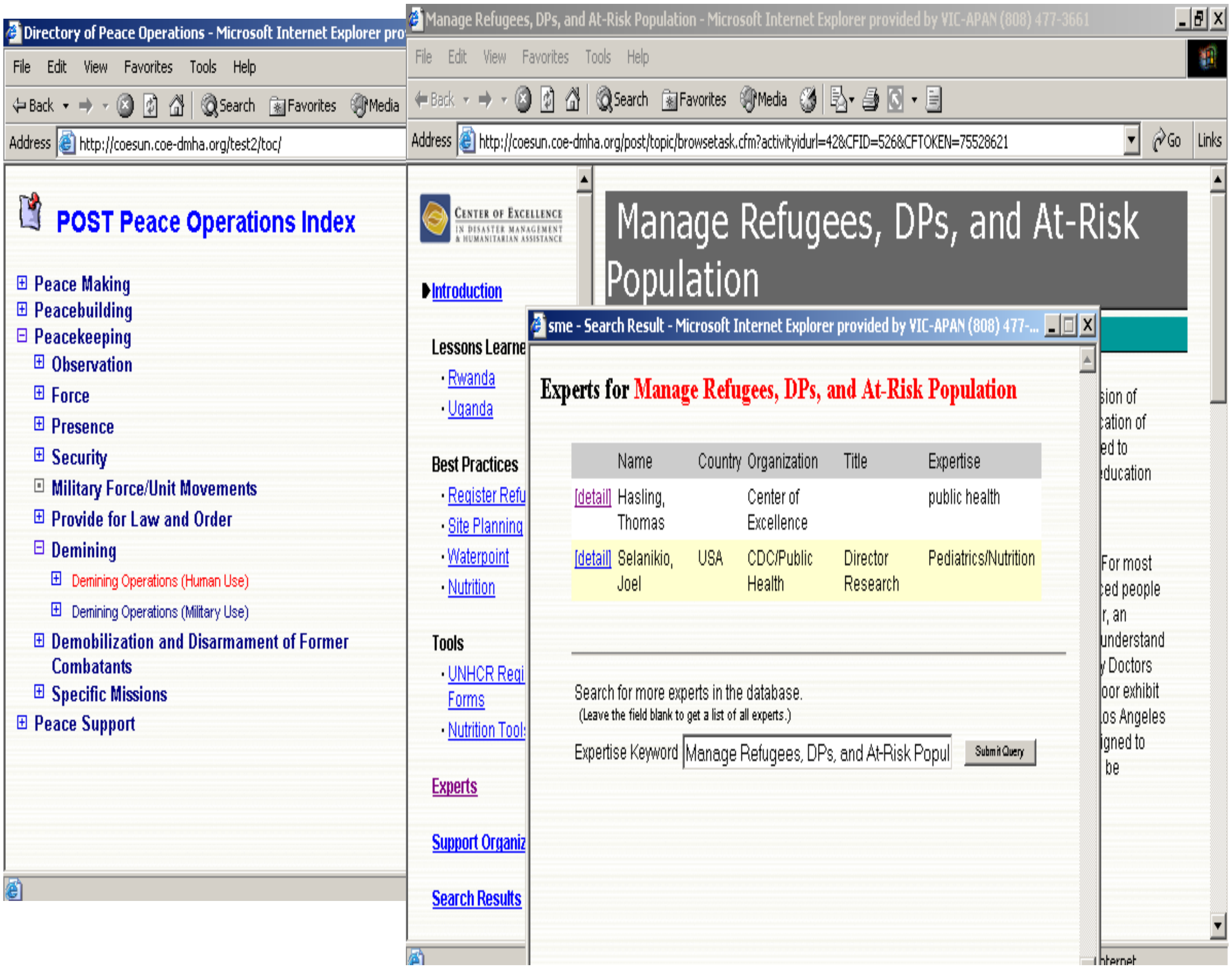


Figure 2.5. Peace Operations Support Tool

F. TECHNOLOGY SOLUTIONS: CIVILIAN

1. Relief Web

a. Background

The humanitarian community recognized early on that the World Wide Web provided a unique opportunity to gather and distribute critical information. During the early stages of the Web there were a number of humanitarian organizations providing data to different sites. Each of these sites contained bits and pieces of critical information relating to humanitarian operations. In order to gain information on a particular operation, one would have to search a number of sites. The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) recognized the need for a one-stop consolidation point for all things relating to Humanitarian Assistance and Disaster Relief. In 1996 they responded by establishing Relief Web under the following mandate:

> To strengthen the response capacity of the humanitarian relief community through the timely dissemination of reliable information on response, preparedness and disaster prevention. (30)

The founding concepts for Relief Web were born from a bottom up consensus among NGOS and IOs that there was a need to consolidate information. "Information was seen as a public good, and that well informed decisions should serve as the basis for relief actions." (IBID) Relief Web operates on the foundation that its partners provide the core of its knowledge base. As a result, Relief Web was recognized early on as a good idea and quickly received buy in from a number of humanitarian, military and government organizations.

According to Relief Web, it receives information from over 700 sources, including NGOs, government agencies and the media. (IBID) They strive to be relevant, dynamic and responsive to their target audience, which is comprised of a wide range of practitioners and advisors. Today Relief Web has approximately 3.5 million hits weekly and is recognized as the primary on-line source of humanitarian information.

b. Functionality

Relief Web operates with a 1.5 million dollar budget and maintains offices in New York, Geneva and Kobe, Japan. They use technology to provide a wide range of information and services to the humanitarian community. Table 2.1 highlights the resources Relief Web has available.

Latest Updates:	Documents posted on emergencies and natural disasters within the past 72 hours
Complex Emergencies:	Humanitarian response information on current emergencies and countries of concern
Natural Disasters:	Disaster response information on current natural disasters and archival material dating back to 1981, listed chronologically
By Country:	Response documents by country with a complete set of external background links by sector
Background:	An extensive set of external background links by country and sector
Financial Tracking:	Funding requirements and donor contributions for complex emergencies and natural disasters
Map Center:	Reference and thematic maps concerning current and past humanitarian emergencies and natural disasters, by geographic region and country
Humanitarian Vacancies:	Jobs and volunteer openings in the global humanitarian community
Directory of Humanitarian [illegible]	Contact information for UN relief agencies and NGOs

Organizations:	
Library:	An on-line archive of humanitarian, human rights and development reference documents
Emergency Telecommunications:	Information and resources available for the provision of emergency telecommunications during relief operations
Early Warning:	Tracking potential emergencies and natural disasters as they develop
Relief Web via Email:	Making Relief Web available to those without web access
Central Register:	A directory of disaster management resources available for humanitarian assistance

Table 2.1. Relief Web Resources

Relief Web focuses on providing high content in a relative low-tech format. They make use of intuitive interfaces and taxonomies, with little bandwidth spent on graphics. Figure 2.6 shows Relief Web's homepage, Financial Tracking System and Directory of Humanitarian Organizations.

Figure 2.6. Relief Web

Relief Web is an impressive example of the use of technology to share critical humanitarian information. In all, it provides services to users in over 170 countries. According to their own statistics, they process request for over a half a million pieces of information on a monthly basis. This information takes the form of maps, documents and financial support regarding 21 CHEs and more that 1000 natural disasters. (IBID) With the increasing reliance on technology, Relief Web will play an even greater roll in future emergencies.

2. Collaborative Techniques for Coalition Teams (CT2)

a. Background

One of many barriers that are often encountered in coalition environments is a language barrier. Many organizations from around the world unite together and partner efforts in a common crisis and yet communication is difficult at best because of differing languages. Yet, are military operational success depends on partnerships with other countries. Many organizations already have collaborative capabilities in the form of email and material published on Web pages, but they do not have a secure real-time translation tool. The MITRE Corporation, headquartered in McLean, Virginia, has a developed a concept called Collaboration Techniques for Coalition Teams (31).

Researchers have developed a collaborative tool prototype with instant messenger that includes a translation feature based on translingual instant messenger technology – called TrIM. The technology can translate English, Spanish, French, German, and can be expanded to cover other languages.

b. Functionality

The prototype was designed to provide multilingual Instant Messaging (IM) between users in independent network or security domains. The CT2 security guard enforces security policy and formatting restrictions to include access control checking, protocol verification, use of digital signatures, and dirty word searching to determine whether messages and presence information should be permitted to traverse a network/security boundary. This type of tool could be used to clarify anomalies in intelligence data, resolve operations and issues pertaining to requirements management, and to set priorities for resource tasking.

CT2 is still being tested but many exercise planners have expressed high interest in the ability to conduct secure "chat" sessions with support for foreign language translation. According to Mark Lawrence, General Manager of NATO's Battlefield Information Collection and Exploitation (BICES) Agency, "We have 17 nations in the BICES community who will be watching CT2 testing closely to see how successfully it performs. Based on the results, we hope to be able to push ahead with providing this capability to the allied nations conducting ongoing counter-terrorism operations and planning as well as complex humanitarian emergencies." (IBID)

The CT2 prototype utilizes the Simple Instant Messaging and Presence Protocol (SIMP) and the Translingual Instant Messenger (TrIM) technology designed at MITRE. The SIMP protocol implements IM and presence services, and enables users to transmit and verify digitally-signed messages. SIMP provides the ability to interconnect distributed communities of interest using real-time collaboration technology. TrIM client software provides machine language translation for IM – a useful capability in multi-national environments. TrIM enables collaborators to overcome language barriers that can impede coalition operations.

As Figure 2.7 shows, The Translator IMP acts as a third-party translator. The IM protocol understands what translations are needed based on the current population of the room. The IMP is visible to all participants, and announces its presence to new participants in the room. All participants have an attribute that indicates their preferred language.

3. The Virtual Operations Coordination Center – VOCC

a. Background

The United Nations Disaster Assessment and Coordination (UNDAC) Team, working under OCHA, generally establishes an On-Site Operations Coordination Center (OSOCC) as soon as possible following a major disaster. The OSOCC is used to assist the local authorities of the affected country with the coordination of international relief. It provides a place to consolidate information and develop an informed assessment for follow-on planning.

In 2000, the International Emergency Response Consultative Mechanism (IERCM) recognized there was a need to take the information consolidated and produced within an OSOCC and make it readily available to a wider group of decision makers. If local and international actors could have timely access to information, it could reduce the chance for redundancy of effort and wasted planning. This began an initiative known as the Virtual Operations Coordination Center.

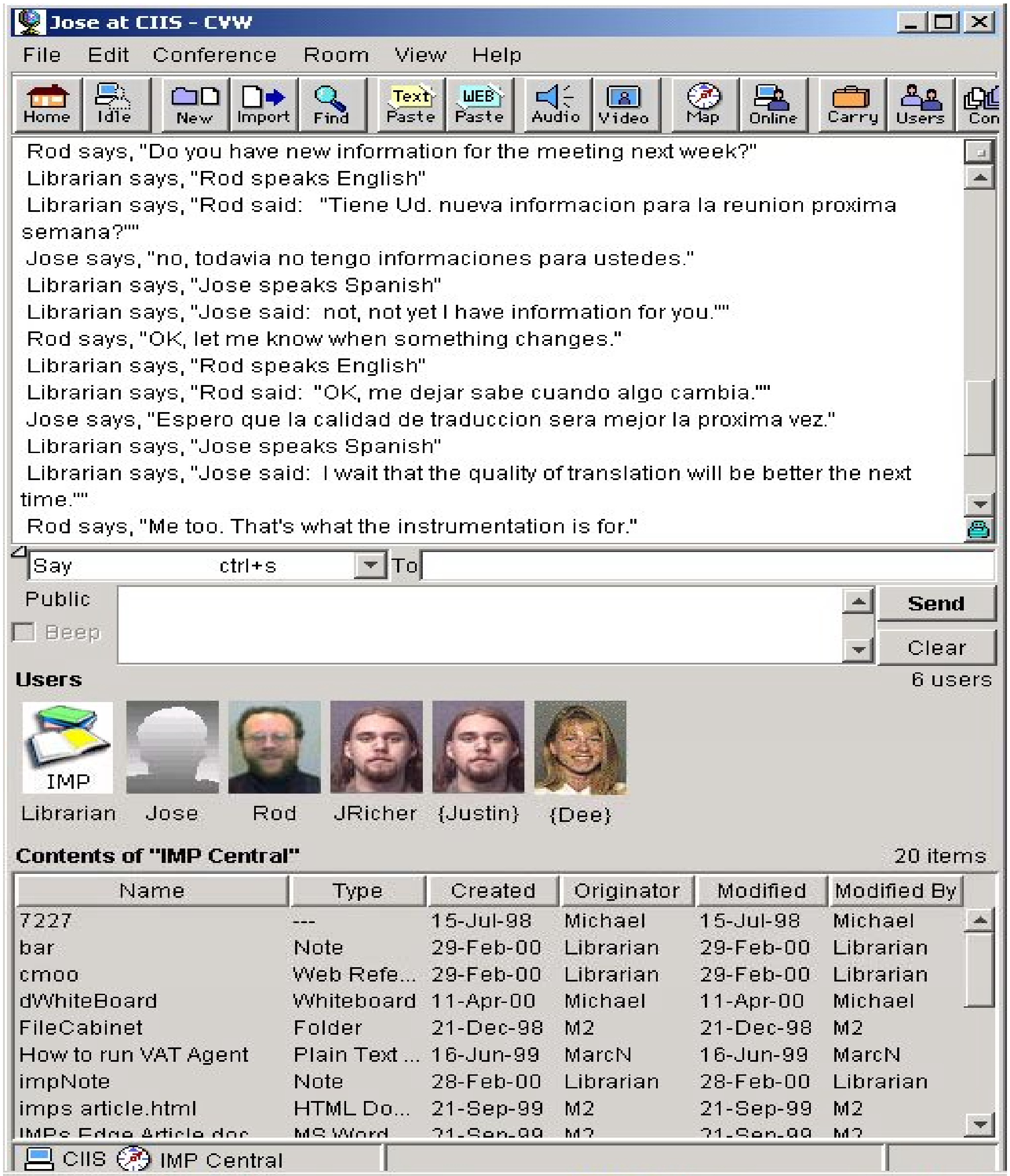


Figure 2.7. CT2

The Virtual Operations Coordination Center was established and is maintained by the Field Coordination Support Unit (FCSU) within OCHA in Geneva, Switzerland. Its primary role is to aid urban search and rescue teams exchange information during the early stages of a large disaster. It allows information sharing when conventional means, such as telephone and fax, have been disrupted. The Virtual Operations Coordination Center strives to "create a real-time communication vehicle for use during emergency response." (32) It accomplishes this by acting as an online tool to enable information sharing between international relief organizations.

b. Functionality

The Virtual OSOCC (Figure 2.8) provides a complement of asynchronous tools and database access. Users can access information relevant to a particular disaster, participate in discussion groups or find out about various training opportunities.

The Virtual Operations Coordination Center is a tool specifically designed for disaster management experts. The target audience for the Virtual OSOCC is a professional core of disaster personnel that consists of the International Search and Rescue Advisory Group (INSARG), the International Emergency Response Consultative Mechanism (IERCM) and members of the United Nations Disaster Assessment and Coordination (UNDAC) Team. Access to the Virtual OSOCC is restricted to these individuals or on a case-by-case basis.

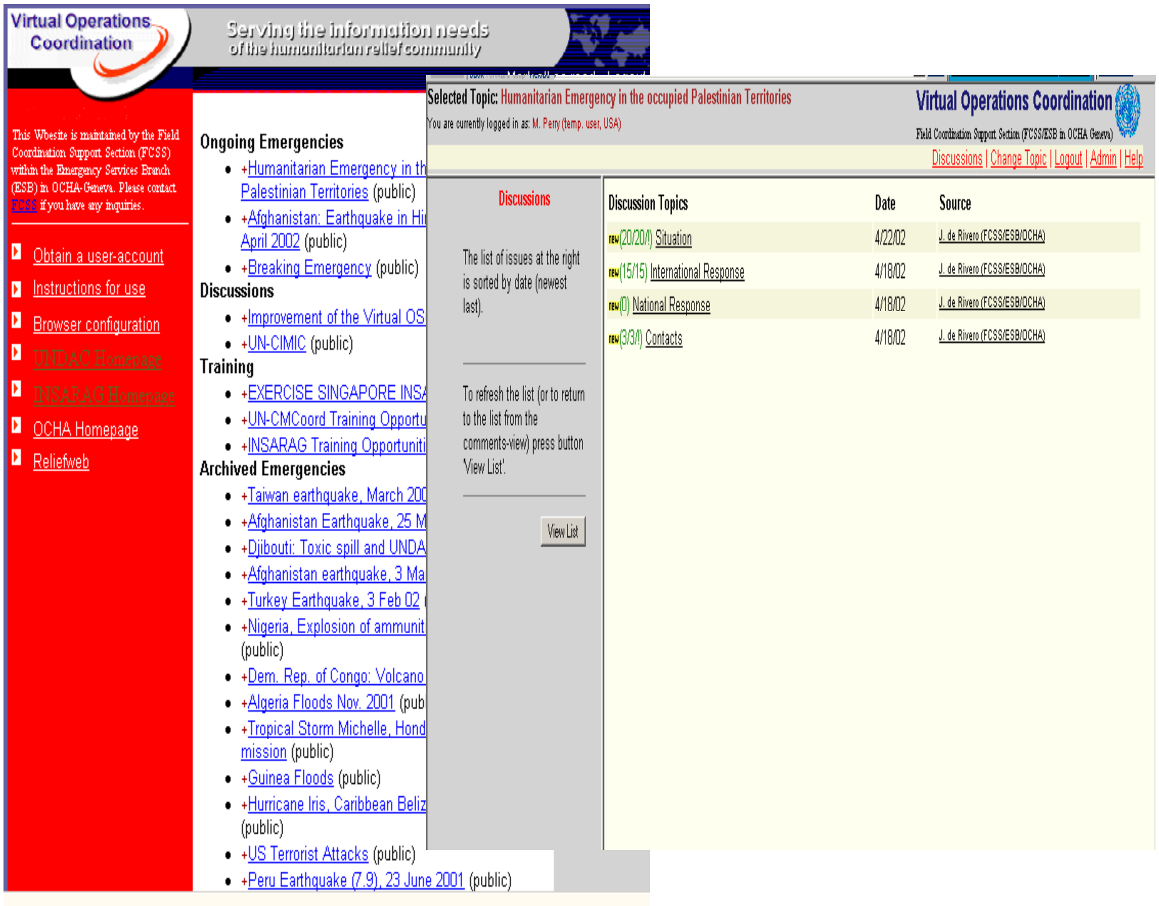


Figure 2.8. Virtual Operations Coordination Center

G. SUMMARY

The underlying issues that spawned the CIMILink project back in 1996 are still very relevant today. This is clearly evident in forums such as the Virtual Diplomacy Initiative 2000 (33) and the Symposium on Best Practices in Humanitarian Information Management and Exchange 2002. (34) Although we still wrestle with complex cultural issues and the challenges of coordination, technology has demonstrated its capability in moving us closer to sharing information and building operational awareness.

III. METHODOLOGY

A. INTRODUCTION

This chapter will outline how the information and system requirements were derived for relief operations. Afterwards, we will select a system model and, when properly utilized, would be the foundation for developing our proposed system solution. In conclusion, this chapter describes our partnership development as well as a brief overview of our future collaborative efforts.

B. REQUIREMENTS

The requirements development for creating an information-sharing environment calls for a definition of the current state and desired state of CHE operations. In addition, we need to explain how technology can contribute to the desired state. In chapter I we learned about the current state. Organizations involved in CHEs are extremely divers, each operates with its own agenda and priorities. As a military footprint is established at the field level, communication difficulties among the participants often increases and produces shortfalls, friction and redundancy of effort. These in turn can result in mutual distrust among the parties.

A lack of shared information is a primary hurdle in establishing effective relief efforts. The desired state includes movement from a collection of uncoordinated separate organizations that execute their relief responses to an environment that allows for organizations to share information using information technology that ultimately increases situational awareness. As a result, situational awareness increases, better decision-making occurs for all parties involved, and lives are saved.

C. INFORMATION REQUIREMENTS

The first step in the process of requirements generation is to determine what type of information needs to be shared. We draw much of our information from the Virtual Diplomacy Series "Taking it to the Next Level" (33) and on our analysis of the personal interviews conducted with relief organization workers actively involved in Bosnia.

1. Conference on Information Sharing

In April 2000, the U.S. Institute of Peace and the U.S. Army's 353rd Civil Affairs Command co-sponsored a conference in San Antonio, Texas. The conference report, "Taking it to the Next Level, Civilian-Military Cooperation in Complex Emergencies," (IBID) recommends information sharing mechanisms to support advanced planning and program implementation by international entities involved in CHEs.

Participants at the conference identified ongoing information needs for both humanitarian and military organizations. Both require accurate and comprehensive information about conditions and activities in the field. Just knowing what information could be exchanged before they come into contact in the field would help manage expectations and reduce suspicions about one another's role during a crisis. Unfortunately, not all information is posted in a central or easily accessible location. Minefield or unexploded ordinance locations, infrastructure damage, military or relief staff rotations are not usually made available to all parties. The lack of notice to the civilian sector about military rotations was a particularly vexing problem for NGOs during the multinational Stabilization Force in Bosnia (SFOR). There was little, if any, continuity in cooperative relationships and joint projects as a result. As conference participants noted:

> Each CHE is different in some respects, but some aspects are similar across crises. One such commonality is the need to acquire, compile, analyze, disseminate, and use information before, during, and even after the emergency. No single approach can satisfy everyone's informational needs, yet there exists in every crisis a core of key information that has wide applicability for all those responding to the crisis. However, despite occasional information sharing, this practice has not been sufficiently institutionalized. Thus, collaboration between civilian and military entities cannot be counted on and is difficult to mobilize at the appropriate time. (IBID)

2. Interviews from Bosnia

In July 2001, a member of the previous thesis group, Major Todd Ford, traveled to Sarajevo, Bosnia, to conduct interviews with designated representatives from NGO, IO and military organizations. (1) The purpose was to collect additional data to establish the requirements for their proof-of-concept application.

