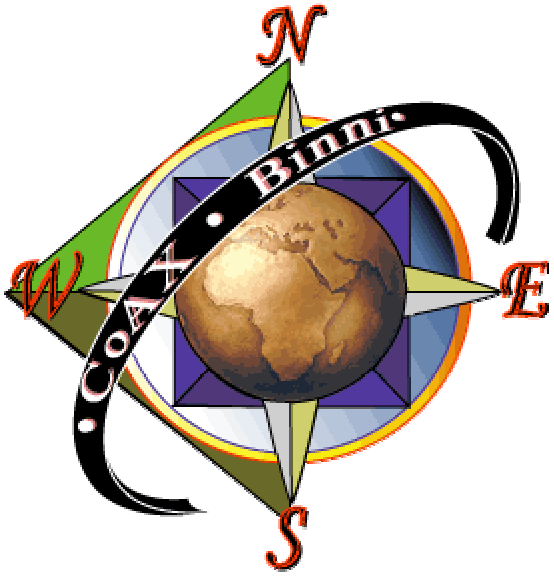
Contents

COALITION AGENTS EXPERIMENT (COAX)
TECHNOLOGY INTEGRATION EXPERIMENT DOCUMENT
(INCLUDING THE BINNI 'FLASH' SCENARIO)



AFRL Rome, AIAI, BBN, Boeing, CMU, Dartmouth, DSTL, DSTO, GITI, LM-ATL, Michigan, NRL, OBJS, Potomac Institute, QinetiQ, TTCP, UMD, USC/ISI, UT-Austin, UWF/IHMC.

With support from: ARL, DREV, ISX, Mitre, MIT Sloan, NRL, NWDC, Schafer, Stanford
See the CoAX web page at http://www.aiai.ed.ac.uk/project/coax/

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If browsing the document electronically, please use these links to aid rapid navigation:

Contents, Document_Structure.
Chapter_1, Chapter_2, Chapter_3, Chapter_4, Chapter_5.
CoAX_Binni_2000_Overview, CoAX_Binni_2001_Overview, CoAX_Binni_2002_Overview

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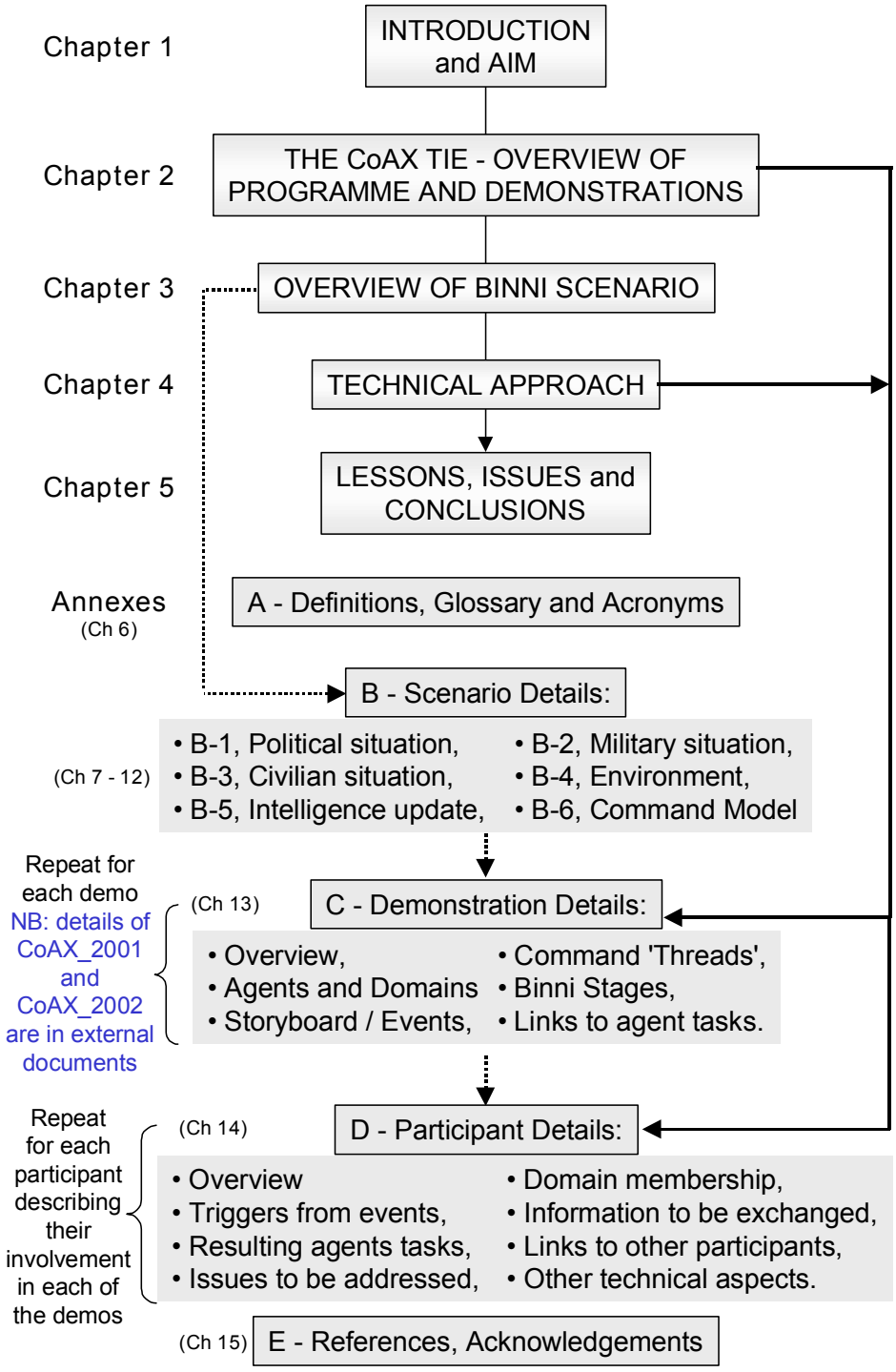
CHAPTER 1. DOCUMENT STRUCTURE, INTRODUCTION AND AIM

STRUCTURE OF THE DOCUMENT

The following are Links to: Contents, Chapter_1, Chapter_2, Chapter_3, Chapter_4, Chapter_5. Annex_A, Annex_B, Annex_C, Annex_D, Annex_E



INTRODUCTION

BACKGROUND AND MOTIVATION

1. As recent events in Bosnia, Kosovo and East Timor have demonstrated, coalition operations are going to become an increasingly important feature in future years. In any military operation, enabling commanders to have access to timely and relevant information is crucially important to a successful outcome. The difficulties are compounded in the virtual organisation of the coalition since there will be a mix of equipment, operational procedures, languages, etc. Moreover, there is a pressing need to set up such organisations rapidly in order to respond decisively to emerging crises.

2. From a technical perspective, coping with this inherent heterogeneity and tight time-scales are major challenges. Traditional approaches to software integration are too brittle to provide the flexibility required to share information between such disparate command systems in the limited amount of time available. The principal motivation for this TIE is to demonstrate that modern software agent technology can provide an advanced infrastructure able to support the demanding information and C2 requirements of a coalition force.

3. In order to demonstrate how some of the planning, visualisation and execution activities in "come-as-you-are" coalition operations can be augmented by agent technology, we have put together a coherent programme of work, a Coalition Agents eXperiment (CoAX) collaboration[1] which includes participants from DARPA CoABS, AFRL and QinetiQ. Between them, the partners have the skills and expertise to address the key scientific issues as follows:

- Agent coalition framework – AIAI and Boeing and IHMC;
- Policy-based management services for agents and agent domains – Boeing and IHMC;
- Agent relationship visualization and match making services – CMI;
- Resource discovery agents – UTexas;
- Mobile agents – Dartmouth, IHMC,OBJS;
- E-mail agents, asynchronous wireless connectivity – OBJS;
- Shared models for agent tasking and activity – AIAI and IHMC;
- Activity planning, co-ordination, process management and workflow – AIAI, Michigan and MIT;
- Execution monitoring, event handling, robustness and repair – AIAI, Boeing, IHMC and MIT;
- Mixed initiative agents and dynamic information flow – BBN;
- Recognising and resolving data inconsistencies – USC/ISI;
- Agents that can deal with probabilistic uncertainty – UMD;
- Flexible data access – Dartmouth, LM-ATL and USC/ISI;
- Information discovery, dissemination and monitoring (IDDM) of JDBC Databases - LM ATL.
- Agent capability representation and matching – AIAI, QinetiQ and USC/ISI;
- Command system execution and visualisation – AFRL, AIAI and QinetiQ;
- Legacy system wrapping / ad-hoc interoperability / integration (QinetiQ).
- Menu-based natural language interfaces (OBJS).

[1] See http://www.aiai.ed.ac.uk/project/coax/

PROJECT AIMS

4. The overall objective of this research is to demonstrate that an agent-enabled infrastructure will significantly aid the construction of a coalition command support system from a diverse range of components. To achieve this, the project will address a number of technically challenging problems, including:

- Dealing with the need to share systems and information.
- Dealing with the need to co-ordinate decentralised tasks and workflow.
- Dealing with different levels of trust.
- Providing mechanisms to translate information between systems.
- Dealing with the integration of systems that were developed with particular nations' processes and doctrine in mind.

