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"Operationalizing C2 Agility"

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Extending ELICIT to Explore Command and Control in Operations Scenarios

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Abstract:

As operations command structures change and become more complex, it is increasing important to be able to determine if they remain effective. Traditionally C2 systems fielded against mission threads have been evaluated at the nodal application level. As systems become more networked this is no longer sufficient. The organizational structure used to network applications can significantly impact overall command and control (C2) performance. Thus, we need to develop tools to measure the effectiveness of networks of systems.

In an Air Operations Center (AOC), two separate networks exist with limited touch points. One set of connections is a technical network that conveys data and the other is a human command network that manipulates data, transforms it, and produces decisions. To achieve an understanding of the overall efficiency and effectiveness of the AOC node requires a tool that can analyze the integration of these two network layers.

In this work, an existing tool is enhanced to meet this emerging need. ELICIT, the Experimental Laboratory for Investigating Collaboration, Information-sharing and trust, was designed to investigate the effects of organization structure on task effectiveness. The original ELICIT tasks are intelligence scenarios. We extend the ELICIT model to handle a more complex, operational scenario. ELICIT is modified to model the operational task of issuing an Air Tasking Order (ATO) change to investigate the effects of organizational and system network structure on effectiveness. Recommendations from this paper include specific requirements to further enhance ELICIT to improve support for operational scenarios.

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Section I: Overview

Previous work developed ELICIT, the Experimental Laboratory for Investigating Collaboration, Information-sharing and Trust as a tool for performing experiments to compare the relative efficiency and effectiveness of various organization types, traditional *command and control (C2)* vs. self-organizing, peer-based *edge (E)* organizational forms, in performing tasks that require decision making and collaboration. (Ruddy (2007), Leweling (2007)).The tool has been extended by related research to investigate additional factors such as the effects of team trust (Powley 2009) and to validate the N2C2M2 (NATO NEC (Network Enabled Capability) C2 Maturity Model) (Manso 2010). To date, one limitation of ELICIT has been the only task scenarios it supports are variations on an intelligence task involving identifying the who, what, where and when of a planned adversary attack. The ELICIT research community has expressed a need to expand ELICIT task scenarios from the initial intelligence tasks to include more complex, operations tasks (Manso 2012).

An important class of complex, operations tasks, where agility is crucial is the creation of Air Tasking Order (ATO) changes. Air Power Command and Control (C2) has unique characteristics. In a full engaged shooting war all tactical forces that are available to fly on any given day are already planned to be employed. In lower intensity conflicts there may be ground alert (Ground Alert Close Air Support (GCAS), Ground Alert Interdiction (GINT), or Ground Alert Air Refueling (GAR), etc.) or airborne aircraft available but their primary ordinance will be static. Air Power actions also execute extremely quickly and any coordination required to meet a new need (change in an ATO) has to happen well before the planned event occurs; and the larger the change, the more coordination is required. There are rules of thumb for the time required for planning an event but they are course grain at best. There has been very little research specifically designed to understand core operational Air Power C2 issues. Successful heuristics have been discovered in the crucible of combat, but it is best not to rely only on this method.

Thus, an air tasking change order scenario is an ideal next use case for ELICIT. Adding an ATO scenario expands the breath of task scenarios covered by ELICIT in an area where more tools are needed. This work is part of a larger effort to research fundamental principles of C2 dealing with AOC operations. AOC operations involve the coordination of a number of different groups and systems. Increasingly the US government and the world public expect air power operations to be both more responsive and more precise, or in other words more agile. It is increasingly important that as individual sub processes and systems are enhanced, we have a way to model the effects of these changes on the agility of the overall AOC/ATO creation system. Any single individual's short term memory is limited to dealing with seven plus or minus two objects before they

become overwhelmed (Miller 1956). As the number of objects swell we naturally use different words to start representing the subsets. Generals can move and place Corps on the battlefield but all would be rendered incompetent if they were required to know where each and every soldier's buttons were the night before battle. As we increase the complexity of the network of systems we are using, it is crucial that we evaluate the overall effectiveness of the resulting meta-system, not just the performance of each individual system component.

The first challenge in modeling an ATO change order scenario was to find a valid ATO example to model. A significant amount of time was spent determining if a robust unclassified secondary data set was available. It was not. The second track explored was to develop an actual venue where primary data could be captured. Cost, time and classification issues, made the second track impractical as it would require real organizations and with a massive infrastructure. The third option was to create a new modeling engine, but to create something new from scratch was expected to be too expensive and time consuming. Therefore, the only viable option was to modify ELICIT to support an AOC/ATO change operational problem using ELICIT software agents as participants. The ATO scenario created for the ELICIT model used is a composite scenario based on Subject Matter Expert (SME) experience with ATO creation/change processes. The development of ELICIT was sponsored for just such a purpose: to create a reusable platform so that C2 researchers can focus on their specific research issues without having to also create the underlying software platform.

Section II: Theoretical Lens for Evaluating Air Tasking Order Change Processes

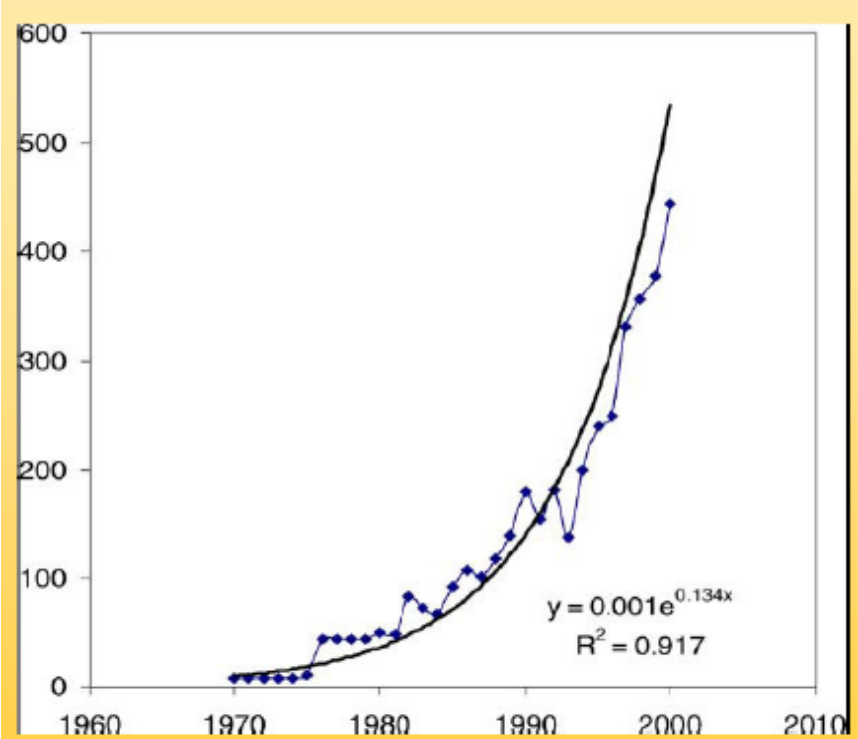
To understand what is going on in the ATO technical infrastructure, we must look at it from an information theory (origination, information flows, IT use, and information-worker productivity) perspective. Studies of IT-productivity demonstrate new technologies as well as adaptation to a different way of working which allow increased absorption of available information with a significant effect on individual and overall unit production (Bharadwaj et. al. 1999, Brynjolfsson & Hitt 2000, Aral & Weill 2007) by increasing asynchronous communication (Hinds & Kiesler 2002). Information can reduce uncertainty (Cyert & March 1963) or temper risk aversion behavior (Arrow 1962, Stiglitz 2000). When information is doubtful or vague, it takes time to verify it by collection of additional data, thus, reducing effective decisions (Hansen, 2002). All these factors point to a measurable chain, where the initial data can be collected, made available, and analyzed. Information Theory treats each human as an information channel minimizing human variability. Applying this theory allows the infrastructure that moves data to be quantitatively understood.

If ELICIT can be made to work well with Air Power operational C2 problems it opens the door to exploring other C2 milieus such as Space, Information Operations, and Counter-C2 operations.

Section III: Additional tools for Evaluation

Social Network Analysis (SNA) is an appropriate tool to evaluate the human networking side of C2. Social network theory looks at relationships in terms of links and nodes. Nodes are the individuals and links are relationships between individuals. There are many ways people can be linked (face-to-face, e-mail, text chat, phone, meetings, etc.) and each interaction has an effect on the whole. Social networking theory says that insights can be gained just by looking at the links between individuals. Those relationships define a structure that can be studied. (Barnes (1954) Granovetter (1973) Milgram (1967)). When any C2 organization is evaluated questions quickly arise; "How does the actual organization compare to the organization chart on the wall." "What paths are available for the information to flow." "Why does some information fall on the floor." "Is critical information available." "How does the organizational structure change over time." or "Are increasing available paths resulting in C2 nodes taking on a less closed-system characteristic?" SNA can provide both a visual and quantitative structure for analysis of complex human systems, because it can be organized in mathematical terms and is grounded in the repeatable analysis of empirical data. These techniques have been used to understand diffusion of information, organizational behavior, the spread of disease, and other phenomena. Social Networking Theory (SNT) is one of the few theories that can apply to small and planet size groups. The simplest of networks has two nodes tied by a link. The node is the end, and the link is what ties them together. An example of this simplest type of network would be to consider two groups involved in tasking airplanes. The groups are the nodes and the link (a shared commonality) is a communication system. Social networking theory applies when a human element is added. Our nodes could be knowledge workers linked by the ability to update a specific database. [Social] Network analysis has grown from the esoteric interest of a few mathematically inclined sociologists to a mainstream technique. This development was spearheaded in the 1970s by Harrison White and Affiliates, who developed a formal apparatus for thinking about and analyzing social structure as networks (Nohria 1998).