A listing of the interviewees and a summary of each interview can be found in the Bosnia Trip Report within Appendix A of the Ford/Hogan/Perry thesis. (1) The trip report provides background information on each interviewee as well as a detailed account on topics these individuals felt were critical to the problem of information sharing and coordination during a CHE.

The following information was compiled from these interviews. The content of each interview was categorized into problem statement, information requirement, and technical issues.

a. Problem Statement

The problem statement described by the interviewees mirrored the coordination and information sharing difficulties previously identified in the conference report and those outlined in chapter one. As Goran Tinjic, an Operations Analyst with World Bank summed up his experience in Kosovo: The "lack of coordination led to an uncoordinated, messy effort. There was total chaos in the relief efforts." Most agreed that given the current situation, "anything is better that nothing."

b. Information Requirements

The interviewees in Bosnia described the following information requirements during a CHE.

(1) The specific mandate of each organization is critical to reducing redundancy and wasted effort and increasing situational awareness. Every organization, regardless of size, needs to post its mandate so that those involved in the relief effort can see who is participating and what the mission is.

(2) Human resource and support information regarding the NGOs and their organizations involved in the relief effort are important. Specific information from each NGO should include: the primary point of contact (POC); the skill sets each NGO possesses; the time the NGO will be involved in the relief effort; the background,

experience, and expertise of the workers; and the support equipment, (logistics, medical, shelter) that is available.

(3) Critical to the relief operation is the ability to locate, track and return to their homes of origin all displaced persons and other migrants. Interviewees expressed a need for a database connected to a website for managing displaced persons with information such as age, medical conditions, family members, home of origin and current location.

(4) Often field workers have the best situational awareness of the relief effort. Their information should be consolidated and passed on to all organizations, especially their assessments on medical treatments, food, shelter, and clothing.

(5) Information about the infrastructure in the area of operations is needed to understand what capability is available for the relief effort and what needs to be built or supplied to a community to get it functioning again. Examples of infrastructure items are utilities, roads, schools, hospitals and stores.

(6) Timely, accurate and updated information to establish situation awareness is critical and would include such things as the location of danger areas, hot spots and safe areas, daily briefings, current maps and locations of organizations in the area, weather information, and local crop information. Providing information on the location of all personnel, organizations, and activities is also essential.

(7) Information on communication systems (radio frequencies, phone lines, wireless, computer networks, etc) is important to facilitate coordination.

(8) Information on transportation and logistic support enables relief workers to know when, how, and where they can travel and move supplies. By maintaining a central repository, this information could be available to everyone and accessed from anywhere.

(9) Background information is helpful before workers are sent to the field. They would find value in having information on the history of the area, the reasons for the crisis, the norms and customs of the people, especially what is considered appropriate or inappropriate behavior, the social and economic context, and the political climate. Most importantly, they suggest collecting and disseminating information on the priorities for aid as seen by the people needing assistance.

c. Technical Issues

Interviewees identified the following technical issues that need to be considered when designing any information technology solution that may be used for a CHE.

- Many CHEs occur in underdeveloped countries that do not have mature telecommunication infrastructures to support wide area networks. The majority of relief organizations still connect to the Internet and local networks using dial-up telephone modems with an average connection speed of 19.2 kbps. This is a critical consideration for application designs, especially when making decisions about the amount of bandwidth required.

- Information must be accurate and capable of being updated quickly.
- The majority of users have computers running some version of a Windows Operating System and application programs from Microsoft Office.
- The technical training/experience level of field workers ranges from the proficient user down to the completely inexperienced. Some training will be required to ensure an acceptable level of proficiency with the application and hardware tools.
- Many NGOs lack funds to procure and maintain information technology equipment and to build communications infrastructures.
- Interviewees recommended that the UN or other neutral third party (contractor) should host and maintain the information system. This would ensure an unbiased perspective to the application and encourage participation and information sharing by all.
- NGO's range from large organizations to individuals. A system must be put in place that enables everyone to share information equally. For example, an Irishman was working to rebuild some schools outside of a small town. He was not affiliated with any particular organization and used whatever material he could get on his own. He needed access to the same type of information and resources as the larger organizations.

D. SYSTEM REQUIREMENTS

Failure to share information, catalog resulting assessments, or to update existing assessments, has increased suspicions, frustrations, and apathy among community members toward the international participants. Conference attendees agreed that information sharing with nationals should be given a priority and would go a long way in strengthening performance in the field.

To address the needs outlined in the Conference Report and the Kosovo interviews, the previous thesis group created a proof of concept, called the Relief Operations Coordination Center (ROCC), that is essentially a web enabled database that would serve as a central repository for a lot of the information needed by all parties within a given CHE. (1) But, the ROCC is just a small solution in achieving a greater desired systems solution. Our vision is to develop a robust information-sharing "habitat", within which some functionality of the ROCC will be embedded, and which will allow other components within the habitat to share resources. This will be described in further detail in Chapter IV.

In designing such a "habitat", we have defined the following system requirements:

- The creation of an information clearinghouse that is publicly available, interoperable, comprehensive, trustworthy, donor supported, and is the principal repository for humanitarian activity information.
- A communications system that is rapidly deployable anytime and anywhere. Must have reach back capability. Highly mobile and able to interface with a larger more robust system once the CHE reaches a more mature state. Mobile capability to include the use of wireless and handheld technologies.
- The ability to integrate Off-the-shelf architecture, common templates, and standardized protocols.
- Management by neutral entities (e.g., ICRC or a UN lead agency or its implementing partner). Must contain management functionality and tools.
- A system that is sustainable, reliable, and unclassified, and that "does no harm."

- An advanced collaborative tool that has peer-to-peer/client server functionality that also will provide real-time interaction and communication. Functionality within the tool should include file sharing/editing, whiteboard, chat, VoIP, project management, and browse capability.
- The ability to access web based applications and to be interoperable with other legacy systems is critical since they will be prevalent within many third world countries.
- Global Positioning System (GPS) that can be utilized on a pocket PC.
- The VCMOC should contain the following requirements:

    - A listing of the organizations and their mandates involved in the relief effort.
    - Points of contact for organizations involved in the relief effort including a listing of the skills, supplies and number of people being provided by each organization and the assets they have available.
    - The capability to manage displaced persons, tracking home of origin, current location, family members, sex, age and medical condition.
    - The ability to search a database to locate specific organizations, points of contact, needs and requirements of displaced persons.
    - Timely and accurate situational awareness information concerning the history, current situation and projected situations for the relief area to include danger areas, infrastructure, safe areas, access routes, media contacts, local authorities and maps.
    - A tool to better coordinate and communicate between NGO and military units involved in the relief operation.

- Awareness of logistical needs such as medical, food, shelter and clothing supplies, where they are needed, when and how much.

If such an information sharing habitat could be developed and implemented, many organizations and participants could save millions of dollars in wasted resources that could be better utilized in supporting the relief effort.

E. MODEL DEVELOPMENT

As we evaluated the many system models discussed, it was felt the above Kast & Rosenzweig model, Figure 3.1, most closely resembled the environment in which CHEs should operate. This system embodies all the characteristics that all organizations involved need to address to ensure successful emergency operations.

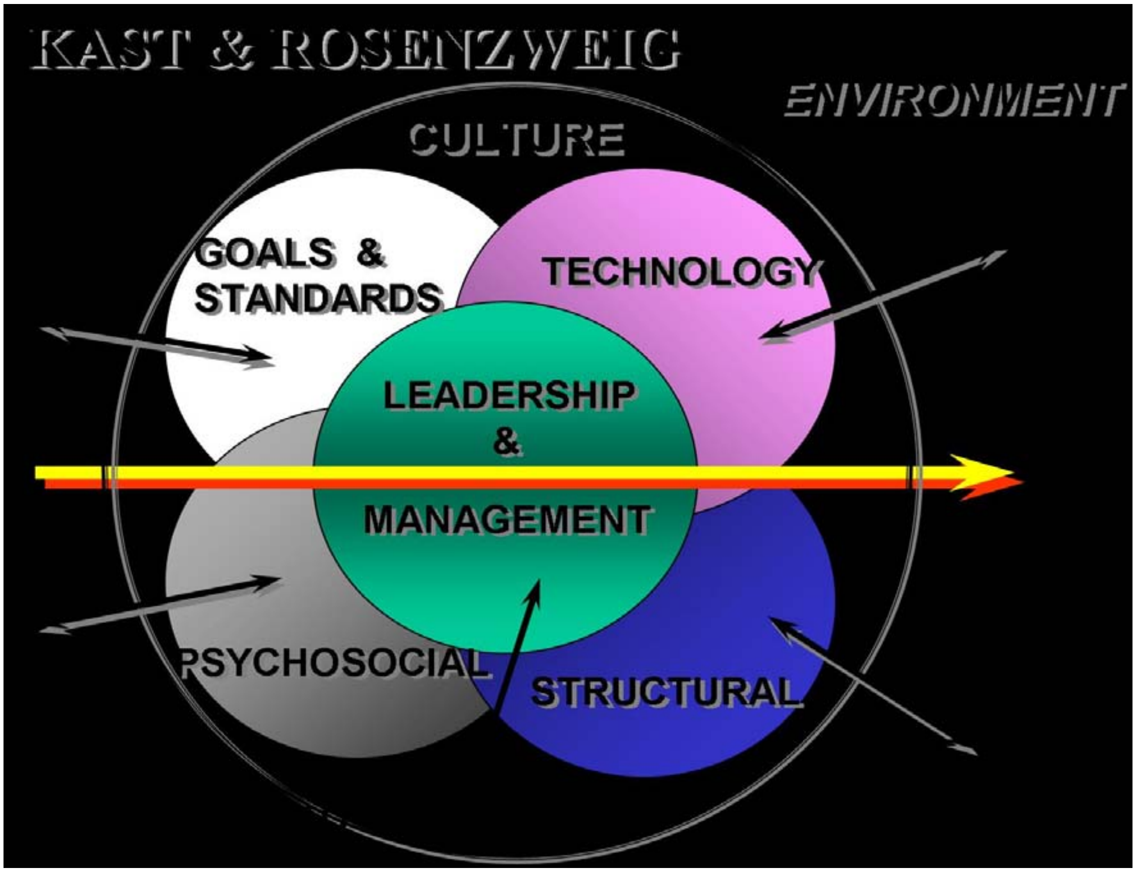


Figure 3.1 Kast & Rosenzweig

The system includes the following subsystems. (35)

1. Technological Subsystem

The technological subsystem includes the use of collaborative technology to provide the knowledge and situational awareness required for the performance of coordinated tasks. Organizational technology means the transformation of inputs into outputs.

2. Social/Political Subsystem

The social/political subsystem consists of individual organizational behavior and motivation, status and role relationships, and group dynamics.

3. Structural Subsystem

Intermixed with technical and social/political subsystems are the structure. Structure is concerned with the ways in which the tasks of the organizations involved are divided and with the coordination of these activities. It is concerned with communication and workflow.

4. Goals and Values Subsystem

Goals and values represent one of the more important subsystems. Knowing and understanding the goals and values of the organizations involved in CHEs is critical. In many cases, their values are derived from society at large and it also influences societal values.

5. Leadership & Management Subsystem

The key to this model is the leadership & management subsystem of the organizations involved. This is the center of all the subsystems. As in most organizations, the leadership of each organization must embrace the change in order to achieve successful results.

F. PARTNERSHIP DEVELOPMENT

A working relationship has been established with US Pacific Command (PACOM J38) Multinational Peace Augmentation Team (MPAT)/Multi-National Force (MNF) SOP (Standard Operation Procedures) and the Asian Pacific Area Network (APAN) Group and the Naval Postgraduate School. In September 2002, (36) our thesis group spent a week visiting Pacific Command. Our objective was to coordinate with key players at PACOM and present to them a myriad of viable IT tools/solutions to consider that would increase situational awareness in crisis action planning. We also wanted to exchange information on MPAT/MNF SOP projects and the requirements for collaborative tools for assisting in their Crisis Action Planning Systems used within the Tempest Express # 5 (TE #5).

Coordination was made with concerned USPACOM staff and agencies: J3 OPT (Jens Jensen and staff), J36 (Mr. Maxfield), APAN (Mr. John Reitz/Mr. Acton), J38 MPAT (Commander Wohlschlegel (USN)/Ron Marvin), and Center of Excellence (COE) (Ms. McHale, Mr. Haut, and Mr. Halings) all receiving demonstration briefings on the latest collaborative planning tools, virtual civil military operations center (VCMOC), and other research endeavors ongoing at the Naval Post Graduate School. All of our objectives were met as an out brief was conducted with Colonel Ferrell (USMC), J38 OIC on 26 Sept 02.

The PACOM staff identified that an ongoing collaboration process with the Naval Post Graduate School in the areas of Informational Technologies/Advanced Collaborative Tools had the potential to greatly enhance MPAT collaboration processes and MNF SOP collaboration processes. Further, it had the potential to become a "living research lab" for the ongoing collaborative tools that can enhance Multinational operations coordination and planning (workshops and actual crisis).

One of the briefs we received from APAN was on their Virtual Civil Military Operation Center (VCMOC). Their concept stems from the need to maximize the availability of information to as many CHE participants as possible, which is very similar to the ROCC. The VCMOC is currently being tested/deployed in the Philippines in support of a classified military Operation. Ironically, our independent efforts have produced similar systems with essentially the same functionality although our system, the ROCC, contains a Refugee Camp Management module and a Situational Awareness tool that APAN’s VCMOC does not contain.

At the encouragement of PACOM/APAN, we continue to collaborate together to further explore how emerging information technologies can be further developed to assist in CHEs where civil-military relationships are crucial to the success of the operations. Weekly conference calls with them with the greatest emphasis being on our collaborative effort to integrate the ROCC’s situational awareness tool utilizing multi-agent architecture within APAN’s VCMOC as well as designing and defining common communication architecture to be used in a CHE.

IV. ENVIRONMENT

A. INTRODUCTION

Following Operation Desert Storm and Desert Shield in 1991, thousands of Kurds who lived in Iraq fled their homes and villages into the mountains of northern Iraq and southern Turkey. Almost 500,000 Kurds faced disease, starvation, and death in the cold spring of 1991. About a year later on the horn of Africa, over 500,000 Somalis died as a result of famine with thousands more near death. Clan violence interfered with international famine relief efforts and numerous Somalis suffered as a result. Still more recently in the Balkans, thousands of refugees lost their homes and fled their war torn homeland because of civil disorder or war. (37)

The chapter will present an analysis of the problem associated with multi-organizational responses to Complex Humanitarian Emergencies (CHE) and recommend a possible solution in the form of a Tactical Humanitarian Relief habitat. First, we will define a CHE and identify the involved groups. Second, we will cover the problems associated with that involvement. Finally, we will conclude with a proposed solution for a CHE environment through the establishment of a Tactical Humanitarian Relief habitat.

B. DEFINITION

A CHE is a Post-Cold War era phrase that has been coined to describe man made, or man exacerbated disasters. A CHE is a situation in a country, region or society where there is a dramatic disruption in the political, economic and social situation, resulting from internal or external conflict or natural disaster, seriously disrupting the population's capacity to survive. These types of emergencies can result in massive numbers of refugees and internally displaced persons, gross violations of human rights and large-scale disruption of cultures within a country. In many cases, Complex Humanitarian Emergencies can require an international response and often times extend beyond the mandate or capacity of any one particular agency. The United Nations Office for the Coordination of Humanitarian Affairs has currently documented more than 22 on-going CHEs around the globe. (38)

Because of the extremely volatile political, military, and human nature of Complex Humanitarian Emergencies, they are very difficult to respond to and operate within. Basic relief in the form of food, water and shelter are a priority during the earliest stages. Safety, stabilization, and subsequent rebuilding become key issues as the relief effort progresses.

C. ORGANIZATIONAL INVOLVEMENT

During a CHE, a number of organizations will enter the region in an effort to provide stability and assistance. The military is usually the more dominant participant in a CHE. International forces provide security and logistical support in an effort to help stabilize the environment and act in a facilitating role to enable humanitarian support from civilian relief organizations. Military intervention may appear in several forms; coordinated under the United Nations (UN), multinational, or unilateral in its make up and organization.

Frequently, as was the case in Northern Iraq and Somalia, non-military relief organizations are operating in the affected region prior to an international military presence. There are a number of different relief organizations with a wide range of mandates and sponsors. They can generally be classified into two broad categories: Non-Governmental Organizations (NGO) and International Organizations (IO). NGOs are non-profit organizations that are not accountable to any government or profit-making enterprises. However, these organizations can work with governments and serve as channels for government assistance during relief efforts. Examples of NGOs are International Federation of the Red Cross, World Vision, Catholic Relief Services, and CARE International. On the other hand, International Organizations (IOs) represent inter-governmental or nongovernmental organizations with broad recognition and endorsement from governments. The following are examples of active IOs: the United Nations, European Union, and Office of Security and Cooperation in Europe. Their purpose is to regulate aspects of international behavior. (37)

D. DIFFERING GOALS

As Complex Humanitarian Participants enter into a region, they bring their own priorities, perceptions, vocational culture, motives, and agendas. During a natural disaster, the goals of the relief participants are usually similar and uncomplicated. However, in a CHE, aligning goals between all the participants is extremely complicated. Each CHE participant tends to have a different approach and operational point of view which make the accomplishment of the overall mission very difficult. This difficulty can be understood when examining the different operational objectives and cultural perspectives of the organizations involved. This is especially true between military and civilian participants.

In accordance with The Joint Doctrine for Military Operations Other than War, the joint task force (JTF) commander is focused on six principles during a Peace Keeping or Humanitarian Assistance Operation. They include:

- Objective – clearly defined
- Unity of Effort – seek team effort
- Security – never a hostile advantage
- Restraint – apply capability prudently
- Perseverance – enduring military support
- Legitimacy – perception of operation

The JTF Commander uses these principles in an effort to provide mission focus. From a military perspective, a high degree of importance is placed on the protection of forces and operational security. (13)

In contrast, Humanitarian organizations are guided by three principles as they respond to a humanitarian crisis:

- Humanity
- Impartiality
- Neutrality

These organizations operate from the premise that human suffering should be relieved wherever it is found. They provide assistance without regard to nationality, political or ideological beliefs, race, sex or religion. In order to fulfill their mandates, they must not allow themselves to become allied with a particular cause or side in an armed conflict.

E. ORGANIZATIONAL STRUCTURES AND CULTURES

In order to understand where one needs to go in a situation such as this, it is important to know where one stands now. All of the organizations involved in responding to a CHE have different organizational layouts, different cultures and different business practices. To summarize, the following is the current organizational status of each CHE participant.

1. Military

Generally speaking, military organizations are very structured and consist of well-trained personnel with multiple skill sets. Command and control is strictly hierarchical and centralized by design with limited flexibility. In most countries, law outlines organizational structure and the missions of the military, and control of the military is under the direction of the civilian government. In general, military personnel regard themselves as being separate and distinct from their civilian counterparts. They have very strong opinions as to what their identities and roles are in society. This is due largely to the ideal of commitment to "duty." Military members do not work forty-hour workweeks like typical American workers. They have given up certain rights and are willing to do jobs that most people would not find pleasant. They are usually disciplined and very patriotic. However, the most significant aspect of military members is the personal pride taken in their particular "profession."

2. International Organizations (IO)

IOs are organizations created by agreements between multiple countries. The UN and the Organization for Security and Cooperation in Europe (OSCE) are two examples. Generally, these organizations are "horizontal" in structure and depend largely on consensus voting to come to any decision. Additionally, and unlike the military, they do not have to respond to direction from outside the organization. They rely heavily on political relationships and tend to reflect the personality of the region in which they are operating. The membership of these organizations is largely made up of people with a "can do" attitude who are goal oriented and want to make the world a better place. However, it is important to note that the culture of an IO cannot be generalized, primarily due to the fact that there are so many of them and that they cover a broad range of functions. (37)

3. Non-Governmental Organizations (NGO)

NGOs are private, self-governing, not-for-profit organizations whose main goal is to assist those sectors of society that are underprovided for by other sectors of society. Their focus varies from organization to organization; therefore it is hard to generalize. However, usually a NGO is a chartered, privately operated organization that is controlled by a set of by-laws established by a board of directors. The membership content of these organizations is as broad as their missions. However, they are generally very specific as to their intentions.

These organizations tend to be very decentralized and non-hierarchical. The work is independently driven by each member and largely relies on the dedication of each member of the work force. These organizations are very flexible and can operate and react very quickly with little concern for relationships or direction from outside. (37)

F. CURRENT STATE VERSUS DESIRED STATE

Although the peacekeeping role of the UN has expanded, its most basic function of preserving order is beset with financial and political obstacles. Ethnic hatred, environmental deterioration, population growth, and poverty have escalated into what is now called the "new world disorder."

In contrast, and due in large part to the global communications revolution, the smaller NGOs are springing up all over the global community and are having a significant effect on the global society. NGOs are not only influencing the global dialogue, but also intergovernmental relationships and multinational corporations. NGOs are demanding and successfully organizing consultative roles at major global events. They are also influential players in annual meetings of international financial institutions such as the World Bank.