PROJECT APPROACH

5. The major technical goal is to research, design and implement a framework that will support a coalition of agent organisations. The key idea that we shall be investigating is to base the framework on agent domains. Each domain will represent a community of agents governed by common agent policies and with a common point of administration. The aim of our research is to show that these communities are able to work together effectively to produce a coherent virtual organisation with capabilities representative of those required by a military coalition command structure.

6. The TIE will include demonstrations of progressively larger numbers and different types of system and human agents. A realistic Coalition scenario and inclusion of actual advanced military system components will ensure validity of the approach.

COALITION SCENARIO

7. The BINNI scenario (described further below) has been chosen for this work. This has the advantage of already being a publicly available scenario generated by an international group of five nations (The Technical Co-operation Program – TTCP) to support experiments for Coalition Operations Command and Control. Our scenario expert will be Tony Rathmell of DSTL, who is working with TTCP Technical Panel 9. Tony has offered to work with the Coalition TIE partners to identify and further develop suitable vignettes within the BINNI scenario to demonstrate this work.

8. This document provides details of an extension to the BINNI [1][2] scenario (see Chapter_3 to meet both the operational and technical needs of the CoAX. This Binni vignette (to be known as the Binni 'Flash' Vignette) is based on TTCP[3] Mission 'A' and certain assumptions have been made:

- The vignette support research to show how agents can work in an integrated manner so some of the action in the Vignette has been 'contrived' to trigger certain technical issues and actions.
- The Command Ethos will be initially based on the UK's Operational Doctrine (UKOPSDOC) manual: ie the Command Process is 'command led'[4] and is characterised by a mix of

[2] See http://www.aiai.ed.ac.uk/project/coalition/binni/ - also see Annex_E_References below.
[3] For explanation of abbreviations see Annex_A_Definitions below.
[4] A description of the military context can be found at Annex_B6_Command_Model below.

deterministic and naturalistic decision making styles focused on achieving command agility. This is described in more detail at Annex_B6_Command_Model.

COAX PARTNERS

9. The following TIE partners have been identified and have all expressed a strong interest in pursuing the issues raised in this proposal:

- AFRL: Rick Metzger (also acts as US Government POC for TIE)
- AIAI, University of Edinburgh: Austin Tate, Jeff Dalton, John Levine and Jussi Stader
- BBN: BBN: Mark Burstein, David Diller and Alice Mulvehill
- Boeing: Rob Cranfill, Mark Greaves
- CMU: Joseph Giampapa, Katia Sycara and Sebastian Thrun
- Dartmouth College: Bob Gray and Sue McGrath
- DREV: Jean Berger
- DSTO: Dale Lambert and Steve Wark
- Lockheed Martin Advanced Technology Laboratory: Martin Hofmann, Ken Whitebread, Pete Gerken, Lori Pridmore and Chris Garrett Michigan University: Ed Durfee
- MIT: Mark Klein, Chris Dellarocas
- NRL: Ranjeev Mittu, Ruth Willis, Sue Numrich, Frank Segaria, Suleyman Guleyupoglu
- OBJS: Craig Thompson
- Potomac Institute: Patrick Worcester
- QinetiQ Malvern (formerly DERA): Mike Kirton, Patrick Beautement, David Allsopp, John Carson
- Stanford: Yoav Shoham
- UMD: V.S.Subrahmanian, Dana Nau and Robert Ross
- USC/ISI: Craig Knoblock
- Utexas at Austin: K. Suzanne Barber, Ryan McKay and Tom Graser
- UWF/IHMC Jeff Bradshaw, Renia Jeffers, Niranjan Suri
- Scenario Specialists: Tony Rathmell (DSTL / TTCP) and Patrick Beautement (QinetiQ)
- Support from: Doyle Weishar (GITI), Pete Haglich (ISX), David Brown (Mitre), Tom Martin (Schafer)

For more information on the demonstrations and the other proposed CoAX activities see Chapter_2.

AIM OF THE DOCUMENT

10. The aim of this set of documents is to explain the Programme of CoAX demonstrations, the operational scenario (the Binni 'FLASH' Mission 'A' vignette) and the technical context (including agent drivers and tasks) for the CoAX TIE demonstrations (to show how the use of software agents can support the command process in Coalition Operations).

NOTION OF AGENCY

11. We do not intend to get wrapped around the axle of what is an agent or what is not, but see the notion of agency as a useful metaphor for dealing with the complexity of Coalition environments and define it as:

> "Agents can be viewed as (software) entities acting on behalf of, or mediating the actions of, a human user and having the ability to autonomously carry out tasks to achieve goals or support the activities of the user. These software agents operate in an infrastructure which provides them with the facilities they need."

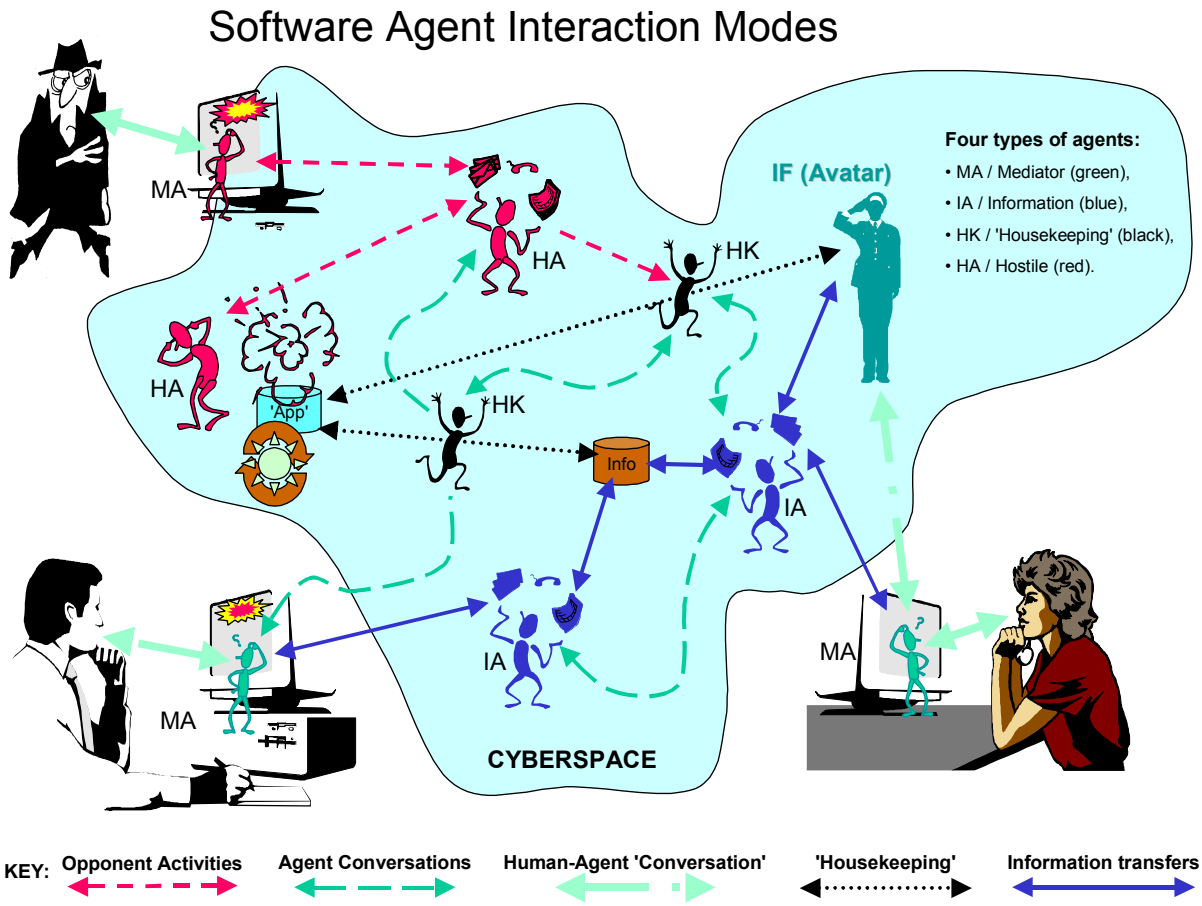


Figure 1-1 - Agent Types and Interactions

Indeed, we identify four types of agents (also illustrated in Figure 1-1):

- Mediator Agents (MA) which act as interface agents and interact with humans to act as a gateway from the real world into cyberspace (in CoAX we use the applications as the gateway from the humans to the agents and QinetiQ will be addressing these issues). As an aside, MA agents include agents which substitute for humans (avatars) providing the human with a presence in cyberspace and which act decisively with delegated human authority,
- Information Agents (IA) which have the ability to autonomously carry out tasks to achieve goals or support the activities of the user,
- Agents which carry out 'housekeeping' (HK) for the 'good of the system' - not necessarily in the direct interest of humans,

- Hostile Agents (HA) - which may any of the types above, but which are motivated with destructive intent towards other agents / cyberspace (in CoAX these are simulated).

DEDUCTION(S): So the characteristics of agent-based environments are that they are open, dispersed, component-based containing many 'virtual' organisations where ill-defined, iterative and recursive interactions take place and where agents themselves can be composed of other agents.

GENERAL COAX IMPLICATIONS: The agent 'toolset' that we are assembling (the Grid, KAoS, Nomads etc) are well aligned to this view of agents and that we can probably use the description of agents above in our briefings to make clear to our audience where we are coming from.

