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An Analysis of the Impact of Modern Collaborative Technology on Battle Rhythm at the Tactical Level

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The U.S. Marine Corps MAGTF Staff Planning Program (MSTP) defines battle rhythm as the "process where the commander and his staff synchronize the daily operating tempo within the planning, decision, execution and assessment (PDE&A) cycle to allow the commander to make timely decisions… Some of the planning and operating cycles that influence the battle rhythm of the command include intelligence collection, targeting, air tasking order (ATO), reconnaissance tasking, and the bomb battle damage assessment collection cycles. This battle rhythm is the commander's battle rhythm. It is his "plan of the day.""

-Marine Corps Gazette, Vol 8, February 2003

I. Developing a Battle Rhythm Model at the Tactical Level

The classical example of battle rhythm exists at the operational staff level. As the quote from the Marine Corps Gazette above alludes to, battle rhythm at the Battle Group Staff and Marine Expeditionary Force (MEF) HQ level, eventually is transformed into a dynamic Tactical Battle Rhythm (TBR) where execution collaboration and real time feedback across the tactical information grid have the potential to synergize the commander's intent and facilitate shared situational awareness (SSA) across the spectrum of combat. TBR is not only a function of the predictive requirements both imposed and indirectly attributed to the operational and tactical command staff level, but it reflects and adapts to the unpredictable, often chaotic external variables (Mission, Enemy, Terrain, Weather, etc.) while simultaneously providing feedback to the commander. It is through this TBR that the labors of staff action and collaboration are realized in the physical joint operations area. It is where the commander's staff battle rhythm is transposed into an execution battle rhythm enabled by real time collaboration and feedback. An ideal collaborative tool set coupled with an extensive sensor (human and technological) and network grid has the potential to transform the battlefield information flow and allow commanders to out-react their adversaries by getting inside of their information processing OODA loops.

This paper develops a conceptual framework of Tactical Battle Rhythm and develops a model of real world TBR in the context of a notional Humanitarian Assistance Operation (HAO). The focus is on the tactical battle rhythm at the Battalion/Squadron/Combat Service Support Group level in an attempt to explore execution phase collaborative tool concepts as an enabler for battle rhythm. Through this lens we hope to explore the dynamic collaborative nature of battle rhythm at the tactical level.

II. Tactical Battle Rhythm Conceptual Analysis and Modeling

At present, most, if not all, formal discussions of battle rhythm in doctrinal literature is centered on the staff level of operational command and control. Successful battle rhythm at this high level is exclusively characterized as the disciplined flow of information focused through time. Information transfer at the Destroyer Squadron, Marine Expeditionary Force, ship, or Corps level is driven primarily by the operational planning/mission order requirements of the Combatant Commander—in direct support of the staff battle rhythm. This battle rhythm is achieved when staffs are able to act as a synchronized, coherent, and predictive whole. Elaborate matrixes of events and times are constructed to prioritize the planning, reports, and information management flows associated with numerous recurring (predictive) and non-recurring (emergent) staff HQ activities. Though this paradigm requires information flow and synchronization with the tactical level major subordinate commands (MSC-DESRON, MEF), staff action is not the only factor that establishes battle rhythm at the tactical operation level. It is the actual execution of the mission, with all of its inherent uncertainties and unique requirements that generate the baseline tactical battle rhythm.

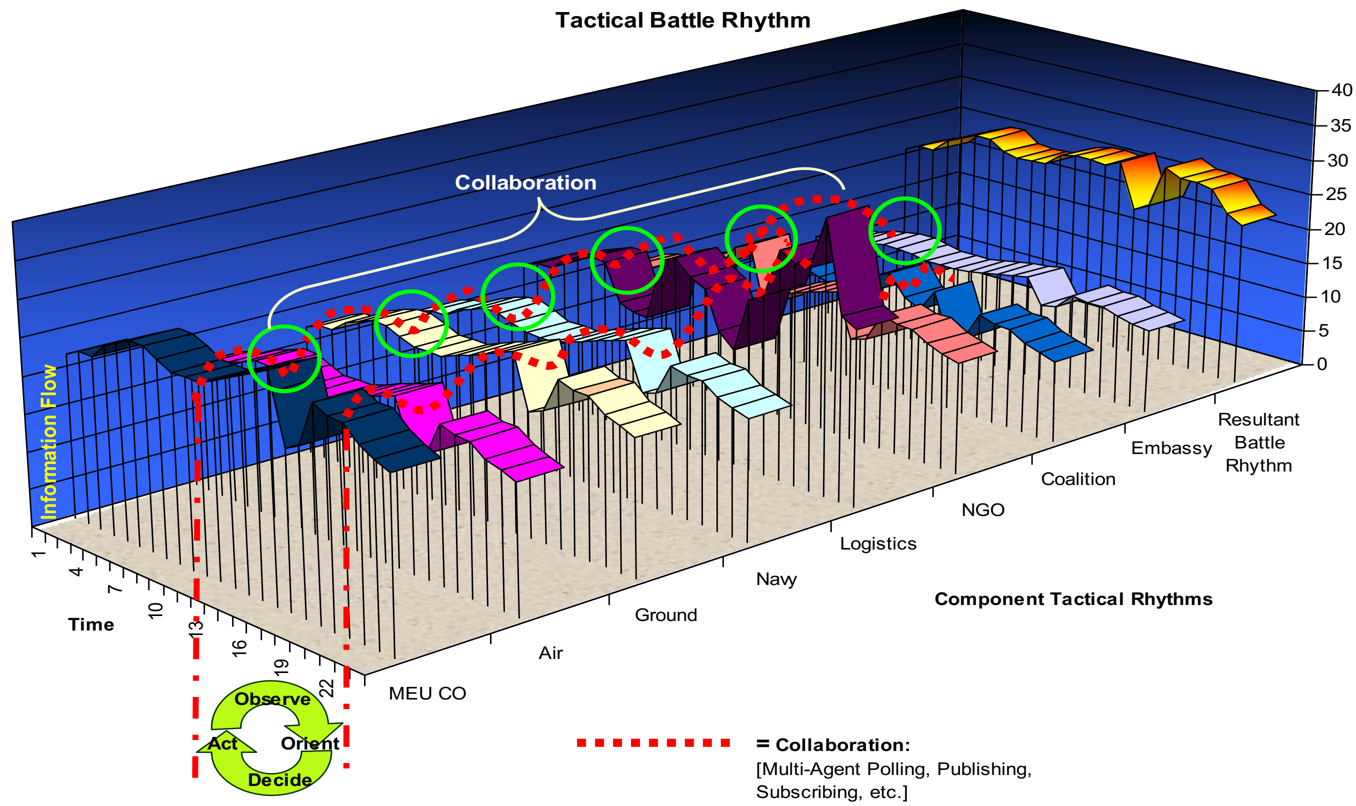
Tactical Battle Rhythm (TBR), as it exists at the execution level, lacks formal analysis—though its existence is undisputed. The primary emphasis at the operational level is the mission, then “care and feeding” (care and feeding is the concept of information flow in support of the staff level battle rhythm); in that order. Collaborative technology may provide a unique opportunity to examine the nature of TBR while simultaneously integrating the “care and feeding” requirement directly into the TBR—real time.

The tactical battle rhythm concept can be visualized through use of a waveform metaphorical construct as depicted in Fig. 1.

In this context, the carrier signal (Group Staff/MEF commander’s battle rhythm) produces a primary driving frequency that all subordinate commands must synchronize to (information requirements requiring information flow-“care and feeding”). The convergence of the MSC battle rhythm wave forms ultimately generates an operation’s TBR. This resultant TBR evolves out of the unique information requirements of the unfolding operation. The goal is to be able to synergize the TBR through use of collaborative methods and technologies (Agents, applications, etc) to provide an instantaneous network centric environment where information flow is distributed and synchronized upon arrival across the tactical information grid.

The three dimensional notional tactical battle rhythm information grid depicted in Fig. 1 is bounded on the X-axis by the component Tactical Operation Centers, or TOCs. This is a generic term that represents a primary heterogeneous network node responsible for specific mission related information flow. This abstract TOC network forms the baseline network structure of the tactical information grid. The entities representing the TOCs in this example are the Landing Force Operations Control Center (or MEU CO TOC), the Tactical Air Coordination Center Afloat (Air TOC), the MEU Ground Combat Element (GCE) battalion combat operations center (Ground TOC), the Naval tactical command center afloat (Navy TOC), Logistics Operation Control Center (Log TOC), Non-Governmental Organization (NGO) operation center (NGO TOC), the coalition TOC, and the US Embassy operations center (Embassy TOC). The Y-axis represents the mission time. Inherent to this time line is the mission commander’s (MEU CO’s) Observe, Orient, Decision, Act loop, or OODA Loop cycle. Information flow exchanged between TOCs provides direct and indirect feedback directly to the OODA loop. The Z-axis represents the amount of information flow per entity at any given time. This information flow is dynamic and is directly related to the information requested from the entity as well as the individual TOC's information requirement. The commander's OODA loop, in conjunction with the run-time uncertainties of the mission, defines each TOC's unique characteristic information battle rhythm.

Figure 1



The key aspect of the TBR in Fig 1 is that information is shared among all heterogeneous nodes rather than just between the MEU command TOC and all subordinate entities. It is this network centric information sharing architecture that truly enables collaboration. Shared situational awareness is facilitated through the employment of multi-agent technologies that continuously communicate and exchange information between heterogeneous systems throughout the information grid. Agents are the autonomous software vehicles that collect and distribute the information. They also manage information requirements through a variety of methodologies. Some of these methods include polling, publishing, logging, subscribing, and alarming.

The synchronization moments (green circles in Fig 1.) are events in time where information is exchanged between grid entities. The mechanisms that comprise the synchronization structure are poll, publish, alarm, and subscribe. Polling is an information pull technique whereby nodes continually probe for desired information and “extract” it once found. Publishing information to the TOCs is a push method used to distribute updated or requested information to the grid. Alarming is another form of information push but it results from specific feedback to a predetermined condition. Nodes that Subscribe to information receive services available on the tactical information grid in order to facilitate the planning, execution, decision, and assessment cycle.