Although many NGOs were founded before the Internet revolution, they are now proliferating more rapidly because of the advances in computer networks and communication devices. In 1909, there were an estimated 176 NGOs. By 1994, that number had grown to over 20,000. The number of NGOs brings with it a multitude of organizational influences and decision-making criteria and methods. Many

NGOs consist of grass-roots organizations that only answer to their own national or sub-national network of partners. An IO on the other hand, has its own international governing body made up of representatives from many countries. These IOs can be further broken down into a country component. For example, Save the Children Federation in the United States is a US organization that is a member of the International Save the Children Alliance. This organization includes Save the Children organizations from numerous countries around the world. (37)

G. PROBLEM DEFINITION

As one can see, there are a number of organizational structures, decision making methods, international and national influences which lead to a disparate mesh of organizations trying to respond to a CHE. Additionally there is the lack of inter-organization communication, individual agendas, conflicting mandates and the lack of a common focus of effort. These affects come not so much from a particular organizational point of view, but from a systems point of view of all organizations contributing to a common intent for the CHE.

The organizations that become involved in CHEs are extremely diverse. These organizations operate simultaneously in theater. Each has its own organizational agendas, priorities, and structure. Even among organizations of the same type (i.e. NGOs); there can be high levels of disparity and competition. At the field level, communication between these groups is often problematic leading to shortfalls, friction, and redundancy of effort. As the military footprint is established in a

CHE, the communication gap often widens between all participants due to distrust of the military methodology and competing priorities.

The lack of communication among these organizations is the primary hurdle precluding effective relief efforts. The problems with communication among these organizations can be attributed to several factors; distrust lack of understanding, and competition for resources. This is extremely unfortunate in that this communication conflict often results in wasted time, redundant efforts, and wasted resources in the form of spoiled food. This lack of communication results in all of the CHE participants effectively countering their primary purpose for engaging in the CHE, which is to help those who need relief.

1. Military Intervention

When evaluating a possible solution, U.S. military forces, or any military coalition for that matter, will need to take account of social, political, cultural, religious, economic, environmental, and humanitarian factors when planning and conducting military operations. Planning must take into account the likely presence of international, local, national, and non-governmental organizations with their own aims, methods, and perspectives.

An additional consideration is the presence of the mass media and the expectations of both the international and local communities that form part of that media's audience. Effective relationships with a wide range of civilian organizations as well as local populations, governments, and other military forces will, most likely, be essential to the success of future operations. Civil-military interface and cooperation will require resources, arrangements, and activities in support of the mission that foster liaison, coordination, and cooperation between and among the coalition force and other key elements in the civil environment. Civil-military activities should be an integral part of the coalition commander's plan and be conducted in support of the overall mission and objectives.

In general terms, the purpose of civil-military cooperation is to help create and sustain conditions that support achievement of a lasting solution to a crisis, even after the military pulls out of the operation.

2. System Archetype

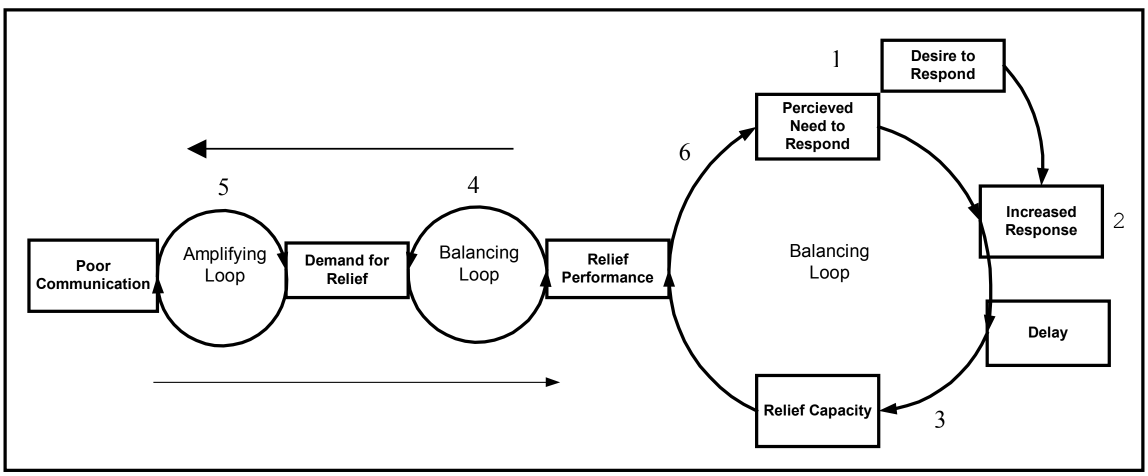


Figure 4.1. Archetype Model

The archetype model pictured above describes the current state of a relief effort based on the need to respond. Starting at #1, there is a need that arises. This triggers the desire to respond by various organizations. There is no communication or coordination at this point so the response may either exceed or fall short of the actual need. All we know is that by #2 the level of effort has increased from where we started at #1. At #3 there still hasn't been any coordination and this is coupled with any delay it may have taken in responding to the initial need at #1. The situation can be exacerbated at this point if there is a perception the need is not being met and the call will go out again asking for organizations to respond. At #4 we see the level of relief capacity providing a level of relief performance balanced against the current demand for relief support. If the capacity to respond matches the demand in both scale and quality, then performance will be acceptable. The demand, capacity and level of performance all depend on the communication channels available shown at #5. These communication channels are the critical link and essential to coordinating the *need* with the *response*, the *demand* to the *capacity* and ensuring an acceptable level of performance. The quality of this communication will determine how well the needy are helped and how efficient and timely an organization's response will be. Currently, the communication process in a CHE is not sufficient to always meet an acceptable level of performance and results in inefficiencies and unfulfilled needs. By the time we get back to #6 no one has a clear understanding of what has been met and what hasn't. This can result in redundant efforts or worse yet a need that receives no response at all.

3. Proposed Solution

In light of the information presented in the previous section, there needs to be a change in the mindset of the organizations involved in CHEs. The interaction between the CHE participants is unstable at best and needs to be improved. A recommended solution that could assist in the humanitarian assistance realm is an open system model diagramming the preferred environment. This model will be helpful in understanding the environment and may encourage all the organizations involved to initiate an internal change to work together in a synergistic fashion. In addition, we believe that the creation of a habitat would aid in restoring trust and confidence among the CHE participants, and encourage communication between all the organizations.

A habitat is a dynamic virtual construct that allows a set of collaborating components to come together and form a team to solve a specific problem. The habitat resides within the global information grid (GIG), using smart information exchange infrastructure technologies, to facilitate the intelligent tailoring and dissemination of knowledge. Simply networking components together does not create a habitat. Components must be able to share resources (information, services, etc.) in a way that optimizes their ability to carry out their assigned tasks effectively within constraints imposed by security or policy. A habitat is dynamically created to support a specific operational mission. It interfaces with other habitats as well as all other "legacy" systems, assets, organizations, or individuals (equipped with a compatible interface or "wrapper"). In order to do this effectively, every habitat uses a "Habitat Specification (HSPEC)" to identify itself, present its credentials, and describe its information requirements and contributions. When enabling a new habitat, a "HSPEC" is automatically formed. The HSPEC identifies:

- The role, or job, of the habitat (based on policy and doctrine)
- Parameters that are important for determining the context in which the habitat is operating
- The security levels, policies, and rules associated with that role
- The physical characteristics (hardware, operating system, communications capabilities, etc.)
- The resource requirements based on the problem or task at hand, potentially tied to formal (machine interpretable) representations of the workflow being executed goal. (38)

H. NETWORK-CENTRIC INFRASTRUCTURE FOR COMMAND, CONTROL AND INTELLIGENCE (NICCI) HABITAT CORE CAPABILITIES

The focus of Defense Advanced Research Projects Agency (DARPA) NICCI is to quickly assemble habitats that seamlessly integrate ad hoc components into an effective task force. This is especially challenging and critical when conducting coalition and CHE operations. NICCI will provide the commander with the tools and capabilities necessary to monitor component performance with regard to the integrated processes and the desired end state. The NICCI approach will be used to provide the information exchange infrastructure for the habitat. Additionally, NICCI will facilitate the ability to coordinate and implement solutions for disparate, distributed, task oriented teams. The technologies that will enable the NICCI approach are characterized by the following six core capabilities: Dynamic Information Management, Dynamic Policy Management, Dynamic Context Management, Dynamic Trust Management, Dynamic Resource Management, and Dynamic Reconfigurability Management. (38)

The habitat will incorporate a Dynamic Information Management capability to share information among habitat components in a seamless, interactive, and reliable manner while enabling controlled interactions among and between habitats, and the rest of the world. There are four major software agents that will be used for the Dynamic Information Management in the Tactical Humanitarian Relief habitat. An agent will be used to accomplish each of the following tasks: resource problem-solving; find, filter and present information for users; provide services to other agents to help them cooperatively solve complex problems; and provide translational services between agents using different standards, communications protocols, languages, etc. Large-scale, cooperative teams comprised of interacting agents from all four groups, could offer new capabilities that are beyond the realm of current software designers. An infrastructure that could provide these capabilities would allow software developers to design smaller pieces of code that would primarily function on solving problems via interaction with each other, rather than by each trying to duplicate functions provided by others. (38)

The heterogeneous systems (Groove, ROCC AND VCMOC, etc), separately developed, will be integrated into compound systems at run-time, based on the needs of the particular problems being solved. Finding these code pieces would be enabled by yellow page servers using taxonomies of common functionalities. Where gaps might exist between the agents, functions such as translation services could provide greater interoperability by seamlessly filling in the pieces. Members of the habitat will be able to program and interact with their agents using interface tools that would allow them to set preferences and describe needs without needing to specify algorithmic details. In addition, the entire GIG of cooperating agents could be managed by the brokering agents – which would help to manage the efficient flow of information across the grid. These agents could also provide tools for access control and information security, and they could provide a database allowing post hoc analysis of problem solving and other grid management services.

The habitat will contain a Dynamic Resource Management capability that is responsible for building a list of key habitat parameters that will communicate to other habitats its purpose, authority, current status, and available resources. This capability will also coordinate with Dynamic Context, Policy, and Trust Management capabilities to generate and maintain the list of resource requirements deemed necessary to accomplish the given objective. As habitat memberships are established, this capability will manage the resource requests both from the local habitat to connected habitats, and vice versa.

Members of the habitat will be able to setup queries to search and filter large knowledge databases, to search through the net or other information sources, or to find computational resources needed for the problems they were trying to solve – all without needing to know the details of the underlying systems or information repositories. Current "legacy" systems will be brought to the grid through software wrappers and service descriptions, allowing their functionality to be tapped without major recoding. In addition, the cooperative nature of the problem solving, using existing software components, would allow both military and industrial users to continue to develop large scale applications without large scale software development efforts. (38)

The habitat will incorporate a Dynamic Policy Management capability to help keep the conflict of rules between all the habitat members to a minimal. At the field/tactical level, communication between the NGOs and IOs is often uncoordinated and/or nonexistent leading to shortfalls, friction and redundancy of effort. As the military footprint is established a U.S. sponsored joint task force (JTF) or some multinational force, the communication gap often widens between all participants. One reason for this communication gap is the distrust of the military by the NGOs and IOs. These organizations operate simultaneously in theater, each with their own organizational agendas, priorities, and structure. The habitat will incorporate a Dynamic Policy Management feature to help overcome this problem. (38)

The habitat will incorporate a Dynamic Context Management capability to the ability to understand the processes and resources needed to accomplish the task under different environmental conditions. Different contexts may require the adoption of different authority and accountability relationships, dynamic task workflow or priorities, needed and available information assets, ontologies, and information processing services. Once enabled, the Dynamic Context Management capability will generate a list of recommended habitat resource requirements it needs to help accomplish its mission. After generating the list, it will coordinate with Dynamic Trust

Management to connect to those available and relevant habitats. It will coordinate with Dynamic Information Management and Dynamic Resource Management. (38)

The habitat will incorporate a Dynamic Trust Management capability to establish and maintain the trust relationships with other habitats, human, or legacy components, as they become available and unavailable, and making sure that only those components that are authorized have access to local resources. Therefore, the capability requires:

- Establishing and maintaining information assurance policies and rules
- Establishing and maintaining chains of trust
- Incrementally establish trust relationships
- Maintaining trust relationships (including dealing with dynamic membership
- Negotiation to authorize access to new components
- Dynamically updateable
- Extend and revoke credentials across systems and networks
- Deal with both symmetrical and asymmetrical trust relationships
- Auditing mechanisms to support analysis, traceability, and accountability. (38)

As the habitat is established, the Dynamic Trust Management capability will coordinate with Dynamic Resource Management to get a list of habitats to connect to, and then will coordinate with Dynamic Policy Management to automatically establish trust relationships with those habitats. (38)

The CHE environment is dynamic with quickly changing operations, hardware and software moving, connecting and disconnecting, and bursty bandwidth availability. Dynamic Reconfigurability will exist in the habitat to monitor and analyze the health of the habitat, adjust resource availabilities, and usages appropriately to ensure that the habitat performs productively. This will allow the habitat group and their relationships to change over time. Dynamic Reconfigurability is basically a life cycle management capability that will enable habitats to automatically react to changes in tasking, policy, and authority, as well as failures, faults, and attacks. Causes for these types of changes may be due to changes in the habitats goals and objectives, tasking or command structure, configuration of forces, situational context, and availability of resources, temporary network or processor failures or faults, or total loss of resources. Therefore, this capability requires features that allow the habitat to self-heal, self-organize (i.e., dynamic recruiting and shedding of resources), self-configure, and provide an overall damage tolerance capability. (38)

I. HABITAT COMPONENTS

The first component to fulfill the construct requirements of the Tactical Humanitarian Relief Operations habitat is a collaborative tool called "Groove." A Groove Workspace is a virtual space for small group interaction. In a Groove Workspace, users make immediate and direct connections to perform a wide variety of activities – from working on a project, brainstorming, planning an event, discussing issues, sharing drafts and proposals, coordinating schedules, to just getting stuff done. This is all done using a networking technique called peer-to-peer (P2P). The essence of P2P is establishing a direct connection between people, so IT isn't necessarily involved. There are tools in the Groove Workspace that facilitate the sharing of content (files, images, maps), conversations on that content (discussions, instant messages, live voice, text-based chat), and working together on shared activities (real-time co-editing and co-viewing of documents, co-browsing, group project management and tracking, meetings management). By bringing these tools together in a single construct, the Groove Workspace streamlines work and communication so that teams can speed up their decision-making and cycle time. (39)

Groove Workspace's awareness capabilities promote serendipitous as well as planned collaboration. Each shared space shows the online status of all members, so that when two or more members 'find' themselves in the same shared space at the same time, they are able to quickly take advantage of the situation and work together in real-time. Likewise, a single user can glance at a single view of all shared spaces to see if there are any 'active' members. The ability to know who is currently and actively working on certain projects is a new and powerful catalyst for enhanced productivity.

While using Groove as the habitat's construct program, the second component of the Tactical Humanitarian Relief Operations habitat are web-based applications called the "Relief Operation Coordination Center" (ROCC) and "Virtual Civil Military Operation Center" (VCMOC)." (37, 40) The ROCC and VCMOC are technological tools that use central HTML and Active Server Pages (ASP) to interface with a database to insert, edit, view, delete and manipulate information to enhance multi-participant communications and the sharing of data. The application will improve the overall dissemination of vital information leading to a breakdown in communication barriers and a focus on mission success.

The ROCC and VCMOC are designed to promote and support better information transparency and exchange to reduce operational security risks and avoid duplication of efforts. It has the capability of keeping information on organizations’ activities, plans, and resources available and up to date. The ROCC and VCMOC will provide the location for field assessments and databases to assist planners, pre-deployment actors, implementers, and post-crisis analysts. Furthermore as a web-based application, it is mobile and accessible with Internet connectivity. The main reason that the ROCC and VCMOC is embedded in Groove is to enhance the ability of geographically distributed users' to plan, organize, and team up for problem solving.

The following system requirements and capabilities have been identified to allow a common, neutral collaboration interface:

- A listing of the organizations and their mandates involved in the relief effort
- Points of contact for organizations involved in the relief effort including a listing of the skills, supplies and number of people being provided by each organization
- The capability to manage displaced persons, tracking home of origin, current location, family members, and medical condition

- The ability to search a database to locate specific organizations, points of contact, needs and requirements or displaced persons.
- Timely and accurate situational awareness information concerning the history, current situation and projected situations for the relief area to include danger areas, infrastructure, safe areas, access routes, media contacts, local authorities and maps
- A tool to better coordinate and communicate between NGO and military units involved in the relief operation
- Awareness of logistical needs such as medical, food, shelter and clothing supplies. Where they are needed, when and how much
- Mobile capability provided by the use of wireless and handheld technologies. (41)

The ROCC and VCMOC has built in reports, queries, and database search options using SQL statements (manipulate and categorize the raw data) to provide useful information for decision support and situational awareness to the end user. Online meetings, discussions, document sharing and editing, planning and executing of operational issues such as personnel and materiel movement and delivery are possible with the application. Using the mobile technology (wireless devices, laptops, and handhelds) IOs, NGOs, and military units involved in relief operations will have the capability to communicate and coordinate with one another. This communications occurs despite the physical distances that may separate the members of the habitat and the lack of an established telecommunications infrastructure.

The ROCC and VCMOC is a tactical/field level operational support tool. It is highly mobile, rapidly deployable, and able to interface with a larger more robust system once the CHE reaches a more mature stage. The ROCC and VCMOC will be assessable through the Internet or the web browser feature of Groove. By using the ROCC and VCMOC within Groove, the members of the habitat will be able to self organize. Having situational awareness of each other and the current status of the relief effort, the habitat members will experience an unprecedented environment that will allow the IO/NGO/military to work together and focus more of their efforts on helping people in need vice communicating.

1. Habitat Nodes and Sensors

A node is a connection point, either a redistribution point or an end point for data transmissions. Additionally, a node has programmed or engineered capability to recognize, process or forward data or information to other nodes. The most popular node in the Tactical Humanitarian Relief Operations habitat is the computer. Computers will be used to send emails, instant messages, and voice over Internet protocol (IP), send files, and search the Internet. Ubiquitous computing will come in many shape and forms in this habitat. The members of the habitat will have laptops, client/server workstations, personal display assistants (PDA), and pocket computers (PC). Though the technology resident in PDAs and pocket PCs is limited when compared to a laptop or workstation, these computers still allows users to conduct basic functions such as send emails, instant messages, send files and search the internet. The computers that are used in the habitat will utilize a telephone line, a fiber optic cable, or a wireless network infrastructure.

Another node in the habitat is a ruggedized portable integrated communications system called the TAC-PAK. This system is a lightweight, battery powered, man portable communication system with full wireless communications functionality integrated into a small suitcase. Personnel operating in remote locations will have full communications capabilities available to them anywhere (back seat of a car, picnic bench, emergency site, etc). The TAC-PAK was developed for emergency incidents in the field. Available options in the battery powered and modular TAC-PAK system include an environmentally secure carrying case, Pentium laptop computer, three simultaneous RF data lines, color printer, fax, copier, digital still/video camera with voice annotation, document scanner, cellular telephones, satellite telephones, GPS system, GIS system, television receiver, and video conferencing. Although the TAC-PAK was researched, it was not used due to its limited bandwidth utilizing the INMARSAT system. The availability of the NASA ACTS satellite system provided the bandwidth desired for this project. (42)

NASA Advanced Communications Technology Satellite (ACTS) is the third node in the habitat. ACTS was developed as an experimental on-orbit, advanced communications satellite test bed, bringing together industry, government, and academia to conduct a wide range of technology, propagation, and user application investigations. This satellites operations in the Ka-band radio spectrum (30/20 GHz) where there is 2.5 GHz of spectrum available for use — five times that available in lower frequency bands. The ACTS network is comprised a variety of terminal types. Two general categories of terminals were developed: fixed and mobile earth stations. We will be using one of the mobile earth stations that were loaned to NPS for research. The ground station is called the Ultra Small Aperture Terminals (USAT) are similar in size to direct broadcast television terminals. The USAT can provide uplinks as fast as 1.5 Mbps as well as downlinks to 45 Mbps. The primary use of the ACTS/USATs in the habitat is for high speed Internet service and real-time video conferencing. (43)

The fourth node/sensor and the most important in the habitat are the habitat members. A sensor is normally a device that feeds raw data values into one or more systems. Physical sensors that provide the raw data vary in quality, reliability, and the extent to which their values must be filtered and combined with others to obtain useful information. A sensor might be as simple as a software switch recording the fact that a pilot turned on an instrument or as complex as an Air Data Computer that reports a number of atmospheric measurements. Humans have built in sensor capabilities too. For example, when a CHE participate inputs to the system (e.g., manually entered position coordinates) he or she also plays the role of sensor data or information provider.

The primary role of the user will be to provide the cognitive and analytically knowledge required to accomplish the requirements of the habitat. Agent technology will be used to take sensor input from habitat members and Global Positioning System (GPS) receivers to match resources with requirements. However, the maturity of agent technology is years from replicating complicated requirements that requiring thinking outside of certain rule set. The ability of humans to learn is unparallel to the capabilities of agents to do so today.

The only equipment sensor that will be used in the Tactical Humanitarian Relief Operations habitat is a GPS receiver. GPS is the only system available today that shows you your exact position on the Earth anytime, in almost any weather condition, anywhere. GPS satellites, 24 in all, orbit at 11,000 nautical miles above the Earth. They are continuously monitored by ground stations located worldwide. The satellites transmit signals that can be detected by anyone with a GPS receiver. Using the receiver, you can determine your location with great precision. Members of the habitat who are operating in a tactical or field environment can navigate in their area of operation and provide position location reports to the other members of the habitat through the use of a GPS receiver can be inserted into a pocket PC or laptop computer. There are several commercial GPS programs that are available for use on the pocket PC or laptop computers. (44)

2. Habitat Taxonomy

A space populated by collaborative technologies is called the T-Space. Each individual groupware product or technology is represented by a point in this large space. Categories of similar technologies are represented by regions in the space, which is the framework. Taxonomies of groupware systems are usually based upon same/different time/place and areas of application. In this paper, we will use the keeper coordinator communicator agent (KCCA) aspects model, which is a classification based upon categorization of groupware according to its T-Space functionality. The first aspect, keeper, groups all functionality that is related to storage and access to shared data. The second aspect, coordinator, is related to the ordering and synchronization of individual activities that make up the whole process. The third aspect, communicator groups all functionality related to unconstrained and explicit communication among the participants. (44)

There are many examples of keepers in the Tactical Humanitarian Relief habitat. One example is the ROCC and VCMOC. This application contains a specialized database of artifacts that can be shared in P2P and/or client/server network architecture. It allows multiple users to simultaneously access the camp diagrams, task and resource requirements, and points of contact information. When used in the Groove construct, it also allows the habitat members to systematically track the work of others. An example of a keeper feature in Groove is called access control - (who has access to what, and who is allowed to change this access?). The owner of the shared workspace in Groove has the ability to set permissions of the members of the space. Additionally, Groove has an awareness feature in its document section that gives versioning, time-stamping, and change agent information.