CHAPTER 2. THE COAX TIE - OVERVIEW OF PROGRAMME AND DEMONSTRATIONS

Document_Structure, Links to the Chapters: Chapter_1, Chapter_3, Chapter_4, Chapter_5.

1. The overall CoAX programme is summarised on the CoAX web site at http://www.aiai.ed.ac.uk/project/coax/ and is described in detail below.

THE COAX TIE – OVERVIEW

2. The partners involved in the CoAX TIE will be building a general framework for the integration of agents and use this framework to integrate (at least) the following software systems:

- MBP: Master Battle Planner (QinetiQ)
- CAMPS: Air Transport planner (AFRL)
- ARIADNE: web-based information providing agent (USC/ISI)
- Process Panels: for task and process management support (AIAI)
- Intelligence Agent: an intelligence gathering agent (Dartmouth College)
- MCA: Multi-level Co-ordination Agent (Michigan)
- OBJS eGents: asynchronous, wireless email agents

3. Five demonstrations are planned over the 30 months of the TIE, with the demonstrations at 9, 18 and 30 months being external deliverables:

- After 1 month: demonstration of MBP and an EMAA/CAST agent working together on the CoABS Grid.
- After 6 months: Binni scenario demonstration centred on MBP containing multiple information providing and monitoring agents using Boeing KAoS on the Grid.
- After 9 months (CoAX Binni 2000): Binni scenario (initial planning phase) demonstration with MBP / CAMPS link respecting the proposed KAoS domain management framework.
- After 18 months (CoAX Binni 2001): a comprehensive demonstration (execution phase) including the dynamic connection of the systems listed above in the framework and showing coalition and country domains.
- After 30 months (CoAX Binni 2002): demonstrate capabilities at all levels of command to support the dynamic 'come-as-you-are' aspects of interoperability, domain management and tasking, along with scalability to more domains and agents.

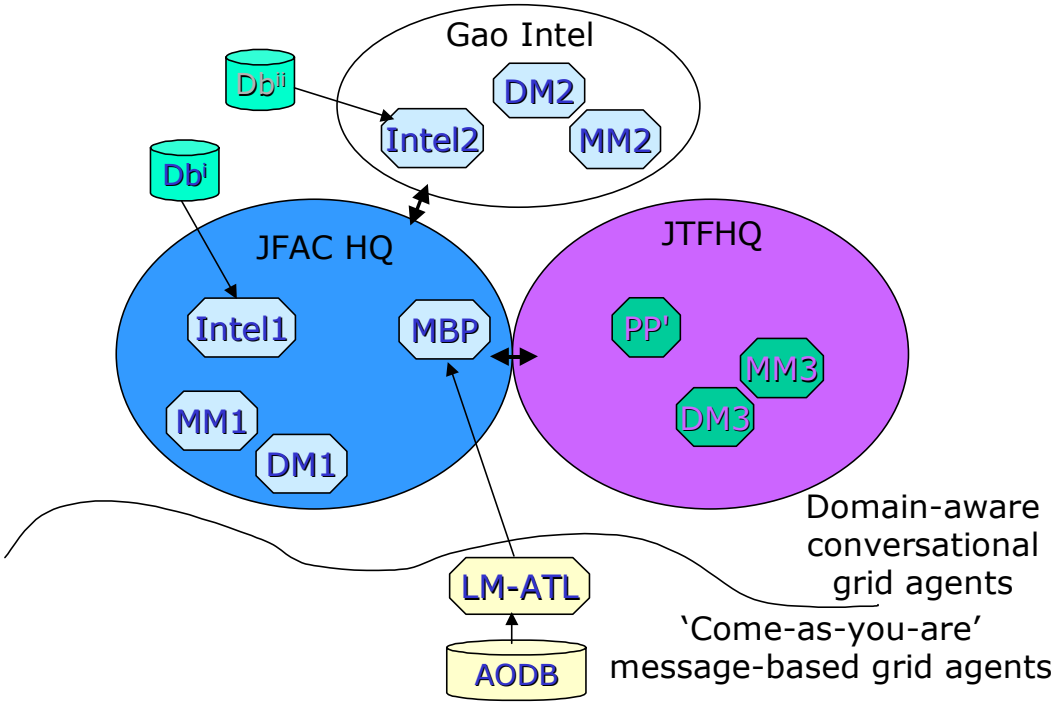
1-MONTH DEMONSTRATION

4. After 1 month (achieved on 16th February 2000), we constructed a demonstration of the framework for coalition mechanisms with MBP and an EMAA/CAST agent working together on the CoABS Grid. The specific concepts highlighted were:

- Construction of a Coalition-wide visualisation from multiple sources across the Grid,
- Update of scenario information on-the-fly (new objects, moving objects, status of objects).

This demonstration was populated with simple/surrogate agents in order to address the chosen scenario vignette and anticipate the 6 and 9-month demonstrations.

Figure 2-1 - CoAX 6-month Demonstration - Agent Domains



CoAX Six-Month Integration

5. The CoAX demonstration at 6 months is an internal project milestone. The aim of this demonstration is to get the agents that form the core of the 9-month demonstration working together in a Binni-related scenario on the grid, using some basic KAoS agent domain and conversation facilities. For the 6-month demonstration each agent will belong to only one domain at a time and there will be a single Air Command demonstration thread.

AGENTS AND DOMAINS AT 6 MONTHS

6. There are three agent domains (see Figure 2-1 above): two of these are coalition functional units (JTFHQ and JFAC HQ - for a detailed discussion of the Command Structures and types of domain see Annex_B6_Command_Model), the other is a country domain (Gao Intel).

7. There are 11 agents: MBP (DERA), the Process Panel (AIAI), LM-ATL EMAA/CAST (Lockheed Martin ATL), two intelligence agents (Intel1 and Intel2) and a Boeing KAoS Domain Manager (DM) and Match Maker (MM) for each of the three domains. Excluding the DM/MM agents, the agents can be classified as follows: 1 planning agent (MBP), 1 monitoring agent (PP) and 3 information providers (LM-ATL, Intel1 and Intel2). More detail follows:

   a. The Process Panel in JTFHQ domain monitors MBP's activities.

b. MBP generates the Coalition Air Operations Plan and visualisation based on:

- Db[i] in the JFAC HQ domain, information source for the Theatre, assets and their capabilities
- AODB information provided by the LM-ATL EMAA/CAST "come-as-you-are" agent
- Db[ii] in the Gao domain, which represents a 'private' intelligence source

c. Boeing KAoS Domain Managers (DM) and Match Makers (MM):

- DMs co-ordinate agent registration, policy administration and enforcement
- MMs federate to provide information about local and remote agent services

STORYBOARD AT 6 MONTHS

8. The storyboard is as follows:

a. JFAC HQ awaits orders from JTFHQ. MBP begins with an empty scenario showing Binni. JTFC's Process Panel (PP) finds MBP using referral of local KAoS matchmaker (MM3) to matchmaker in remote JFAC HQ domain (MM1).

b. PP sends UNWAFB Mission Document and JTFC's Mission Directive to MBP and MBP acknowledges.

c. JFAC HQ begins to assemble information and intelligence. MBP agent communicates with non-domain-aware LM-ATL agent to get AODB information. MBP uses local and remote KAoS matchmakers to find domain-aware Intel agents. These agents are queried and may provide occasional updates. In cases where the same information is received from Intel1 and Gao's Intel2, Gao's is preferred as being more up-to-date.

d. JFAC HQ begins air planning. The planner outlines reconnaissance and firestorm areas, and sorties.

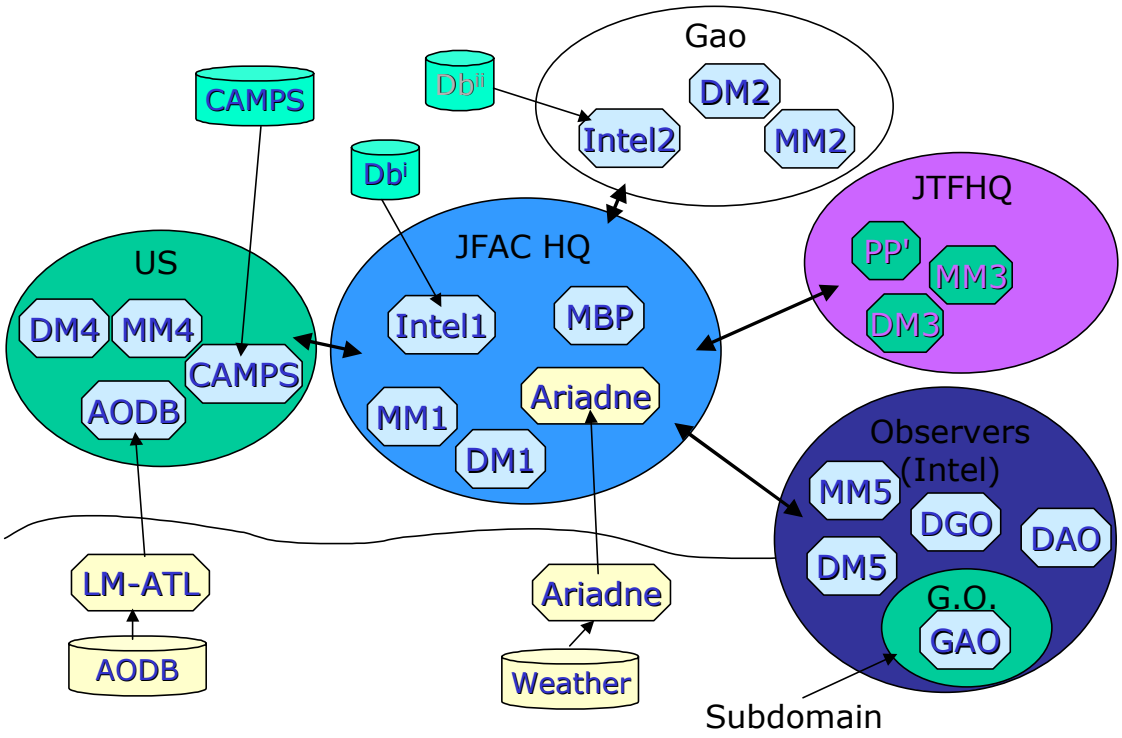
e. An analyst at JFAC HQ discovers that Gao's Intel2 agent is deliberately providing misinformation. JFAC HQ domain administrator uses Domain Administration Tool on the Web to block any further communication with Intel2 and other Gao agents. MBP henceforth only relies on less-frequently-updated but more reliable information from the Intel2 agent.