The employment of multi-agent technologies creates a dynamic, user-configurable feedback mechanism which responds in real time to the changing operational picture. This real-time feedback loop accelerates the Commander’s OODA (Observe, Orient, Decide, Act) loop and provides him tactical leverage over his adversaries decision cycle. Feedback is enhanced through the employment of intra-agent collaboration *[see DARPA COAX Binni 2002 Experiment]* which utilizes *“detectors”, “effectors”, “conversors”,* and *“actors.”* *Detectors* observe and detect and feed the ***Observe*** cycle of the OODA loop. *Effectors* are programmed to control “events” and in conjunction with conversors (message exchangers) and actors (ability to display appearance/behavior) form the ***Act*** cycle of the loop. Additionally, *conversors* supply information to the ***Observe*** cycle as well.

This resultant rhythm is bounded by information requirements. At the tactical level, predicted, formal staff action is supplanted with shared situational awareness and collaboration which results in mutual adjustment and synergy. True collaboration at the tactical level can only be realized through network centric warfare architecture enable through the control of agent based technology (CoABS). In this essence, all nodes in the battle rhythm network are connected and information is instantaneous and ubiquitous, provided a user has the appropriate access. This framework eliminates the formal doctrinal situation report (SITREP), logistics report s (LOGREP), personnel report (PERSREP) submissions because each node has awareness of all the nodes and this information is distributed throughout the network. Through this network warfare architecture, the Commander’s mission orders, and more importantly, his intent is distributed and his information requirements are supplied via an agent based feedback methodology.

III. Tactical Battle Rhythm Experimentation

Control of Agent based technology is one of many possible future collaborative shared situational awareness tools. Less capable, but more readily available tools such as Groove provide a means to examine the dynamic and collaborative nature of battle rhythm at the tactical operational level in a simple experimental environment. To develop a framework capable of generating some baseline battle rhythm from which to illustrate the conceptual tactical battle rhythm model, a notional humanitarian assistance operation was created. The operation was scripted in order to require notional units to collaborate in order to accomplish specific tasking during the course of a 7 hour period; and from the nature of this collaboration, validate the conceptual tactical battle rhythm model. Appendices A thru C detail the notional operational scenario maps, script, and a brief statistical analysis, respectively.

The notional Republic of Lyboria is superimposed onto the Naval Postgraduate School Quad. The basic scenario is formed around a humanitarian assistance operation off the cost of the notional country Lyboria. A Marine Expeditionary Unit (MEU) comprised of approximately 2,000 Marines has transitioned ashore. The Aviation Combat Element (ACE), a composite squadron of 30 assault support aircraft, remain embarked aboard the Amphibious Ready Group (ARG) shipping. The ARG is composed of an LHD, LPD, and LSD. USMC forces have secured the airfield and the US embassy. Additionally, a combined battalion of German and Roman coalition forces were flown into theater and their Tactical Operation Center (TOC) is located near the Relief Operation Control Center (ROCC) in the vicinity of the food staging area. Two remote food distribution sites have also been secured. Site 1 is under USMC control and site 2 by the coalition.

Allied coalition assets consist of a combined battalion of German and Romanian forces. Coalition organization is integrated into the US command structure. Coalition forces may be used to form military patrols and to create joint vehicle checkpoints. There may also be a need for Explosive Ordnance Disposal Teams for minefield sanitation and destruction of unexploded ordnance.

Aside from the coalition tactical operations center, other participating tactical-level entities include the maritime-based tactical operations center, the non-governmental organization tactical operations center, the American embassy operations staff, and a Special Operations Force element.

Humanitarian Missions may require close collaboration with Lyborian authorities, UN agencies, International Organizations, and Non-Governmental Organizations. As a result liaison teams/representatives must ensure the permanent contact with these partners via Groove. Other missions may require direct involvement in Civil Military Cooperation projects throughout the region, focusing on the provision of basic human needs such as fresh water, electric, power, and shelter.

IV. Collaborative Technology Platform

Collaborative computing is a term which covers two main aspects of human collaboration:

- *The asynchronous aspect* represented by e-mail, discussion groups, news servers and similar software products which provide the basis for the so-called "groupware"
- *The real-time aspect* where interaction between people and specialized hardware and software facilitates handling data and representing information, person-to-person communication by the ability to share, modify and collaboratively create data and information.

The two existing technological methodologies for developing collaborative software include the *client-server* and the *peer-to-peer* models.
Client/server applications enable communication between clients but only after they connect to the server, which acts as middleman, keeping the master copy of all the

information, running nearly all the application logic, and downloading the results to the client.
Peer-to-peer applications demand almost all the application logic and information reside on the client, which communicates directly with other clients without server intermediation. Peer-to-peer is also called decentralized computing but that doesn't entirely exclude the use of the servers.
Based on its capabilities "collaborative software" can be segmented into two major categories: perceptual collaborative tools, collaborative workspaces.

Perceptual collaborative tools imply the existence of a session leader or initiator, all the other participants sharing this person's view, that meaning only one participant at a time can perform collaborative actions. As a result, these tools require high bandwidth and are implemented using the client-server model. Collaborative interactions are limited to what can be viewed at one time. In addition, anything one participant can see or modify all participants can see or modify which leads to difficulties in supporting data control and basic security. Examples of currently available perceptual collaborative tools are **NetMeeting** and **WebEx**.

> **NetMeeting** "Microsoft conferencing software allows to communicate with both audio and video, to collaborate in Windows-based programs, to exchange graphics on an electronic whiteboard, transfer files, or use a text-based chat program. Common uses of NetMeeting include real-time document collaboration, technical support in a HelpDesk environment, training and distance learning, and conducting remote meetings." It is based on the Real Time Protocol (RTP) which works over User Datagram Protocol (UDP) and H.323 for audio and video transmissions and call control. The Light weight Directory Access Protocol (LDAP) is used by the Internet Locator Servers (ILS) which in turn are used by the clients to locate and communicate other clients - a type of directory access system.

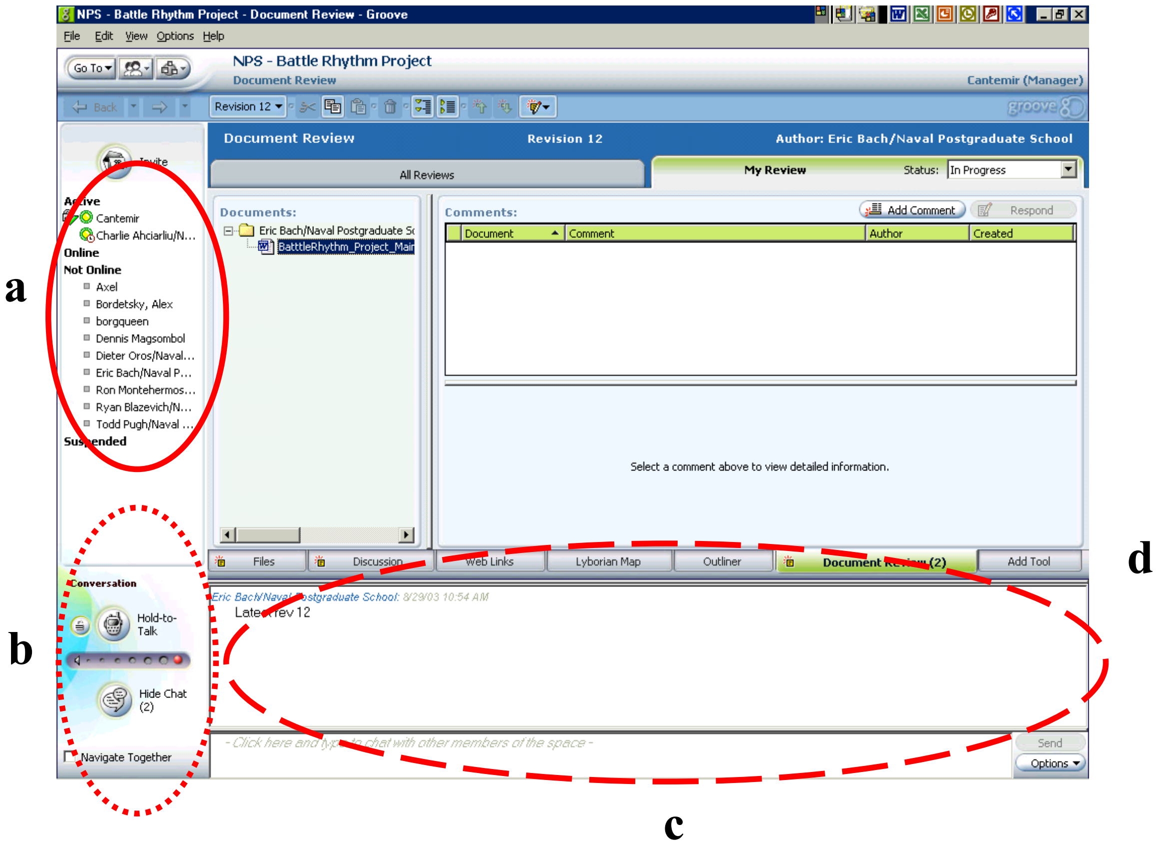
Collaborative workspaces (affinity communities) provide asynchronous collaboration and team management utilities to a synchronous group of participants, allowing multiple people to work on a single file and communicate with each other, but not at the same time. Extensive file sharing and document management capabilities are essential to collaborative workspaces, because shared simultaneous access to the same file is not possible. These workspaces provide low-level connectivity functions that enable the transport of raw data. Examples of currently available collaborative workspace products are **eRoom** and **Groove**.
Groove Workspace 2.5 was the collaborative tool chosen to host the TBR experiment for the following reasons:

- Groove has an outstanding ability to work securely both within and across organizational boundaries
- It can be used whether online or offline;
- Its has a decentralized architecture that enables groups to form quickly, to add/remove members, to tailor their workspace to needs, and to easily disestablish the workspace when it is no longer needed, all without requiring an IT administrator.