Sometimes the emphasis of a group is not on artifacts, but on activities that must be performed in a specific order to fulfill certain group goals. The calendar and task features of Groove demonstrate the coordinator components of the application. The application sends notification to users that they may start an activity, or that an activity is late. Agents imbed within the ROCC and VCMOC will assist in the synchronization of steps in the process, execute automatic activities, provide helpful data and notifications, and keep track of important information such as state of a job or process, and deadline dates. If necessary, the agents will send reminders to critical members of the habitat when deadlines are missed. For example, let us say that a warehouse of grain needs to be delivered to a camp. The task is posted in the requirement section of the ROCC and VCMOC for visibility by all the habitat members. Whoever can fulfill the requirement will simply bring up the task and check the "I can fulfill" checkbox under the requirement. Then an agent will notify the habitat member that their requirement has been fulfilled and by whom.

Communication is a basic aspect of any collaborative endeavor. In a mainly keeper application such as a database, there is implicit communication when one participant changes the data and that is observed by the others. In a mainly communicator application, there is implicit communication when one participant finishes an activity that enables other participants to start other activities. But in many endeavors, there is also a need for explicit communication among the participants. The communicator aspect of Groove is electronic mail (text or voice), instant messaging, voice over Internet protocol (IP) for real-time communications and the awareness feature that shows what habitat members are doing when the mouse arrow is placed over their name or a section with the workspace. On the other hand, the ROCC and VCMOC as a standalone application only communicator feature is email.

3. Networking Platform

The networking platform for the habitat will be a combination of Peer-to-Peer (P2P), client-server communications, wired and wireless Local Area Networks (LAN), and access to the Internet cloud. P2P will be used to take advantage of fully distributing service functionality among all nodes participating in the system and routing individual requests based on a small amount of locally maintained state. The goals extend much further than just improving raw system performance: such systems must survive massive concurrent failures, denial of service attacks, etc. Client Server will be used to allow members of the habitat to access information from the internet to maintain a knowledge base and use the Groove applications, which requires some client-server interaction for establishing and locating users.

The P2P wireless collaborative network will be comprised of mobile terminals (Pocket PC (iPAQ) with GPS receiver and/or wireless laptop) with connectivity to wired or wireless LANs. Access points will be distributed in the area of operation to provide local area coverage and routing functionality. Servers capable of handling application and web request from clients and uploading/downloading data via satellites or telephone infrastructure capable will be used too.

J. AGENT TECHNOLOGY PLATFORM

Control of Agent-Based Systems (CoABS) is a program of the U.S. Defense Advanced Research Projects Agency (DARPA) to develop and demonstrate techniques to safely control, coordinate, and manage large systems of autonomous software agents. DARPA is investigating the use of agent technology to improve military command, control, communication, and intelligence gathering. CoABS will be used to bridge different systems, because of its ability to wrap legacy systems and interfaces to other components (or agents) and legacy systems. This ability to work with other components and legacy systems to accomplish complex tasks in flexible teams instead of using a single monolithic application to adapt to changes in the battle space, the task at hand, or the computing environment is critical to the functioning of the habitat. Groove will allow us to scale collaboration communities involving people, systems, and databases. This will support the requirements of the members in the habitat to for an environment that improves their ability to share and organize data, information, and knowledge in addition to managing the interactions of the entities involved. (45)

The CoABS Grid is middleware that integrates heterogeneous agent-based systems, object-based applications, and legacy systems. It includes a method-based application programming interface to register agents, advertise their capabilities, discover agents based on their capabilities, and send messages between agents. The grid also provides a logging service, to log both message traffic and other information; a security service to provide authentication, encryption, and secure communication; and event notification when agents register, deregister, or change their advertised attributes. The CoABS Grid features include flexible run-time communications and dynamic registration and discovery of relevant participants. It is adaptive and robust, with the system evolving to meet changing requirements without reconfiguring the network. The grid is only one part of the overall CoABS program, the plumbing that connects the legacy system components to solve real world problems. Therefore, you can also think of the grid as this infrastructure layer and all the agents and services running on it. (45)

Currently, there is not a formal, unbiased, technological based CHE or Peace Operations ontology or operations support system in place that would facilitate the sharing of data and information. The Tactical Humanitarian Relief Habitat described in this chapter is our recommended solution. This habitat was designed to improve the overall dissemination of vital information leading to a breakdown in communication barriers, less organizational friction and redundancy of effort between the IOs, NGOs, and military units.

V. DEVELOPMENT OF A TECHNICAL EVALUATION

A. INTRODUCTION

The research of this thesis thus far, has focused on further development of a working prototype of a collaborative and information sharing habitat designed to support Civil-Military Operations (CMO) during a CHE. The overarching intent is to take the technology of a previously developed proof of concept (The ROCC), combine it with the emergency site tactical communication platform (NASA Advanced Communication Technology Satellite (ACTS)), the NICCI Habitat concept, the functionality of the CMOC, collaborative tools, wireless technologies, and a situational awareness application and integrate them to form a peer-to-peer, interagency, information sharing habitat. This technical evaluation will seek to demonstrate how the successful integration of these functionalities will prove effective in facilitating information sharing and collaboration by all organizations involved in a CHE.

Currently, there is not a formal, unbiased, technologically based CHE ontology or operations support system in place that would facilitate the sharing of data and information (25) during a CHE. In order to facilitate the efficient collection and dissemination of the information relevant to a particular CHE, a robust, reliable, and redundant communication architecture, that provides universal access for all organizations involved, is required. This fundamental requirement, however, poses a challenge since every CHE is different in its composition, organization and location. This is especially true in cases of interoperating with the legacy equipment that is utilized by many organizations (e.g. NGOs, IOs and Host Nations). It is also true for those rural areas that have no infrastructure due to a much lower subscriber density, or areas with geographic challenges such as large bodies of water, jungles, and mountainous terrain. Finally, interoperability between multi national forces and requires detailed coordination to facilitate effective communication.

B. COMMUNICATION ARCHITECTURE

A communication architecture that is representative of what would be used in a CHE environment will be utilized in the design of this technical evaluation, however, this architecture will be flexible and scalable in order to accommodate the different environments in which a CHE may occur. Wireless technologies will be examined in order to take advantage of the reduced logistical footprint required in wireless communication networks. Satellite communications will also be utilized in order to demonstrate establishing worldwide connectivity without existing infrastructure. Furthermore, access to information resident on a database through a web based application utilizing these communications means will be demonstrated. Figure 5.1 shows the diagram of the basic communication architecture.

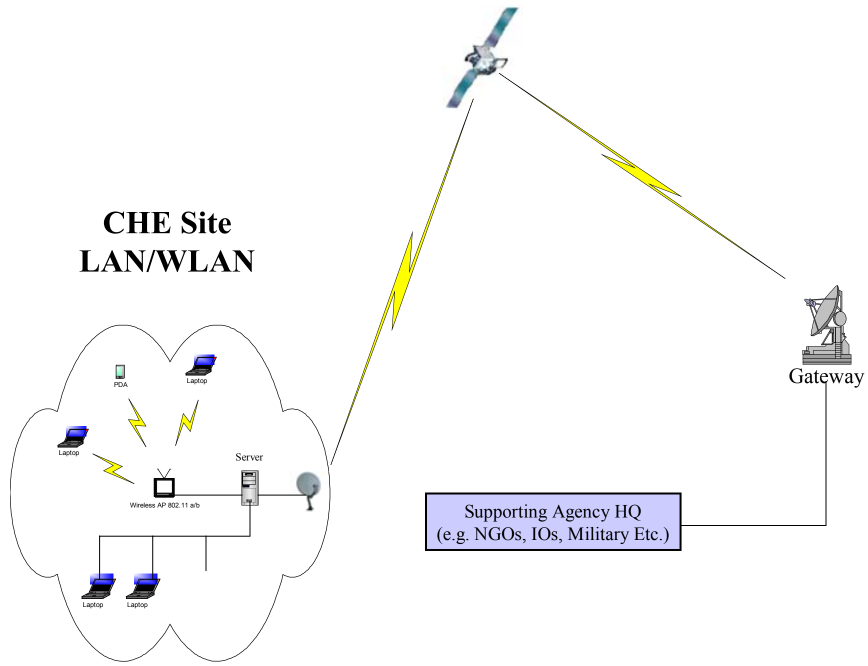


Figure 5.1. Basic CHE Communication Architecture

In its most basic sense, a Network is a way to connect machines or computer systems in order to exchange information quickly and with relative ease. Essentially, a network is information technology and business rules combined in such a manner to be used as a tool to increase business proficiency. A network is nothing more than wires, data, connections, and the users who access the mediums and information. Our network, although it will provide this same type of basic functionality and connectivity, is intended to provide the organizations involved in a CHE the access to an 'environment,' a habitat, that is specific to a CHE and is further connected to other habitats by way of the CoABS Grid (The CoABS Grid is further discussed later in this chapter under the Situation Awareness Tool).

1. Habitat Components

This section will discuss the different components that provide the framework for the habitat that is being presented and evaluated in this thesis. There are four main components to the habitat; the Virtual Civil-Military Operations Center (VCMOC), the Relief Operations Coordination Center (ROCC), a Situational Awareness (SA) tool, and a Collaborative Tool. These components, once integrated with the network architecture, are the essence the habitat.

a. Virtual Civil-Military Operations Center (VCMOC)

Before discussing a 'Virtual' Civil-Military Operations Center (VCMOC), it is appropriate to recall the information about a CMOC discussed in Chapter II. The Virtual CMOC concept is another cutting edge technology project pursued by USPACOM and its resources. This program is still at a very early stage. It is presented here because it directly applies to our area of research and has the potential to embody the concepts and findings presented within this thesis.

The Virtual CMOC concept stems from the need to maximize the availability of information to as many CHE participants as possible. As mentioned above, the CMOC is the U.S. Military's principal field level coordinating mechanism during Civil-Military Operations and CHEs. The Virtual CMOC will focus on using technology and taking existing information structures and looking for efficient and rapid ways to digitally process and share the information. This would enable critical information to be accessible not just at the field level in a designated tent or building, but at the operational and strategic levels as well via a data network. This will also help integrate, and more widely disseminate, key pieces of data. The framework of the Virtual CMOC depends heavily upon the following:

- United Nations documents
- Local procedures
- CMOC policies, procedures, meeting schedules, agendas
- Reporting formats
- Other operation-specific references

The above information sources and processes will help structure the core functionality of the Virtual CMOC. Although much of the functionality for the Virtual CMOC is still under development, there is a basic consensus of what should be included based on research (46). Some of the already agreed upon capabilities involve:

- Humanitarian tracking. The ability to provide a database of who's doing what where. This would enable operational planners, both military and civilian to focus effort and maximize resources.
- Assistance request and tracking. One of the main functions of the CMOC is to provide a place where civilian agencies can request assistance from military forces. The ability to process and track these request for assistance would be a vital function of the Virtual CMOC.
- Personnel locator. During an operation in response to a CHE, finding key personnel can be difficult in a chaotic environment. The Virtual CMOC would incorporate the ability to locate and perhaps contact key decision makers during a humanitarian response. (IBID)

b. Relief Operations Coordination Center (ROCC)

The one common denominator between each of the participants in a CHE is the need for timely and accurate information. The ROCC application is a dynamic. HTML-based tool designed to enable these disparate organizations to access and share relevant pieces of data synthesized and made accessible through technology. This application has the ability to provide a digital bridge by enabling these organizations to collaborate, coordinate and share information via web interface. This information might not normally be shared due to differing mandates, cultures or competition for funds. The ROCC application provides a filter for these biases. Information is the currency and its source is unimportant, as long as it is accurate and timely and can be used to facilitate the relief effort.

The thesis will integrate the ROCC into a network-based, collaborative environment that will allow for improved coordination among agencies and organizations that provide relief during and after CHEs. The integration and further development of this application will increase efficiency in providing relief, thereby reducing costs, reducing spoilage, reducing redundancies and therefore ultimately increasing the amount of people who may receive the assistance. It is our belief that this application will be cost effective since it requires the customer to have only a web browser, and it will also contribute to the saving of lives.

The ROCC has some of the functionality of the intended Virtual CMOC, which once integrated into the entire system, would provide a wealth of functionality for users during a CHE. For example, The ROCC can provide a database of who's doing what and where they are doing it. This enables operational planners, both military and civilian, to focus effort and maximize resources. The ROCC also has the ability to request for assistance. Assistance requests and tracking is one of the main functions of the CMOC. The ROCC provides a place where civilian agencies and other organizations can request assistance from military forces. The ability to process and track these request for assistance is a vital function of the Virtual CMOC. Additionally, the ROCC has a personnel locator function. During an operation in response to a CHE, finding key personnel can be difficult in a chaotic environment. The ROCC incorporates the ability to locate and perhaps contact key decision makers during a humanitarian response.

c. Situational Awareness Tool

Within the Department of Defense (DoD), shared situational awareness (SSA) is generating a lot of interest as a new paradigm for Command and Control (C2) and the common operating picture at the small unit level. The U.S. Defense Advanced Research Projects Agency (DARPA), Advanced Technology Office (ATO) researches, demonstrates, and develops high payoff projects in maritime, communications, special operations, and information assurance and survivability mission areas. The ultimate goal is superior cost-effective systems the military can use to respond to new and emerging threats. Currently ATO is working on a SA project for small unit operations to provide mobile communication system with high data-rate capacity that is optimized for restrictive terrain (46).

In 2002, the Joint Futures Laboratory of the Joint Forces Command (JFCOM) Joint Experimentation

Directorate and NPS conducted the Limited Objective Experiment over a period of several months culminating with a role-playing scenario 12-14 March 2002. SA is defined as the real-time ability to acquire and process a host of different data in a constantly shifting environment, and the ability to translate an assessment into action aimed at maintaining integrity (of self, of dependants, of mission) – basically, SA is knowing what is going on around you and adapting to it. Some of the objectives of the LOE were to explore these key factors in SSA, determine the situational awareness of the individual team members, the overall generic SA of all teams (together), the SA of the en route Supporting Area Commander, and the JFCOM headquarters in Norfolk, Virginia.

In response to an interest in exploring SSA, a web agent based application titled "CHE situational awareness tool" was created to study SSA in the field environment as it relates to CHEs. The purpose of the CHE SA tool is to allow CHE participants to have SSA of each other's location and common knowledge of events in their area of work. The tool is designed to use either the Microsoft Internet Explorer or Netscape Navigator browser as the graphical user interface (GUI). The user determines which browser they will use to interface with the CHE SA tool based on their preference for an Internet web browser.

Flash application is the technology that is used to bring pictures and icons into the web browser in the CHE SA tool. Flash is used to develop interactive animated graphics for the SA Management Agent to display. This application is bandwidth-friendly and has browser-independent vector-graphic technology. Flash requires

Microsoft Windows as the operating system and the flash plug-in has to be downloaded if a CHE participant doesn’t have it as a standard feature with there web browser. Within the CHE SA tool, Flash takes the input/output of the agents through the sockets to work to support the display functionality provided by the SA Management Agent.

The CHE SA tool exists in two different spaces at the same time. The web server (client/server) is the first space that is discussed. The client/server software architecture was chosen for one of the spaces for the CHE SA tool because it is a versatile, message-based and modular infrastructure that is intended to improve usability, flexibility, interoperability, and scalability in networks. A single machine can be both a client and a server depending on the software configuration. A major advantage of making this tool a web-based application is that clients do not have to download any software in order to use it. Thus, the user gets the best of both worlds by taking advantage of the benefits of client/server architecture while not requiring clients to download or purchase the CHE SA tool as an application. As long as CHE participants can get network connectivity, they will have access to the CHE SA tool.

The Control of Agent-Based Systems (CoABS) grid is the second space that the CHE SA tool resides. CoABS, a current program of DARPA, is designed to develop and demonstrate techniques to safely control, coordinate, and manage large systems of autonomous software agents. The CoABS Grid is middleware that integrates heterogeneous agent-based systems, object-based applications, and legacy systems. It includes a method-based application-programming interface to register agents, advertise their capabilities, discover agents based on their capabilities, and send messages between agents. The grid is only one part of the overall CoABS program; it is the plumbing that connects the components of legacy systems to solve real world problems. Therefore, you can also think of the grid as an infrastructure layer and all the agents and services running on it. (45)

The CHE SA tool is a multiagent system that consists of several software agents that perform a number of functions. All of the agents reside on the CHE SA web server. The first agent is called the GPS Tracking Agent. This agent provides the input data to the SA Management Agent. The data that the GPS Tracking Agent will collect to supply to the SA Management Agent will come from a global positioning system (GPS) receiver. If the CHE participant is inside a building or does not have a GPS receiver, the GPS Tracking Agent can accept manual inputs from the CHE participant to provide location information to the SA Management Agent.

The SA Management Agent is the second agent in the CHE SA tool. This agent provides the visual interface display for all CHE participants through their web browser. This agent supports the SSA of all the users. The SA Management Agent uses input from the Flash and the GPS Tracking Agent to display the location of CHE participants and significant events.

The CoABS Grid Agent is the third agent in the CHE SA tool. This agent performs the liaison role between the CHE SA tool and the CoABS grid. The CoABS Grid Agent makes bridges to different systems, because of its ability to wrap legacy systems and interfaces to other components (or agents) and legacy systems. This allows the CHE SA tool to use data from any database that is a part of the grid. This approach was taken to overcome the challenges of stove-piped legacy systems.

The Agent Database is the final agent in the CHE SA tool. This agent is the manager of the database repository for all the events that occur in the CHE SA tool. For example, when a CHE participant wants to use the CHE SA tool they will have to login to the tool via their web browser. This login event along with all the actions of the CHE participant in the CHE SA tool are captured and stored by the Agent Database in a database.

d. Collaborative Tool

The potential of a network to take advantage of "intellectual capital" has created a demand for collaborative technology. The intent of collaborative technology is to provide a medium within which people may coordinate their individual activities regardless of their location. This is a powerful capability; however coordination of activities requires time for interaction. Subsequently, one of the main focuses of collaborative technologies is to provide a means of coordination that requires little time but increases access to pertinent information.

The collaborative tool this thesis has chosen to utilize is 'Groove.' Figure 5.2. Groove is a decentralized collaboration platform designed for peer-to-peer interaction across technical and organizational boundaries (such as firewall protected corporate LANs). Groove is premised on the belief that effective collaboration between enterprises is a requirement for organizations serious about productivity.

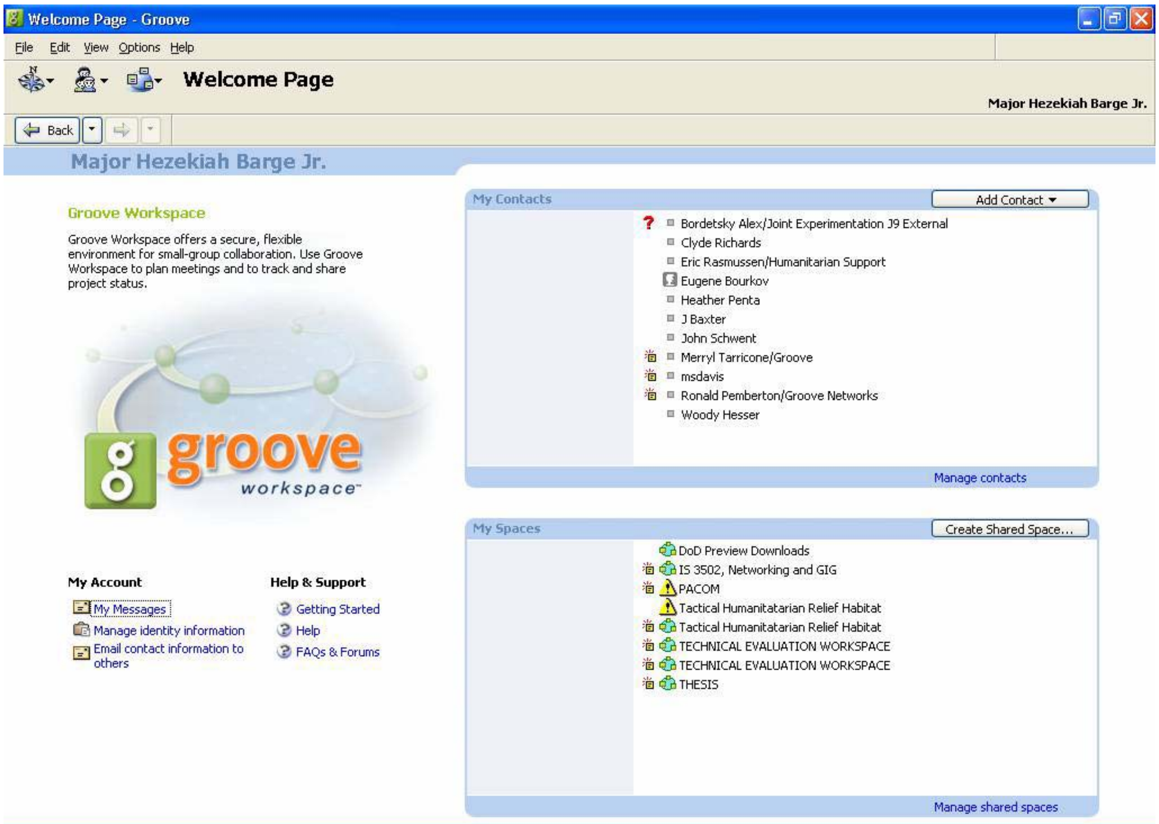


Figure 5.2. Groove Home Page

The Groove architecture allows the user to be in control. The application and content sit on each user's PC—not centralized servers—letting the user decide how, when and with whom to interact. Like the phone and email, Groove is easy to use and requires no special set-up, configuration, or IT involvement to get started. One can work online or off, with others or on their own, in real-time or asynchronously.