SNA techniques are becoming increasing accepted (Figure 1) and can provide both a visual and quantitative structure for analysis of complex human systems like the AOC. These techniques can be used to understand diffusion of information, organizational behavior, the spread of disease, and other phenomena.



Exponential growth of publications indexed by Sociological Abstracts containing "social network" in the abstract or title.
(Source: Borgatti and Foster, 2005)

Figure 1 SNA Growth

Section IV: Data Flow issues

Any electronically stored, transmitted, or recorded data is neither information nor knowledge. Humans must give these mathematically defined and physically manipulated voltages context. At the same time, the language of data/ knowledge/ information can be used to convey an appropriate slice of reality.

To understand what is going on in the technical infrastructure, we must look at it from an information theory (origination, information flows, IT use, and information-worker productivity) perspective. Studies of IT-productivity demonstrate new technologies as well as adaptation to a different way of working which allow increased absorption of available information with a significant effect on individual and overall unit production (Bharadwaj et. al. 1999, Brynjolfsson & Hitt 2000, Aral & Weill 2007) by increasing asynchronous communication (Hinds & Kiesler 2002). Information can reduce uncertainty (Cyert & March 1963) or temper risk aversion behavior (Arrow 1962, Stiglitz 2000). When information is doubtful or vague, it takes time to verify it by collection of additional data, thus, reducing effective decisions (Hansen, 2002). All

these factors point to a measurable chain, where the initial data can be collected, made available, and analyzed. Information Theory treats each human as an information channel minimizing human variability. Applying this theory allows the infrastructure that moves data to be quantitatively understood.

The military is not the only command node in the human condition that relies on an artificial representation of reality to make decisions and provide life changing outputs. The operations center of a nuclear power plant (NPP) has similarities with military command nodes. Information theory work has been accomplished in conjunction with NPPs using a Conants' Model as a tool for describing human information processing (Kim, 2003). Using a cross discipline tool to evaluate any C2 node can provide a proven quantitative measure. Discussions relating to how "organizations construct meaning" differs from "processing of information" as it applies to knowledge organizations are available in Bruner (1990), Kelly (1963), Malhotra (1999), Morris (1938) and Strombach (1986). Replicating an actual C2 technical milieu, if theoretically possible, would be cost prohibitive. As with all military infrastructures that technically transform over time it is important to understand how any new box "fits" within its various data chains. By incorporating a measure for information process, the goal of repeatability may be achieved. More importantly, a quantitative measure of information processing provides a hope of minimizing the human variable by putting the human variability in the background.

The origins of Information theory (IT) can be traced to C.E. Shannon and his article "A Mathematical Theory of Communication" published in 1948. Shannon proposed entropy as a measure of information, choice, and uncertainty. Entropy had been used as a measure in such diverse communities as biology, decision theory, and thermodynamics. Two research centers that expanded on Shannon's original work are Bell Telephone Laboratories (in which Shannon worked) and Massachusetts Institute of Technology (MIT). Information relates to uncertainty, which can be given as a function. The amount of information, bits, is equal to the base 2 logarithm of the inverse of the probability:

$$H_i = \text{Log}_2 1/P_i$$

Where H_i is the amount of information and P_i is the probability of occurrence of *i*. Using a formal mathematical construct for information, we can remove the human subject constraint concerning any "value" of one generic informational blob as compared to another.

In his paper, *Laws of Information Which Govern Systems,* Conant (1976) argues that systems be viewed as information transfer through networks. Interactions in the system should be modeled as communication with each other. Changes in the value of any variable in the system can be represented as messages transmitted the other parts of the system. Conant's Law of Partitioning of Information Rates provides a method to determine total information processing capacity and how that capacity can be distributed to various tasks.

By quantitatively looking at information flow, one can begin to understand how human bandwidth (available workload) and latency (an accurate extraction of reality) and system design can be fundamentally changed to maximize C2 resources. Speed may become more important than volume!

Section V: Proposed Evaluation Tool

The Experimental Laboratory for Investigation Collaboration, Information-sharing and Trust (ELICIT) is a tool for modeling the behaviors of individuals in various organizational networks. Sponsored by a project within the Office of the Assistant Secretary of Defense (OASD) Networks and Information Integration (NII), ELICIT has an online multi-user software platform for conducting experiments and demonstrations in information sharing and trust. The ELICIT software platform (Ruddy 2011) allows researchers and instructors to precisely model specific Command and Control processes, as well as edge organization processes and to fully instrument all interactions. The original project objective (Ruddy 2007) was to enable a series of online experiments to compare the relative efficiency and effectiveness of various organization types, traditional *command and control (C2)* vs. self-organizing, peer-based *edge (E)* organizational forms, in performing tasks that require decision making and collaboration. ELICIT supports configurable task scenarios. The original baseline experiment task is to identify the who, what, where and when of an adversary attack based on information factoids that become known to individuals in a team or group of teams. The independent variable for the baseline experiment is whether a team is organized using traditional Command and Control vs. Edge organization principles. The software agent-based version of ELICIT (abELICIT) (Ruddy, 2009) uses software agents whose behavior is defined by over 50 variables, which can be configured to model various social and cognitive behaviors; and operations and performance delays.

To date, ELICIT experiments have been run with both human and software agent participants internationally at both military and civilian institutions. The agent behavior was modeled upon and validated against the actual behavior of human participants in ELICIT exercises.

Adding a new system to a complex set of systems can have unintended consequences. In a world where military systems are increasingly interconnected, it makes sense to model new networked processes and optimize them using various tools before they are put into operational use. ELICIT can be used to model the overall task efficiency of a proposed system of networks before changes are instantiated in order to understand the overall dynamics of the resulting system and to identify critical bottlenecks in the network. ELICIT is unique in that it not only can model complex networks and information flows, it can also be used to assess whether an intelligent agent assigned to a particular part of the network has sufficient situational awareness to effectively execute their assigned task. ELICIT output can also be used to drive SNA tools.

OASD (NII) currently makes use of the ELICIT software platform available free of charge to members of the ELICIT Community of Interest. Information on joining the ELICIT Community of Interest is available at http://www.dodccrp.org/html4/elicit.html.

Section VI: ELICIT Baseline Task Model

By evolving the ELICIT software platform, tools and procedures we will be able to support conducting ELICIT experiments using operations tasks. We begin with the baseline ELICIT task (Ruddy, 2007), which is an intelligence task. Periodically during an experiment, ELICIT distributes *factoids* (i.e., information elements that are pieces of the scenario) to the participants. Participants can choose to disseminate or not disseminate *factoids* to others by Sharing information directly with a particular participant or by Posting a factoid to a particular information system. However, only by communicating information can participants achieve sufficient levels of awareness to complete the task.

The four original baseline factoid sets each contain 68 factoids (four for each of the 17 participants). These factoids only contain true information. There is no incorrect or conflicting information. Each factoid belongs to one of four categories:

Key (K) - Contains information which is essential for a specific problem space,

Expertise (E) - Contains information which is essential for solving the problem and may be important for more than one specific aspect of the task space, such as special information a team leader may possess.

Supportive (S) - Contains information which supports key and expertise factoids

Noise (N) – Contains information that is irrelevant to solving the task.

Each baseline *Factoid Set* consists of 17 Key or Expertise, 17 Supportive and 34 Noise factoids. Thus, the ratio of relevant information to noise is 50%. In the baseline factoid set, ELICIT distributes the factoids in three waves.

Thus it is not until after that third wave, that all the information is available to the participant group to fully identify the who, what, where and when of the adversary attack. The factoids are evenly distributed so that by the end of the third distribution each participant has received one Key or Expertise factoid, one supportive factoid and two noise factoids. For purposes of the original experiment design, care was taken to treat each participant equally. The factoid scenarios are anonymized to reduce distractions based on previous experiences.

In the baseline ELICIT task scenario, four information systems are potentially available to participants. The first is a who website that specializes in collecting information about who is planning the attack. There are also what, where and when websites. Depending on the organization structure and role assignment, participants have access at least one and up to four of the websites. This role-based access is binary: either no access or read/write. This baseline task and organizational options are sufficient to elicit a wide range of responses. The original task is scoped so that a human exercise can be completed in under an hour.

Section VII: Changes Made to ELICIT to Model of the Air Operations Center Task

A number of changes needed to be made to ELICIT to support an AOC operations scenario. The specific task selected was an air tasking order (ATO) change order.