f. Replanning occurs in the light of the newly corrected intelligence. The reconnaissance and firestorm areas are revised. Other air sorties may be revised.

g. End of demonstration. Planning would continue until a draft estimate is provided.

COAX BINNI 2000 (9-MONTH) DEMONSTRATION: OVERVIEW

A more detailed description is at CoAX_Binni_2000_Details



CoAX Nine-Month Integration

Figure 2-2 - CoAX Binni 2000 - Agent Domains

9. After 9 months, we will give a demonstration of the framework for coalition mechanisms, which will be on the grid. This could identify potential development directions for the grid with respect to multiple agent domain management. This demonstration will address the creation of domains, tasking and control within and across domains and domain model management.

10. The 9-month demonstration will be an extension of the 6-month demonstration to include a US domain which is separate from the JTFHQ and JFAC HQ domains, an Observers domain, and agents from 3 further CoAX partners (CAMPS, Ariadne and two Dartmouth observer agents).

11. We demonstrated some elements of the 9-month demonstration at the TTCP meeting at DERA, Malvern in September 2000 (see http://www.aiai.ed.ac.uk/project/coax/demo/2000/ for the script, handout and briefings given. It should be noted that the 9-month integration is ambitious and contains risks, hence not all elements shown above may be ready for the September meeting. The following elements are to be added to the 6-month demonstration to form the 9-month demonstration:

- MBP / CAMPS link for distributed planning (with CAMPS in new US domain)
- Ariadne 'open data' weather information agent (grid-based agent)

- Dartmouth observer agents in new Observers domain
- Gao Observer agent (GAO) in new Gao Observers subdomain
- Extra steps / threads in storyboard to show functionality of new elements

AGENTS AND DOMAINS AT 9 MONTHS

12. There are six agent domains: three are coalition functional units (JTFHQ, JFAC HQ and Observers), one is a special subdomain (G.O. – Gao Observers) and two are country domains (US and Gao). The subdomain is used to allow the Gao agent to join the Observers domain restrict what the Gao agent can do, because there is some mistrust of Gao.

13. There are 20 agents: MBP (DERA), the Process Panel (AIAI), LM-ATL EMAA/CAST (Lockheed Martin ATL), two intelligence agents (Intel1 and Intel2), Ariadne (USC/ISI), CAMPS (AFRL), two Dartmouth observer agents (DGO and DAO), a Gao observer agent (GAO) and a Boeing KAoS Domain Manager (DM) and Match Maker (MM) for each of the domains (*except G.O.)*. Excluding the DM/MM agents, the agents can be classified as follows: 2 planning agents (MBP and CAMPS), 1 monitoring agent (PP), 4 information providers (LM-ATL, Ariadne, Intel1 and Intel2) and 3 observer agents (DGO, DAO, GAO).

STORYBOARD AT 9 MONTHS

14. The storyboard at 9 months will have the same flavour as the storyboard at 6 months, concentrating on Phases 1 and 2 of the Coalition Process (see Annex C). The main addition is that the 6-month storyboard will be augmented to show the linkage between CAMPS and MBP, with CAMPS (logistics airlift planner) providing MBP with missions to be worked around. Details are as follows:

a. Process Panel shows overall progress / tracks objectives being achieved.

b. Multiple restricted (e.g. AODB) and open (e.g. Ariadne) information feeds are shown, with Ariadne Weather data being treated as unrestricted:

(1) The LM-ATL EMMA agents support 'persistent queries' where updates are provided over an agreed timeframe.

(2) CAMPS generates and feeds airlift missions to MBP for deconfliction.

c. Dartmouth observer agents: within the CoAX scenario, a team of observers can be sent to several different locations, and can monitor several different kinds of activity.

d. Gao / Agadez ground and air traffic in and around the Total Exclusion Zone (TEZ).

e. Ground traffic and other activities at the suspected WMD site.

f. Air and ground traffic and other activities at the Salisbury military airbase.

g. In all cases, the observations can include the numbers, types and locations of military equipment (especially aircraft and airbase status), deployed units, and civilian or refugee populations, as well as the current condition of roads, railroads, buildings and bridges.

NOTE: In the 9-month demonstration, the Dartmouth component will be stand-alone, and will consist of an observation feed from the Total Exclusion Zone (TEZ) observers.

(1) The Gao Observer Thread. Gao requests to put one of their agents (Gao Agadez Observer, GAO) on the sensor that is hosting DAO, so that they can observe Agadez movements independently. Because there is some mistrust of Gao, permission is granted, but GAO is required to join a special subdomain (Gao Observer, G.O.) of the Observer domain, which is “safer” than the standard observer domain because it uses the IHMC Aroma VM (part of Nomads). After the Gao country domain is cut off (as in the 6-month storyboard), Gao intends to revenge itself by launching a denial of service attack (e.g. writing continuously to hard disk or network) by its GAO agent within the G.O. domain. Using the combination of KAoS domain management and NOMADS facilities, the denial-of-service attack is stopped by imposing resource rate limits on the agent and DAO’s ability to continue observing is unimpaired.

COAX BINNI 2001 (18-MONTH) DEMONSTRATION: OVERVIEW

A more detailed description is at CoAX-Binni-2001-Approach.doc

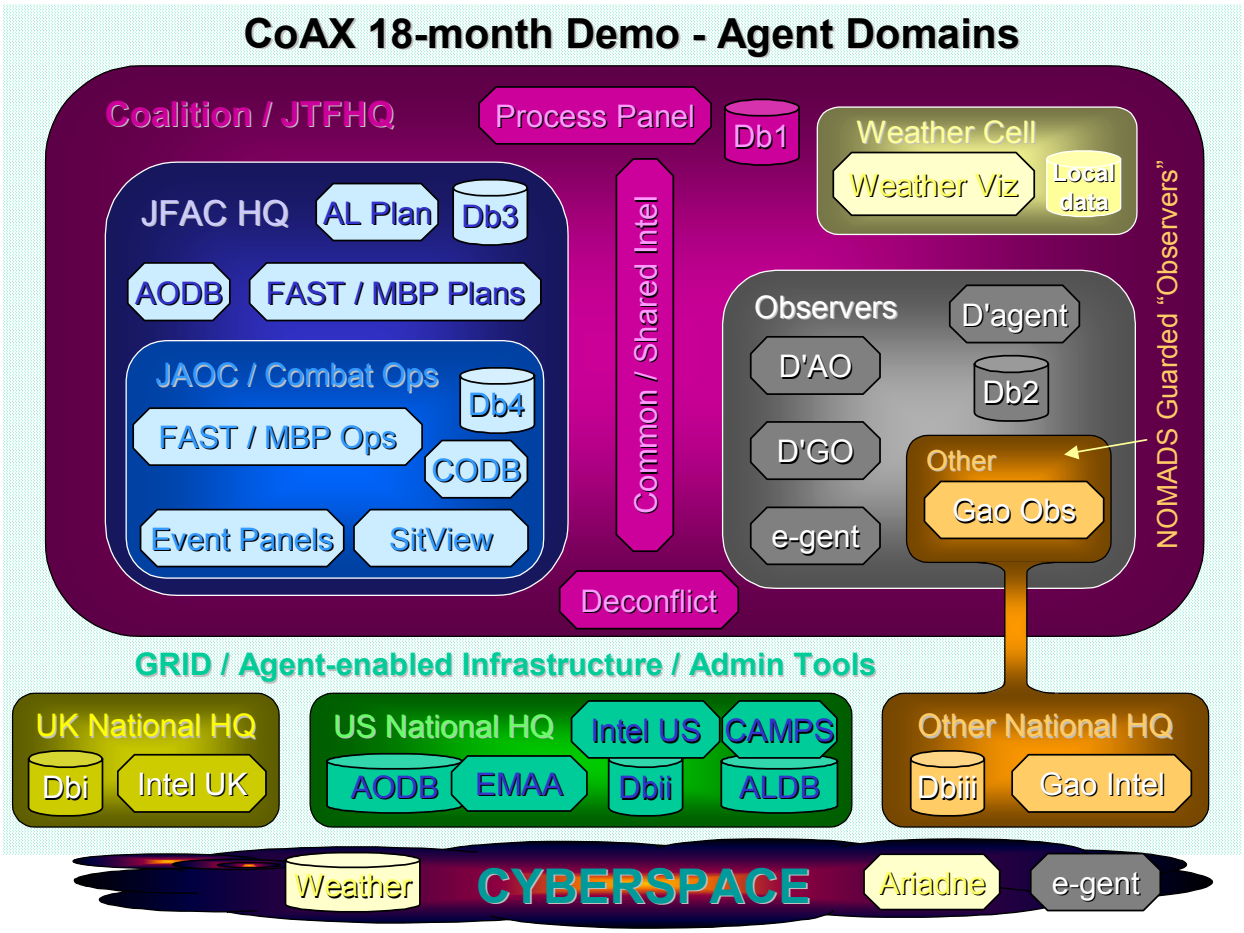


Figure 2-3 - CoAX Binni 2001 - Agent Domains

15. After 18 months we will give a key TIE demonstration in which the framework is populated with agents/capabilities from each of the TIE partners. There will be a central Coalition domain, containing three subdomains representing coalition functional units. Our aim is to show that by using agent technology a small number of disparate systems can be integrated to form a cohesive command structure.