The Groove platform is extensible. For developers, Groove is a flexible environment for building custom collaboration solutions using their existing skills and familiar tools. To simplify the developer's task, applications built for Groove automatically inherit unique Groove features like cross-firewall transparency and online/offline use. Finally, Groove can be integrated with existing business systems (using the Groove Enterprise Integration Server) to enable in-context collaboration among all members of the organizational chain. Figure 5.3.

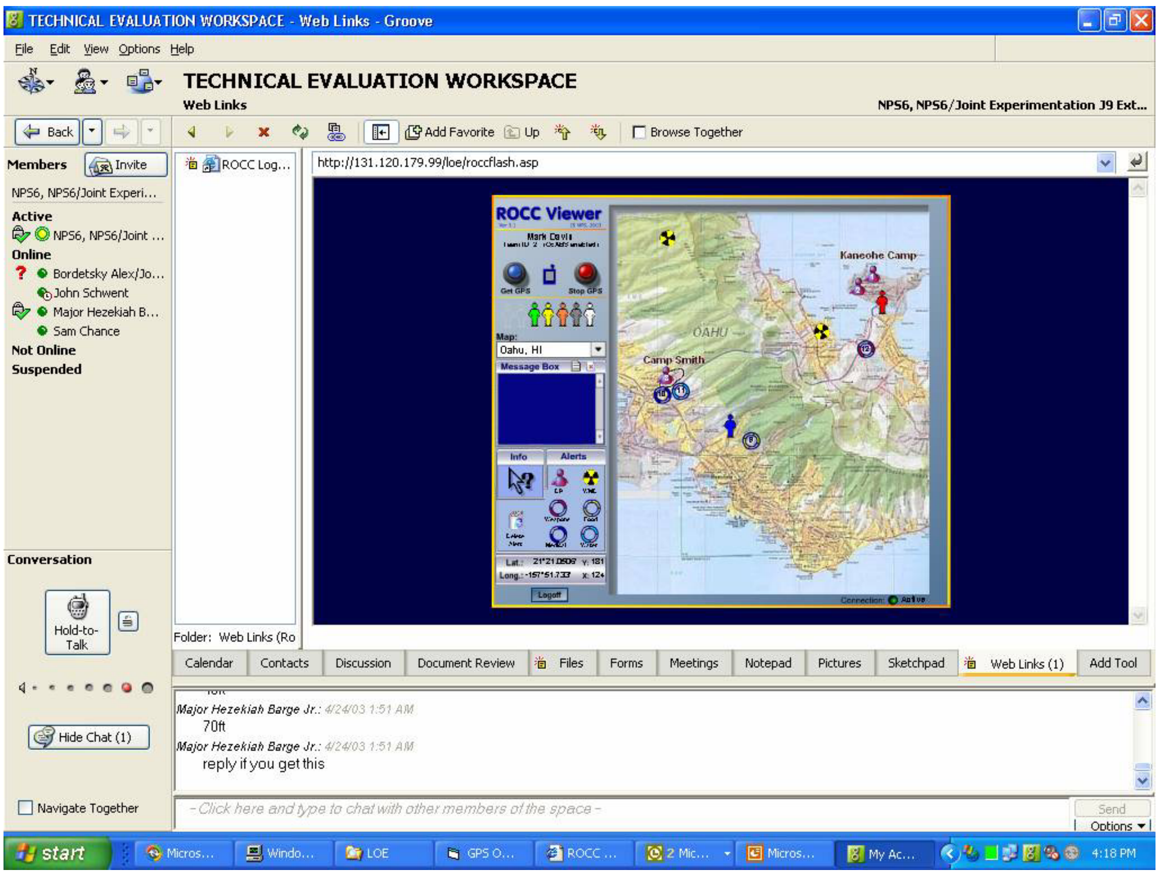


Figure 5.3. Groove User Workspace

Groove was chosen for this thesis because it is easy to use, install and manage. Additionally, Groove presents itself to be the least invasive collaborative application, thus addressing the potential reluctance, by organizations normally involved in a CHE, of using a new system.

2. NASA Advanced Communications Technology Satellite (ACTS)

a. Background

The NASA ACTS communications system is the major component in the communication architecture. This communication system that provides the global connectivity required for efficient CHE operations. The ACTS system is made up of a spacecraft and a ground segment. The spacecraft consists of a multibeam communication payload and the spacecraft bus. The key technology components of the communications payload are the multibeam antenna (MBA) assembly, the baseband processor (BBP), the microwave switch matrix (MSM), and Ka-band components. The spacecraft bus houses the communications payload and provides attitude control, electric power, thermal control, command reception, telemetry transmissions, and propulsion for station keeping.

The ground segment is comprised of the spacecraft/communication network control stations and the user terminals. A Master Ground Station located at NASA Glenn Research Center (GRC) in Cleveland, Ohio transmits commands to the satellite, receives all spacecraft telemetry, and provides network control for all user communications. As part of network control, it processes and sets up all traffic requests, assigning traffic channels on a demand basis.

A Satellite Operations Center was located at Lockheed Martin Astro Space in East Windsor, New Jersey (later transferred to the Lockheed Martin Communications and Power Center facility in Newton, Pennsylvania in 1998) connected to the Master Ground Station via landlines. It has the prime responsibility for generating spacecraft bus commands and for analyzing, processing, and displaying bus system telemetry data. Orbital maneuver planning and execution are also handled by the Satellite Operations Center.

ACTS is a three-axis stabilized spacecraft weighing 3250 pounds at the beginning of its on-orbit life. It measures 47.1 feet from tip to tip along the solar arrays and 29.9 feet across the main receiving and transmitting antenna reflectors. The ACTS multibeam antenna is comprised of separate Ka-band receive and transmit antennas, each with horizontal and vertical polarization subreflectors. The 7.2-foot, 30 GHz receive antenna collects up linked signals, while the 10.8 foot, 20 GHz transmitting antenna radiates downlink signals. Antenna feed horns produce narrow spot beams with a nominal 120-mile coverage diameter on the surface of the earth.

Fast (less than 1-microsecond), beam-forming switch networks consisting of ferrite switches, power dividers and combiners, and conical multiflare feed horns provide sequential hopping from one spot beam location to another. These hopping spot beams interconnect multiple users on a dynamic traffic demand basis. A separate 3.3 foot, mechanically steered antenna, receiving uplink and radiating downlink signals, is used to extend the ACTS communication coverage to any location within the hemispherical field of view from ACTS' 100 degree West longitude position. Beacon signals at 20.2 GHz and 27.5 GHz are radiated from two small, separate antennas.

b. NASA ACTS Program

ACTS was developed as an experimental on-orbit, advanced communications satellite test bed, bringing together industry, government, and academia to conduct a wide range of technology, propagation, and user application investigations. NASA Glenn Research Center awarded in August 1984 the ACTS contract to an industry team consisting of:

- Lockheed Martin, East Windsor, NJ for system integration and the spacecraft bus.
- TRW, Redondo Beach, CA for the spacecraft communications payload.
- COMSAT Laboratories, Clarksburg, MD for the network control and master ground station.
- Motorola, Chandler, AZ for the baseband processor.
- Electromagnetic Sciences, Norcross, GA for the spot-beam forming networks.

The contract was awarded to RCA Astro Space of East Windsor, NJ, which was subsequently acquired by General Electric, and then by Martin Marietta (itself acquired by Lockheed Aircraft Corporation in 1995 to become Lockheed Martin). In 1988, as a result of a congressionally mandated program funding cap, Lockheed Martin assumed responsibility for completing the development of the communications payload. Subsequently, Lockheed Martin (then General Electric Astro Space) subcontracted with Composite

Optics, Inc. San Diego, CA for the manufacture of the antenna reflectors and part of the bus structure.

(1) Launch. ACTS was launched as the primary payload aboard the Space Shuttle Discovery (OV-103) from the Kennedy Space Center, Pad 39B, as part of the STS-51 mission on September 12, 1993. At launch and for insertion into its geosynchronous orbit, ACTS was mated to the transfer orbit stage component (TOS) for a total weight of 6108 lbs.

(2) Orbit. ACTS was stationed at its designated geosynchronous orbit location at 100 degrees west longitude. In July 1998 the spacecraft's north/south station keeping was stopped to extend operations in an inclined orbit. In August 2000, the satellite was moved to 105.2 W longitude to be permanently located.

(3) Experiments. Experimental studies began twelve weeks after ACTS was deployed. The communications payload has continued to operate flawlessly 24 hours per day, seven days per week, year round. The only periods of "down time" occur during parts of the spring and fall equinox periods when the ACTS’ solar panels are eclipsed. Experimentation supported by ACTS continued until June 2000. In May 2001, the Ohio Consortium for Advanced Communications Technology began using ACTS for educational research. It is through this consortium that NPS, and subsequently our thesis team, has gained access to this system (43).

c. Ground Station Parameters

NPS has what is called an Ultra Small Aperture Terminal (USAT). The USAT is similar in size to a direct broadcast television terminal, however, equipped with a 60 cm antenna, it can provide uplinks as fast as 1.5 Mbps as well as downlinks to 45 Mbps. Our desired application for USAT is high speed network access and global connectivity.

d. Ground Station Architecture

The USAT ground station is modular in design for easy configuration and integration. Consisting of five major subsystems, the ground station is easily assembled, operated and serviced. The five USAT subsystems are the following:

- The antenna (60 cm).
- The combined low noise receiver/down converter.
- The combined up converter and solid-state power amplifier.
- The intermediate frequency up converter.
- The oscillator subsystem.

3. Network Management

Because this architecture involves utilizing a Wireless LAN (WLAN), and more specifically, a WLAN in a potentially remote environment as may be encountered in a CHE, it was decided that wireless network management procedures would be pursued and utilized. Therefore, this thesis had to determine how to best manage a small wireless network. This network consists of one Access Point (AP) and up to 6 nodes. Our nodes are laptop computers configured with wireless adapters and Personal Digital Assistants (PDAs) with wireless cards. This allows us to see how effective network monitoring and subsequent management works on different end user devices. The proposed Network Operations Center (NOC) is simply a combination of a management station (laptop CPU) and a PDA configured with a network management tool.

a. Network Operations Center

For network managers, the intent is to gain enough knowledge about the network to effectively manage it. To start, we want to know what nodes are accessing the network through the wireless access point. This information allows one to see if any unauthorized users are accessing the network and also allows us to maintain the best possible network accessibility for authorized users. The network management tools we decided to utilize for managing our network are SolarWinds and Air Magnet.

(1) SolarWinds. SolarWinds has several network discovery tools that allow a manager visibility of what nodes are accessing a particular wireless access point, monitor hundreds of devices and keep track of response time and packet loss. The SolarWinds Network Monitor package can also send pages or E-Mails when a device stops responding. SolarWinds also has a tool that scans a range of IP address and looks at the Domain Name Service (DNS) information to determine if users are actually logging on to a network. Any errors found during the scan will be highlighted. Managers can also filter the results to show the reverse DNS errors, the IP addresses that did not resolve or forward DNS errors. Another SolarWinds tool can do network performance monitoring. This

tool is a real-time network monitor that can track network latency, packet loss, traffic and bandwidth usage

In addition, the CISCO wireless access point (AP) used in the network has a proprietary protocol associated with it that allows one to see what we wanted to see. This is called 'CISCO Discovery Protocol.' By simply typing in the IP address of the AP in a web browser, a manager can gain access to the Management Information Base (MIB) information, Media Access Control (MAC) addresses and limited traffic information about the desired nodes of interest. This is what is desired for effective network management. The information extracted from the CISCO software used in conjunction SolarWinds provides a powerful management tool. SolarWinds network monitoring applications take the information from the CISCO software and monitor the network much more efficiently then with either tool alone. The combination of the two software tools provided powerful network management ability.

Since our network was relatively small, we liked this tool because we simply plugged in the IP addresses of interest, collected with the CISCO protocol, and the application alerted us when there was a potential problem and allowed us to investigate further. The response time of each device is monitored and when response time begins to deteriorate or the device begins dropping packets, a light beside the device turns yellow or the light turns red if the device stops responding (47).

The SolarWinds application, used in conjunction with the CISCO discovery protocol, provides us as managers some useful methods by which to manage the network, but these tools are not all inclusive with regard to functionality. We need to collect more information and

SolarWinds is not designed to sniff or analyze wireless packets. Therefore we utilized another tool, AirMagnet, to accomplish this type of network management functions.

(2) AirMagnet. The AirMagnet Wireless Local Area Network (WLAN) Handheld Analyzer is a network administration and diagnostic tool that operates on a Pocket PC. The AirMagnet Handheld's product suite includes administration tools in the following areas: wireless administration, installation surveying, performance management, security assessment, and connection troubleshooting. These tools help to quickly eliminate connection problems, maintain desired network performance levels, and maintain a high level of network security.

The AirMagnet Handheld presents information in a logical hierarchical structure. It gives users an intuitive and simple interface with the control and flexibility to access more detailed information as needed. Near real-time network status information is made available through a series of performance alarms. These alarms are helpful when it comes to staying on top of the negative changes to the radio frequency (RF) spectrum that can pose performance problems, or lead to service disruptions. AirMagnet also has some network profile tools that keep track of varied WLAN environments through the designation of multiple configuration profiles and address books for logical name mapping as depicted in Figure 5.4.

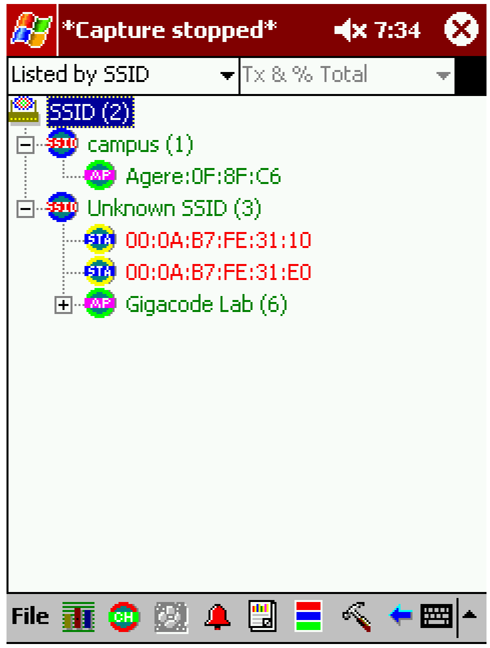


Figure 5.4. View of All SSIDs with MAC Address.

The AirMagnet Handheld Analyzer helps network managers stay on top of the performance curve, with an Expert Performance Analysis Tool that monitors WLAN networks and identifies the potential source of performance problems as they are happening. This tool helps us to identify any unauthorized access points that may be on the network.

The addition of a WLAN introduces a whole new class of threats for network security. Because of the nature of RF signals (penetrate walls and extend beyond intended boundaries), a WLAN is easily detectable and potentially exposed to unauthorized users. In addition, rogue APs that are not properly secured puts the entire network at risk of outside penetration and attack. The AirMagnet Handheld is designed to help defend against such threats through the use of security tools that provide alerts to more than 10 different threat conditions (48).

When it comes to network management, AirMagnet provides the WLAN network operation center (NOC) with a great ability to troubleshoot WLAN problems at the layer 1-3 level. This is important because NOC staffs need to be aware of what is occurring in the RF spectrum in their work area.

C. TECHNICAL EVALUATION OF HABITAT FUNCTIONALITY

1. Scope of Evaluation

The Technical Evaluation (TE) will be conducted for the Tactical Humanitarian Relief Habitat to see how well CHE participants can collaborate and share information locally or while geographically dispersed. The TE will take place at Marine Corps Base Hawaii (MCBH). This location was selected because it provided us with an environment that simulated a CHE in a remote area and without an existing infrastructure. Furthermore, going to MCBH would require us to pack and ship all the equipment needed to create a Tactical Humanitarian Relief Habitat. Additionally, the NASA ACTS spot beam coverage includes Hawaii. Operators and maintainers consist of the thesis team members and Evaluation support personnel who are located at the Naval Postgraduate School and the NASA ACTS support locations.

a. Evaluation Approach

The TE will be conducted with one KA-band satellite ground station and its associated equipment, a hub, web servers, laptops and PDAs (The laptops and PDAs will serve as clients). The evaluation is designed to be conducted over a three-day period. The TE is structured to simulate a CHE environment to include at least one NGO/IO and CMOC management personnel.

During the three-day period, we will examine connectivity, the ability to access information via the established network, the ability to collaborate, and conduct a network analysis of data that is transferred throughout the network. Evaluation personnel will operate on an as required basis although the system will operate continuously for the duration of the TE. Throughout the three days, special events may be conducted at the discretion of the thesis team for the purpose of adding additional value to the evaluation.

The evaluation will commence with the installation and initialization of the satellite ground station equipment. The LAN will be established utilizing wired and 802.11b wireless networking equipment. The evaluation is based on two scenarios. These scenarios are based on the establishment of a Tactical Humanitarian Relief Habitat in a CHE environment and the participation of the military/NGO/IO in the relief effort. The information exchange is designed to simulate actual field information exchange between involved organizations.

b. Evaluation Objectives

There is one overall objective for the technical evaluation of this thesis. We will demonstrate organizational (military/NGO/IO) communication between dispersed habitat participants. The following Tactical Humanitarian Relief Habitat technical evaluation objectives were developed during the spring quarter of 2003 and validated during the technical evaluation.

- Demonstrate intra-camp communication utilizing local area network technologies.
- Demonstrate global connectivity using a satellite system for reach-back communication.
- Conduct and analysis network management functions.

2. Schedule of Events

The first step in the TE is the installation of the NASA ACTS satellite system. The NASA ACTS system consists of four major components: the antenna assembly, mobile ground station (MGS), satellite spacecraft, and the satellite control station (located in Cleveland, OH). After unpacking the equipment, the antenna assembly is the first component that is put together. The antenna base is the first to be assembled. The antenna dish hardware is then mounted on the antenna base. Then the two vertical and horizontal angle/azimuth antenna actuators are mounted on the center section of the antenna/actuator mount. Next, the dish is put on top of this mount followed by the antenna high power amplifier/feed cone. The outdoor power module is connected to the antenna's high power amplifier/feed cone through the use of three short cables that supply power, and the capability to receive and transmit.

The antenna assembly is connected to the mobile ground station (MGS) through the use of five cables (power, receive, transmit, vertical, and horizontal actuator control). All the cables are labeled individually and at the interface connectors for both the antenna assembly and MGS. The MGS is preconfigured for rapid deployment and use. Inside the MGS, there is a component rack that holds two routers, a computer, the antenna control module, the modem and the AGC module (used for attenuation). The antenna base must be leveled before the proper angle and azimuth can be obtained. Once this is accomplished, power may be supplied to the antenna assembly. Next you power up the rack and go through the satellite acquisition SOP (see Appendix A).

Our experience in setting up the ground station is limited and confined to acquiring a signal while at NPS. This is a painful process at times because getting a signal is not just a science, but an art as well.

Once an uplink and downlink signal has been acquired, continue with the network connectivity troubleshooting. One of the laptops should be connected to the MGS’s hub via CAT 5 cable and the hub should be connected to one of the MGS routers. The NASA ACTS satellite has the capacity to uplink data at 384 Kbps and downlink data at 2 Mbps. Connectivity between routers can be verified through the use of the PING function. We start by PINGing the internal router of the MGS rack then subsequent routers outside the MGS rack.

Once network connectivity is established, then it is time to start the scenarios. The first scenario simulates a CHE participant conducting humanitarian relief efforts as a member of the Tactical Humanitarian Relief Habitat. This is done by the CHE participant accessing the VCMOC via the established network and requesting a user identification and password. The Tactical Humanitarian Relief Habitat administrators will conduct a background check to validate that the individual/organization that is requesting to join the habitat is US or UN sanctioned. After the CHE participant and their organization has been validated and cleared for access to the habitat, the real work begins.

3. Evaluation Scenarios

The evaluation scenarios will be conducted in accordance with Appendices B and C.

THIS PAGE INTENTIONALLY LEFT BLANK

VI. TECHNICAL EVALUATION RESULTS AND RECOMMENDATIONS FOR FURTHER RESEARCH

A. RESULTS OF TECHNICAL EVALUATION

1. NASA ACTS System

The NASA ACTS installation began with the assembly of the antenna. A level piece of ground with a clear view in the direction of the required azimuth and elevation was selected and the antenna base was assembled and leveled. The 60 cm parabolic dish was then attached to the antenna base. The wave-guide and high power amplifier/feed cone assembly was attached and the corresponding cables connected between the amplifier and the outdoor power supply box. The horizontal and vertical actuators were then attached to the base and to the dish mount. The actuator controller cables run to the antenna control module in the mobile ground station (MGS) component rack. The 100’ radio frequency (RF) cables were then connected between the outside power supply box and the component rack (the receive cable into the AGC box and the transmit into the modem module).

The MGS component rack was placed inside the lodging facility and the cables were appropriately connected. The antenna assembly is connected to the MGS through the use of five cables (power cable, receive and transmit RF cables, and the vertical and horizontal angle/azimuth actuator control cables). All the cables are labeled individually and at the interface connector for both the antenna assembly and MGS. The MGS is preconfigured for rapid deployment and use. Inside the MGS there is a component rack that holds two routers, a computer, the antenna control module, the modem module and the attenuator (AGC) module. Once all the cables were properly connected, power was supplied to the MGS and the antenna. The final step is to acquire the satellite, which was done according to the satellite acquisition standard operating procedure (SOP) (see Appendix A).