The required Operating Environment includes:

- Operating System: MS Windows XP, 2000, NT 4.0, 98, ME
- Connection to the INTERNET : Min 58K dial-up (recommended DSL, ISDN or LAN)
- Microphone & Speakers for the audio features

A short description of its features and functions is presented based on the basic layout of Groove Workspace 2.5:



Basic layout of Groove Workspace 2.5 (Communication features & Tools area)

a. **Extended Presence Detection** section shows detailed information such as:
   - Whether collaborative team members are active in the current workspace, and if so, which tools they are currently using
   - Whether they are online, but not in the current workspace
   - How long they have been inactive

b. **Audio Conversations/Voice Messaging**. Allows half-duplex or full duplex.

c. **Public Chat**. The Instant Messages appear to all workspace members.

d. **Tools Area**. May be customized for the needs of each shared space.

There is a large number of tools that are available either from Groove or from third-party vendors (Discussion, Calendar, Meetings, SketchPad, Contact Manager, Forms). In order to satisfy specific needs, software developers can create customized tools. Tools of specific interest for *document collaboration* include:

- **Files Tool.** Store, organize, and share any type of computer file. Microsoft Office's Word files can be *co-edited* by two or more shared-space members; PowerPoint files can be shown in *presentation* mode with multiple members viewing.
- **Document Review Tool.** Post documents for review by multiple members, review and merge changes, publish a new revision, and start the process again if desired. By using threaded discussions comments and replies may be captured. This is an advantage over Microsoft Office's features because the product adds the ability to organize, manage, and track progress throughout the review process.

Offline Use. This ability differentiates Groove from other server-based virtual workspaces. After working offline all updates and additions are automatically synchronized with those of other workspace members when connecting again

Encryption and Security. Groove data is encrypted and compressed both when it is stored on a hard drive and while transmitted over the Internet. Whenever possible, data is transmitted directly to the other people in the same shared space. A copy of this data is stored on each user's computer. At times, Groove does need to store data on a server. For example, if data is transmitted to someone who is not online, that data is stored temporarily on a server but then relayed to the person's computer when it comes online. In this case, that data is encrypted so that it is unreadable on the server.

Integration with Other Products. A growing number of Groove Workspace's features are integrated with Microsoft products, including Word, PowerPoint, Outlook, Project, and SharePoint. This integration allows the user to shift more easily between the work environments currently used and Groove's collaborative environment.

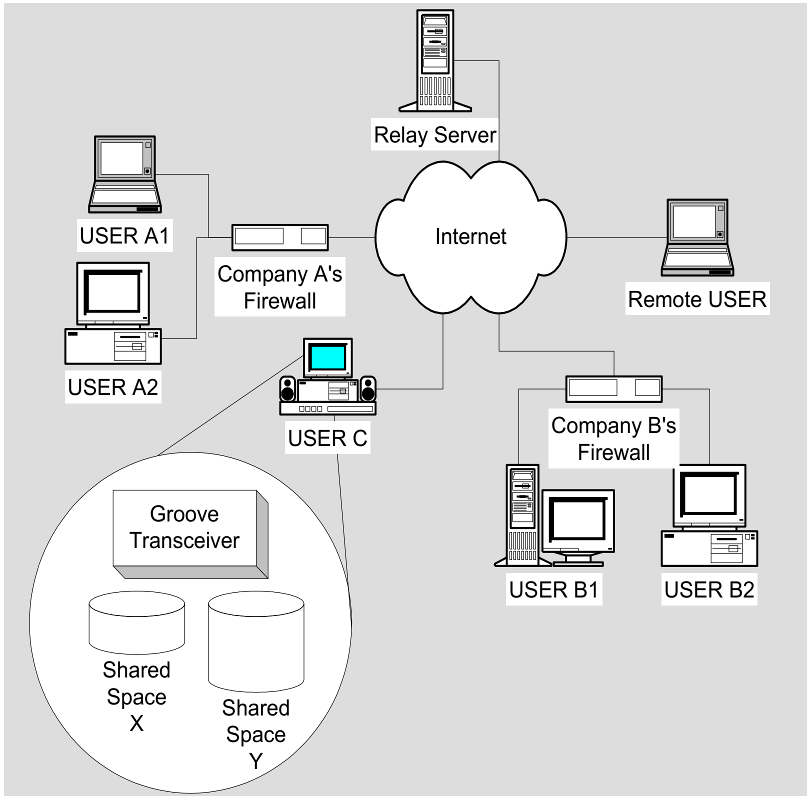
Specifically, the user can:

- Collaboratively edit Microsoft Word documents
- Collaboratively view Microsoft PowerPoint presentations
- Send a copy of an email message or calendar entry from Outlook to a Groove shared space

Architecture

Groove's distributed *peer-based architecture* may be regarded as a hybrid peer-to-peer and client/server architecture. Groove Workspace is the client piece installed on users' machines, encompassing both the client software (the *transceiver*) as well as user data sets (the *shared spaces*). Groove transceivers can communicate directly with each other in peer-to-peer mode. The reason to use a relay server resides in the need to enable initial contact between two users, to provide presence information, firewall navigation services and synchronization of offline users.

Next figure shows details for one Groove USER C, who is a member of two different shared spaces (X and Y). Membership for these shared spaces could virtually include any combination of clients shown on the diagram who can be either directly connected to the Internet or behind a firewall. They can work from more than one location, online/offline all workspaces being automatically synchronized when users reconnect. For a better understanding of its features let's examine Groove's peer-to-peer and client server aspects[1].



Groove's peer-based architecture is a blend of peer-to-peer and client/server aspects.

Peer-to-Peer Aspects. Each copy of Groove Workspace maintains encrypted local copies of its shared spaces on the local PC's hard drive. It keeps these shared spaces synchronized with other members' copies by transferring and receiving small packets of changes, or *deltas*. For example, when one member edits a file, those changes (not the entire file) are transferred to other members. Groove creates deltas for all user activities, including presence detection and instant messages.

Groove uses its proprietary Simple Symmetric Transfer Protocol (SSTP) to compress and encrypt all deltas for efficient and secure storage and transport over the wire across port 2492. SSTP also provides the routing mechanism that allows deltas to traverse network firewalls and Network Address Translation (NAT) routers.

Client/Server Aspects. While two Workspace clients *can* communicate with each other directly in peer-to-peer mode, Groove uses relay servers extensively to pass information in certain cases. The resulting impact of these situations is that workspace information is at least temporarily stored on Groove's relay server.

- If even one workspace member is offline when another makes changes, Groove stores all deltas on the relay server until the offline user

[1] **Dana Dolan** - Groove Workspace 2.5 Detailed Evaluation Paper - *Software Productivity Consortium*

reconnects. This feature allows the formerly offline user to receive all changes regardless of the online status of the other members.

- If a user suffers from a slow connection, then Groove Workspace will publish a delta to a relay server instead of that user sending deltas directly to all other members. The server will then fan out the single delta message into multiple messages, one for each workspace member.
- If Groove's SSTP is blocked by a firewall, Hypertext Transfer Protocol (HTTP) tunneling is employed. Groove sends the compressed, encrypted deltas to the relay server where they are wrapped in HTTP and routed via port 80 on the destination machine.

That is why a given Groove shared space, with many members behind tightly managed firewalls would depend on the relay server for 100% of its communication needs. It is also important to remember that the data typically stored on these servers consists of compressed, encrypted deltas, rather than entire shared spaces.

Another approach used to tackle collaboration problems is the usage of a multi-agent architecture which resides within the global information grid and uses the information exchange infrastructure, to facilitate the intelligent tailoring and dissemination of knowledge. The concept was developed by researchers led by DARPA in an attempt targeted to the better usage of technology in the effort of improving communication between International Organizations (IO), Non-Governmental Organizations (NGO) and the military in humanitarian and peace operations.

An important theoretical concept is the creation of a so-called **habitat** where all the actors must be able to share resources (information, services, etc.) in a way that optimizes their ability to effectively carry out their assigned missions within the imposed security or policy constraints. As a result, this is a dynamically created concept meant to support a specific operational mission having interfaces which ensure its connection with other habitats as well as with all other "legacy" systems, assets, organizations, or individuals.

Former experiments conducted by the NPS have been focused on creating a Tactical Humanitarian Relief Operations habitat based on Groove - Groove Workspace providing the virtual space for immediate and direct connection between its users which can join efforts in performing a wide variety of collaborative activities.

This ensures a better communication within the team members, which benefit from the enhanced awareness of the other members sharing the workspace and consequently the speed and the quality of decision-making are increased. The Tactical Humanitarian Relief Operations habitat was created using a web-based application called the Relief Operation Coordination Center (ROCC) which is based on the use of HTML and active server pages (ASP) to interface with a database to insert, edit, view, delete and manipulate information to enhance multi-participant information sharing. The application is web-based in order to be mobile and accessible via internet connectivity and can be embedded in Groove in order to enhance the ability of geographically distributed users to plan, organize, and collaborate for problem solving.

Using the principles revealed by the DARPA CoABS program, which deals with the techniques used to safely control, coordinate, and manage large systems of autonomous software agents, the NPS has developed an agent-based application, also known as the Complex Humanitarian Emergency Situational Awareness Tool (CHESAT). Its main mission is to give the users self-aware capability to maintain situational awareness on each other's location and have a common knowledge of events in their area of operations.