The primary SME mapping the ATO change order process to ELICIT, was Marvin L "Lenard" Simpson. Lenard has a BS in Mechanical Engineering Technology from Virginia Tech, an MS in Administration from Central Michigan and is an Engineering Management doctorial candidate at Old Dominion University. Lenard's knowledge and experience span a broad and diverse spectrum of operational and technical fields as well as an extensive educational experience. Current academic work places him on the cutting edge of Systems of Systems Engineering (SoSE), with a focus on SoSE (process, methods and trends) and complex system theory. His operational background includes 20 years experience in the Air Force accomplishing air-to-air and air-to-ground fighter missions, the use of "special weapons", leading operational support teams, exercise planning, and over 18 years in command and control informational systems associated with the Combined Air Operations Centers (CAOC). He is a published author and a recognized operational, technical and theoretical Subject Matter Expert on Air Operations Centers and operational air power. He has served in four CAOC 's engaged in combat operations, most recently serving as AOC Systems Manager at AL UDIED Air Base Qatar (fourth Air Operations Center engaged in Combat operations). Other CAOC positions he has severed in include Deputy Chief of Strategy, Chief of Combat Operations, Time Critical Targeting, Chief ATO Production, Chief Master Air Attack Planning and Chief Special Technical Operations. He is a Commercial Pilot with more than 1500 flight hours in, F-4, T-43, T-37, T-38 aircraft and in general aviation aircraft to include gliders. As part of this process, his mapping of the ATO change order process to ELICIT was reviewed by 3 additional AOC Subjects Matter Experts (SME's) to provide validation of the ELICIT developed task scenario.

Dynamic targeting is any targeting inside the air tasking order (ATO) cycle. It is a process that identifies emerging and/or fleeting targets and determines how they are prosecuted via kinetic or non-kinetic means. Time sensitive targets (TSTs) start with guidance, categorization, relative prioritization, assessment criteria, collection requirements, and many other aspects of prosecution. Most of the information is built or determined in the pre-operation planning and/or as part of deliberate targeting. Often a TST decision matrix is created, but it is not a substitute for the warfighter fully understanding the underlying TST guidance, Rules Of Engagement (ROE), collateral damage methodologies, and TST operating procedures form the TST decision matrix document. A good TST decision matrix framework should include TST prioritization, approval authority, restrictions, acceptable risk level, identification (ID) criteria, and desired effects. Operator guidance is reviewed periodically to ensure it is appropriate and relevant as the nature of the threat and/or conflict changes. The result could be some sort of execution through the Man Machine Interface (MMI) depicted in Appendix A. In an application of Conant's Model, total information flow is represented by the sum of the total rate for the subsystems.

The fundamental approach taken by this effort was to map organizations interacting with the AOC to ELICIT participants and to model the key information flows between these groups as messages. Required changes are categorized into configuration changes and coding changes.

First, 28 groups were identified as related to the operation.

- JFC - Joint Force Commander
- JFACC - Joint Force Air Component Commander
- CCO - Chief of Combat Operations
- SODO - Senior Offensive Duty Officer
- SADO - Senior Air Defense Officer
- SIDO - Senior Intelligence Duty Officer
- IRSD - Intelligence Reconnaissance Surveillance Division
- IO - Information Operations
- Space - Space
- Tanker - (Air Refueling) Tankers
- JAG - Judge Advocate General
- WX - Weather
- Airspace - Airspace
- ISRC Joint Search and Rescue Center
- BCD - Battlefield Coordination Detachment
- SOLE - Special Operations Liaison Element
- NALE - Navy Operations Liaison Element
- MARLO - Marine Liaison Officer
- CALE - Coalition Air Liaison Element (term created for this effort)
- CR - Control and Reporting Center
- CRCA - CRC (Airborne) {AWACS}
- WOC -Wing Operations Center
- ASOC - Air Support Operations Center
- CORP - CORP (largest army group)
- SOC - Special Operations Centers
- Fleet - Fleet
- TACC - Tactical Air Control Center (Marine AOC)
- C-CP - Coalition-Command Post (term created for this effort)

In addition, owners of ten shared information points (webpage's) were identified.

- JFC - Joint Force Commander
- JFACC - Joint Force Air Component Command
- CRC - Control and Reporting Center

- WOC -Wing Operations Center
- ASOC - Air Support Operations Center
- CORP - CORP (largest army group)
- SOC – Special Operations Centers
- Fleet - Fleet
- TACC - Tactical Air Control Center (Marine AOC)
- C-CP - Coalition-Command Post system

We mapped the access matrix of each group to each information system website and instantiated it in an ELICIT organization configuration file. See Appendix B. Since some of the systems were read only with respect to some of the groups, we enhanced the ELICIT organization file structure to support read only access. This organization file was also configured to reflect whether point-to-point sharing was possible between the groups. Variations on this structure were created to determine the efficiency and effectiveness of various intergroup process flows and procedures.

In addition to creating a new organization file, we also created a new task scenario. In ELICIT task scenarios are configured in a file called a factoidset. The operations task chosen was the creation of an ATO change order. Based on an understanding of the steps that need to be taken before a new ATO can be issued, factoids were created to represent the intergroup communications that were needed for each step. For example, information about target location, and information about local sunrise and sunset times for a particular date in that location, etc. Communications about permissions were also modeled such as whether DMPIs associated with a target are on the restricted target list. A total of 51 Key and Expertise factoids were created and their order of precedence mapped into seven sequential waves of information flow. In addition, 81 supportive and noise factoids were also created and mapped. The operations factoid set is listed in Appendix C.

Next 28 ELICIT software agents were configured to represent each of the 28 groups collective behavior with respect to information flows with the other groups. For example, when a decision is made that a target should not be hit, the target is added to the no hit target list system. As is typically done with ELICIT agents, their actions were configured with a series of task process delays so that the time the agent takes to perform a task is mapped to human time rather than computer time. In configuring the agents, we found a few areas where modifications needed to be made to support posting of information to website names that were other than the traditional who, what, where and when names.

The ELICIT system creates elaborate files that date and time stamp all participant actions. These logs can be analyzed by a log analyzer tool, which provides statistics about each participant's situational awareness over time and how long it takes the information to flow though the overall system so that the task can be successfully completed. Note that in creating the new configuration files for this operations scenario, we ran into some conflicts with variable names that were reserved by ELICIT, ELICIT agents or the ELICIT log analyzer so we had to slightly modify some of the group and information system names to avoid conflicts.

ELICIT output can also be used to drive SNA tools. In general, most real world large networks have twice as many links as nodes. (Newman, 2003) Some network-centric warfare theories state that every node should be connected to every other node in the network to have the best performance (*n2*), exploiting the principles of Metcalfe's Law. (Alberts, 1999) Alberts other writing has not proven the "best" clustering coefficient for C2 and having fewer links between nodes provides an economy of resources while the structure still can accomplish the needed behavior. Having a higher link to node ratio may provide more robustness but, if it gets too high, there may be too much excess structure in the overall macro-system.

We can also measure the networked systems using SNT. One metric is characteristic path length (CPL). The characteristic path length is the median of the average distance from each node to every other node in the network. CPL is expected to be approximately the logarithm of *n.6* . CPL can be useful in determining the diffusion rate of the network. The shorter the CPL the quicker information is passed. The final metric is the clustering coefficient. The clustering coefficient can be used to determine the amount of combat operations division (COD) node cohesion. The clustering coefficient measures the number of a node's direct neighbors that are also direct neighbors of each other. The higher the clustering coefficient, the higher the amount of collaboration in the network. In order to gain more insight into the structure and dynamics of COD, a more detailed analysis could be attempted. A number of additional statistics can be examined including:

- In and out degree distributions
- Betweenness centrality
- Collaboration metrics
- Random and targeted robustness measurements
- More detailed annotated network diagrams

The degree distribution of a network is a depiction of the connection pattern of the network. The more connections a node has the more important it is to spreading information through a network. By plotting a histogram of degrees, the class of a network (regular, random, scale-free, etc.) may be determined. If the number of web post and web pulls and direct interactions a particular degree could be plotted on a log-log scale it may be possible to determine if the network is scale free, as the plot would be linear. The networks that have a very few number of nodes, have very large degrees and a large number of nodes have small degrees. The initial starting assumptions for human interaction are depicted in Appendix D:

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Section VIII: Conclusion

This paper is part of research designed to understand some of the core issues associated with operational Air Power C2 and to develop tools to analyze operational systems. The assumption is the AOC is comprised of two networks, the technical (where data/information flow) and human (defined by social networking where decisions are made) with limited touch points (e.g. the various PC's). One of the goals of this effort was to modify ELICIT so that it could be used to conduct future experiments in this area. ELICIT now supports an AOC ATO change order scenario, and can be used as part of a future effort to run formal experiments using software agents as participants to investigate the effect of varying AOC data flow (increasing noise and system fragmentation/network fragmentation) on social networking metrics and situational awareness. We are now also able to vary organizational structure to determine the effects on operations situational awareness. ELICIT was modified and configured to demonstrate that complex networks of applications performing operations tasks could be modeled in ELICIT so that software agent-based experiments could be run to compare the efficiency and effectiveness of differing human organization structures on those using the network,

Analyzing C2 must be more about seeking a holistic way to evaluate C2 than about the past performance of individual C2 subsystems. By seeking to understand the potential benefit in cross correlating two major themes of thought (Social Networking and Information Theory), a lens can be placed on a single command node within a single physical domain. The resulting investigation has the potential to allow the extraction of truths that could be used to better understand the entire battlefield military C2 structure and/or other knowledge centric structures than the current process.