Our experience in setting up the ground station was limited to acquiring a signal while at NPS. Fortunately, this was a positive experience. We were able to conduct a video teleconference, arguably the most bandwidth intensive application, using the satellite as the communication pipe. This success in the lab at NPS provided this thesis team with the confidence and experience to conduct similar operations once deployed to Hawaii. However, it was discovered that the satellite acquisition process proved to be a painful at times because getting a signal is not just a science, but an art as well.

Before deploying the MGS to Hawaii, the team took the appropriate planning steps to insure the proper angle and azimuth was identified given the location in Hawaii. We sent the latitude/long for our remote location to the NASA ACTS Operations center and they subsequently gave us an azimuth and elevation to acquire the signal. When we arrived at the location (Monday, April 28 about 1600 local Hawaii time) we began setting up the system. Using the information provided by the satellite operations center, we assembled the system and powered up and initially obtained a signal (or so we thought). Unfortunately, we were never able to get the required carrier lock. We spent countless hours going through this painful process of trial and error to try and obtain a signal. Troubleshooting, in the form of phone conversations with Hans Kruse (Managing Executive of the Ohio Consortium for Advanced Communications Technology), Bruce Turry and Jeff Glass (Cleveland Operations center), and John Graham (ACTS subject matter expert), continued until Wednesday morning. It was at this time that another Cleveland Ops employee, Dave, informed us that the satellite has a 22 degree offset angle. This meant that we had been aiming 22 degrees too high the whole time and any signal we thought we were getting was simply noise. The adjusted angle of 3-5 degrees now aimed us directly at a sizable terrain feature, which completely blocked our signal.

We went around the base on a site survey that morning to determine if there was a viable location for us to move the equipment. We found a site and made the coordination to use it. We coordinated obtaining the cargo van to transport the equipment and began the tear down procedures. We packed and moved all the equipment to a site along our azimuth on the other side of the terrain feature (mountain). As soon as we finished set up, we obtained a signal and received the actual frequency from the satellite (this is indicated in one of the configuration windows of the modem). This verified that we were actually hitting the satellite with our signal and receiving a signal from the satellite. However, we never obtained modem or carrier lock. All the fault lights were off and the carrier lock light rapidly flashed green but never locked and allowed us to send or receive data. Thursday morning the decision was made to shift all efforts elsewhere in the thesis and terminate the efforts of acquiring the satellite.

2. Technical Evaluation Results of Scenarios

Scenario 1 in Appendix B was executed on an ad-hoc wireless local area network (WLAN) that was setup at Marine Corps Base Hawaii (MCBH). The purpose of this scenario was to demonstrate the ability of a CHE participant to effectively conduct humanitarian relief efforts within the Tactical Humanitarian Relief Habitat. The scenario consisted of three CHE participants in the Habitat representing the following organizations: military civil affairs, NGO and IO. Two of the CHE participants had a laptop computer and one had a PDA configured to function on an ad-hoc WLAN. Furthermore, the PDA user had a GPS receiver.

The CHE participants worked in remote area of MCBH, which contained a few buildings and basic services such as running water, restrooms, electricity, and two telephones. This was done to simulate a CHE working environment. However, it was noted that some CHE environments during the early phase of execution lack most of the basic services listed in the previous sentence. The only reach-back capability that the CHE participants had were cellular phones and the two telephone lines that could be used to make long distance calls and establish internet connectivity at rates varying between 28Kbps and 45Kbps.

Prior to the start of the scenario, a few basic assumptions were established. First, the NGO and IO representative had already conducted the required coordination for approval to join the Tactical Humanitarian Relief Habitat. This would be accomplished via telephone calls and emails based on the information provided on the login page of the VCMOC. Previous CHE after action reports have pointed out the importance of the need for preplanning when it comes to NGO and IO who want to provide assistance during a CHE. For example, during a Groove session on the state of humanitarian affairs issues in Iraq, US Navy Cmdr Eric Rasmussen, Deputy Health Minister for Iraq in the Secretary of Defense Office of Reconstruction and Humanitarian Assistance stated in April 2003 that there were approximately 17 NGO/IO organizations in Iraq with humanitarian supplies that were useless to the pending needs. When these organizations arrive in country without participating in any planning conferences for the CHE, there is normally a great disparage in the logistic coordination of matching up the critical needs at a particular time with the proper resources. The VCMOC registration process was designed specifically to deal with this issue.

The second assumption is that all the members of the habitat would have received the training and software needed to be productive members of the habitat. The components of the habitat were designed for non-technical computer users. Two to three hours of training would have to be conducted to give a new member of habitat a good understanding of all the functionality that is resident within the CHE SA tool, VCMOC and Groove. The only software license that would have to be given to new habitat users is Groove. The CHE SA tool GPS poster was developed at NPS and does not require a license to distribute to habitat members who desire to use GPS receivers for positional reporting.

Most of the executed tasks were based on the premise of the habitat being a virtual environment in which the members of the habitat could collaborate and coordinate with each other without the direct control of a centralize authority. During scenario A, the members of the habitat were able to use all the functionality of the CHE SA tool, Groove, and the VCMOC. Face to face meetings at the CMOC (physical operation center) were done primarily for final coordination of issues that were discussed in the VCMOC. As requirements were posted in the VCMOC, the members of the habitat had the freedom to either fulfill or not fulfill the requirement.

The transmission speeds for sending data varied between 2-11Mbps depending on the distance and obstructions (buildings, vehicles, etc.) between the nodes. The average travel time between when a text or voice message was sent and received using Groove was 4 seconds. On the other hand, the average travel time between when a text or voice message was sent and received using the CHE SA tool was 2 seconds. When sharing files in Groove, the average time for a 25K file that was posted in a Groove workspace to be synchronized in the workspace of the other members of the habitat was 90 seconds.

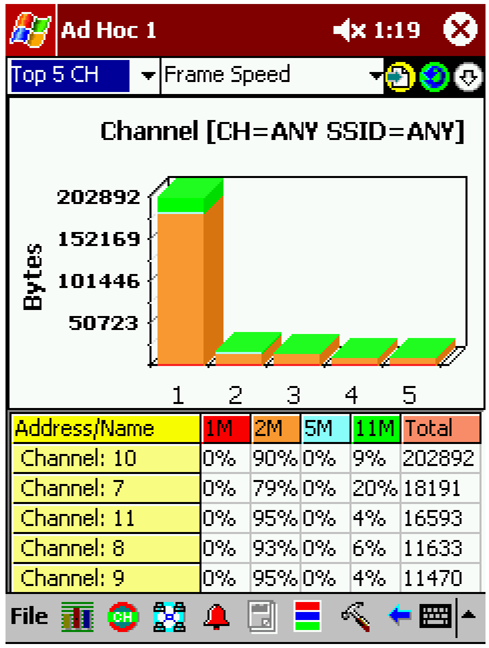


Figure 6.1. Chart of Frame Speed by Channel

All of the habitat members were impressed with the combined capabilities of technology tools that existed in the habitat. The ability to share files, conduct Microsoft PowerPoint briefs, and use voice over IP while browsing internet web pages with the use of Groove was a combat multiplier in the humanitarian sense. The CHE SA tool ability to show the location of the members of the habitat based off a manual or GPS input is tremendous. Figure 6.2 is a screen shot of a program that uses CoABS wrappers and software agents to take positional information and post it to the ROCC viewer web display in figure 6.3. The red and blue people icons represent actual CHE participants. This displaying of this type of information enhances the shared situational awareness of the members of the habitat.

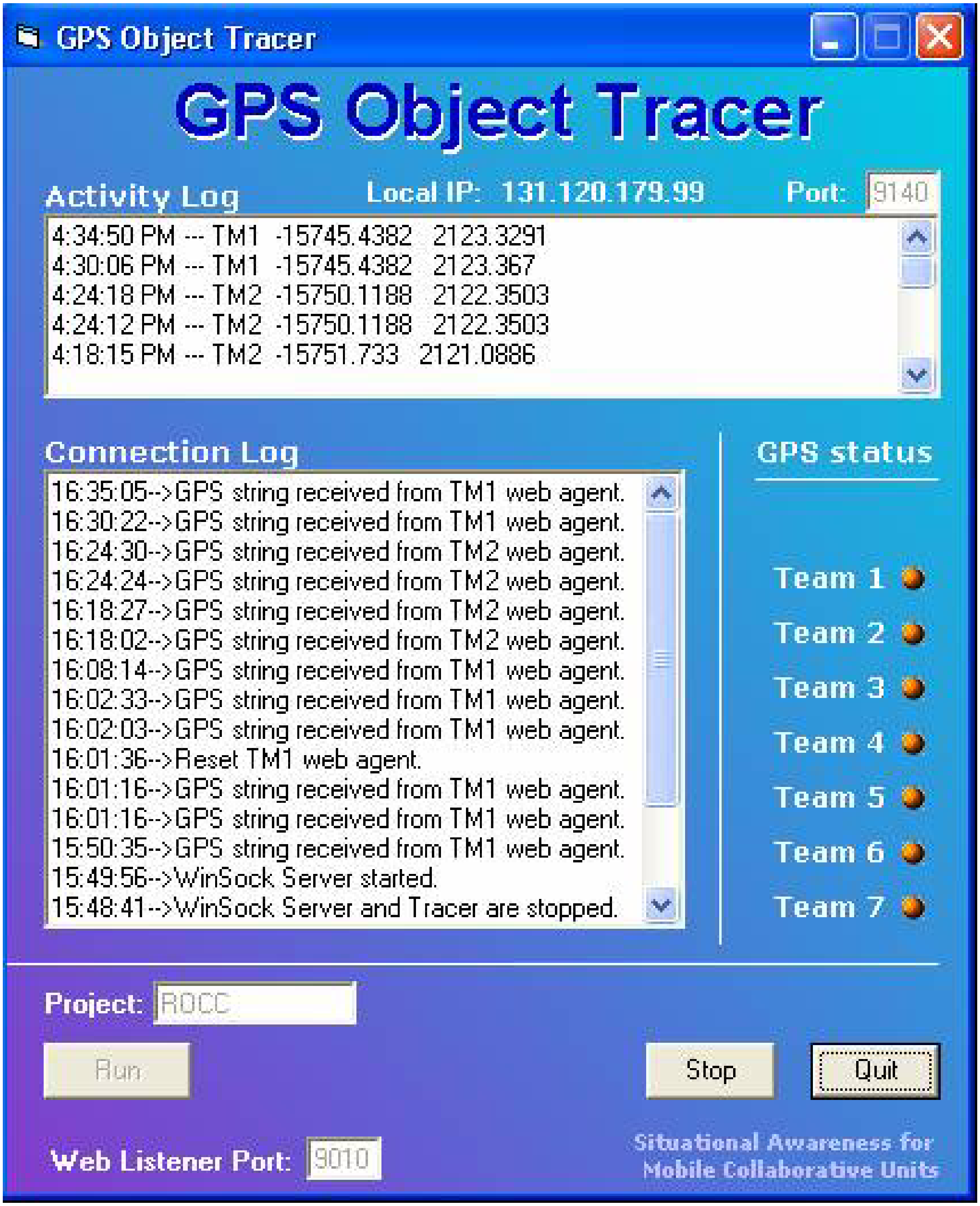


Figure 6.2. GPS Poster Program

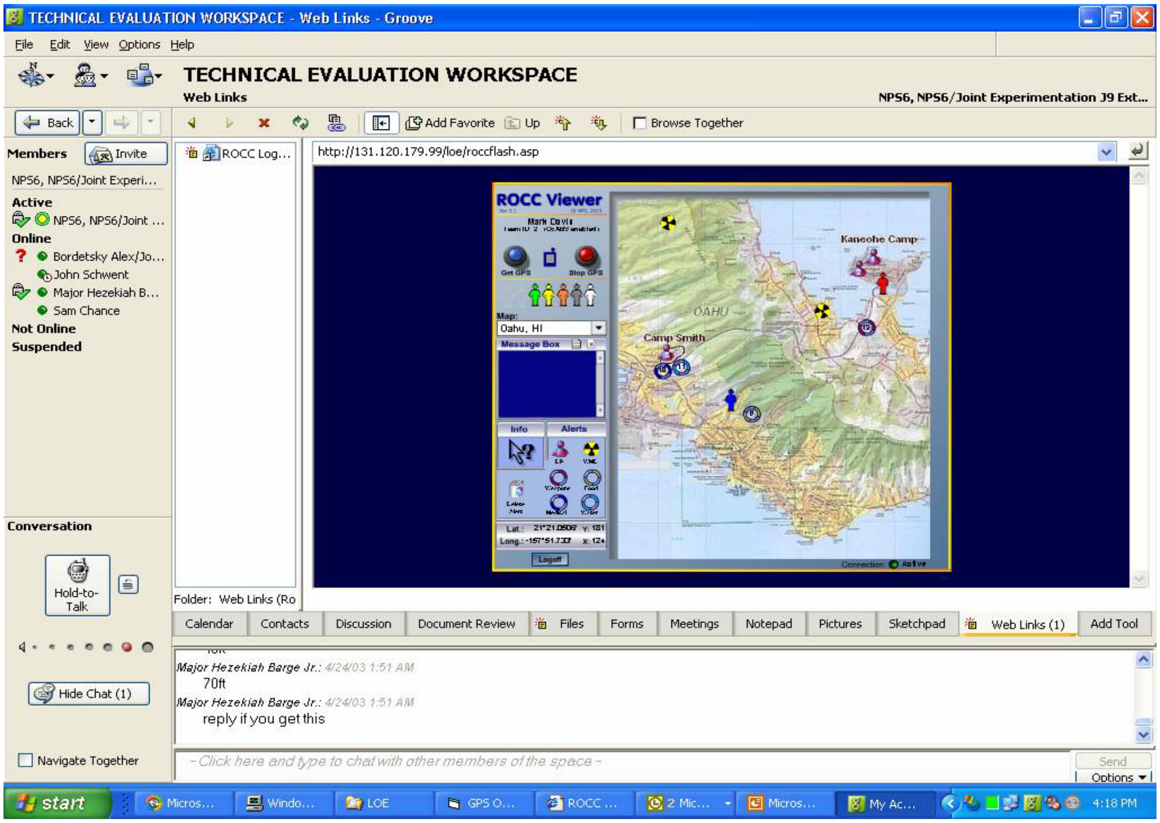


Figure 6.3. CHE SA Tool Display within Groove

The next screen shot in Figure 6.4 is a visual depiction of the CHE SA Tool in the Internet Explorer web browser. Additionally, the red line between the people icons (red and blue) shows that members of the habitat are communicating with each other through the use of the text messaging functionality embedded within the tool.

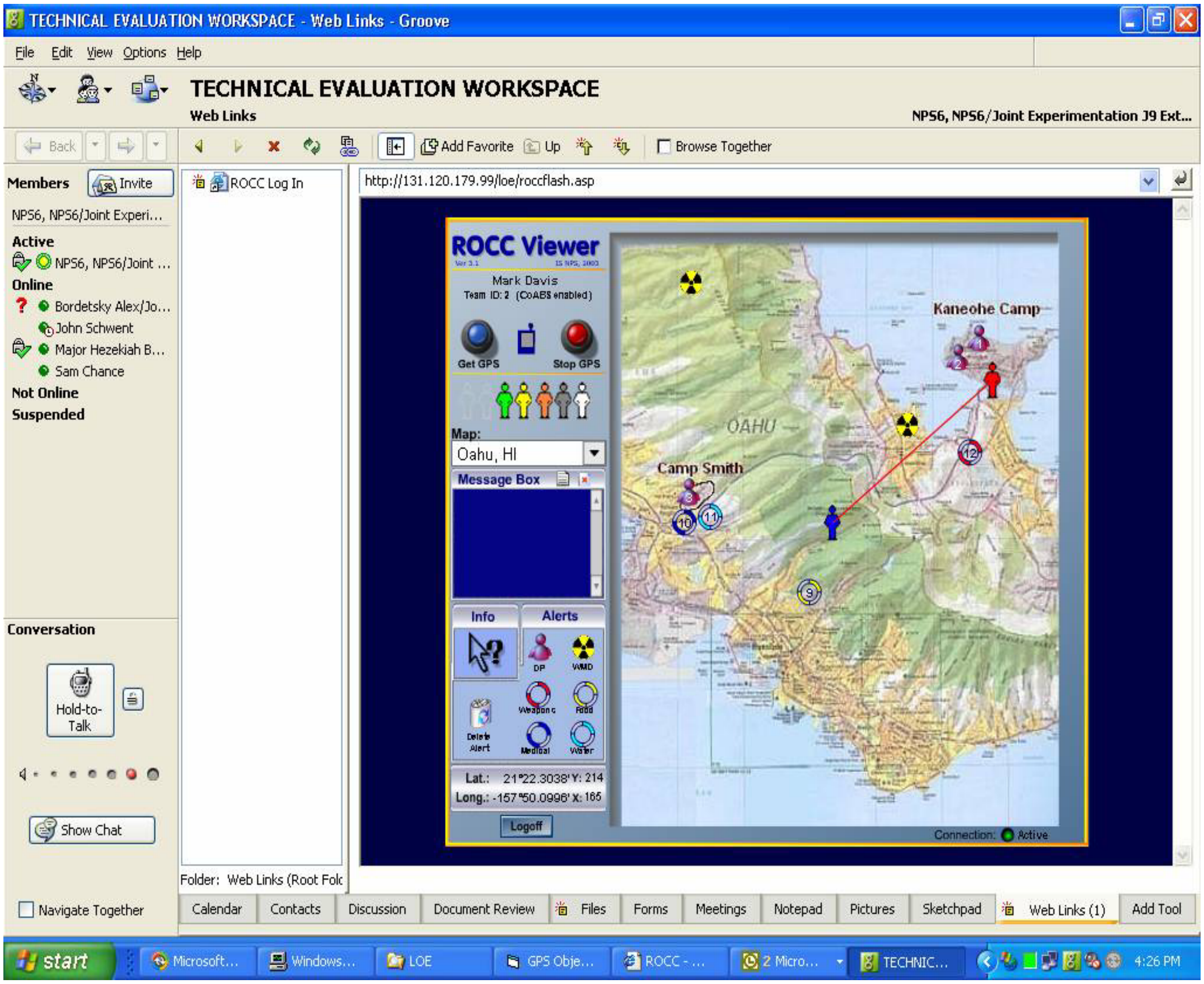


Figure 6.4. CHE SA Tool Display with Message Line

The next screen shot in Figure 6.5 shows what happens when you place the informational arrow on an alert icon. These icons are posted by members of the habitat. There are six alert icons for the following the categories: displaced person, food, medical, water, weapons dump, weapons of mass destruction, and other.

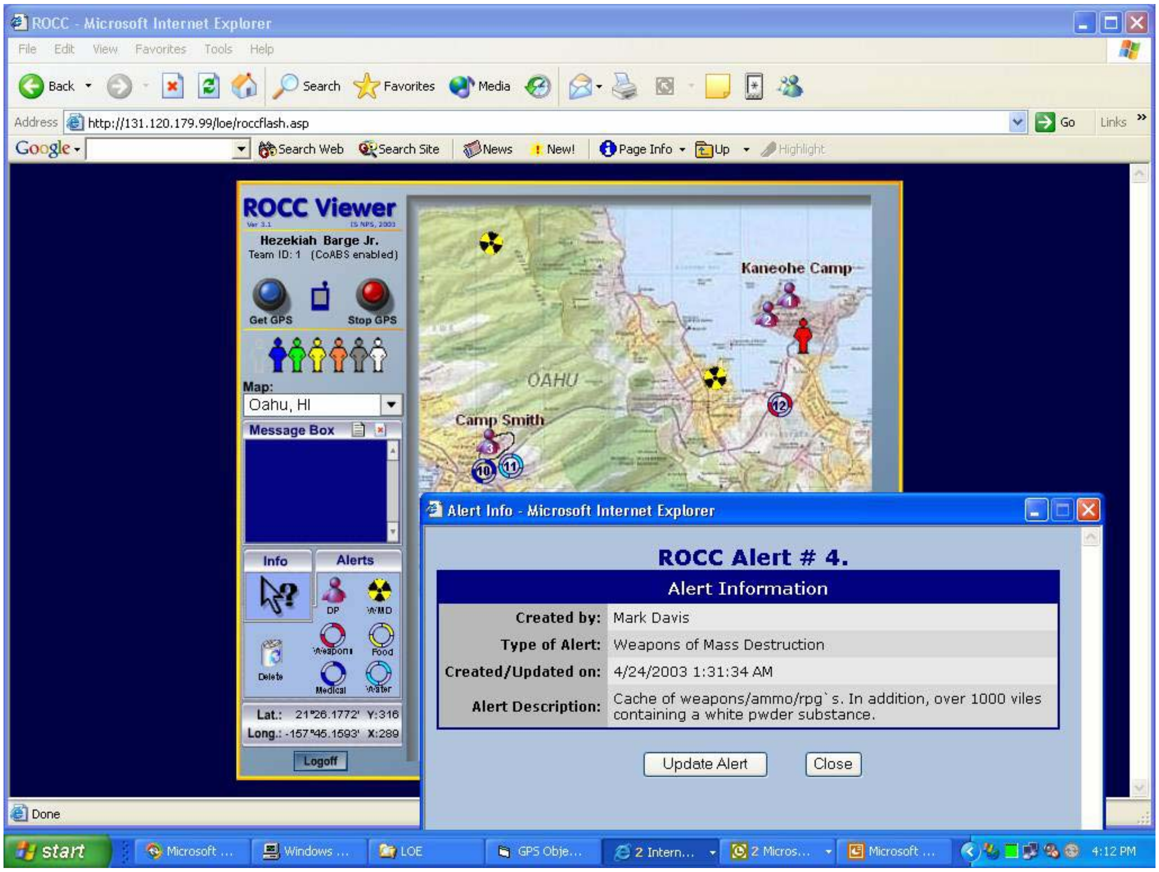


Figure 6.5. Alert Information on Posted Icon

The next screen shot in Figure 6.6 shows what happens when you place the informational arrow on a person icon. Each member of the habitat has a biographical profile. This information is provided to allow the members of the habitat to contact each other based off the communication devices that the habitat member possesses. For example, the profile displayed in Figure 6.6 states that ROCC Team 1 has the capability to conduct video teleconferencing conduct Groove sessions, and have their position posted by a GPS receiver.