The tool manages to integrate a series of in-house developed agents with the ROCC web-based application and with the Groove client. A short description of the functions covered by the two most important agents is:

> **The SA Management Agent** provides the visual interface display for all participants through their web browser and is intended to support the shared situational awareness for all the tool's users. It provides display capability for a great amount of information which allows a user to make informed decisions on how to assist in a particular event and also provides the necessary information to coordinate assistance.
>
> **The Tracking Agent** provides position-location information to the SA Management Agent for display in the browser. Data collected by the Tracking Agent comes from one of two input sources. One source uses manual inputs from the user who clicks and drags a user icon to a location on the display. The icon is then dynamically displayed to everyone accessing the CHESAT. A second input source is from a GPS receiver. This is accomplished by enabling a software agent that takes the GPS receiver input and transmits it to the SA Management Agent in the CHESAT, which subsequently moves the user icon to the correct location on the display. This method is much more accurate and requires no user input to adjust position information. This method of input is obviously hindered when a participant is obstructed from GPS detection (e.g. inside a building) or does not have a GPS receiver. In this situation, the user can easily switch to manual inputs by clicking the appropriate button on the CHESAT display.

Finally, the Complex Humanitarian Emergency Situational Awareness Tool may exist in two different spaces at the same time:

- **on the web server** – that means it is accessible to all the users that can access the server where it resides;
- **on the CoABS Grid** – which can be understood as the infrastructure layer that has all the of the agents and services running on it.

V. Shared workspace concept and integration with multiple rhythms

The primary shared tactical workspace consists of layers of graphically portrayed information that can be filtered by the individual user based upon his/her security access permissions. The Joint Operations Area (JOA) is parsed into three dimensional Lat/Long segments. JOA Sensor information (HUMINT, SIGINT,ELINT, etc) is catalogued and "tagged" with an appropriate Lat/Long sector pertaining to its coverage or relevance. As a user enters an objective area, his collaborative digital screen will indicate what types of networked information he has available at his disposal. For instance, all friendly and known enemy positions would be instantly plotted on the map, the imagery tab would light up indicating that imagery products are available for the area. Selecting the flashing air tab would display aircraft in direct support of the mission, complete with call signs, frequencies, A/C type/model/series, time on station and ordnance load. As the unit entered into the objective area, the Ground tab on the MEU Landing Force Operations Center (LFOC) display panel would flash, and if selected, would display the current unit's position in real time. Other associated tabs would indicate real time voice, streaming video, or other data is available. Data sharing could be tailored as push or pull depending upon the command relationships and need to know criteria. For example, a helicopter in route to a pick up zone (PZ) would have real time updated blue and red force locations and threats appear on his moving map display. Placing a cursor on the PZ icon would bring up the unit's call sign and tactical frequency. If desired, selecting the icon would auto tune the radio to the desired frequency or initiate a text messaging function if desired. Additionally, the Forward Air Controller (FAC) at the PZ could submit current imagery of the landing zone to help familiarize the pilot with zone lay out, hazards, etc. prior to landing.

In addition to the geographically-keyed, action-centric portions of the shared workspace, there also exists a robust reference library tool, an instant messenger tool, and a time-synchronized calendar/reminder tool.

The reference library makes up the core of the semi-static portion of the shared workspace. This area contains a vast database of information that is both operationally relevant and laboriously cross-referenced for ease of use. Pointers to all the data exist on the end user's machine, but just the core database is loaded before operational activity begins. This allows the user to operate in austere communication environments by pulling only data that is deemed relevant or necessary. Uploads to the library primarily include lessons learned and after action reports that are less time-sensitive than geo-keyed items.

The instant messenger is always-on and is designed to be the primary means for routine communication with other members of the operation. IM spheres are created based upon working relationships, not a pre-defined hierarchical structure. This gives the user latitude to seek out other users that may have answers to a question rather than working up and down a strict chain of command.

The calendar/reminder tool exists to prompt the user that he must make periodic inputs to the overall battle rhythm process. Daily requirements that feed up the chain are vital to keeping higher echelons informed and prepared for continuing operations.

VI. Networking segments & enabling technologies

Networking Segments

Integrating information across a Coalition is not just a matter of employing technology — it involves the creation of a coherent 'interoperability of the mind' at the human level as well, where many social and cultural factors come into play. The mapping between the human and technical worlds is thus not straightforward. From the human perspective, four different ‘domains’ can be identified:

- **Organizational Domains**: for example the Joint Task Force HQ (JTF HQ)
- **Country Domains**: each of the National command chains would be a separate, self-contained domain
- **Functional Domains**: sets of entities collaborating on common tasks, for example Meteorology or Intelligence
- **Individual Human Domains of Responsibility**: Commanders have responsibility for their own HQ and all subordinate ones (in practice they delegate). Hence the individual human domains of influence may overlap.

These types of domains are not entirely exclusive and there are many different levels of overlap and interaction depending on the viewpoint taken. It is this complexity at the human level that creates difficulties for technical systems. [1]

Military Context

Success in military operations involves carrying out fast, coherent, decisive actions faster than the enemy or opponent can react, resulting in decision dominance and sovereignty through the use of command agility. This process is command led; human decision-making is primary and the role of technology is secondary. Shared understanding and Information Superiority (IS) are key enablers in this process. Battle rhythm is the well-established way to keep or set the pace to gain mentioned IS.

In addition to the problems of integrating single-service and Joint capabilities into a coherent force, the nature of Coalition (multi-national) operations implies some need to rapidly configure foreign or ‘come-as-you-are’ systems into a cohesive whole. Many problems in this environment can only be solved by organizational changes and by ‘aligning’ doctrine, concepts of operations and procedures. Due to the inevitable absence of pre-existing coordinated systems, Coalition scenarios require a rapid, flexible, on-the-fly approach that allows capabilities to be assembled at run-time. However, in addressing this requirement for interoperability, it is also crucial to address issues of security of data, control over semi-trusted software from other Coalition partners, and robustness of the resulting system (e.g. the ability to withstand denial-of-service attacks).

Currently coalition operations are often characterized by data overload, information starvation, labor-intensive collection and co-ordination of information, and standalone stove-pipe command systems that use incompatible data formats. This leads to a horrendous technical integration task and gives commanders only scattered snapshots of the battle space. This paper aims to show that the agent-based computing paradigm offers a promising new approach to dealing with such issues by embracing the open, heterogeneous, diverse and dispersed nature of the Coalition environment.

Enabling Technologies

This part provides an initial description of the enabling technologies required to support and facilitate collaboration on the tactical level of described organizations as well as the inter-collaboration between the different TOCs. The overall goal is to enable and maintain the rapid establishment of effective networking and collaboration.

A list of existing technologies to support our specific scenario can be found in the 'Existing Technologies' paragraph.

Overall we talk about three categories – basic, existing and advanced architectural technologies. The basic enablers consist of those technologies that are required to support the conventional networked communication and collaboration we know today. The advanced enablers consist of technologies that are required to support the more advanced (future) requirements. Since future, the advanced list is more to be understood as an architectural wish list.

While the basic aspects of these technologies are commercially available today, considerably more work is required to fully realize most of the advanced technology, especially in military settings where large-scale interoperability and security is a requirement.

The items in the following lists are not necessarily complete.

Basic Architectural Technology

- advanced shared information space support
- flexible and powerful search facilities
- intelligent agents for seeking / gathering information, monitoring processes
- notification mechanisms
- automatic data entry mechanisms (to reduce/eliminate difficulty of getting information into systems
- non-traditional I/O mechanisms (e.g., voice input to or actuation of systems, and voice or other audio representation of output data, as in some aircraft systems)
- highly portable devices (satellite dishes, laptops, sensors) that enable communications to be maintained with smaller units (down to the vehicle or individual), and enable those units to be tracked and status reported (e.g., automatically)
- a rich suite of specialized tools, e.g.,
  - simulation tools
  - models
  - planning tools
  - knowledge-based and other tools for situation assessment and course of action analysis and recommendations
- a rich suite of presentation mechanisms, e.g.,
  - scaleable map displays
  - dynamic distributive overlays
  - interactive graphics
  - three-dimensional terrain visualization and "fly through" capabilities

- support for mediated collaboration (enhances unmediated collaboration environments by imposing specific structure, rules, or protocols on interactions)

Existing Technologies

Networking Technology

- Phone system to establish contact and collaboration initially
- IPv4 standard Internet Protocol with
  - Wired 802.3 broadband components as backbone and
  - Wireless 802.11x components as supplemental components
    - Infrastructure Mode as standard
    - Ad Hoc Mode as backup
  - Dialup connections may be used as backup.
- GPS, to acquire positions and allow to track assets
- SatCom as backup system whenever wired or wireless can not be established
- …

Collaboration Technology

- Groove Software (managed version)
- ROCC Software (implemented video transmission)
- …

Advanced, Future Technologies

- a scaleable, open architecture
  - based on a suite of widely adopted commercial technologies and standards
- interoperability
  - among a wide variety of object models and data types
  - between currently diverse systems (e.g., between sensors and C4I systems in military applications)
  - wrappers, mediators, object adapters, bridge components for use where necessary
  - data has associated metadata (data describing data) to allow data from diverse sources to be merged or transformed (e.g., registration of spatial data to a common coordinate system)
  - standards for key data types (including metadata) and formats
- flexible, rapid application development
  - "plug and play" dynamic configuration of hardware and software components that meet specific applications requirements
  - flexible location and size of components; e.g., ability to dynamically move objects between platforms (like the file sharing), to adjust for platform size or communication constraints, without changing overall system function
  - self-mobile objects to support "agent" technology (ROCC)

    - ability to quickly and easily modify and upgrade individual components, and distribute changed components (or the changes themselves) to locations where they are needed
- survivable, with system and component resilience to failures, loss of components or degradation of component capabilities, errors, environmental conditions, and information warfare attacks
- "non-stop operation"; e.g., modifications/upgrades to system configuration or individual components should be possible without disrupting normal operations
- support demanding performance requirements
    - support for hard real-time processing requirements
    - global or decentralized load balancing; dynamically distribute load among replicated resources according to demand and transient network conditions
    - decisions made dynamically on quality of service observations
- advanced networking and related technologies
    - provide automatic dynamic bandwidth allocation and advanced services within available bandwidth; applications must be capable of taking advantage of changes in available bandwidth (and be capable of operating in situations where bandwidth is degraded)
    - ability to integrate different communication channels as parts of the same interaction, and optimize usage of those channels based on their characteristics; (e.g., ask for a large piece of data via a low-bandwidth "direct" message, and have it delivered via a high-bandwidth broadcast)
    - "smart caching" to avoid unnecessary communications
- flexible, modular security mechanisms, including
    - support for handling information at multiple security levels (e.g., in a military operation, automatic data sanitization to allow release of US-only information to coalition partners)
    - user/software authentication, authorization, and access controls
    - mobile objects that migrate between clients that do not trust each other
    - safe mechanisms for executing untrusted code, scripts
    - support for trusted path between user and code
    - accounting mechanisms that can stop software that exceeds its resources

---

1. Peer to Peer

The Groove tool uses peer-to-peer technology and is a secure, just-in-time decision-making and information-sharing …tbd

As federal agencies reorganize to meet new challenges, the need for seamless inter-agency cooperation is greater than ever. Groove Workspace makes it possible, providing officials with a better way to work together across organizational and technical barriers.