16. The suggested agent architecture (see Figure 2-3) for the 18-month demonstration contains elements from the 9-month demonstration. The main changes are that all agents are now governed by a domain and there is a Coalition domain which governs all coalition agents and functional units. The separate domains for coalition and participant countries is proposed to reflect the nature of a coalition: there is a *single* coalition plan which is developed and which all coalition partners have a share in.

AGENTS AND DOMAINS AT 18 MONTHS

17. There are nine agent domains: the Coalition domain itself containing the JTFHQ and JFAC HQ domains, the Observers domain, three domains representing countries (US, UK and Gao), a Gao Observers subdomains (G.O.) and a domain containing weather forecasting agents (Met).

18. There are 37 agents: MBP Plans and Ops (QinetiQ / DERA), the Process Panel and Event Panels (AIAI), LM-ATL EMAA/CAST (Lockheed Martin ATL), three intelligence agents (Intel UK, Intel US and Gao Intel), Coalition Situation Viewer (QinetiQ), email eGents (OBJS), Ariadne (USC/ISI), CAMPS (AFRL), two Dartmouth observer agents (DGO and DAO), a Gao observer agent (GAO), a weather agent (QinetiQ), and a Boeing KAoS Domain Manager (DM) and Match Maker (MM) for each of the domains.

19. The Michigan plan deconfliction capability runs as a separate agent (the Multilevel Co-ordination Agent) on the Grid. It accepts hierarchical plan descriptions from any agents that request it services, and can summarise the potential needs and effects of the plans, and can accept selected plans on the parts of several agents and can detect and recommend resolutions for conflicts between plans.

STORYBOARD AT 18 MONTHS

20. For the 18-month demonstration, the storyboard will start moving into the execution phase of the Binni scenario (Stages 3-8 see Annex_B6_Detail_of_8_Stages). These Stages are as follows:

- Stage 3 - Maintenance of Estimate / Cyclic Strategy Development,
- Stage 4 - Current Joint and Air Planning,
- Stage 5 - Master Air Plan development,
- Stage 6 - Air Tasking Order production,
- Stage 7 - Execution and Battle Management of Current Operations,
- Stage 8 - Combat Assessment of completed operations.

21. The demonstration starts by explaining that the UN forces have been deployed for some time and that we are now focusing on the more challenging Execution Phase of conflict and on one part of one day of the conflict (29th Sep 2012 at 1500) for which the plans have been produced and the orders issued. We will feature the monitoring of the execution of the Firestorm mission and will see that media concerns about the location of wildlife in the Laki Safari Park and of Agadez / Gao forces will cause short-notice replanning to take place with only minutes to spare. New orders will have to be disseminated, plan elements deconflicted and events tracked and handled. Also, we will see the opponents, Agadez, fly hostile air-to-air missions against UN 'high-value assets' such as the AWACS and JSTARS - with both humans and agents responding. The various parts of the demonstrations are as follows:

> **Part 1 - 29 Sep 2012 - 1505: At the start of the 18-month CoAX Binni 2001 Demonstration:** Information about the Firestorm has leaked to the media and there are concerns about the protected mammals in the Laki Safari Park. The UN Special Representative orders the JTFC to consider alternatives to the Firestorm mission. The JTFC tasks the JFACC to report on: moving objects in Firestorm area, ground activity by

Gao / Agadez and to report the time left before the 'cancel Firestorm mission' might have to be given.

Part 2 - 1515: JFAC HQ / Combat Ops Staff Consider Options: The JFAC HQ / CCO staff enter to-do actions to meet the tasking into the Event Panel (EP). They use MBP Ops to find out time left for decisions (106 mins at most to TOT, 48 minutes to commit). EP used to confirm action to JTFC.

Part 3 - 1520: Information on Mammals in Laki Safari Park Located: Combat Ops staff try to locate wildlife info - RFI initiated and Internet searched. MNBLI used to identify animal movement trends. Staff subscribe to the e-Gents service to obtain customised information.

Part 4 - 1525: Near-real-time update from Laki Added to Coalition Situation Viewer: Combat Ops staffs create feed to MBP Ops / Coalition SitViewer from Laki site using Ariadne wrapper and XSLT Translator. Staff update Event Panel to show task achieved.

Part 5 - 1526: Ground Observations of Vehicle Movements Updated: The JTFC authorises Firestorm 'Go' (NB: mission to NE area diverted to 2ndry target and re-tasked later - this event added to Event Panel). Dartmouth Observer ground vehicle movement info sent to Coalition and displayed on SitViewer etc. This shows Gao and Agadez forces advancing towards each other into Firestorm area. Also, resource usage priorities are changed in the Observer domain to hasten notification of further ground movements.

Part 6 - 1535: Part of Firestorm Package diverted to Secondary Target - change is Deconflicted: Change / diversion of Firestorm NE Package to 2ndry target must now be deconflicted with existing plans. MBP Ops is used to generate a changed plan which is sent to the MCA for deconfliction with plans from the rest of the Coalition. Conflicts are detected with two helo flights: a MedEvac mission and a Ground Observer extraction from Laki.

Part 7 - 1601: Agadez Mount High-value Asset Attack on UN JSTARS: Agadez fighters start a HVAA which is detected and displayed on the Coalition SitViewer (the attack is noted in Event Panel, UNWAFB AD activated and PP informed - not part of the demonstration) - the JSTARS must 'regress' and so observer agents on board 'SCRAM' to an alternative processing platform".