Since an AOC is a knowledge management entity, we hypothesized that situational awareness can be captured and analyzed using SNA. When a group of people connect by text chat, e-mail or other application, a social network is created. Social Networking Analysis is used to describe human/agent interaction patterns and see how those relationships effect the outputs and outcomes. The networking approach encourages understanding beyond any single pair of interactions. SNA is well understood and used across many different communities. Use of SNA analysis is becoming more common and should become ubiquitous. when analyzing C2 systems. The AOC is an organization that, on its best days, is qualitatively efficient and accurate in its planning and execution. The quantitative approach techniques of SNA may have potential to improve the efficiency, accuracy, and specificity required in the operational planning and tactical delivery of air power.

As the military changes from industrial to information style warfare the corresponding change required for the supporting C2 systems is even less well understood. In industrial warfare each C2 node had a specific role, and function which could be costed and built into a Unit Type Code

(UTC). In an information war milieu it may be more important to know which "chat rooms" are used to accomplish what functions. This paper purposes a method to examine operational C2. In the battle for Crete in World War II, the British had broken the German crypto code and they knew who was coming, when they were coming and how strong they would be - and they still lost the battle. In the information age, buying and stringing together more and more systems that rely on highly structured formatted data while experiencing an explosion in semi-structured and non-structured data (e-mail, text, tweets, video, radio, etc.) may become our generations' "Crete".

Recommendations for next steps

Models can always be made more specific, and a key decision is the level of granularity to use in making a model. The model must be detailed enough to accurately model the behavior being studied, and abstract enough that the model is more practical to use than the actual full-scale system. In mapping the task to ELICIT, some areas were identified where further enhancements to ELICIT would be helpful. One is the information processing of the agents. The current ELICIT agents were designed to perform logic tasks. The agents do not have any computational capabilities, (for example determining the length of time between two times) so factoids needed to be defined to work around this restriction. To simplify agent computation load, the potential time for the attack was modeled to the nearest hour, rather than the nearest minute. It would also be helpful to enhance the software agents to have more control over what types of information warrant point-to-point sharing.

For the current effort, information flows were modeled in seven waves. It would also be desirable to model the waves of information flow with more granularity. Ideally, each information exchange would be modeled as occurring at a separate time. It would also be possible to model groups with more granularity. It would also be helpful to enhance the ELCIIT log analyzer to support team names in addition to who, what, where and when.

In addition, theories of behavior and performance can be validated by constructing agents with specific capabilities (personalities) and confirming the resulting outcome by running experiments using agents with those personalities. The ability to construct agents with specific behavior styles (information hoarders, members of a hierarchy with a narrow task focus, and so forth.) enables the design of additional experiments to investigate which organization types more resilient under specific staffing and training scenarios.

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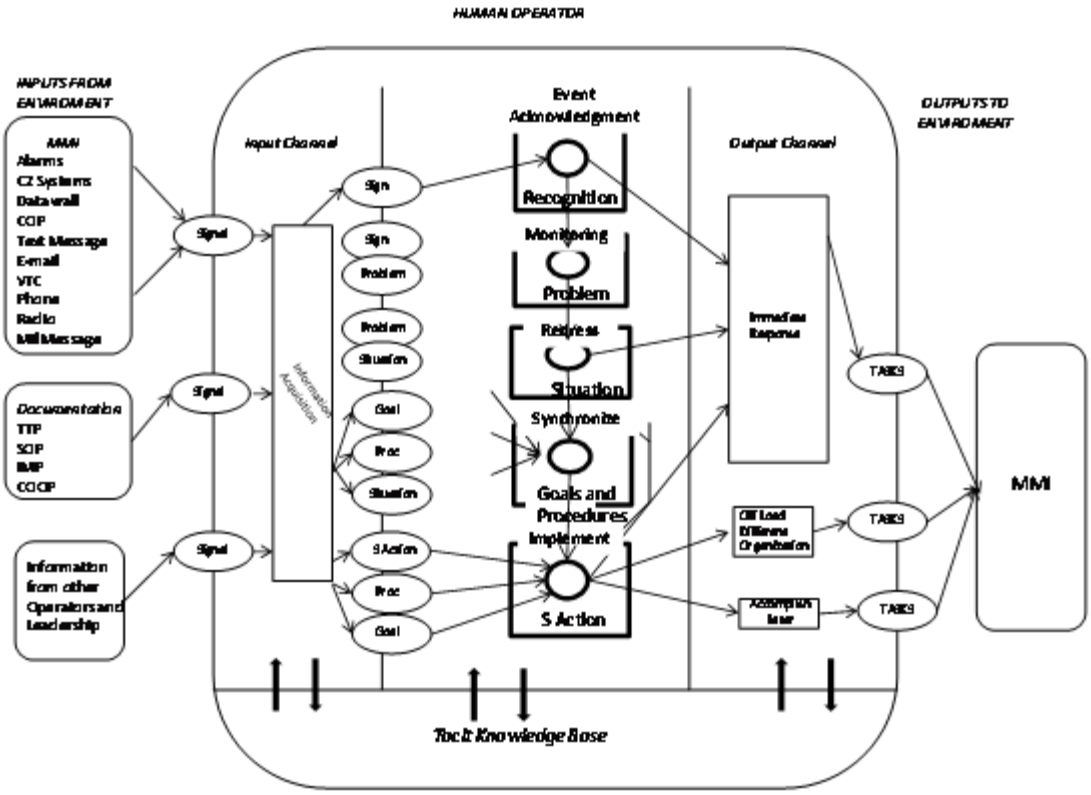
Appendix A – Man Machine Interface Execution



Appendix B – Operations Organization Configuration File

How to read table:

n|Role|Team|Country|1|2|3|4|5|6|7|8|9|10|11|12|13|14|15|16|17|18|19|20|21|22|23|24|25|26|27|28|website1|website2|website3|website4|Website5|website6|website7|website8|website9|website10|

<begin actual table>

1|oJFC team|who|USA|0|1|0|0|0|0|1|1|1|0|1|0|0|1|0|0|0|0|0|0|0|0|0|1|1|1|1|1|1|R|R|R|R|R|R|R|R|

2|oJFACC team|who|USA|1|0|1|0|0|0|1|1|1|0|1|0|0|1|1|1|1|1|1|1|1|1|1|1|1|1|1|1|R|1|R|R|R|R|R|R|R|

3|oCCO team|who|USA|1|1|0|1|1|1|0|0|0|1|1|0|1|1|1|1|1|1|1|1|1|1|1|1|1|1|1|1|R|1|R|R|R|R|R|R|R|

4|oSODO team|who|USA|0|0|1|0|1|1|0|0|0|1|0|0|1|1|1|1|1|1|1|1|1|0|1|0|0|0|0|0|R|R|R|R|R|R|R|R|R|

5|oSADO team|who|USA|0|0|1|1|0|1|0|0|1|1|0|1|0|0|0|1|1|1|1|1|1|1|0|0|0|1|0|0|R|R|R|R|R|R|R|R|R|

6|oSIDO team|who|USA|0|0|1|1|1|0|1|1|1|0|1|0|0|1|0|1|1|1|1|1|0|0|0|0|0|0|0|0|0|R|R|R|R|R|R|R|R|R|

7|oIRSD team|who|USA|1|1|1|1|1|1|0|1|1|1|1|0|0|1|1|1|1|1|1|1|1|1|1|1|1|1|1|1|R|R|R|R|R|R|R|R|R|

8|oIO team|who|USA|1|1|1|1|0|1|1|0|1|0|1|0|0|1|0|0|0|0|0|0|0|0|0|0|0|0|0|0|R|R|R|R|R|R|R|R|R|

9|oSpace team|who|USA|1|1|1|1|1|1|1|1|0|0|0|1|0|1|1|0|0|0|0|1|0|1|1|1|1|1|1|1|R|R|R|R|R|R|R|R|R|

10|oTanker team|who|USA|0|0|1|1|1|0|0|0|0|0|0|1|1|1|0|1|1|1|1|1|1|1|0|0|1|1|1|1|R|R|R|R|R|R|R|R|R|

11|oJAG team|who|USA|1|1|1|0|0|0|1|1|0|0|0|0|0|1|1|0|0|0|0|1|1|1|1|1|1|1|1|1|R|R|R|R|R|R|R|R|R|

12|oWX team|who|USA|0|1|1|1|1|1|0|0|1|0|1|0|1|1|1|1|1|1|1|1|0|0|0|0|0|0|0|0|0|R|R|R|R|R|R|R|R|R|