2. Software Agent Technology

Software agents are currently receiving much attention in the research community. This interest is being driven by the phenomenal growth of the Internet and the World-Wide-Web. Agents can be viewed as semi-autonomous software designed to help people cope with the complexities of working collaboratively in a distributed information environment. This involves the agents communicating between the users and between themselves. The agents are used to find, format, filter and share information, and work with users to make the information available wherever and whenever they need it. The agents are also able to proactively suggest courses of action, monitor mission progress, and recommend plan adjustments as circumstances unfold.

3. Personal Digital Assistant (PDAs)

Currently, Groove Workspace platform is being developed to utilize the technology with PDAs. Groove Workspaces will become more robust with use of PDAs. PDA's are more compact than most PC Laptops and Tablets. But, the most viable hardware for the Groove Platform is the Laptops and PC Tablets. Microsoft is partnering with Groove in order to effectively harness the PC Tablets capabilities.
In regards to the Battle Rhythm Project, the tactical force, especially the "ground pounders" would be more inclined to utilize a PDA vice a Laptop PC. Obviously, PDAs are smaller and weigh much less than Laptops. It is easier to pull out a PDA out of your pocket vice a PC from a backpack.

4. WindowsXP Tablet PC Edition

WindowsXP Tablet PC edition and Groove Workspace is a fitting combination that integrates the automatic synchronization and the integrated wireless support. This new Operating System integrated with the mobility of the Tablet PC and its ink and speech tools will pave the way for the most versatile computing experience. The combine capabilities of Windows XP Tablet PC Edition and Groove Workspace will provide a simple and powerful means for business people to get work done. In addition to the robustness of its computing versatility, WindowsXP has the security "always-on" 192-bit encryption of Groove Workspace that assures complete security for group interaction and data.

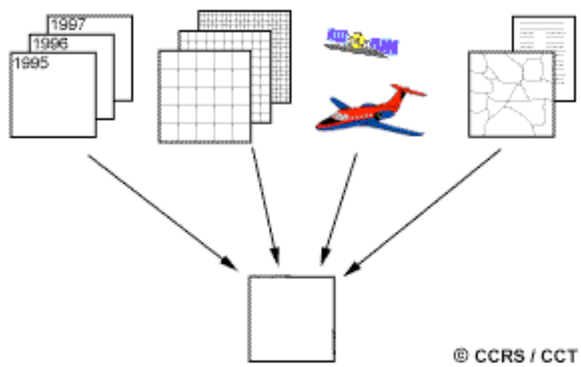
5. Management Server

Groove's Enterprise Management Server allows IT administrators to centrally manage Groove deployments by using current policies and network assets. This server provides Groove user identities to be deployed and managed via integration with Active Directory services and simultaneous allows Groove clients to automatically authenticate others within and across network domains.

The Enterprise Relay Server gives network administrators robust control of Groove client traffic within their enterprise. In addition, administrators can optimize network resources and QOS effectively with the needs of their staff. In order to capture the full capabilities of Groove network, the Enterprise Management Server and Enterprise Relay Server were designed to work together in an enterprise.

The Enterprise Integration Server is the best suited for companies desiring to integrate their existing business systems. This server extends secure centralized systems, data, and functions to authorized users across the company network boundaries. Server-based programs can be created to provide users with task-specific support called “bots”. A Groove bot, for example, can increase the server capability by implementing the enterprise resource planning system to securely exception notifications to company suppliers when inventories become depleted.   In the long run, Groove Enterprise Servers is cost beneficial when properly utilized.

VII. Remote data sources and data integration



In the early days of analog remote sensing when the only remote sensing data source was aerial photography, the capability for integration of data from different sources was limited. Today, with most data available in digital format from a wide array of sensors, data integration is a common method used for interpretation and analysis. Data integration fundamentally involves the combining or merging of data from multiple sources in an effort to extract better and/or more information. This may include data that are multitemporal, multiresolution, multisensor, or multi-data type in nature.

Combining data of different types and from different sources is the pinnacle of data integration and analysis. In a digital environment where all the data sources are geometrically registered to a common geographic base, the potential for information extraction is extremely wide. This is the concept for analysis within a digital Geographical Information System (GIS) database. Any data source which can be referenced spatially can be used in this type of environment. A DEM/DTM is just one example of this kind of data.

Other examples could include digital maps of soil type, land cover classes, forest species, road networks, and many others, depending on the application. The results from a classification of a remote sensing data set in map format, could also be used in a GIS as another data source to update existing map data. In essence, by analyzing diverse data sets together, it is possible to extract better and more accurate information in a synergistic manner than by using a single data source alone.

There are a myriad of potential applications and analyses possible for many applications

VIII. Experiment Observations and Findings

In retrospect, the overall experimental design could have been structured such that basic tasks were known before hand and participant roles held constant for the duration. This would minimize non-mission specific communications and facilitate more accurate data collection. Though this added to the real world "fog and friction", the script could be made dynamic by injecting scenario modifications by a designated exercise facilitator. Well defined roles and mission tasks would provide a standardized "launch" point for each task. Then the task completion times could be correlated with the frequency of data transmission and Groove features utilized in order to provide a metric for measuring overall collaboration.

Data Collection Topology

The data collected was insufficient to correlate the frequency of collaboration between all collaborative entities (TOCs, etc.) per a given event and time. This resulted in a 2-D data histogram (see Appendix C) vice a 3-D presentation similar to Figure 1. Though the histogram data reveals a frequency of communication exchanges, it does not delineate the individual entity's frequency of collaboration. Future designs should incorporate more robust data capture mechanisms to better identify collaboration "trigger" moments for each entity.

Anomalous Events

a. Disturbances: Technological interruptions were the largest category of disturbance encountered within the experiment. Less than ideal wireless coverage was the biggest impediment to smooth collaborative workflow. Although this shortcoming was quickly recognized, there was no effective workaround to ensure "always on" collaborative nodes.

b. Script Driven: Role changes and pre-planned contingencies were the two major classes of script driven disturbances that were introduced. Both of these elements increased collaboration activity, especially in the request-response category (see Appendix C).

Groove Features Used

Attempting to use Groove as a mobile collaborative platform (Laptop & PDA) proved challenging. A functional experiment space was created and several features implemented to include web links, digital whiteboard, message and Intel tabs, and a project manager tab to issue and manage mission tasking. Groove was augmented with local applications ROCC (GPS enabled) and a live streaming mission video website. The intent was to increase the synergy of collaboration through enhanced situational awareness.

The Groove workspace quickly became cluttered and it was realized early on that the application was platform challenged and not ideally suited for tactical mobile operations. Groove is better suited for a staff-oriented, semi-stationary environment (office, tent, etc). A more robust mobile platform is required for tactical-level field use. Aside from the global chat functionality, the digital white board and image storing features provided a low cost way of quickly sharing information.

Frequency of Collaborative Transactions

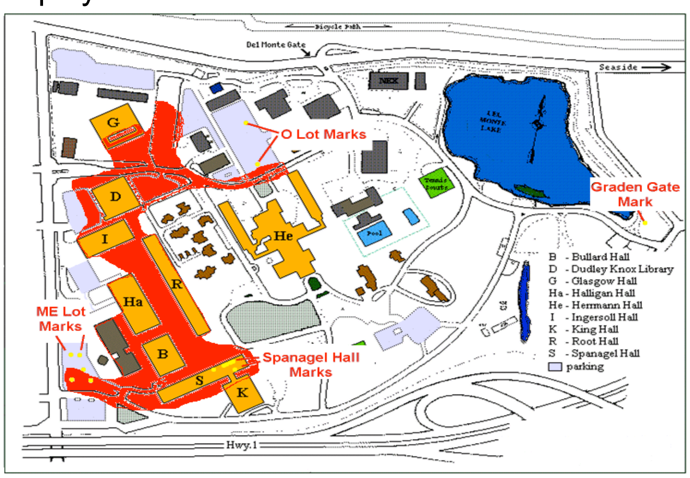
Collaboration frequency, predictably, increased with environmental ambiguity. As scenarios became more complex and participants faced multi-step decision processes, collaborative transactions peaked.

State of the Network

This section examines the influence of certain failures on the collaboration behavior of the participants.

Network:

In preparation of the experiment the wireless network coverage was examined and displayed as follows:



NPS SITE MAP: ACCESS POINT CONNECTIVITY

The red marked area was supposed to be within range of any access point. This turned out to be not true since connectivity was lost in a couple of spots on campus. Since 802.11b was the only network we used, its failure hampered some tasks significantly. Especially the operations which needed a high frequency exchange of information became critical. This fact made clear that, as simple as it is, it is very important to make sure that critical areas are either connected or have a backup for the primary connectivity.