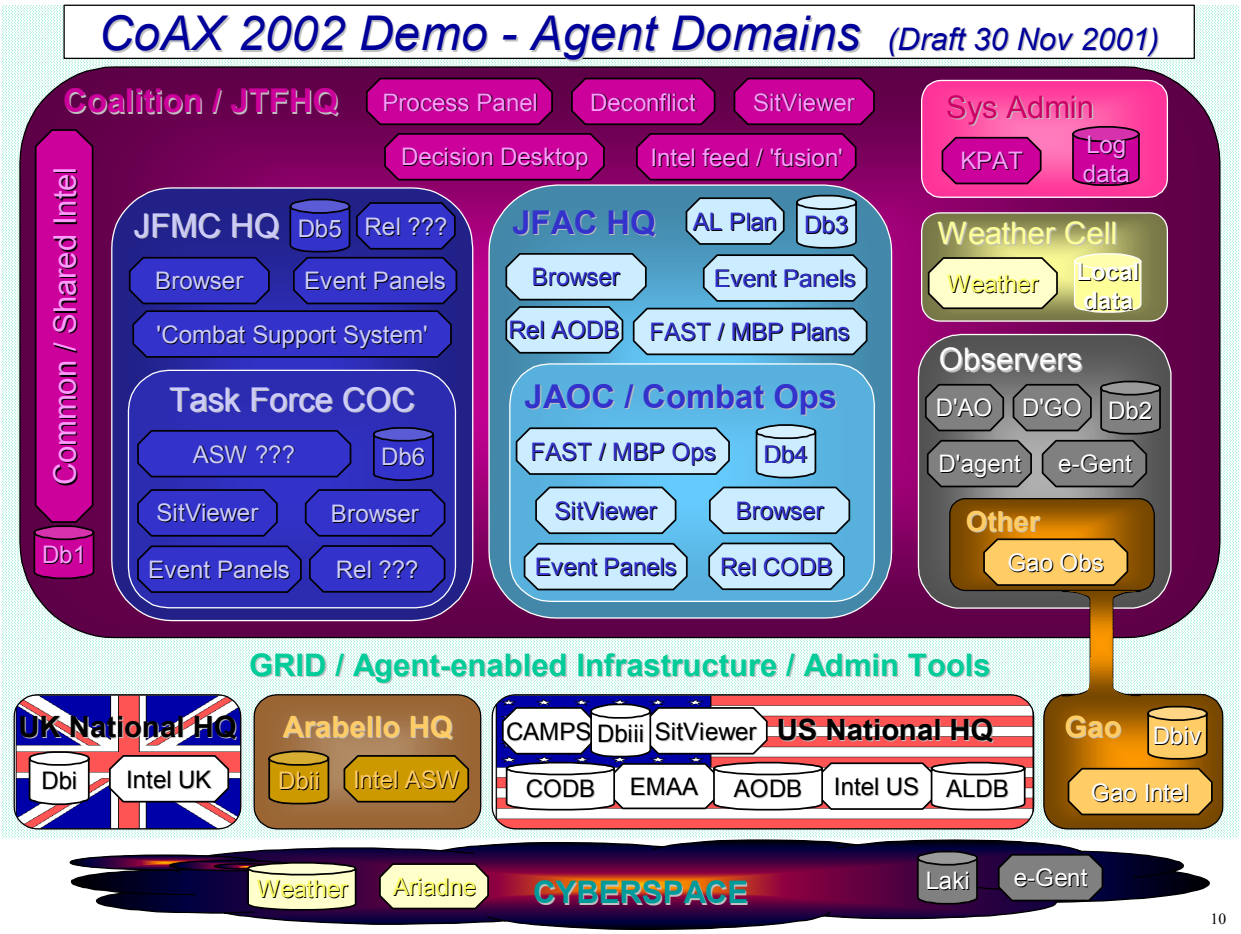


Figure 2-4 - CoAX Binni 2002 - draft Agent Domains

22. Building on the work of the previous demonstration, the main objectives of the CoAX Binni 2002 demonstration are as follows:

a. To demonstrate the potential utility of advanced agent technology in the context of all phases of Coalition operations at all levels of command across different national boundaries to provide seamless interoperability and coherent battlespace awareness.

b. To show the added value that the use of agent technology can bring to Coalition warfighters.

c. To extend agent capabilities onto tactical communications networks and hence provide 'end-to-end' support throughout the battlespace.

d. To show the utility of using an agent-enabled infrastructure as a prototype to reduce risk for an "information system interaction infrastructure" [5] (such as the Global Information Grid[6]) which would be capable of supporting Network-Centric Warfare.

e. To rapidly effect the setup and maintenance of agent organisational structures and policies that mirror the complexity of relationships among coalition partners.

[5] As defined in the SPAWAR (www.spawar.navy.mil) BAA Solicitation No: N66001-01-X-6042.
[6] See Capstone Requirements Document JRCOM 134-01 from Jt. Forces Command (https://jdl.jwfc.jfcom.mil).

f. To package coalition-oriented services in a way that makes them generic and easily used by other grid agents and existing military applications and users.

g. To show that our methodology will scale to larger numbers of agents and systems.

h. We would wish to demonstrate the effectiveness of novel, market-based algorithms for coalition formation and maintenance.

i. We would wish to demonstration the effectiveness of an execution element with a bidding / auction model (cf. the AGILE model).

j. The overall goal is to investigate the contribution that agents could make to building coalition inter-operability more quickly.

In order to achieve these goals we will seek to involve other TTCP nation participation (and beyond if desirable) and other participants from the CoABS community. Specific systems to be included will be influenced by the TIE partners added at this stage.

AGENTS AND DOMAINS AT 30 MONTHS

23. There are at least twelve agent domains (see Figure 2-4 above): eight are coalition organisational / functional units (JTFHQ, JFAC HQ, JAOC, JFMC HQ, COC, Sys Admin, Weather Cell and Observers), one is a special subdomain (Gao Observers) which is used to allow the Gao agent to join the Observers domain - but restrict what the Gao agent can do, because there is some mistrust of Gao. There are also three country domains (US, UK and Arabello).

24. There will be at least 52+ agents: an air battle planning agent, MBP (DERA), the Process Panel (PP) and four Event Panels (AIAI), LM-ATL EMAA/CAST (Lockheed Martin ATL), one decision desktop (QinetiQ), four intelligence agents (Intel UK, Intel ASW, Intel US and Gao Intel), a weather agent (QinetiQ), Ariadne (USC/ISI), airlift agents for CAMPS (AFRL), two Dartmouth observer agents (DGO and DAO), four browsers, three Coalition Situation Viewers (QinetiQ), a combat support system, an ASW tool, plan deconfliction agent (UMICH), a Gao observer agent (GAO) and a Boeing KAoS Domain Manager (DM) and Match Maker (MM) for each of the domains.

25. Excluding the DM / MM agents, the agents can be classified as follows: decision aids / planning agents (eg: Decision Desktop, MBP and CAMPS), monitoring agents (PP), visualisation tools (Coalition Situation Viewer, QinetiQ), information providers (eg: eGents, LM-ATL, Ariadne), event handlers (the Event Panels), observer agents (DGO, DAO, GAO) and system administration agents.

STORYBOARD AT 30 MONTHS

26. The storyboard at 30-months / CoAX Binni 2002 scenario can utilise the events of the 2000 and 2001 demonstrations where these are useful to demonstrate agent technologies or the value to Coalition operations or Coalition participants. But to provide greater scope for novel and exciting contributions, the events also move on following the regression of the high-value assets when Agadez attacks as follows:

a. Agadez, seeing that its fighter attack cannot be successful, activates two submarines in the Red Sea that attack an Australian monitoring ship causing damage and casualties. Arabello, a country on the edge of the Red Sea, has sophisticated Anti-Submarine Warfare (ASW) capability due to its reliance on the free flow of shipping in the region. It has been unwilling to join in the Coalition operation in Binni to date due to regional concerns. Now seeing the escalating situation, wishing to support a trading partner and friendly nation under direct attack (Australia) and seeing the risk to shipping posed by the Agadez submarine activity, they offer their services to the Coalition.

b. This is quickly agreed, and in-place monitoring facilities from Arabello are linked rapidly and appropriately into the Coalitions C^3I agent framework. Coalition ASW activity forces Agadez to back down. Seeing the resolve of the Coalition forces and the strengthening international support for its operations, Gao and Agadez agree to return to the peace talks conference at the UN.

CHAPTER 3. BINNI SCENARIO - OVERVIEW

Document_Structure, Links to the Chapters: Chapter_1, Chapter_2, Chapter_4, Chapter_5.

CAMPAIGN SCENARIO

1. This Chapter provides an overview of the CoAX Binni scenario and refers to Annex_B which contains the Political, Environmental, Military, Civilian, Historical and Technical factors. In addition, a description of the military context can be found at Annex_B6_Command_Model.

OVERVIEW

2. The overall history of how the Binni crisis came about is summarised here, but has been described fully in http://www.aiai.ed.ac.uk/project/coalition/binni/. The change to a wetter climate in this region of Africa by 2010 had enabled the population of Gao (to the north of the region) and Agadez (to the south) to produce wheat in large quantities and a vigorous export market had developed. The only way to transport this increasing volume of food to the European market was by sea, either through the Gulf of Suez or around Cape of Good Hope. However, Gao was effectively landlocked by Agadez as it contained the only deep-water harbours, at Sikasso and Costa del Maria, capable of handling bulk carriers (see the summary map below at Figure 3-1, a more detailed map of the region is at http://www.aiai.ed.ac.uk/project/coalition/binni/