13|oAirspace team|who|USA|0|0|1|1|1|0|0|0|0|1|0|0|0|1|1|1|1|1|1|1|1|1|1|1|1|1|1|1|R|R|R|R|R|R|R|R|R|

14|oJSRC team|who|USA|1|1|1|1|1|1|1|0|0|1|0|1|1|0|1|1|1|1|1|0|1|1|1|1|1|1|1|1|R|R|R|R|R|R|R|R|R|

15|oBCD team|who|USA|0|1|1|1|0|0|1|0|0|0|0|0|1|0|0|0|0|0|0|1|0|0|1|1|0|0|1|1|R|1|R|R|R|R|R|R|R|

16|oSOLE team|who|USA|0|1|1|1|0|1|1|1|0|1|1|0|1|1|1|0|1|1|1|0|0|0|0|0|1|0|0|0|R|1|R|R|R|R|R|R|R|

17|oNALE team|who|USA|0|1|1|1|1|1|1|0|0|1|0|0|1|1|0|1|0|1|1|0|0|0|0|0|0|1|0|0|R|1|R|R|R|R|R|R|R|

18|oMARLO team|who|USA|0|1|1|1|1|0|0|0|0|1|0|0|1|1|1|1|1|0|1|0|0|0|1|0|0|0|1|0|R|1|R|R|R|R|R|R|R|

19|oCALE team|who|USA|0|1|1|1|1|0|0|0|0|1|0|0|1|1|0|1|1|1|0|0|0|0|1|0|0|0|0|1|0|R|0|0|0|0|0|0|R|

20|oCRC team|who|USA|0|1|1|0|1|0|0|0|0|0|0|0|1|1|0|0|0|0|0|0|1|1|1|1|1|1|1|1|R|1|R|R|R|R|R|R|R|

21|oCRCA team|who|USA|0|0|1|1|1|0|1|0|0|1|0|0|1|1|0|0|0|0|0|1|0|1|1|1|1|1|1|1|0|0|0|0|0|0|0|0|0|

22|oWOC team|who|USA|0|1|1|1|1|1|1|1|1|0|1|1|1|0|0|0|0|0|1|1|0|1|0|0|0|0|0|R|R|R|1|R|R|R|R|R|R|

23|oASOC team|who|USA|0|1|1|1|0|0|1|0|0|1|0|0|1|1|0|0|0|0|0|1|1|1|0|1|1|1|1|1|R|R|R|R|1|1|R|R|R|R|

24|oCORP team|who|USA|1|1|0|0|0|0|1|0|0|0|0|0|1|1|1|0|0|0|0|1|1|0|1|0|1|1|1|1|R|R|R|R|1|1|R|R|R|R|

25|oSOC team|who|USA|1|1|1|0|0|0|1|0|0|1|0|1|1|1|0|1|0|0|0|1|1|0|0|1|0|1|1|1|R|R|R|R|R|R|1|R|R|R|

26|oFleet team|who|USA|1|1|1|0|1|0|1|0|0|1|0|1|1|1|0|0|1|0|0|1|1|0|1|0|0|0|1|1|R|R|R|R|R|R|R|1|R|R|

27|oTACC team|who|USA|1|1|1|0|0|0|1|0|0|1|0|1|1|1|0|0|0|1|0|1|1|0|1|0|1|1|0|1|R|R|R|R|R|R|R|R|1|R|

28|oC-CP team|who|non-USA|1|1|1|1|1|0|1|0|0|1|0|1|1|1|0|0|0|1|1|1|1|0|1|1|1|1|1|0|0|0|0|0|0|0|0|0|1|

A

sJFC

sJFACC

sCRC

sWOC

sASOC

sCORP

sSOC

sFleet

sTACC

sC-CP

<end actual table>

Appendix C – Operations Factoidset Configuration File

01|E|4|2|2|1|5 The attack is during ATO L between 0600 on the 11th and 0500 on 12 of September 2015.

02|K|4|10|4|1|33 The best times to attack are at 0400Z and 1600Z and 0700Z hours.

03|K|4|20|1|1|73 Moonrise is at hour 14 and moon set at hour 2.

04|E|4|4|2|1|The attack won't be during the thermal change.

05|k|4|22|7|1|81 The attack will be between 2100Z and 0600Z hours

06|K|4|17|7|2|61 The attack will be at night when there is no moonlight.

07|K|4|21|1|3|77 There are thermal changes between 1100Z and 1300Z and between 0210Z and 0340Z.

08|E|4|2|2|3|The package requires direct, indirect and support resources.

09|E|2|3|2|3|9 There will be a compat airpower package to support RIF during ATO L

10|E|1|4|3|3|14 The attack package is package A and should have strike, EW and be well supported.

11|K|1|5|2|3|17 The iron triangle will be in position to support package A. Predator 11 is available to provide direct overhead support.

12|K|1|10|5|3|37 ARCO 22 (1KC10) will be flown off of Ground Alert to support Package A ARCO 23 (1 KC10) is available as a spare. Both aircraft are equiped with a boom and drogue.)

13|K|1|17|5|3|65 HARM 2 EA18G are available to support package A. They are currently scheduled to be equipped with Anti-radiation missles and active jamming pods. They will need drogues to refuel.

14|E|3|6|3|3|21 Primary support for the enemy forces engaging Corp RIF is being delivered from Hamilton Airfield

15|K|3|7|6|3|25 To remove Hamilton Airfied as a viable base of enemy operation for 6 to 24 hours the following DMPI's need to be struck: E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558

16|K|3|8|2|3|29 Targets being attacked with package "A" need to be evaluated for camouflage, concealment and deception (CCD).

17|K|3|11|1|3|41 The targets package "A" attack cannot be on the No Strike Target list nor should they be on the Restricted Target list (RTL) as appproval may take too long to receive.

18|K|3|13|5|3|49 A HDAA will be established over the RIF with two ROZ. One ROZ over RIF and one ROZ over Hamilton Airfield.

19|K|3|18|2|3|69 Targets with DMPI's that are on the JIPTL have measured coordinates ensuring the quickest planning time for Laser, GPS and IR ordance

20|K|3|24|4|3|93 Hamilton Airfield is where the enemy is embarking all replacement troops that continue to attack the RIF

21|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00546 RUNWAY 380300000N1223000000W

22|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00547 TAXIWAY 380300000N1222954000W

23|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00548 PARKING APRON 380254000N1222954000W

24|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00549 DISPERSAL AREA 380254000N1223006000W

25|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00550 DISPERSAL AREA 380300000N1222948000W

26|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00551 DISPERSAL AREA 380306000N1223000000W

27|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00552 DISPERSAL AREA 380312000N1223000000W

28|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00553 MAINTENANCE FACILITIES 380306000N1223006000W

29|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00554 MAINTENANCE FACILITIES 380300000N1223006000W

30|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00555 AMMO STORAGE 380312000N1223006000W

31|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00556 AMMO STORAGE 380254000N1222948000W

32|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00557 POL STORAGE 380254000N1223000000W

33|K|3|7|3|3|Hamilton Airfield 0992-00107 380259990N1223000000W E00558 POL STORAGE 380306000N1223006000W

34|K|3|7|2|3|E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558 are on the JIPTL.

35|K|3|7|1|3|E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558 are not on the RTL.

36|K|3|7|1|3|E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558 are not on the NSTL.

37|K|3|7|1|3|E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558 have been checked for CDD.

38|K|2|14|7|3|53 Two HH-60 are on 60 minute alert and are available to provide medical evacuations for RIF troups.

39|K|2|16|2|3|57 The RIF is continually being engaged by fresh enemy troups.

40|K|2|27|4|3|105 Two flights of F-18 are available to fly BAI mission to support RIF at 1800Z on the 11 and at 0530OZ on the 12 of Sep. Flights will have GPS guided weapons.

41|K|2|28|5|3|109 Three C-130 are available for Tactical resupply for the RIF troups.

42|E|2|1|2|3|1 RIF continues to be engaged and needs air support.

43|K|4|12|1|3|45 Sunrise is at 0650Z and sunset is at 2059Z.

44|K|1|22|3|3|85 4 F15E are available from 11 Sep 2400 to 12 Sep 0600 with PS, IR, Laser and conventional ordanance.

45|K|1|23|4|3|89 10 min before package A will start stacking XCAS and GCAS to support RIF

46|E|4|25|2|3|97 Target is at Hamilton Airfield and is scheduled to leave at 0600 on 12 Sep.

47|E|4|26|3|3|101 4 Tomahawks are available with 8 hours notice.

48|K|3|7|1|3|E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558 are on the JIPTL.

49|K|3|7|1|3|E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558 are not on the RTL.

50|K|3|7|1|3|E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558 are not on the RTL.

51|K|3|7|1|3|E00546, E00547, E00548, E00459, E00550, E00551, E00552, E00553, E00554, E00555, E00556, E00557, E00558 are not on the NSTL.

52|S|3|1|1|3|The JWICS VTC for all Commanders will be 1000 slides describing planned support for RIF forces are required 15 min before the briefing startes.