Hardware:

Simple hardware failures also affected the experiment negative. There have been two incidences that delayed tasks. Since all participants used mobile computers, they were limited by their batteries. An operation with critical tasks needs a backup for the electrical power supply of the platforms that allows a recharge of the batteries without powering the system down.
Second point here is that the combination of the used applications (e.g. Groove, video feed, MS Producer for data extraction) can easily overload the laptop that is set up for that purpose. An easy fix could bet to standardize the components in order to being able to maintain performance and uptime. This could also be useful to have platform independent, standard wireless connectivity.
GPS agent was not able to post the position data to the ROCC application due to the bad wireless coverage within the experiment location
Software:
It was foreseen to use the ROCC Tool during the experiment to maintain situational awareness. Since the roles of all participants changed every hour, the use of ROCC was reduced because of the failure to log off due to these changes of roles. Through this unhandy side effect ROCC became orphan and was less used than expected.
A second reason for this was the improper connectivity of the IPAQs to the wireless network which canceled their GPS capabilities.

Better training before the beginning of the exercise would have:

- revealed more of the qualities of the Situational Awareness Tool;
- made participants more confident in using IPaq's;
- revealed some of the scenario deficiencies which led to the inefficient usage of these software and hardware tools.

This thing would have been possible if the required hardware and software would have been up and running at least few days prior to the experiment, so each of the participants would have had a "hands-on" training opportunity.

On the day of the experiment, IPAQ's should have been assigned not to the person but to the functionality. As a result, each participant to the exercise would have known the pre-assigned colors for each functionality in the ROCC software and situational awareness would have been easier to share – not necessarily through email/chat messages.

This exercise was supposed to simulate a real world environment where knowledgeable attending personnel fulfill the assigned tasks. Specialized collaboration between people within a certain mission presumes a certain level of required training for each member of the team and the existence of a common language. Therefore, whenever using people with different education, from different countries, it is mandatory to ensure the minimal requirement of sharing a common set of terms, expressions that facilitate a clear share of information between participants.

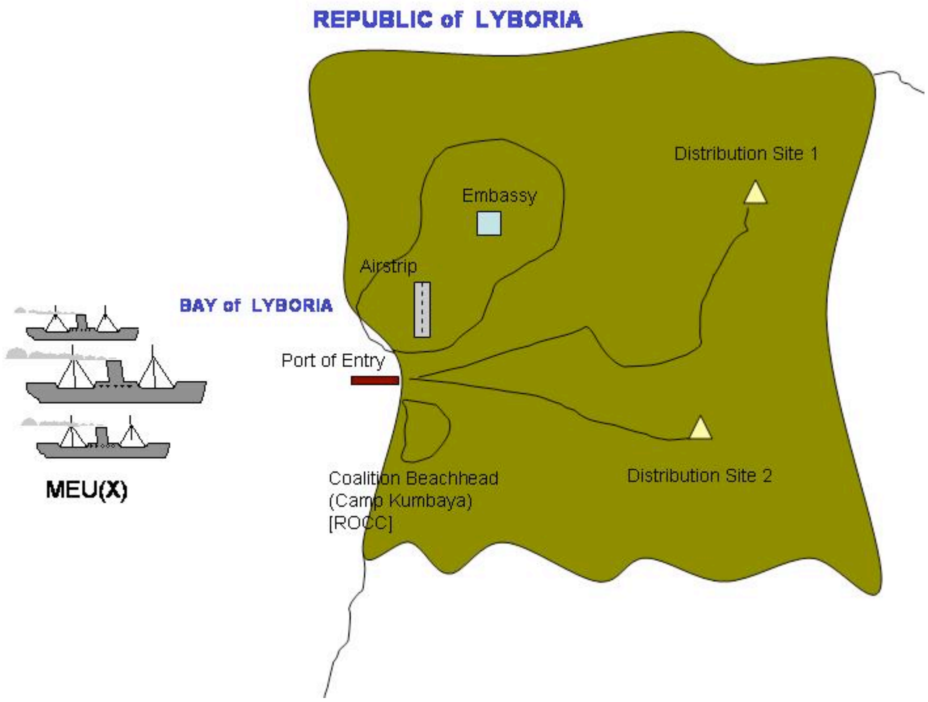
IX. Summary of the Effects of Collaborative Technology on TBR

Collaborative technology can serve as a major enabler to Tactical Battle Rhythm (TBR), if employed correctly across the spectrum of interrelated decision-making elements. Execution-time collaboration has the potential to drastically transform the battlefield, or humanitarian assistance environment, in ways not possible just a few years ago. The key to realizing the benefits of collaborative technology at the tactical level is to mitigate environmental ambiguity by leveraging collaborative technologies that build a shared situational awareness.

The inherent request-response model that occurs within collaboration serves as the metric to be monitored for effective participant interchange. Translating commander's intent into action is directly related to this activity model, as is establishing ubiquitous shared situational awareness. The variable component of the model is the response threshold aspect. While response threshold is dependent upon participant activity level, nature of request, and criticality, a common baseline develops across participants over time. This response threshold becomes extremely important, again, as environmental ambiguity increases. Correctly implemented collaborative technology can help key on common trigger points and increase situational awareness, thereby shortening the request-response cycle time and resultant OODA loops.

At the tactical level, then, collaboration becomes a force multiplier if utilized when and where needed at a level robust enough to speed OODA loops and decision processes. As with any technology solution, however, the risk of network/technical issues increases proportionally to the dependence upon it. Tactical battle rhythm is much more sensitive to anomalous behaviors than are either operational or strategic battle rhythms. This sensitivity requires that collaborative solutions be well-implemented, robust and redundant in order to be effective and to ensure maximum safety for all who rely upon them in today's environment, and beyond.

Appendix A: Operational Scenario Maps



Notional Map of Fictional Country of Lyboria

Lyborian Map Overlaid on to NPS Campus

Appendix B: TBR Experiment LOE/Geography/Script

GEOGRAPHY/LOE UTILIZING NPS QUAD:

- The grass area of the entire quad is the sea. The sidewalk along Root, in front of Ingersoll, and in front of Spanagel is the shoreline. The Thai Shack is on a peninsula of land (the peninsula ends behind the Thai Shack). Assume all perpendicular sidewalks connected to Root Hall sidewalk are trenches, and Lyboria is a deep water island surrounded by a barrier reef (the Mech E building, Halligan, and Bullard are the barrier reef approximately 50nm off the coast of Liboria).
- The SeaCDR represents the fleet at sea, and represents the position of the fleet, as such, must not run aground. The SeaCDR and ShoreCDR are mobile and may be located anywhere to maintain maximum mission readiness (but must ensure their location is constantly updated in ROCC.asp).
- NGO OPS will generate requirements which lead to Military tasking. Communication of requirements back to Military element (SeaCDR or ShoreCDR) is kick-off event.
- FOR ALL: BE AGGRESSIVE w/ your roles! If you think you should be RCVing information—THEN ASK FOR INFO!! REQUIRE REPORTS, do whatever it takes to develop the Tactical Picture and maintain your SITUATIONAL AWARENESS. Update without being asked, and when asked in GROOVE. PUSH as much information as you can, and PULL as much information as you need. REMEMBER, we are trying to capture the Tactical Battle Rhythm of information flow across our scenario. If you are passive and just sit idly by, you negatively affect OUR overall TACTICAL BATTLE RHYTHM.

ROLES/AGENTS/TOCS:

1. Sea Commander (**SeaCDR**)
   AMPHIBS/CRUDES/LOGISTICS
   Coordinates all ship to shore movement.
   NPS location= QUAD
2. Shore Commander/Coalition TOC (**ShoreCDR**)
   Coordinates all shore based movement, use of humvees, and SOF Team.
   NPS Location= Anywhere on land
3. Port Facility SOF Team (**port**)
   NPS location= Root 228
4. Detachments:
   [(**detachments)** share common icon in ROCC.asp]
   a. Embassy Det
      NPS location= Root [Conf Rm]
   b. Distro Site 1
      NPS location= Anywhere in/near Ingersoll
   c. Distro Site 2
      NPS location= Library [1st floor rear]

5. NGO/HA OPS TOC (**NGO**)
NPS location= Root [Prof. Bordetsky's Office]

Transportation assets:
Helo (Helo's are sea-based)

6. SEA BISCUIT 601/602 (**SEABISCUIT**)

HUMVEE (Ground transportation located at Port Facility)

7. humvee (**humvee**)

ROCC.asp USERID's & passwords

USERID	PASSWORD
SeaCDR	SeaCDR
ShoreCDR	ShoreCDR
NGO	NGO
port	port
detachments	detachments
SEABISCUIT	SEABISCUIT
humvee	humvee

Task 1 (Window 0800-1000):
CAST:

- NGO OPS
- ShoreCDR/Coalition TOC

NOTE: THE ShoreCDR/Coalition TOC FOR THIS MISSION WILL BE ASSIGNED THE SAME ROLE FOR THE EXECUTION PHASE OF THIS MISSION.

Using the TBR sked inputs, plan, assign actors to roles, and build the supporting Execution Timeline in Groove to complete task 4A/B (WITHOUT PRE-DISCLOSING EXACT NATURE OF THE RESULTS OF RECON MISSION 4A—NGO OPS). Task 4B should be planned similarly to task 4A, allowing for 3 waypoints and an undisclosed final destination. Plan for the mission to take 2 hours, from 1200-1400.

Success Scenario: ShoreCDR/Coalition OPS will be judged on:

1. Successful identification and assignment of available assets;
2. Successful construction of the Execution Timeline in Groove to support mission;
3. Efficient use of the Groove environment to facilitate planning and execution.

Task 2 (Window 1000-1100):
CAST:

- SeaCDR
- ShoreCDR/Coalition TOC
- NGO TOC

NGO OPS needs an exact “maximum capability force structure document” (MCFSD) from SeaCDR and ShoreCDR/Coalition TOC in 45 minutes for urgent ops planning/tasking.

SeaCDR and Coalition TOC will be fed information packages on the separate elements that they possess. They must collaborate to assemble and submit a unified document to the NGO TOC.

Success Scenario: There will be only one correct answer to the question of “maximum capability force structure.” This one correct answer must be supplied to the NGO OPS within the time window.

Task 3 (Window 1100-1200):
CAST:

- SEABISCUIT 601
- SEABISCUIT 602
- SeaCDR
- HUMVEE
- NGO OPS
- DISTRO SITE 1

Get MEDICAL SUPPLIES (Tiger Cry Spicy Beef) from location near port facility and deliver to Distro Site 1 Detachment. [MEDICAL SUPPLIES=Tiger Cry Spicy Beef].