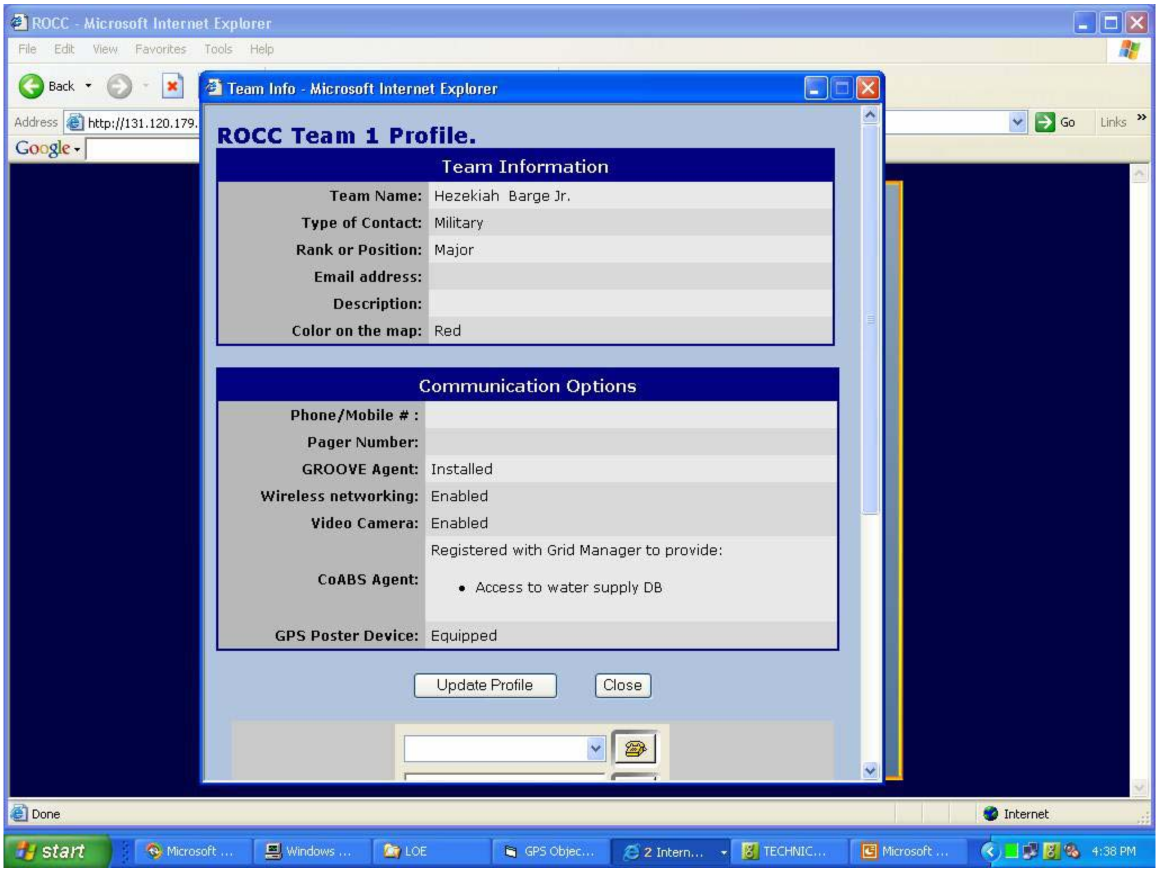


Figure 6.6. Habitat Member Profile

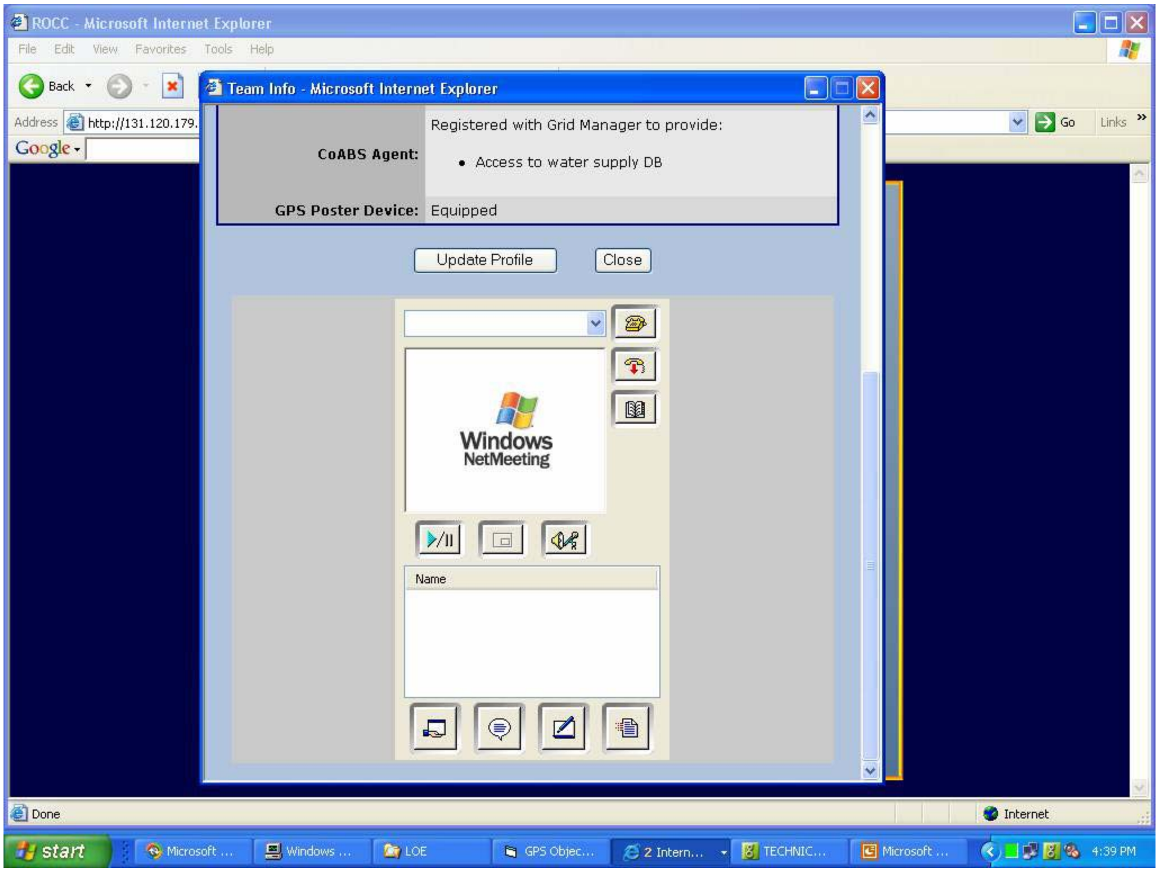


Figure 6.7. Habitat Member Profile with Embedded MS NetMeeting Application

The next screen shot in Figure 6.8 shows what happens when you place the informational arrow on a displaced person icon. The information shown here is inputted by the camp managers and used to linkup separated family members.

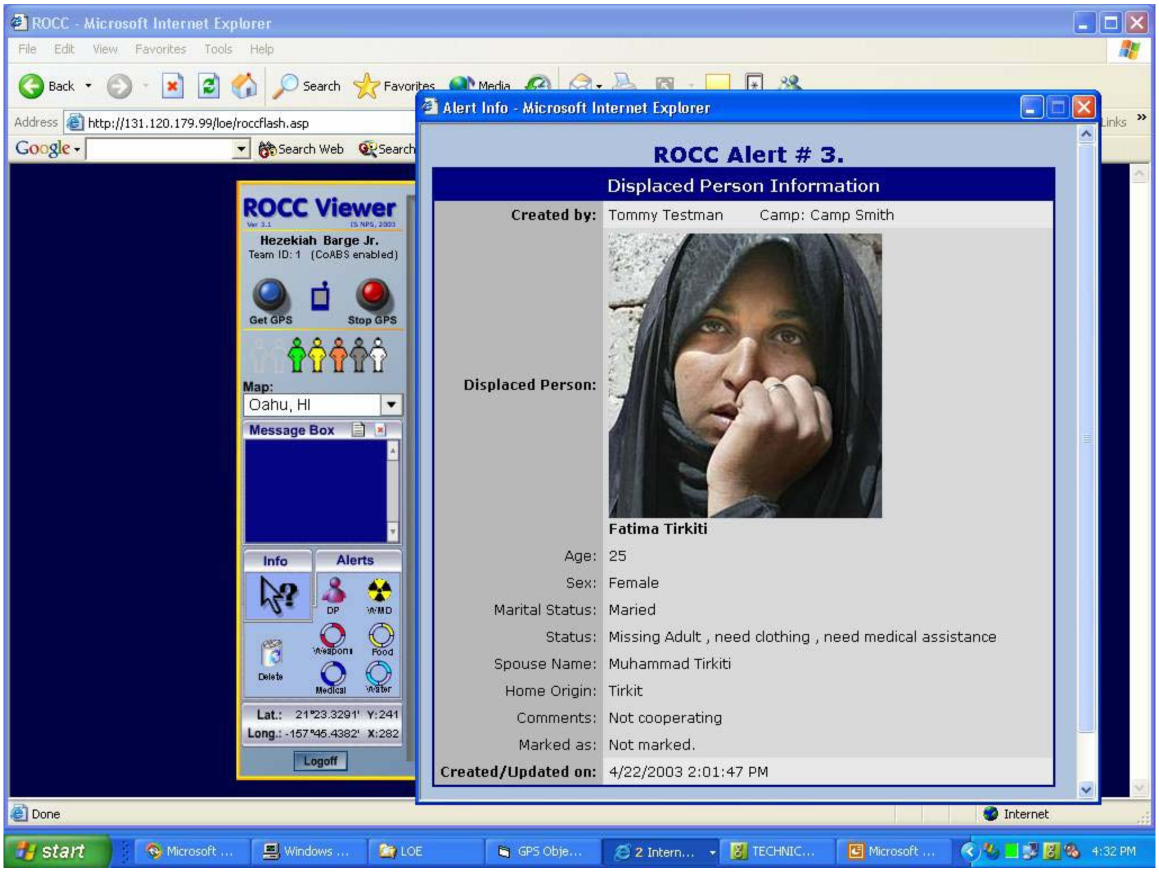
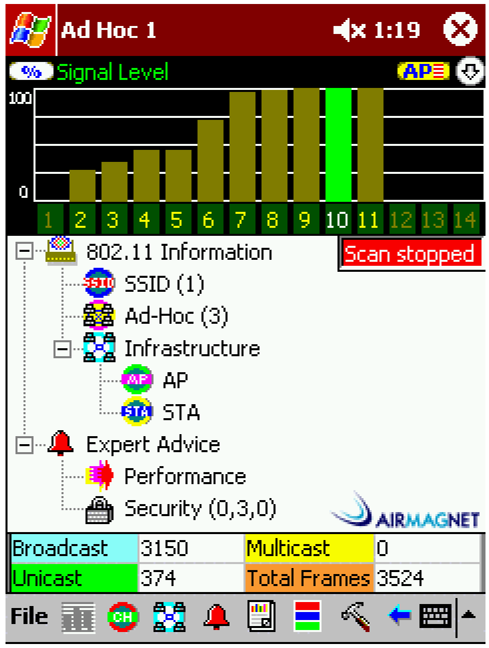


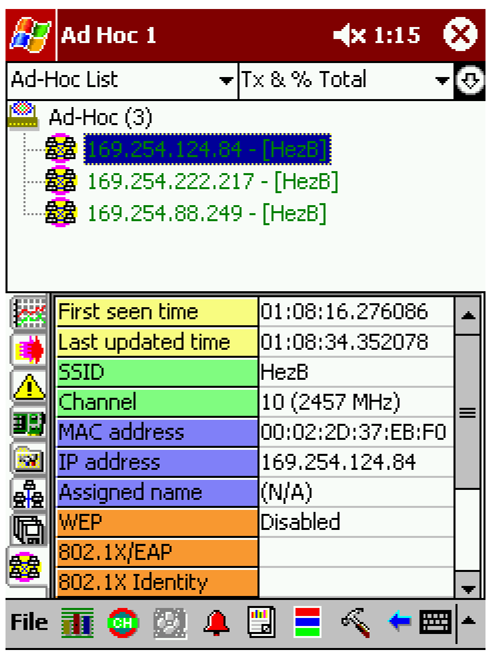
Figure 6.8. Displaced Person Alert

As friendly fire incidents continue to plague coalition forces in Iraq during Operation Iraq Freedom as in it did in Afghanistan and previous CHE events, this tool greatly enhanced the SSA of the physical location of all the members of the habitat. No one wants a repeat of what happened during Operation Enduring Freedom in Afghanistan when a Red Cross warehouse was mistaken as a Taliban arms warehouse and bombed by coalition forces. The dynamic database of the VCMOC was a great aid to the members of the habitat when it came to tracking displaced persons and maintaining the most current information on meetings, requirements, and points of contact.

Scenario 2 in Appendix C was executed on the ad-hoc WLAN used by the members of the Tactical Humanitarian Relief Habitat. The purpose of the scenario was to demonstrate the ability of the habitat network manager to effectively administer the network. Air Magnet was used as the network management tool through the use of a PDA. While the members of the habitat were executing tasks associated with Appendix B, Air Magnet was used to monitor the network performance.

The AirMagnet network management system provides for a comprehensive toolset for the network manager to monitor their WLAN. AirMagnet's product suite consists of the following: wireless administration, installation surveying, performance management, security assessment, and connection troubleshooting. Over the monitoring period of approximately two hours, AirMagnet collected data in a real-time manner. Using a program called "Pocket Screen Capture" we were able to capture "screen shots" of the discovery, performance, and security events. The greatest indicator of network flow was the analysis of the network transmission rate.


Ad Hoc 1
1:19
Signal Level
AP
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
802.11 Information
Scan stopped
SSID (1)
Ad-Hoc (3)
Infrastructure
AP
STA
Expert Advice
Performance
Security (0,3,0)
AIRMAGNET
Broadcast 3150
Multicast 0
Unicast 374
Total Frames 3524
File


Ad Hoc 1
1:15
Ad-Hoc List
Tx & % Total
Ad-Hoc (3)
169.254.124.84 - [HezB]
169.254.222.217 - [HezB]
169.254.88.249 - [HezB]
First seen time 01:08:16.276086
Last updated time 01:08:34.352078
SSID HezB
Channel 10 (2457 MHz)
MAC address 00:02:2D:37:EB:F0
IP address 169.254.124.84
Assigned name (N/A)
WEP Disabled
802.1X/EAP
802.1X Identity
File

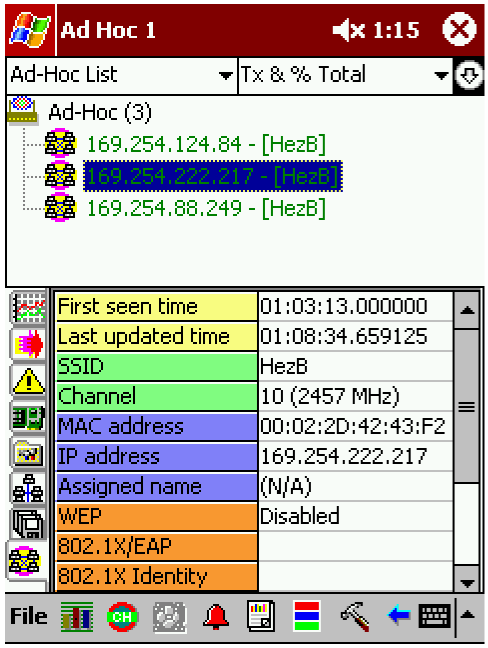


Figure 6.9. Node Listing 2 with Detail Information by Node

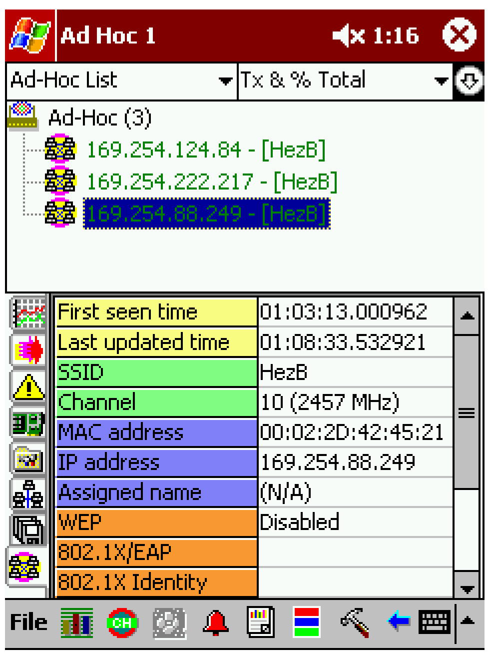


Figure 6.10. Node Listing 3 with Detail Information by Node

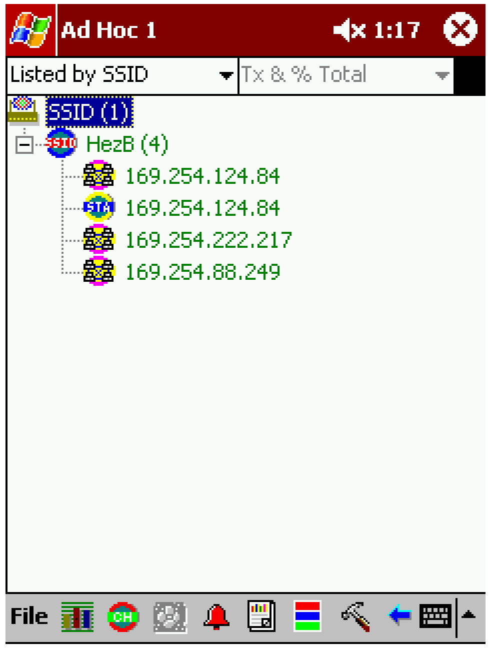


Figure 6.11. SSID Listing

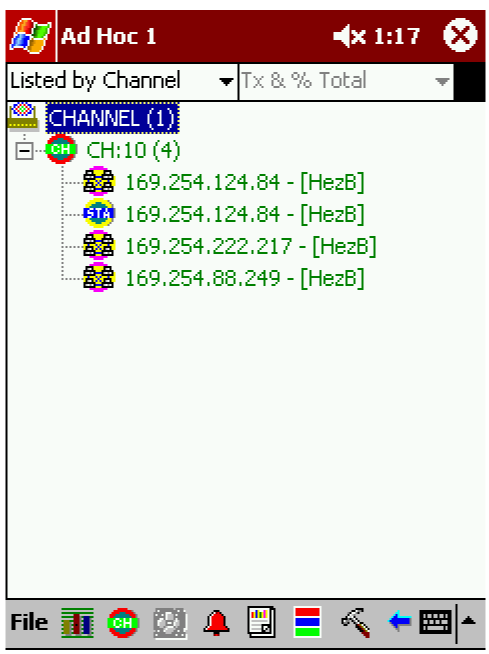


Figure 6.12. Channel Listing

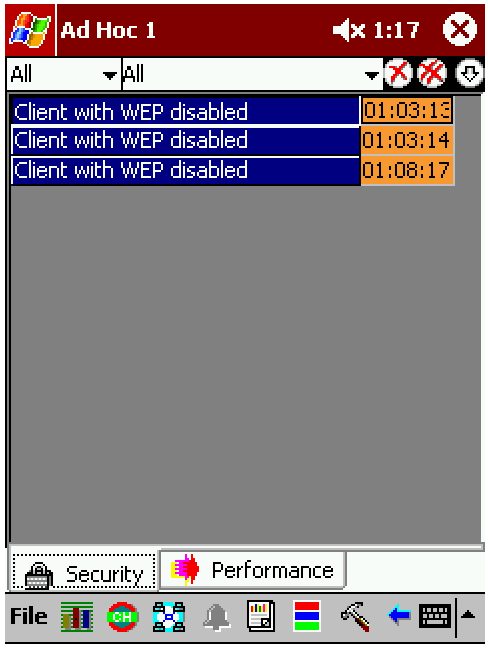


Figure 6.13. Performance Display

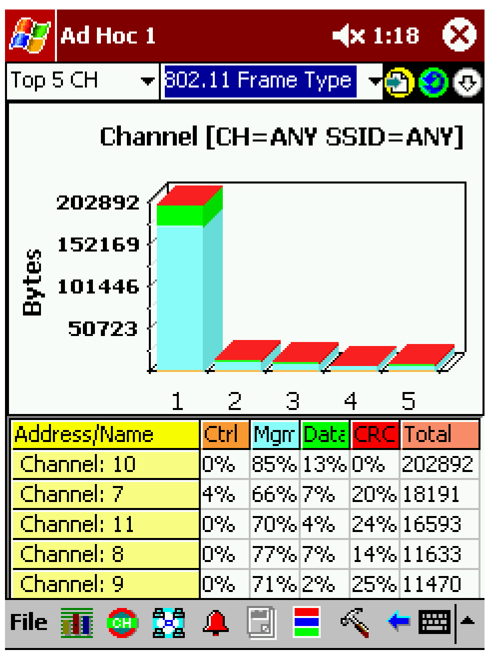


Figure 6.14. Chart of Frame Types

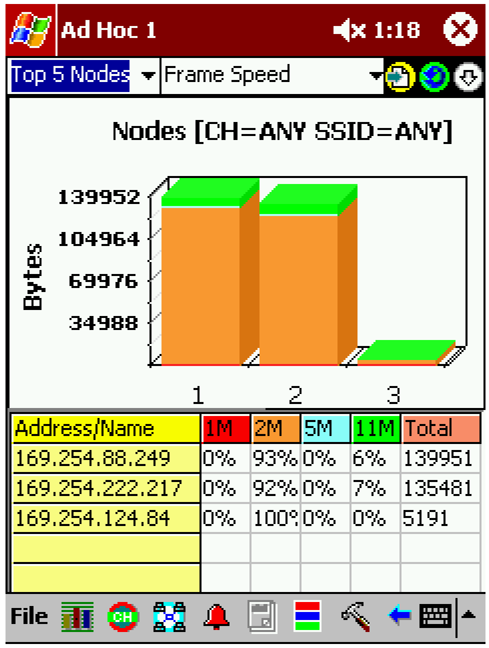


Figure 6.15.   Chart of Frame Speed by Node

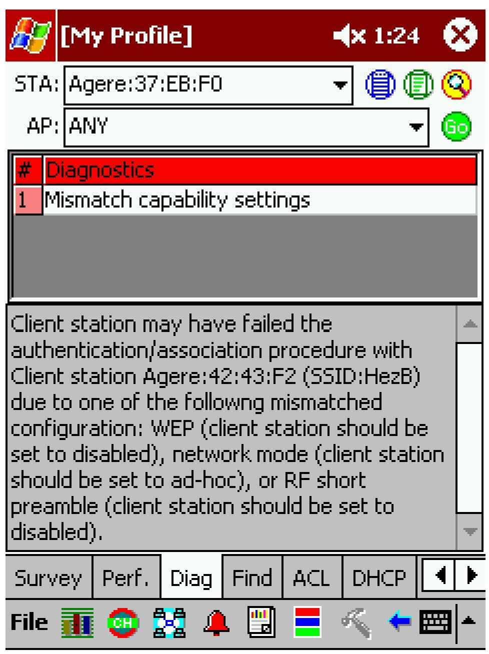


Figure 6.16.   Diagnostic of a Node

Overall, all of the technical evaluation participants agreed that the Tactical Humanitarian Relief Habitat is an impressive approach to solving the traditional problem of bringing CHE participants together in a self-organizing environment to work effectively in providing aid to those in need. Despite not having Internet reach-back connectivity, the habitat members who were in charge of camp management functions were able perform their jobs as camp managers. All the other role players were able to self organize and collaborate with each other. This was all made possible through the use of the peer-to-peer applications such as Groove and the CHE SA Tool on a WLAN without access points. This result validates the concepts of peer-to-peer communication survivability and the ability to have shared awareness in an austere environment.