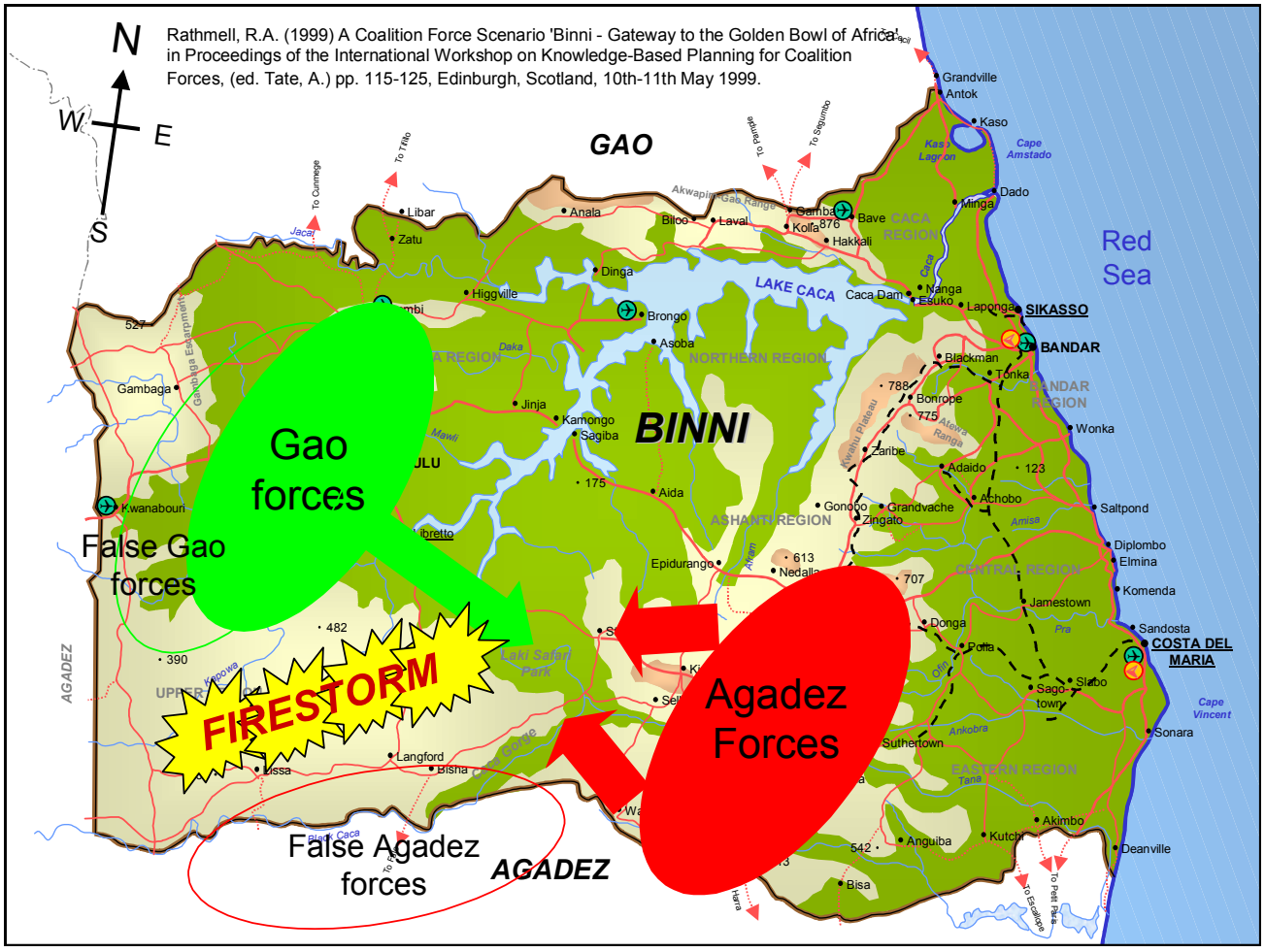


Figure 3-1 - Binni Geography

3. In desperation, Gao launched a pre-emptive strike to open up a corridor to the sea. Such was the audacity of the manoeuvre that it caught Agadez by surprise and was accomplished with little local resistance because the indigenous people bore a close affinity with their tribal brothers from Sudanese Plains. Immediately the borders had been established, Gao declared the annexed area to be the independent country of Binni. This action incensed the Government of Agadez and they launched repeated guerrilla activities to dislodge the Gao forces from Binni. The Provisional Government of Binni was quickly established and sought the protection of the UN in order to secure its stability. Gao, for its part, agreed to withdraw to its own borders once the security of Binni had been established, providing it could have assured access to the Ports of Sikasso and Costa del Maria. Geographical and environmental information on Binni is in Annex_B4_Environment.

4. As a result of this dangerously unstable situation that had developed in Binni, the UN passed Resolution 955 to create and deploy a UN War Avoidance Force for Binni (UNWAFB). This is composed of the military resources from five UN member nations (Australia, Gao (mythical), Netherlands, USA and the UK) supplemented by advisors and personnel (e.g. language / dialect and cultural specialists' etc.) from the wider international community.

5. The resulting mandate sparked considerable debate. The UN could not agree on the order in which the items in the mandate should be conducted and it was therefore left to the UN Commander to establish priorities for the operation in accord with the prevailing circumstances. Details of the UN Secretary General's instructions and other political guidance given to the UN's Special Representative (SRSG), the UN Refugee High Commissioner (UNRHC) and the UNWAFB Joint Task Force Commander are in Annex_B1_Political_Situation.

6. At the time featured in this Vignette (September 2012) the Peacekeeping mission in Binni has been active (but politically hampered) for some months and the Peace-Keeping Operations have been beset by difficulties. Early threats of belligerence by Gao and Agadez (neighbouring states to Binni - Gao to the north and Agadez to the south) came to nothing as a result of internal bickering and because there were a number of phases of negotiation by 'Elder Statesmen'. However, recently, the situation has deteriorated again and there are about to be a number of defended evacuation operations to extract individuals from BINNI following threats and actual occurrences of 'minor' violence to NGO organisations and personnel. In addition, advancing opposing forces and an escalation of SAM deployments are threatening friendly forces. More detailed / up-to-date intelligence on the situation is provided in Annex_B5_Updated_Intelligence.

7. To this date (September 2012 in the scenario) there have been no major offensive actions against Agadez forces in Binni by the UN Forces. It has now been decided to carry out two offensive tasks in Theatre (described, with Commander's Guidance, in Annex_B2_Military_Situation) which have been designated "Mission 'A' " and are as follows:

a. A Weapons of Mass destruction (WMD) threat has emerged with clear (but not yet widely known) evidence of a weapons storage facility which has been established within Binni by Agadez forces. The facility is associated with a particular power generation source. It has been decided that these facilitates must be disabled as a 'demonstration of intent'.

b. In addition, the UN Forces are required to establish and enforce a Total Exclusion Zone (TEZ) between the Agadez and Gao forces and the UN Forces have three days in which to achieve this objective. If the mission can't be achieved in the allotted time there is an

unacceptable risk that the Gao troops will be drawn into an Agadez trap (from which the probability of escape is minimal) which it is believed will result in widespread fighting.

8. Therefore, this first offensive action has a political element: Agadez has perceived the UN Forces as being weak and consequently actions against the UN Forces are becoming increasingly aggressive - the Mission aims to counter this perception.

9. The assets in the scenario are initially limited, both to reflect a real-world situation (such as Bosnia) and to create planning conflicts and difficulties with which the systems can assist. Details of the extended BINNI scenario are provided in Annex_B below.

10. The CoAX demonstrations will focus on assembling and maintaining the Coalition, marshalling the military effort required for Mission 'A' (using those tools which are part of the demonstration), tasking the forces and monitoring the execution against the stated objectives.

11. The military and civilian activities relating to Mission 'A' can be characterised as a number of process 'threads' and the activation of these 'threads' will trigger the interactions between human and software agents being studied for the CoAX TIE. The threads (storyboard - and the agent tasks which result) are described in Annex_C.

CHAPTER 4. TECHNICAL APPROACH

Document_Structure, Links to the Chapters: Chapter_1, Chapter_2, Chapter_3, Chapter_5.

MILITARY AND TECHNICAL SCENARIO DRIVERS AND ISSUES ARISING

1. The Binni Flash Mission 'A' vignette has been specifically designed to stimulate and trigger the technical issues being demonstrated in the CoAX TIE. The scenario triggers both operational and organisational as well as technical issues. The non-technical (operational) issues will shape the assumptions and provide constraints on the technical design of the agent-based infrastructure. The drivers are discussed below.

MILITARY SCENARIO DRIVERS

2. Military: Military drivers (expanded in Annex_B2_Military_Situation) divide into two types; Organisational (related to the Command Ethos and C2 structures) and Operational (related to the processes, the actual tasks to be carried out and the manner in which the forces are deployed and employed to deliver the military capability). Military drivers are as follows:

a. Organisational (Coalition Management Processes): Including:

(1) A valid Command Structure (UK-led) with identified Command positions and staff elements with defined areas of responsibility,

(2) A Task Organisation which includes 'Contingent Commanders' from several nations (not just US Command elements); this triggers doctrine etc alignment issues,

(3) A variety of Doctrines and Concepts of Operation (CONOPS),

(4) Changes in the Coalition membership as members join or withdraw,

(5) A mix of cultural and religious beliefs and of what is acceptable behaviour in conflict / war (expressed through the political situation),

(6) Changes in the roles which Coalition assets are allowed to perform,

(7) Some reflection of Other Government Departments (OGDs), eg: police, fire, coastguard, local government etc and Non-Government Organisations (NGOs), eg: refugee, charity and medical organisations and their activities,

(8) Some reflection of the media (all forms), both within the military structure and outside it,

(9) A variety of users of differing levels of competence (augmentees etc) and training,

b. Operational (C3I processes / Plan and Performance): The scenario should have / reflect:

(1) Forces which include a variety of Component elements making up a joint capability,

(2) Forces which include a variety of equipment and platforms (in addition to US equipment etc); this triggers interoperability, force capability data issues, etc,

(3) Activities which include: setting aims, planning, analysing and communicating the plans; monitoring execution and short-notice re-tasking etc

(4) A mix of planning, tasking and monitoring systems (including prototypes),

(5) A requirement for different visualisation to be made available for different Coalition members / commanders (this relates to different visual codes, eg: Western – read L → R; Arabian read R → L),

(6) Some consideration of logistics supply via a number of military and commercial (civilian) methods; this will trigger interoperability, security, commercial IPR interests etc,

(7) A mix of languages (both human and machine) and formats for information, maps etc,

(8) A mix of dispersed, heterogeneous infrastructures,

(9) A realistic set of security policies, sensitivities and interests (though the "COALITION RELEASABLE" data may be at the lowest level of classification),

(10) The need for access to information from various feeds / data sources (including archives) at various levels of timeliness and qualities of service. Exceptions which occur could be relayed in the form of "issues" (along with suggested means to address them perhaps) that could be passed to an appropriate agent (perhaps simply to the appropriate commander via a "process panel"),

(11) Some use of deception, propaganda and 'Information Operations',

(12) Consideration of the UFWAFB's Courses of Action (COAs); the scenario must not be a walkover - a "ruthless enemy" must be provided so that the agents have to cope with varying numbers (and condition / status) of Coalition assets. This reflects the impacts of the opponents activities,