Contingency 1: Chip light on Helo just after take off, RTB and re-task another bird.

Contingency 2: Thai Shack may have a long line.

Contingency 3: Specifically, outlined requirement is one of the daily specials for a day other than the day of the experiment. This creates a contingency situation so that the Helo has to get in touch w/ the SeaCDR to tell them the special is not available. Helo should query SeaCDR as to what they should get instead. The SeaCDR must then contact NGO OPS relay that it is not available and RCV new orders for Medical Supplies.

IMMEDIATE
O 102115Z SEP 03 ZYB MIN PSN 07DF3452
FM COMSCRIPTGURUS//DNS//
TO SEACDR
SHORECDR
NGO OPS

BT
EXERCISE EXERCISE EXERCISE

CONFIDENTIAL //N02300//

MSGID/GENADMIN/COMSCRIPTGURUS/DNS/-/SEP//

SUBJ/SEVERE WEATHER ADVISORY--LIBORIA//

REF/A/DOC/CNO/26FEB2003/-/NOTAL//

AMPN/REF A IS THE LYBORIAN ROE//
POC/RYAN BLAZEVICH/CNOCM/OPNAV/LOC:WASHINGTON DC
/EMAIL:RJBLAZEV@NPS.NAVY.MIL.MIL//

RMKS/1. SEVERE WEATHER FRONT ADVISORY IN EFFECT 101115LSEP03 TO 101200LSEP03.
2. A SEVERE TROPICAL DEPRESSION IS MOVING ACROSS THE CENTRAL COAST OF LYBORIA. WINDS IN EXCESS OF 80NM ARE EXPECTED. ALL SHIPS ORDERED UNDERWAY DURING PERIOD OF ADVISORY. FLIGHT OPERATIONS NOT ADVISED.
3. ALL HUMANITARIAN ASSISTANCE FLIGHT OPERATIONS CANCELED DURING PERIOD OF THIS ADVISORY.//

BT
#0690
NNNN

Contingency 4: New MEDICAL SUPPLIES requirement is generated from NGO OPS to SeaCDR, but, following onload, severe weather makes it impossible for Helo to land at Distro Site 1 and must negotiate with HUMVEE to transfer cargo for land transport to Distro Site 1. Helo must navigate to Port Facility and make the transfer to HUMVEE.

Success Scenario: Medical supplies delivered in 45 minutes.

Task 4A (Window 1200-1300):

CAST:

- NGO OPS
- ShoreCDR/Coalition TOC
- Port Facility SOF Team
- Humvee
- SEABISCUIT 601
- SEABISCUIT 602

ShoreCDR/Coalition TOC tasked by the NGO OPS to conduct Special Reconnaissance Mission on possible rebel activity. Intelligence imagery provided via National Reconnaissance Office in Intelligence Imagery tab, NRO Image Serial-001.

ShoreCDR tasks Port SOF Team to view imagery and conduct Special Reconnaisance Mission. Insertion can be via air or land. Once in position, Port SOF Team will report on activity at suspected location.

ShoreCDR must then relay back to NGO OPS. NGO OPS will determine that reported activity is hostage related. The ShoreCDR must then instruct the SOF team to sanitize and move for extraction and RTB (port facility).

Success Scenario: Port SOF Team, ShoreCDR, humvee/SEABISCUIT will be judged on:

1. Successful infiltration and extraction;
2. Successful check-in and reporting;
3. Initiation of Task 4B.

Task 4B (Window 1300-1400):
CAST:

- NGO OPS
- ShoreCDR/Coalition TOC
- SeaCDR
- Port SOF Team
- Humvee
- SEABISCUIT 601
- SEABISCUIT 602
- Distribution Site 2

FLASH

Z 102322Z SEP 03 ZYB MIN PSN 076997S38

FM COMSCRIPTGURUS//DNS//

TO SEACDR

SHORECDR

NGO OPS

BT

EXERCISE EXERCISE EXERCISE

SECRET //N02300//

MSGID/GENADMIN/COMSCRIPTGURUS/DNS/-/SEP//

SUBJ/REBEL ACTIVITY IVO LYBORIA//

REF/A/DOC/CNO/26FEB2003/-/NOTAL//

AMPN/REF A IS THE LYBORIAN ROE//
POC/RYAN BLAZEVICH/CNOCM/OPNAV/LOC:WASHINGTON DC
/EMAIL:RJBLAZEV@NPS.NAVY.SMIL.MIL//

RMKS/1. RECONNAISSANCE MISSION REVEALED REBEL FORCES HAVE TAKEN HOSTAGES BACK TO THEIR ENCLAVE. NGO OPS NEEDS COALITION TO SEND HUMVEE AND/OR SEABISCUIT TO THE ENCLAVE AND EXCHANGE FOOD FOR HOSTAGES (=BUY COFFEE).
2. THE HUMVEE AND/OR SEABISCUIT SETS OUT FROM THE PORT W/ PORT SOF TEAM TO PICK UP HOSTAGES IN EXCHANGE FOR FOOD AT THE REBEL ENCLAVE (BUY COFFEE). TRANSPORTATION ASSET MUST REPORT:

I. SOF INSERTION;
II. AWAIT FIRST VECTOR TO THE SECRET HOSTAGE DELIVERY LOCATION FROM SHORECDR/COALITION TOC;
III. SOF/HOSTAGE EXTRACTION;
IV. ENR DELIVERY LOCATION;
V. ARR DELIVERY LOCATION;
VI. RTB.

PORT SOF TEAM MUST REPORT:

I. VISUAL CONFIRMATION OF REBEL HOSTAGE ACTIVITY;
II. EXCHANGE OF FOOD FOR HOSTAGES;
III. MOVEMENT TO EXTRACTION W/ HOSTAGES.

3. RELEASED BY ADMIRAL V. T. CLARK, CHIEF OF NAVAL OPERATIONS.//

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Coalition TOC queries NGO OPS about where to take the former hostages. NGO TOC reveals final destination (Distribution Site 2) – ShoreCDR must vector the extraction vehicle to the final destination in three vectors before finally revealing the final drop off destination.

Humvee/SEABISCUIT must then report vector progess and ultimately successful drop of hostages at secret drop off destination (Distribution Site 2).

Report Mission complete, and RTB.

Success Scenario: ShoreCDR/Coalition TOC, humvee/SEABISCUIT, Port SOF Team will be judged on:

1. Successful exchange of food for hostages;
2. Reporting;
3. Successful check-in at each intermediate destination;
4. Completion of all 4A/B tasking within 120 minutes;
5. Efficient use of Groove habitat and tool sets to execute mission.

Task 5 (Window 1400-1500):
CAST:

- NGO OPS
- SeaCDR
- Port SOF Team
- SEABISCUIT

A possible launch of medium range ballistic missile potentially chemical WMD detected from rebel launch site. Live TOP SECRET Missile Launch and Impact Zone video footage available in NGO/HA Reference Library TAB. Imagery of launch site (NRO Image Serial-006) and missile (NRO Image Serial-005) available from National Reconnaissance Office in the Intelligence Imagery tab. Locate and secure launch site, then locate missile impact zone and determine if weapon is inert CHEM-BIO weapon and country of origin.

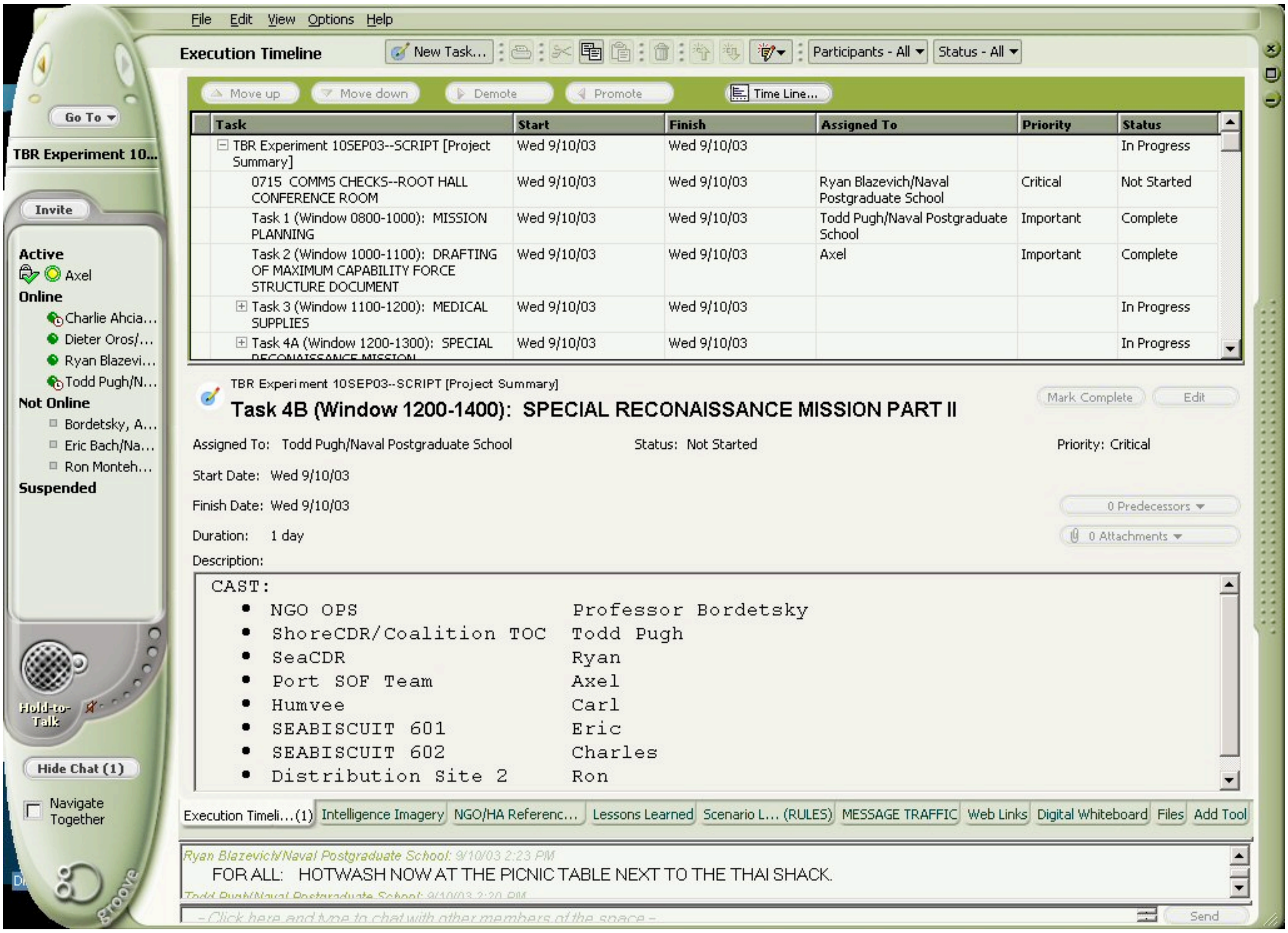
Success Scenario: SeaCDR, SEABISCUIT, Port SOF Team will be judged on:

1. Successful location and neutralization of missile launch site;
2. Successful location of missile impact zone;
3. Coordination b/w SEABISCUIT/SeaCDR/NGO OPS to determine if missile is inert or an active WMD;
4. Successful determination of country of origin of weapon—USING GROOVE FUNCTIONALITY;
5. Completion of all tasking within 30 minutes.

Hotwash-up to be completed upon conclusion of task 5.

Appendix C: Description of the Groove Workspace Used in TBR Experiment

This part explains how the standard Groove application was used to fulfill the needs of this experiment.

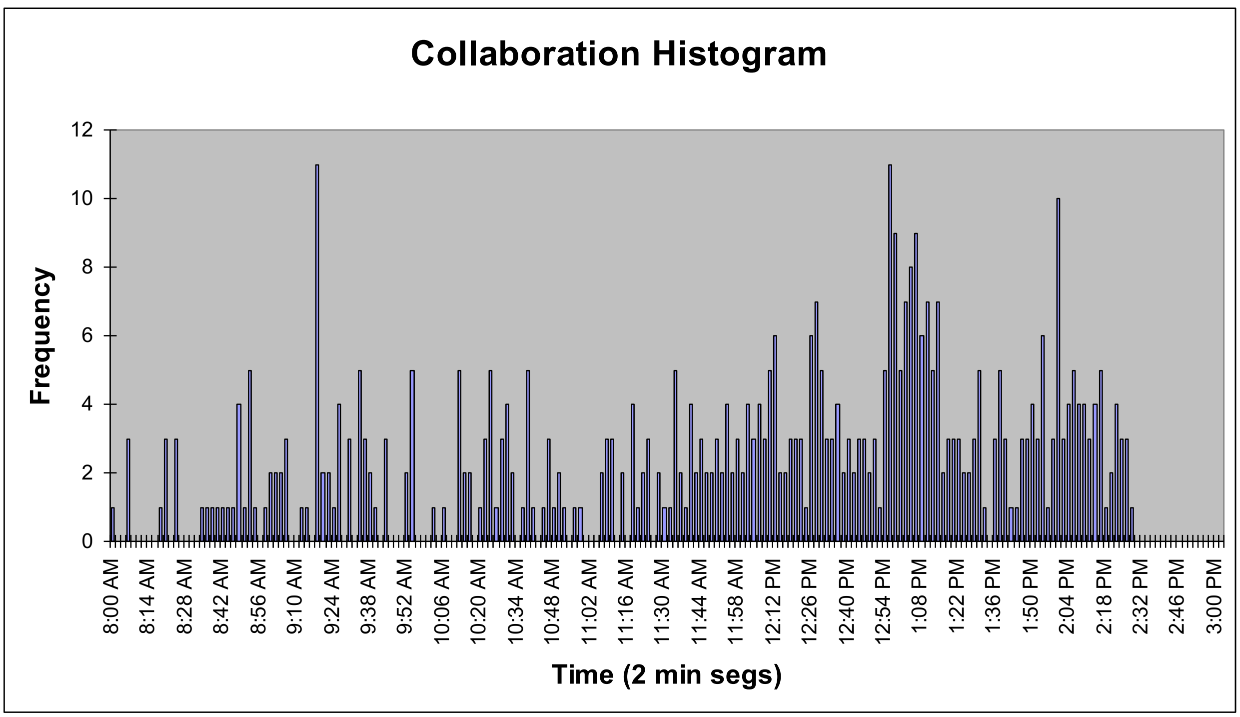


The Groove Habitat displayed above shows the user interface the participants used during the TBR Experiment. The scripting team modeled the workspace by deciding on the number and content of the Tabs on the bottom above the chat window. The left most tab, the Execution timeline shows all tasks that were foreseen to be accomplished, including columns to whom they are assigned, importance and status. The very left column inside the execution time line window shows a little notification icon in case that content has changed.

Appendix D: Brief Statistical Analysis

Analysis of the collaboration communication data throughout the TBR experiment yielded insight into how modern collaborative technology affects the rhythms inherent in multi-node operations. Two separate aspects of the communications during the experiment were examined.

The initial examination consisted of a frequency analysis of the total communications conducted during the experiment in both the global chat and individual messaging functions within the Groove workspace. The sorted histogram, using two minute bin sizes, is shown below. There were 474 discrete communications in 388 minutes, for an average of 1.22 communication events per minute. By overlaying the experiment timeline onto the distribution of the communication events, a definite pattern emerged with respect to complexity of the scenarios and collaboration. Within the experiment, during the period from 12:00 pm to 2:00 pm the most complex scenario was conducted. During this same period, there were 234 discrete communications. This comprised 49.4% of the total communications in a period that was just 30.9% of the total time. While there were more participants in the complex scenario, the spike in exchanges was significant.



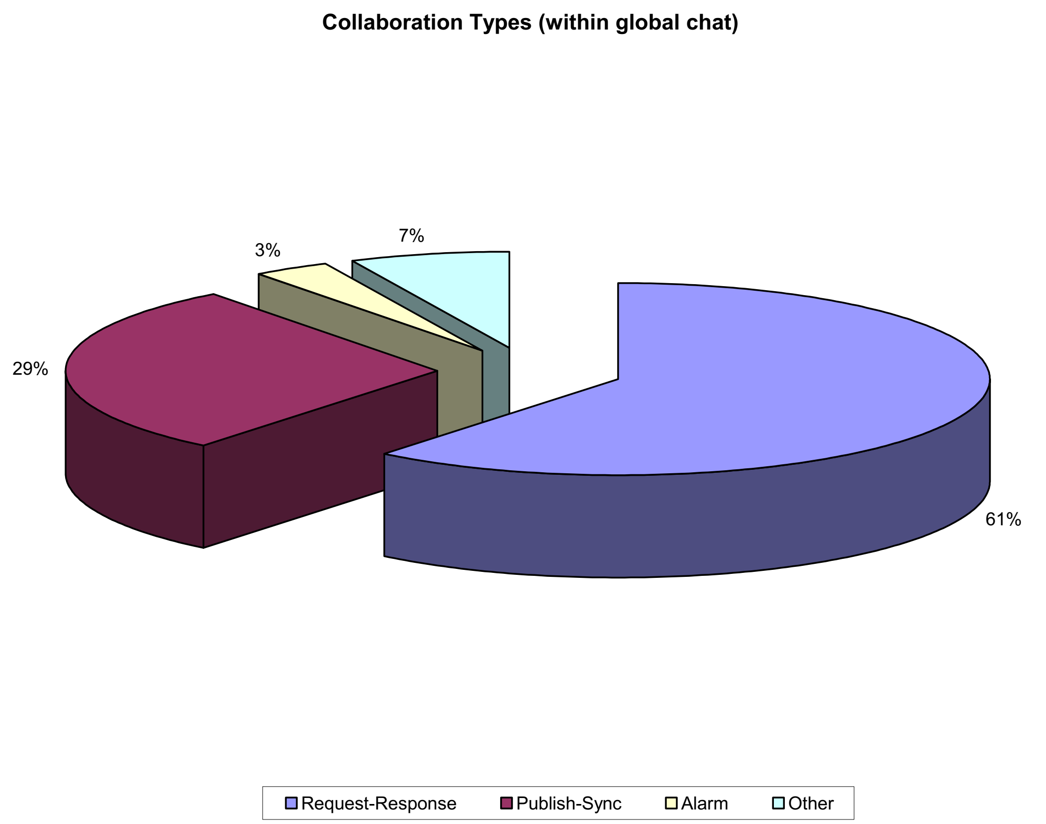
The secondary analysis consisted of an examination of the type of collaboration communication events contained within the global chat portion of the Groove workspace. There were 313 discrete chat posts in the 388 minutes of the experiment. Those posts fell into roughly four categories which included:

- Request-Response,

- Publish-Synchronization,
- Alarm, and
- Other.

The distribution of each of those categories, by percentage of total global chat events, is illustrated in the chart below.

The request-response category was primarily composed of queries for tasking, direction, and clarification, and the associated answers to those queries. The publish-synchronization category included general announcements and situation reports that sought to promote widespread situational awareness without prior prompting. The alarm category was made up of broadcasts that were similar to the publish-synchronization items, but with high importance and possible immediate, major impact on overall operations. The final category included items that were sent in error or that had no bearing on the experiment, itself.



As anticipated, the request-response cycle comprised the greatest portion of chat items (61%). The need for information, tasking, and periodic polling were the driving factors behind the high numbers of request-response elements. Interestingly, though, publish-synchronization types of communications became more common as the experiment progressed. In theory, as the group grew more comfortable in roles and behavior patterns became more established, information was simply broadcast to let others know how to self-synchronize according to the current scenario. This discovery may have larger implications when applied to actual, tactical-level operational environments.

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