53|N|3|1|1|3|All units be prepared to operate under MISSION-ORIENTED PROTECTIVE POSTURES (MOPP) Level 3. Report equipment shortfalls to the JTF-J-4

54|S|3|1|1|3|Joint Targeting Control Board (JTCB) Meetings will meet daily at 1600 Zulu in DCO room JTF_Targeting

55|S|3|2|1|3|Long range planning to support the RIF troops will be accomplished by Combat Plans starting with ATO M

56|S|3|2|1|3|All units ensure 100% completion of all personnel ISOLATED PERSONNEL REPORT (ISOPREP) information. Report when 100% complete.

57|S|3|2|1|3|JFACC Decision Brief will occur at 1400Z in DCO room JFACC_Leadership.

58|S|3|3|1|3|The Go-No Go decision for the plan to support RIF troops during ATO M will be made no later than (NLT) 3 hours to execution to insure we have fuel, weather and ordanice required

59|S|3|3|1|3|Madatory meeting for COD personnel at 1300Z in DCO_CCO room.

60|S|3|3|1|3|Provide OPTASKLINK corrections NLT 1000Z to JICO

61|S|3|4|1|3|The extension of aircraft flying in L will increase the number of residual aircraft in ATO M. Insure all of ATO M first wave of aircraft is accurate

62|S|3|4|1|3|Implement TST ROE update with ATO L.

63|S|3|4|1|3|Meeting of the Dynamic Targeting Cell (DTC) will occur daily at 0300Z

64|S|3|5|1|3|The Predator supporting RIF will be a National level support asset

65|S|3|5|1|3|Theater Missile Defense Net (TMDN) is now operational.

66|S|3|5|1|3|Meeting of the IAMD Cell will occur at 0400Z dail in DCO room IAMD Cell

67|S|3|6|1|3|The RIF troops will need additional CAS support along the inflows routes from the North East

68|S|3|6|1|3|Utilize RSTA Annex change 2 effectively immediately for ATO_L.

69|S|3|6|1|3|Meeting of the SIDO team will occur at 0100Z daily in the DCO SIDO room.

70|S|3|8|1|3|Special Technical Office (STO) capabilites are in place and ready to support the RIF.

71|S|3|8|1|3|All USAF units will implement Electronic Warfare Integrated Reprogramming (EWIR) load B effective 2200Z.

72|S|3|8|1|3|Meeting of the EWCC will occur daily at 1800 in DCO room EWCC.

73|S|3|9|1|3|National Level overhead collection will be available post strike

74|S|3|9|1|3|Their will be no GPS degradation due to Solar Storm activity.

75|S|3|9|1|3|DIRSPACEFOR update briefing will occur at 1000Z daily in SCIF.

76|S|3|10|1|3|SHAMU 52 (KC135 boom only) the reliability orbit tanker is available if needed

77|S|3|10|1|3|Air Refueling Control Team (ARCT) will meet daily in DCO room ARCT at 0200Z

78|S|3|10|1|3|Tanker tasking requests will be coordinated with the TACC NLT 0300Z

79|S|3|1|1|3|To remove a traget from the RTL the Polmil officer must coordinate and approve the request

80|S|3|11|1|3|Effectively immediately, all TSTs must receive JAG approval.

81|S|3|11|1|3|Report all enemy LOAC violations immediately to the JAG

82|S|3|12|1|3|A cold frount will be pushing out of the RIF area and clearing weather should be expected.

83|S|3|12|1|3|Weather at KVPS will remain sunny and dry for the next 10 days.

84|S|3|12|1|3|Hurricane Irene is developing off the coast of Africa

85|S|3|13|1|3|Tanker track Rebel will have to be moved south by 60 miles before a HDAA can be extablished over the RIF troops.

86|S|3|13|1|3|C2 Plans meeting will occur daily at 0200Z in DCO room C2 Plans.

87|S|3|13|1|3|ACP B is available on the ShareDrive under C2 Plans- airspace

88|S|3|14|1|3|ISOPREP information will be need before any launch to recover down aircrew members

89|S|3|14|1|3|JSRC meeeting will occur daily at 1800Z in DCO JSRC room.

90|S|3|14|1|3|CSAR operations will be approved by the JSRC prior to execution.

91|S|3|15|1|3|RIF Advanced Field Artillery Tactical Data System (AFATDS) network connections are intermittent and replacement equipment is requested

92|S|3|15|1|3|Air Support Requests will be prioritized by the BCD prior to submission.

93|S|3|15|1|3|BCD coordination meeting will occur at 1800Z in via VTC.

94|S|3|16|1|3|HC-130 are available for helicopter refueling if required.

95|S|3|16|1|3|SOLE daily meeting will occur at 0200Z in DCO room SOLE.

96|S|3|16|1|3|Special Operations BFT will be filtered by the JDNO .

97|S|3|17|1|3|Aircraft Carrier cycle time are every 90 min starting at 0600

98|S|3|17|1|3|Navy ASRs must be submitted through MOC channels

99|S|3|17|1|3|NALE will meet daily at 1100Z in DCO NALE room.

100|S|3|18|1|3|EA-6B aircraft are available on ground alert to provide EW support as needed

101|S|3|18|1|3|the US Maritime Administration released a Maritime Advisory for US Vessels Transiting in the Strait of Hormuz, Southern Arabian Gulf, and Western Gulf of Oman

102|S|3|18|1|3|GOVERNMENT AND INDUSTRY SOURCES CAN CONFIRM THAT THE CLAIM BY THE ABDULLAH AZZAM BRIGADES (AAB) THAT THE GROUP HAD ATTACKED THE TANKER M.STAR IS VALID. THE GROUP REMAINS ACTIVE AND CAN CONDUCT FURTHER ATTACKS ON VESSELS IN AREAS IN THE STRAIT OF HORMUZ, SOUTHERN ARABIAN GULF, AND WESTERN GULF OF OMAN.

103|S|3|19|1|3|There will be a change of command in the Australian coalition compound at 1500, heavy libations immediately following

104|S|3|19|1|3|Coalition Elements report IAMD status updates via CENTRIX.

105|S|3|19|1|3|Coalition IAMD LNOs provide system laydowns NLT 1800Z daily via CENTRIX

106|S|3|20|1|3|Commerical air traffic centers will be notified of the expected need to reroute traffic around the area associated with the RIF troops.

107|S|3|20|1|3|CRC report all airspace violations NLT 1800Z daily.

108|S|3|20|1|3|Implement OPTAKLINK B at all CRCs effective 1800Z

109|S|3|21|1|3|Airborne checkin for RIF forces will be with Red Crown on 235.6 TAD 256

110|S|3|21|1|3|All Targets of Interest (TOI) will be reported.

111|S|3|21|1|3|All Targets of Interest (TOI) will be reported.

112|S|3|22|1|3|The Bomb Dump build up team report a full supply of ordanice parts except for MK 903 contact fuses

113|S|3|22|1|3|Units will report all ATO SCL changes to the WOC prior to 1800Z.

114|S|3|22|1|3|Unit take off times will be reports to the WOC with in 10 minutes of takeoff.

115|S|3|23|1|3|Two additional FACP will be available to work any increase in CAS sorties on the 12 of september

116|S|3|23|1|3|Night operations will be conducted in the area around Fort Bogger to include illumination rounds at or below 5000 feet UFN.

117|S|3|23|1|3|BAO Kit version 10 update available

118|S|3|24|1|3|Artillery training operations will commmence from 1000Z to 1900Z near Fort Bogger

119|S|3|24|1|3|All Corp UAV operations will remain below the coordination altitude.

120|S|3|25|1|3|SEAL Team 6 has eyes on the trageted indivdual at Hamilton Airfield.

121|S|3|25|1|3|Flights above the coordination altitude will SQK mode I and III at all time in All sectors.

122|S|3|25|1|3|All Air Defense engagements will be reported through applicable SOC channels.

123|S|3|26|1|3|Tomahawk C (a unitary warhead) and Tomahawk D (Dispenser with submunitions) are both available.

124|S|3|26|1|3|All aircraft will squawk mode I III and III when operating in CVN airspace.

125|S|3|26|1|3|All electronic jamming is prohibited within 50 NM of US vessels.

126|S|3|27|1|3|Leatherneck 41 a flight of 2 F-18's scheduled takeoff of 2200 have been redirected to provide CAS for JFACC support

127|S|3|27|1|3|Daily TACC cooridnation meeting will occur at 1500Z in the TACC DCO room.

128|S|3|28|1|3|Approved airlift support requests will be available on S drive under TACC at 1800Z daily.

129|S|3|28|1|3|Canadian C-130 aircraft have 27 stations available to carry wounded troops on litters

130|S|3|28|1|3|Coalition Ground Forces will wear reflective IR tape on future operations around right arm.

131|S|3|28|1|3|Use of CPoF applications in C-CP is resriticted to view only.

132|A|0|0|0|0|ATO change plans to attack to support RIF troups unil ATO M in Hamilton Airfield on Sep 12 a 0400 at night.