B. FUTURE RESEARCH

In previous chapters, we discussed the issues, challenges and value created when connecting people and organizations within virtual networks. In addition, we conducted a technical evaluation to demonstrate some of the capabilities and limitations of technology aimed at increasing communication and coordination efforts for CHEs. The next step is to build on what we have accomplished and to recommend areas for further research and development. There are several capabilities that were developed for the first version of the ROCC. These capabilities need to be developed further and other capabilities need to be defined and developed. This system needs to be fielded in an environment where the true users can provide additional information on what our system needs in order to assist them. In addition, continued efforts using satellite communications needs to be further developed and will only enhance the communications capability during a CHE. Further analysis on the infrastructure requirements must be addressed as well as adding modularity and integration within a collaborative environment could be expanded upon.

1. Future ROCC/VCMOC Development

This section is dedicated to identifying areas for further development and integration of some of the ROCC functionality with PACOM's VCMOC. PACOM has established the Asian Pacific Area Network (APAN) which is a consortium of 17 foreign nations working together to provide each nation with better operational to Humanitarian Operations, Peace Keeping, and Peace Enforcing. We have established a working relationship with APAN on furthering the development of the VCMOC. We recognize that the viability of this system will ultimately rest with PACOM who has the resources and the "players" to evaluate and implement such a system into the operational forces. The following areas are considered for further research: (1)

a. Personalization

This is one area that is open to most any idea for additional capability. Personalization is used on most web sites and may be the most useful area of the VCMOC in that it can be integrated with the other areas to truly personalize the information based upon the user profile and database access histories. Personalization may be critical to the multi-national force participants to be more inclined to use such a system.

Examples of potential capabilities are:

- Reports generated based upon user profile, i.e. a camp manager could have a link to a daily report that summarizes several pieces of data for his camp

- Users could be alerted when someone that they frequently communicate with changes locations or contact information
- Alerts provided when requirements arise within a specific user or organizations capability

b. Operations

This may be the most important part of the VCMOC in that the information contained here is the important day-to-day information that is used by every potential user in the operation area. Some ideas for development:

- Better integration of digital maps into the web site.
- Method of storing and accessing historical information and reports on the situation
- Continued improvement on the ability to provide real-time updates to the user either via alerts on the web page or via email updates

c. Organizations

This section is the most basic in content and information. However, it is still in need of additional functionality.

- Provide the user with the ability to search organizations by capability.
- Provide links to the organizations parent site via the registration process (i.e. when an organization is registered, the link is inserted in the database for display on the details page).

d. Displaced Persons

This section is ripe for additional functionality. The basic problem of entering data into the database could be made easier by automating entry of the photo into the database. Additional improvements are:

- Automatic report reconciling missing family members
- Notification reports to camp managers of displaced persons being relocated to their camp
- Additional queries to the database based on demographic information
- Reports generated on displaced persons who are missing family members
- Automated method of integrating photos into the displaced persons database

e. Points of Contact

This module is very similar to the organization module in that the information is basic and easily manipulated. However, the following improvements should be considered.

- Automated method of integrating photos into the point of contact database
- GPS tracking of point of contact location integrated into the database
- Ability to contact POC based on location, including GPS, integrated into a collaborative envelope tool such as Groove

f. Camp Management

This is a very important part of the VCMOC in that each campsite, whether it is for an organizations headquarters or a relief area, needs to be registered with information available to those who may need it. The basic information is available in the current version of the ROCC, however the entire Displaced Persons module within the ROCC needs to be integrated into the VCMOC as well as additional pieces of information. Further exploration is required in the area.

g. Requirements

If the contact information is the most important aspect of the VCMOC, then this section is a close second. Currently in Kuwait, the Civil Military Operations Unit are having to deal with over 15 International Organizations who showed up in theater with medical supplies for the relief effort and yet, they are not needed (XX). This is where there is the most potential for relief operations. Organizations need the ability to evaluate and analyze requirements prior to arriving in theater in order to optimize their resource potential. This module is ripe for additions in functionality.

- Reports that match providers with requirements
- Automated alerts when capabilities are present to meet specific requirements utilizing multi-agent architecture
- Integrated logistics module that coordinates and monitors delivery of promised goods and services

2. General Development

a. Database Verification

Due to recent events, it has become very apparent that we need to be very cautious with individuals who may be trying to infiltrate US or UN refugee/EPW camps and may be known or suspected terrorists. As individuals are being processed into camps, data on these individuals will be collected and input into the database to include a picture, name, city of origin and many other data elements. Another aspect for further research is the implementation of digital fingerprinting and ubiquitous surveillance integrated within the ROCC/VCMOC to further identify these individuals. Ultimately, further research could be conducted to provide a link between our database and the CIA/FBI known terrorist or most wanted database for a possible match either by name, facial recognition, or by digital fingerprints. In fact, utilizing intelligent agents between the two databases to conduct the search and then prompt/alert proper authorities as well as the CMOC for possible investigation and/or action.

b. Satellite Communication

Although adhoc peer-to-peer networks work great in remote locations, satellite connectivity is critical for real-time situational awareness throughout the theater as well as having reach back connectivity to essentially anywhere in the world. As demonstrated throughout Operation Iraqi Freedom, embedded reporters throughout Iraq were able to report the events as they unfolded in real-time via mobile satellite ground stations mounted on tactical vehicles. The satellite terminal used throughout the war was the TT3082A. (37) It is a vehicular Global Area Network satellite terminal designed for voice fax, data and video communications from stationary and moving vehicles. It supports the two key operating modes of the Inmarsat Global Area Network including Mobile ISDN and Mobile Packet Data (MPDS). Mobile ISDN supports voice, fax, large data files and video transmission while Mobile Packet Data is ideal for email, Internet and other burst transmission applications from the vehicle. Its features include:

- Provides Mobile ISDN and Mobile Packet Data Transmission to remote sites.
- Provides voice, fax and 33.6 or 64 kbps data communications including digital video in Mobile ISDN mode.
- Use of dual terminals permits videoconferences and data transmission at 128 kbps.
- New MPDS mode allows continuous connection for packet transmission only - ideal for email and Internet.

Satellite ground stations such as the TT3082A has proven itself in a time of war and is worth pursuing to provide the robust real-time reach back connectivity that is ultimately desired.

c. Modularity

Decision Support Systems (DSS) are interactive, computer-based tools that help decision makers use information and models to solve unstructured problems. (1) Often the term modularity or design by modules is used when describing decision support systems. Modularity during design allows for incremental development and modifications, which can be done on isolated components without affecting the whole system. When a system is built with functional modules or components it is constructed with standardized units based on functional categories providing for flexibility and variety in use depending on the scale and scope of the implementation.

The VCMOC should contain enough modularity to accommodate the myriad scenarios to which it will be applied during relief operations. A "core" suite of the VCMOC should be built to include the basic functionality for any relief operation including a standard database and hardware configuration. This core capability will be rated to accommodate a set number of relief workers and process a set number of individuals receiving aid. As the number of people involved increases, the appropriate number of core component assets will be added.

In addition to the core components, the VCMOC should contain specific functional modules that can be added to the core system based on specific scenarios. The following are some examples of the types of modules that could be added:

- Geographic location - hot weather, cold weather, desert, jungle.
- Size of effort.
- Composition of organizations involved - Military, Civilian, NGO, IO, Independent.
- Modules based on the languages involved.
- Hostile and non-hostile environment.
- Multiple databases.
- Network architecture - mature well-established or expeditionary wireless.
- Application integration - does the scenario provide for the ROCC to tie into a larger system or is it stand-alone.

Modularity allows for the appropriate response to be tailored to the specifics of the requirement. This allows for a level of efficiency and allocation of assets, that directly targets the scale and scope of the operation.

C. THESIS CONCLUSION

The next big challenge for this thesis will not be technological, but the beta testing of this project in a real world CHE. We have devoted a significant amount of time working with the staff of the USPACOM APAN on the integration of the camp management, displaced persons, and situational awareness tool into the VCMOC. APAN is scheduled to conduct a technical evaluation similar to the one conduct at MCBH, but at the joint task force level during Cobra Gold 2003 in Thailand. During this event, military civil affairs personnel, NGOs, and IOs will survey the components of the Tactical Humanitarian Relief Habitat and provided valuable feedback.

This completes the second phase of the project as described in Chapter I. APAN will initiate Phase 3 in May in partnership with Dr. Bordetsky and Eugene Bourakov. They will continue to use existing COTS technology to establish satellite Internet connectivity and to setup an ad hoc wireless network in the field/tactical environment that will enable the beta testing of the VCMOC. Additionally, more software agents will be incorporated into the prototype to enhance the situational awareness and decision support functionality.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A. SATELLITE ACQUISITION INSTRUCTIONS STANDARD OPERATING PROCEDURES

Purpose. These instructions are intended to provide necessary information required for the proper installation of the NASA Advanced Communication Technology Satellite (ACTS) antenna assembly and mobile ground station (MGS).

Assumptions. A basic understanding of satellite communication systems (NPS Classes SS-3011 and SS-3613).

Instructions. The following is the instructions for installation of the NASA ACTS system:

- Level the antenna base using the level bubble on the base.
- Put dish at the appropriate elevation for location (e.g. 18 degrees from vertical for NPS, 04 degrees for Hawaii).
- Point the dish in the azimuth for the given location (e.g. aim at approximately 140 degrees for NPS, 103 degrees for Hawaii). It is advisable to place the azimuth actuator in the center of its range in order to allow for maximum flexibility in sweeping and adjusting (e.g. the numerical output on the antenna controller has a range for the angle that extends from 30 to 1000 units. Adjust the controller until it is at about 500 units and then physically move the antenna base to point to the intended azimuth).
- Power up dual access antenna controller.
- Verify the transmit and receive frequencies and the corresponding data rates. This is accomplished by checking the modem configuration settings and confirming those settings match the Cleveland Operations center settings.
- Attempt to use the ‘Auto’ mode to acquire the satellite. On the antenna controller, push the mode button until you see ‘Auto’ on the digital

display and push 'Enter.' (This usually does not work to acquire the satellite).

- Turn master attenuator knob clockwise to increase attenuation counterclockwise to decrease attenuation. Begin acquisition with both attenuation knobs turned all the way down (counterclockwise).
- On the SM3000, if the status/fault light is red, you don't have a signal
  - If no signal is received (indicated by the signal strength meter on the antenna controller) after attempting to auto track, switch to 'Manual' mode. This is done the same way as selecting Auto mode. Press the 'Mode' button until 'Manual' appears and then press 'Enter.'
  - If a signal is detected, allow auto mode to peak the signal. If the signal strength gets too high (the range is 0-999, if the signal is too strong a *** will appear), increase attenuation until minimal signal is received and continue to track until the 'CARR LOCK' light is green.
- In 'Manual' mode, the same concept is used to find the strongest signal strength.
  - Use up/down buttons in order to get signal strength. Sweep horizontally until the strongest peak is identified and then sweep vertical until that peak is identified. Continue process until the 'CARR LOCK' light is green. (Note: Sometimes signal strength can be peaked without getting carrier lock. This is probably because the antenna is tracking on a lobe of the signal and not the main signal. Continue sweeping to search for main lobe).
- This is an iterative process and takes time and patience.
- Once a signal is acquired and Carrier lock is achieved, optimize signal strength by going to auto mode.

- The carrier lock must be green in order to transmit data.
- The status fault light must not be red in order to receive data.
- Once all is in order, begin network troubleshooting to access the Ohio university network.
- Important phone numbers:

Hans Kruse	740-593-4891 Voice 740-593-4889 Fax 740-707-1711 (cell)
NGS Ops (Cleveland) (Bruce Curry/Jeff/Dave)	216-433-2287 216-433-8925 Fax
John Graham	408-393-6945 (cell)
Vince Darago	831-224-0132 (cell)

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B. TECHNICAL EVALUATION SCENARIO 1

Purpose. This scenario is designed to demonstrate the ability of a CHE participant to effectively conduct humanitarian relief efforts with the Tactical Humanitarian Relief Habitat.

Assumptions.

- Each participant has access to the Tactical Humanitarian Relief Habitat.
- Each participant has Groove collaborative software.
- Each participant has the 'Object Tracer' software in order to utilize the GPS functionality of the CHESA tool.

Evaluation Objectives.

- Register as a new member.
- View CHE information (e.g. needs, other participants, meetings, POCs).
- Post CHE resource information (e.g. available resources for support).
- Sign up for meetings.
- Conduct Groove session.
    - Share files.
    - VoIP conversation.
    - Chat.
    - Text messaging.
    - Voice messaging.
    - Conduct Power Point presentation.
- Utilize CHESAT.
    - Post alert.

- Use GPS Poster
- Send and receive text messages within the CHESAT.
- Search displaced persons.

APPENDIX C. TECHNICAL EVALUATION SCENARIO 2

Purpose. This scenario is designed to demonstrate the ability of the Tactical Humanitarian Relief Habitat manager to effectively administer the network.

Assumptions.

The network administrator has SolarWinds and AirMagnet network management software.

802.11b wireless technology will be utilized within the network.

Evaluation Objectives.

Identify what nodes are accessing the network through the wireless access point.

Monitor network latency, packet loss, traffic and bandwidth usage.

Obtain IP addresses of nodes on the wireless network utilizing the CISCO discovery protocol.

Conduct an Access Point installation survey.

Identify unauthorized Access Points.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

1. Ford, Hogan Perry, Thesis Titled "Communication During Complex Humanitarian Emergencies: Using Technology to Bridge the Gap," September 2002.

2. "Taking it to the Next Level: Civilian-Military Cooperation in Complex Emergencies," Conference Report, August 2000, United States Institute of Peace, Washington D.C.

3. [www.Reliefweb.int], November 26, 2002, February 2003.

4. Multiservice Procedures for Humanitarian Assistance Operations, Air Land and Sea Application Center.

5. UN: Fribourg Forum on Crisis Management to Discuss Thorny Issues, Duplication of Mandates and Obstacles to Rapid Delivery of Humanitarian Assistance, June 7, 2000, M2 Presswire, Coventry.

6. [www.AIMS.org.pk], October 18, 2002.

7. JP 3-08, Interagency Coordination During Joint Operations, 2 Volumes, October 9, 1996.

8. JP 3-07 Joint Doctrine for Military Operations Other Than War, June 16, 1995.

9. Virtual Diplomacy Series, Taking It to the Next Level, Civilian-Military Cooperation in Complex Emergencies, Appendix 1, The Realities of Coordination/Cooperation: Debunking as a Survival Tool, H. Roy Williams, Director of the Office of Foreign Disaster Assistance, Bureau for Humanitarian Response, USAID.

10. Seiple, Chris, *The US Military/NGO Relationship in Humanitarian Intervention*, Peace Keeping Institute, Center for Strategic Learning, U.S. Army War College, 1996.

11. Hotstetter, Melinda, Cross Cultural Relations Between Civilian and Military Organizations, Presentation by Melinda Hotstetter, Center for Disaster Management and Humanitarian Assistance, Tulane University, Washington, DC, 2000.

12. Interview, Michael W. Perry with Michael D. Schultz, Program Manager C3AITG, February 13, 2002.

13. Joint Publication 3-57 Doctrine for Joint Civil Affairs, June 21, 1995.

14. Wilkins, Aaron L. Major, THE CIVIL MILITARY OPERATIONS CENTER (CMOC) IN OPERATION *UPHOLD DEMOCRACY* (HAITI) A Research Paper, Air Command and Staff College, March 1997.

15. III Marine Expeditionary Force, *Draft CMOC Standard Operationing Procedures,* December 1994.

16. JP 3-08, Interagency Coordination During Joint Operations, 2 Volumes, October 9, 1996.

17. [http://www.mod.uk/jdcc/cimic.htm], March 10, 2003.

18. [http://www.reliefweb.int/undac/documents/insarag/guidelines/DutiOSO.html], March 14, 2003.

19. [http://www.reliefweb.int/hcic], March 14, 2003.

20. McDaniel, John R. Evidence Based Research, Personal Correspondence – Email, May 22, 2002.

21. Davidson, L., Hayes, M. and Landon, J., *Humanitarian and Peace Operations: NGOs and the Military in the Interagency Process*, National Defense University Press Book, 1996, [http://www.ndu.edu/inss/books/ngopvo], March 2003.

22. World Disaster Report, International Federation of Red Cross and Red Crescent Societies, 1997.

23. Joint Publication 3-07.5, Joint Tactics, Techniques and Procedures for Noncombatant Evacuation Operations.

24. MacIntyre, Douglas J., *Current Technology and NEO: Bringing a MEU(SOC) Mission Into the Digital Age*, 2001.

25. Jaques, Lynda, *Complex Humanitarian Emergency/Peace Operations Planning Tool*, DMSO, STID Proposal White Paper, U.S. Pacific Command, Research and Analysis Division, J08, 2000.

26. Sovereign, Michael G., Humanitarian Assistance and Disaster Relief in the Next Century, National Defense University, 1997.

27. [http://coe-dmha.org/Liaison/Vol_2No_1/Feat02.htm], February 3, 2003.

28. Document, *Using the Conceptual Model of Peace Operations (CMPO)*, The Program on Peacekeeping Policy, The Institute of Public Policy, George Mason University.

29. Jaques, Lynda, Peace Operations Support Tool (POST), Presentation Given by Dr. Lynda Jaques, U.S. Pacific Command, Research and Analysis Division, J08, 2002

30. [http://www.reliefweb.int/hcic], March 18, 2003.

[http://www.reliefweb.int/help/whatwedo.html], March 18, 2003.

[http://www.reliefweb.int/help/mandate.html], March 18, 2003.

31. Berry, Sharon, "Collaborative Tool Buddy-Lists Coalition Partners," *SIGNAL*, May 2002.

32. [http://www.reliefweb.int/undac/documents/iercm/Report_IERCM_CoreGroup_June00_Geneva.doc], March 3, 2003.

33. "Taking It to the Next Level: Civilian-Military Cooperation in Complex Emergencies," Conference Report, August 2000, United States Institute of Peace, Washington D.C.

34. [http://www.reliefweb.int/symposium/bp_resources.htm], March 21, 2003.

35. [http://www.cs.man.ac.uk/ipg/CS637/quicktour.pdf], December 22, 2002.

36. Bratton, John M., (US Pacific Command), Memorandum for Record, September 26, 2002.

37. [http://www.comsatsys.com/Pages/satellite_phones/tt3082a.htm], April 30, 2003.

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California

3. Marine Corps Representative
   Naval Postgraduate School
   Monterey, California

4. Director, Training and Education
   MCCDC, Code C46
   Quantico, Virginia

5. Director, Marine Corps Research Center
   MCCDC, Code C40RC
   Quantico, Virginia

6. Professor Dan C. Boger, Code IS
   Naval Postgraduate School
   Monterey, California
   dboger@nps.navy.mil

7. Professor Alex Bordetsky, Code IS
   Naval Postgraduate School
   Monterey, California

8. LCDR Glenn Cook, Code IS
   Naval Postgraduate School
   Monterey, California