<end factoids>

<begin question/answer area>

who| |ATO change

what| |to support RIF troups until ATO M

where| |Hamilton Airfield go

whenMonth| |September

whenDate| |12

whenHour| |04

whenDaynight| |night

<end question/answer area>

<begin factoid dimensions>

who = individual, group, direct, indirect, support, package, boom, drogue, GPS, XCAS, GCAS, Feighteen, Ffifteen, THAWKS, Conethirty, AWACS, RJ, JSTARS, HHsixty, Predator, HARM, KCten, need boom, need drogue, MOPP, ISOPREP, OPTASKLINK, TMDN, approve, report, reportedTo, approvedBy, VTC, CENTRIX, SOC

what = target, targetAffiliation, ROZone, ROZtwo, ROZCount, TST ROE, RSTA Annex, EWIR, TTR, reportedWhat, CSAR, AFATDS, HC-130, BFT, ASR, MOC, EA-6B, TOI, MK-903, FACP, BAO, artillery, Corp UAV

where = location, desiredLocation, DMPI, CCDchecked, NSTL, RTL, JIPTL, altitude

when = month, day, hour, daynight, thermalchange, moonlight, sunlight, weather

month:January,February,March,April,May,June,July,August,September,October,November,December

day:1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31

hour:1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24

daynight:day,night

thermalchange:yes,no

moonlight:yes,no

sunlight:yes,no

group:ATO change

RTL:yes,no

JIPTL:yes,no

CDDchecked:yes,no

NSTL:yes,no

desiredLocation:yes,no

DMPI:yes,no

location: Hamilton Airfield go, Hamilton Airfield no go

direct:yes,no

indirect:yes,no

support:yes,no

ROZCount:1,2

GPS:yes,no

boom:yes,no

boom needed:yes,no

drogue:yes,no

drogue needed:yes,no

XCAS:yes,no

GCAS:yes,no

Feighteen:yes,no

Ffifteen:yes,no

THAWKS:yes,no

Conethirty:yes,no

AWACS:yes,no

RJ:yes,no

JSTARS:yes,no

HHsixty:yes,no

Predator:yes,no

HARM:Yes,no

KCten:yes,no

MOPP:yes,no

ISOPREP:yes,no

OPTASKLINK:yes,no

TST ROE:yes,no

TMDN:yes,no

RSTA Annex:yes,no

EWIR:yes,no

TTR:yes,no

approve:yes,no

approvedBy:JAG,JSRC,JDNO

report:yes,no

reportedTo:JAG,WOC

reportedWhat:LOAN,IAMD,airspace violations,ATO SCL changes,take off times,Air Defense engagements

weather:clear,unclear

CSAR:yes,no

AFATDS:yes,no

HC-130:yes,no

BFT:yes,no

ASR:yes,no

MOC:yes,no

VTC:yes,no

CENTRIX:yes,no

TOI:yes,no

MK-903:yes,no

FACP:yes,no

BAO:yes,no

SOC:yes,no

altitude:below,above

Corp UAV:yes,no

<end factoid dimensions>

<begin factoid translations>

0

[DMPI:no] [NSTL:yes] [RTL:yes] [JIPTL:no] [CDDchecked:no] = 0

[Feighteen:no] [Ffifteen:no] [THAWKS:no] [indirect:yes] = 0

[XCAS:no] [GCAS:no] [direct:yes] = 0

[Conethirty:no] [AWACS:no] [RJ:no] [JSTARS:no] [Predator:no] [HHsixty:no] [KCten:no] [support:yes] = 0

[XCAS:yes] [drogue:no] = 0

[drogue:no] [drogue needed:yes] = 0

[boom:no] [boom needed:yes] = 0

1
day:(1,2,3,4,5,6,7,8,9,10,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31) = 0
[day:11] [hour:1,2,3,4,5] = 0
[day:12] [hour:6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24] = 0
month:September = 1
targetAfiliation:until ATO M

2
hour:(6,8,9,10,11,12,13,14,15,17,18,19,20,21,22,23,24,1,2,3,5) = 0

3
[moonlight:yes] [hour:(3,4,5,6,7,8,9,10,11,12,13)] = 0

4
thermalchange:no = 1

5
hour:(6,7,8,9,10,11,12,13,14,15,16,17,18,19,20) = 0

6
daynight:night = 1
moonlight:no = 1
sunlight:no = 1

7
[thermalchange: no] [hour:2,3,11,12,13] = 0

8
[direct:no] [indirect:no] [support:no] [group:ATO change] = 0

9
target:until ATO M = 1
targetAffiliation:to support RIF troups = 1

10
package:A
[direct:no] [indirect:no] [support:no] [group:ATO change] = 0

11
AWACS:yes = 1
JSTARS:yes = 1
JR:yes = 1
boom needed:yes = 1
[package:A] [indirect:no] = 0

12
drogue:yes = 1
boom:yes = 1
KCten:yes = 1

13
HARM:yes = 1
drogue needed:yes = 1

14
targetAffiliation:to support RIF troups = 1
location:(Hamilton Airfield go, Hamilton Airfield no go)
[desiredLocation:no] [location:Hamilton Airfield go] = 0

15
[DMPI:yes] [desiredLocation:no] = 0

16
CCDchecked:yes = 1

17

NSTL:no = 1
RTL:no = 1

18
ROZone:RIF = 1
ROZtwo:Hamilton Airfield = 1
ROZCount:2 = 1

19
JIPTL:yes = 1

20
location:(Hamilton Airfield go, Hamilton Airfield no go)
[desiredLocation:no] [location:Hamilton Airfield go] = 0

21
[DMPI:yes] [desiredLocation:no] = 0

22
[DMPI:yes] [desiredLocation:no] = 0

23
[DMPI:yes] [desiredLocation:no] = 0

24
[DMPI:yes] [desiredLocation:no] = 0

25
[DMPI:yes] [desiredLocation:no] = 0

26
[DMPI:yes] [desiredLocation:no] = 0

27
[DMPI:yes] [desiredLocation:no] = 0

28
[DMPI:yes] [desiredLocation:no] = 0

29
[DMPI:yes] [desiredLocation:no] = 0

30
[DMPI:yes] [desiredLocation:no] = 0

31
[DMPI:yes] [desiredLocation:no] = 0

32
[DMPI:yes] [desiredLocation:no] = 0

33
[DMPI:yes] [desiredLocation:no] = 0

34
[DMPI:yes] [JIPTL:no] = 0

35
[DMPI:yes] [RTL:yes] = 0

36
[DMPI:yes] [NSTL:yes] = 0

37
[DMPI:yes] [CCDchecked:no] = 0

38
HHsixty:yes = 1
boom needed:yes = 1

39
targetAffiliation: to support RIF troups = 1

40
Feighteen:yes = 1
boom needed:yes = 1
hour:(6,7,8,9,10,11,12,13,14,15,16,17) = 0

41
Conethirty:yes = 1
boom needed:yes = 1

42
targetAffiliation:to support RIF troups = 1

43
[sunlight:yes] [hour:(1,2,3,4,5,6,22,23,24)] = 0

44
Feighteen:yes = 1
boom needed:yes = 1

45
XCAS:yes = 1
GCAS:yes = 1
boom needed:yes = 1

46
[day:12] [hour: (7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

47
THAWKS:yes = 1

48
[DMPI:yes] [JIPTL:no] = 0

49
[DMPI:yes] [RTL:yes] = 0

50
[DMPI:yes] [RTL:yes] = 0

51
[DMPI:yes] [NSTL:yes] = 0

52

53
MOPP:yes = 1

54
[group:JTCB] [location:DCO room JTF_Targeting] [hour:(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18,19,20,21,22,23,24)] = 0

55
target:until ATO M = 1
targetAffiliation:to support RIF troups = 1

56
ISOPREP:yes = 1

57
[group:JFACC] [location:DCO room JFACC_Leadership] [hour:(1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18,19,20,21,22,23,24)] = 0

58

59
[group:COD] [location:DCO_CCO room] [hour:(1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,18,19,20,21,22,23,24)] = 0

60
[OPTASKLINK:yes] [hour: (11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

61

62
[TST ROE:no] [targetAffiliation:ATO L] = 0

63
[group:DTC] [hour:(1,2,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

64
[Predator:no] [targetAffiliation:to support RIF troups] = 0

65
[TMDN:yes] = 1

66
[group:IAMD Cell] [location:DCO room IAMD Cell] [hour:(1,2,3,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

67
targetAffiliation:to support RIF troups = 1

68
[RSTA Annex:no] [targetAffiliation:ATO L] = 0

69
[group:SIDO] [location:DCO SIDO room] [hour:(2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

70
targetAffiliation:to support RIF troups = 1

71
[EWIR:no] [hour:22] = 0

72
[group:EWCC] [location:DCO EWCC room] [hour:(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,20,21,22,23,24)] = 0

73

74
GPS:no = 1

75
[group:DIRSPACEFOR] [location:SCIF] [hour:(1,2,3,4,5,6,7,8,9,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 1

76
boom:yes = 1

77
[group:ARCT] [location:DCO ARCT room] [hour:(1,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

78
[TTR:no] [hour:(3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

79

80
[approve:no] [TST ROE:yes] [approvedBy:JAG] = 0

81
[reportedTo:JAG] [reportedWhat:LOAN] [report:no] = 0

82
[weather:unclear] [location:RIF area] = 0

83

84

85

86
[group:C2 Plans] [location:DCO C2 Plans room] [hour:(1,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

87

88

89
[group:JSRC] [location:DCO room JSRC] [hour:(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,19,20,21,22,23,24)] = 0

90
[CSAR:yes] [approve:no] [approvedBy:JSRC] = 0

91
AFATDS:no = 1

92

93
[VTC:no] [group:BCD] [hour:18] = 0

94
HC-130:yes = 1

95
[group:SOLE] [location:DCO room SOLE] [hour:(1,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

96
[approvedBy:JDNO] [BFT:yes] [approve:no] = 0

97

98
[ASR:yes] [MOC:no] = 0

99
[group:NALE] [location:DCO room NALE] [hour:(1,2,3,4,5,6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,22,23,24)] = 0

100
EA-6B:yes = 1

101
[location: (Strait of Hormuz, Southern Arabian Gulf, Western Gulf of Oman)] = 1

102
[location: (Strait of Hormuz, Southern Arabian Gulf, Western Gulf of Oman)] = 0

103
[group:Australian coalition] [hour:15] = 0

104
[reportedWhat:IAMD] [CENTRIX:yes] [report:no] = 0

105
[group:IAMD] [CENTRIX:yes] [hour:(19,20,21,22,23,24)] = 0

106

107
[group:CRC] [reportedWhat:airspace violations] [report:no] = 0

108
[OPTASKLINK:yes] [hour:(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18)] = 0

109

110
[TOI:yes] [report:no] = 0

111
[TOI:yes] [report:no] = 0

112
[MK-903:yes] = 0

113
[reportedTo:WOC] [reportedWhat:ATO SCL changes] [report:no] [hour:(18,19,20,21,22,23,24)] = 0

114
[reportedWhat:take off times] [reportedTo:WOC] [report:no] = 0

115
[FACP:no] [day:12] [month:September] = 0

116
[daynight:day] [location:Fort Bogger] = 0

117
BAO:yes = 1

118
[location:Fort Bogger] [artillery:yes] [hour:(1,2,3,4,5,6,7,8,9,20,21,22,23,24)] = 0

119
[altitude:above] [Corp UAV:yes] = 0

120
location:Hamilton Airfield = 1

121

122
[reportedWhat:Air Defense engagements] [SOC:yes] [report:no] = 0

123
THAWKS:yes = 1

124

125

126
[support:no] [targetAffiliation:JFACC support] = 0

127
[group:TACC] [location:DCO room TACC] [hour:(1,2,3,4,5,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21,22,23,24)] = 0

128

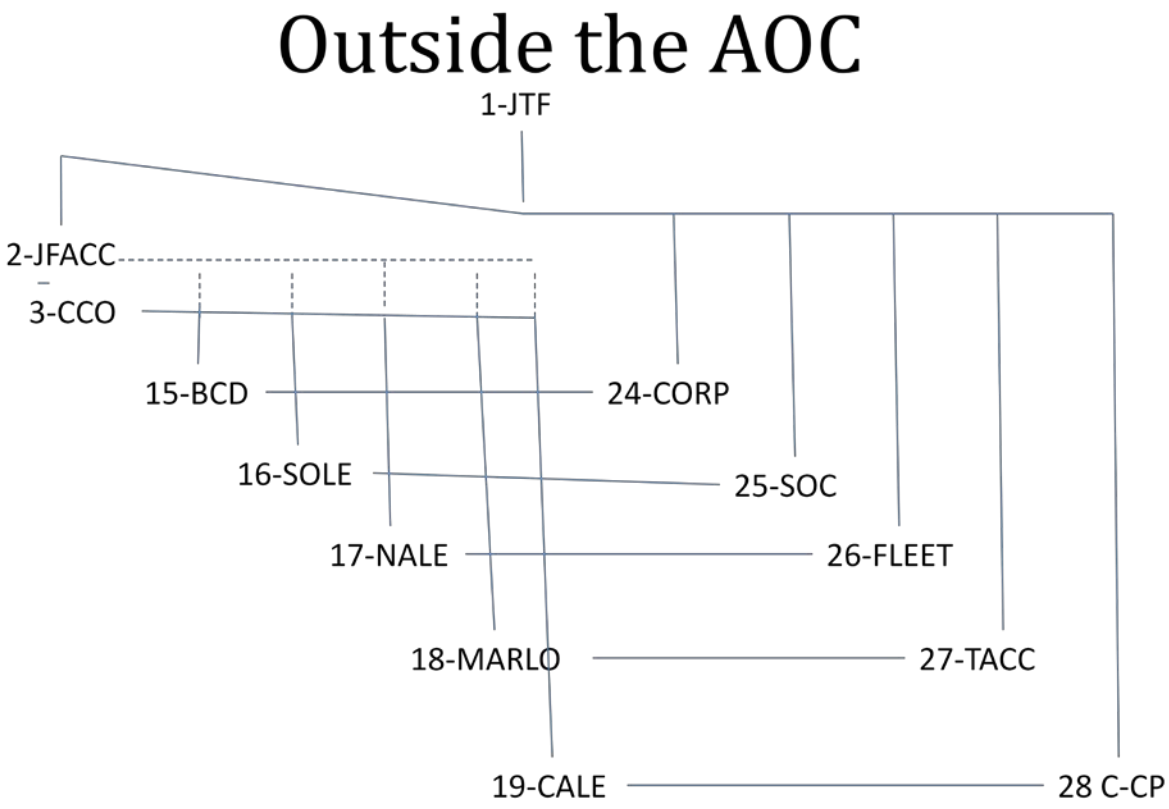
129

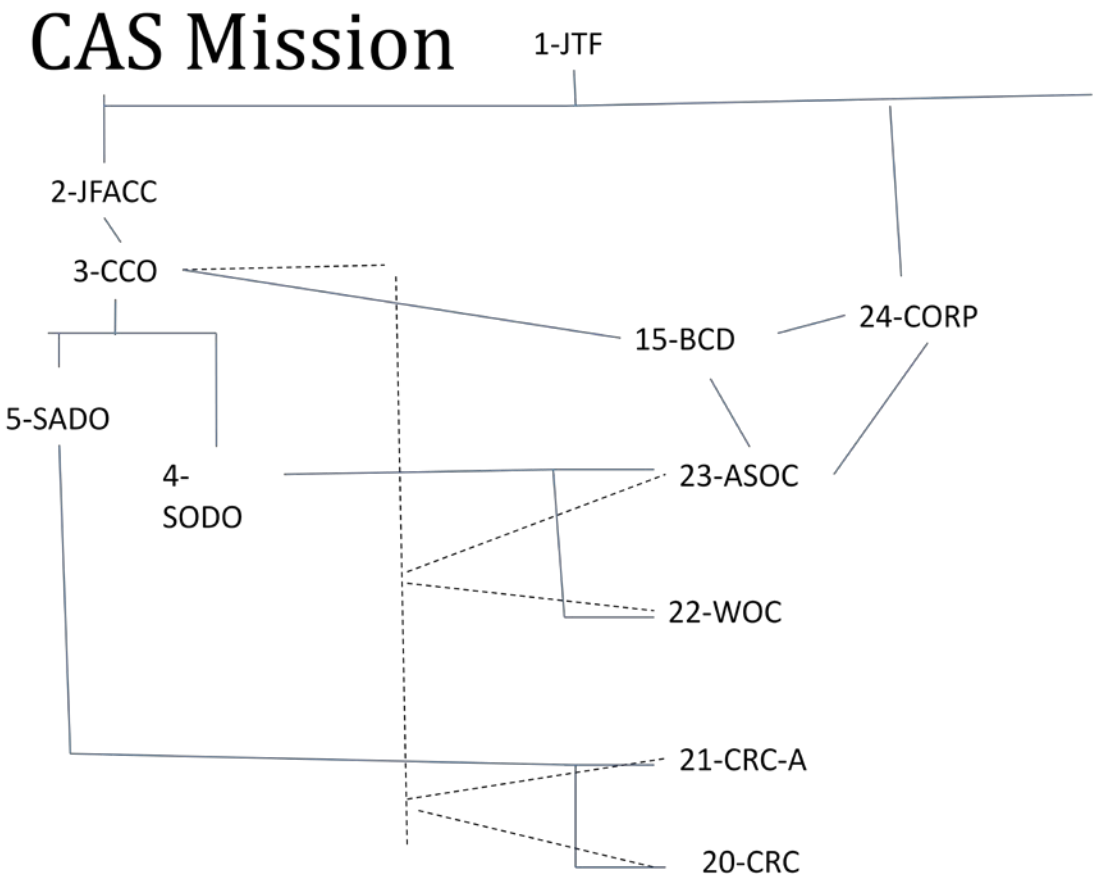
130

131

<end factoid translations>

Appendix D – Interaction Starting Assumptions




CAS Mission
1-JTF
2-JFACC
3-CCO
15-BCD
24-CORP
5-SADO
4-
SODO
23-ASOC
22-WOC
21-CRC-A
20-CRC

Inside the AOC