(13) The need to record decisions for later justification / litigation,

TECHNICAL SCENARIO DRIVERS

3. Technical: Technical drivers relate to the issues with which an agent-enabled infrastructure will have to cope. These are expanded further in and are as follows:

a. It should not be necessary (a priori) to have to specify the content and meaning of the agents interactions / communications,

b. Events must not be pre-scripted; this means that the agents have to cope with a dynamic, reactive environment,

c. Levels of access (negotiation of authority to access / change of security policies) should vary to reflects changing security / levels of trust,

d. Coalition systems should come and go so that the agents have to cope with varying availability and qualities of service from rich to spartan and which will include exception-handling and performance monitoring,

e. A varying (and dynamic) set of demands for competing computing (and other) resources which might be met via some sort of incentives / market / auction model),

f. Timely reconfiguration (at 'run-time) to cope with changes (however caused) should be required,

g. Interworking should be provided via a variety of services and communication concepts - these should include the Domain Management Services,

h. Agent / software component aggregation (User driven) into Command Support Applications should be required,

i. Data / information formatting, messaging, meaning, and language conversion should be required (so that translation / conversion services have to be found),

j. Human / agents and agents / agents interaction via 'conversation policies' should occur so that 'mixed initiative' issues can be triggered,

k. Agents should have to describe their capabilities to each other as an aid to aggregation (which should include optimisation of the aggregation and how such optimisation decisions were realised),

TECHNICAL AND AGENTS ISSUES ARISING

4. The general issues arising from the Factors described in Chapter_2, the Scenario described Chapter_3 and from this Command and Technical Model are listed below. Their ***specific*** implications for the CoAX demonstration and the tasks that the CoAX agents will be carrying out are expanded at Chapter_4B_Agent_Tasks. The general issues are as follows:

a. Agents will need to operate in a heterogeneous, dispersed and dynamic environment (which encompasses humans-in-the-loop and agents at all functional and security levels) so that they can collaborate to create a virtual organisation,

b. Though we expect to see changes at the agent and policy level operational (e.g., agents joining and leaving domains, some event triggering an access policy change) in the 9 and 18-month demos, we do not expect to be adding whole new domains dynamically in that time frame.

c. Agents will have to be able to deal with dynamically varying levels of information services and security policies which accept that degradation will happen (ie: a move from risk aversion to risk management),

d. Agents should have to deal with data / information formatting, messaging, meaning, and language conversion (so that translation services have to be located on the Grid),

e. Agents will have to deal with the demands of Users who require different types and styles of visualisation (ie: 'mixed-initiative' situations),

f. Timeliness of reconfiguration (at ‘run-time) to cope with changes (however caused) will have to be judged / monitored (eg: 'socialisation' services wherein each agent specifies how the exception handling services should handle the different exception types (by selecting from a set of options). It makes sense that system-wide policies be able to constrain the set of allowable options,

g. Users should be able to influence the aggregation of agents into ‘applications’ if required - they should not have to be agent experts to do this,

h. Agents will have to be able to cope with conflicting imperatives from Users with different political, military, religious and cultural backgrounds,

i. Aggregation of agents will necessitate dynamic, reliable agent teaming and intention / commitment behaviour,

j. Trust and security will have to be maintained ***at an acceptable level*** in the open environment which the Scenario demands (this is partly a policy and organisational issue).

k. Agents will need to be able to advertise their capabilities both to each other and to human users,

l. The complexity of the problems triggered by the Scenario will require the use of sophisticated inter-agent communication protocols which involve explicit message-level semantic (speech-act) analysis and the ‘understanding’ of the meaning, context (and implications) of any action. This implies the need for various conversation types, policies and dialogue structures and the ability to cope with a content which would not be known in total *a-priori*,

m. Emergent interaction in a society of agents will occur. Agents will be able to participate in dialogues which are not rigidly determined in advance and which will emerge from the interactions between the state-machines previously set out by designers. Humans routinely communicate in this fashion: we construct conversational meaning 'on the fly,' and dynamically react to and re-plan conversations to suit changing circumstances. This implication relates to the sociology of agents and their ‘control’,

n. The incorporation of legacy systems will require the use of tools to ‘wrap’ this (specialised) software in a framework which supports secure and reliable high-level communications with other agents.

o. Some agents will have to understand the concept of ‘being owned’ and will have to have a ‘mental map’ of their User’s preferences,

p. Agents must be able to find their Users where and whenever they ‘plug-in’ to the Grid,

q. Agents must be able to maintain a semi-autonomous sense of purpose when Users are not explicitly making demands of them,

5. The investigation of all the drivers listed above is not possible from the start of the CoAX TIE and so an incremental approach will be employed. The exact partitioning of drivers to phases is described below. Each of the CoAX demonstrations (see Chapter 2) will seek to address some of the technical challenges for agents in coalition operations described in this Chapter. Each demonstration seeks to address a specific set of technical problems as outlined in the sections which follow.

TECHNICAL ISSUES AT 1 MONTH:

- Basic framework for coalition agents on the CoABS Grid,
- Transforming MBP from a stand-alone system to an agent,
- Creation of domains,
- Simple tasking and control within a domain,
- Simple domain model management,
- Construction of a Coalition-wide visualisation from multiple sources across the Grid,
- Update of scenario information on-the-fly (new objects, moving objects, status of objects).

Result: all of these problems were successfully addressed.

TECHNICAL ISSUES AT 6 MONTHS:

- Framework for coalition agents using KAoS on the Grid,
- Creation of multiple domains, with each agent belonging a single domain,
- Domains to represent coalition function units and countries,
- Tasking and control across coalition functional units,
- Limited change of organisation due to information received,
- Visualisation of coalition C2 process via a process model,

Result: all of these issues were successfully addressed at 6 months. The limited change of organisation comes about as a result of the feed from the Gao Intel agent being blocked to the JFAC HQ domain. The process model used for the 6-month demonstration is a hierarchical partial order plan, which gives one visualisation of the planning process, but it is clear that other views will be required, such as a view onto the products of the planning process.

TECHNICAL ISSUES AT 9 MONTHS:

- Creation of multiple domains and subdomains in KAoS,
- Selective registration of agents and assignment of GAO agent to subdomain,
- Multiple restricted (e.g. AODB) and open (e.g. Ariadne) information feeds are shown,
- Distributed planning between MBP in JFAC HQ domain and CAMPS in US domain,
- Prevention of denial of service attack from rogue agent,
- Visualisation of coalition C2 process and process products,

6. In a Coalition, during Execution, the partners will offer capabilities and bring individual goals and policies to the negotiating table. The Coalition will develop and maintain a Campaign Plan and will promulgate the Commander's Intent which will provide the overall context for all tasks. In meeting objectives, the Coalition Teams will negotiate and re-distribute sub-tasks among the partners to meet the Coalition's objectives while respecting individual Coalition partner aims. The partners will negotiate with the Commander and each other throughout the operation and the objectives will be continually reviewed as the progress of the execution is monitored. Changes will need to be made and plans adjusted in timescales from days to seconds. The Coalition will need to reorganise during the execution phase as partners come and go, as events unfold and as the opponent's actions take their toll.

DEDUCTION(S): The exact same process is carried out by an agent-based software system: individual software agents come online, advertise capabilities and are assigned or select tasks. They may negotiate over which tasks are carried out and what resources will be provided to them in order to perform these tasks. During execution of the tasks, agents may perform badly or fail, so agents may need to reorganise and reassign tasks. There will be no single controller as this is a vulnerable point of failure which would generate a 'brittle' system, rather than the robust one required.

GENERAL COAX IMPLICATIONS: From the above it can be seen that the CoAX will need to address the following technical issues to support effective Coalition operations:

- **rapid creation of virtual organisation(s) with agents playing their part,**
- **enabling the unity of command / coherence of action through the creation of shared views / understanding (this involves the negotiation of information sharing between agents acting for Coalition partners),**
- **the need to organise the agents into separate technical domains which can share some common resources and act within policies appropriate to the domain. However, there has to be a mapping between these technical domains and domains with meaning in the 'real' world, which may be:**
  - **national / country domains,**
  - **organisational / functional domains,**
  - **individual decision-maker's domains,**
  - **virtual / 'overlapping' domains.**
- **respecting the autonomy of partners and their agents and providing secure and assured environments supporting different levels of security classification / trust,**
- **coping with changes of organisation and policies due to the current imperatives of the execution of plans,**
- **provision of flexibility, adaptability, robustness and command agility using a dynamic reconfigurable dispersed component architecture(s),**
- **enabling the aggregation and sharing of Coalition capabilities / applications systems / infrastructures,**
- **providing means to translate information / enable interoperability between systems,**

dealing with the integration of systems that were developed with particular nations' processes and doctrine in mind.

TECHNICAL ISSUES AT 18 MONTHS:

- A comprehensive demonstration of all CoAX partners,
- Security and firewall issues beginning to be addressed,
- Monitoring: observer agents in the field performing monitoring role,
- Exception monitoring and handling,
- Plan deconfliction agent in coalition domain,
- Moving into the execution phase of coalition operations,

TECHNICAL ISSUES AT 30 MONTHS:

- Rapid creation of virtual organisation,
- Dynamic creation and change of overall coalition process,
- Tailored visualisations of process for multiple participants,
- Dynamic reconfiguration of agent domains,
- Generic / packaged agent services,
- Large numbers of agents in dynamic domains,
- Generic task and process management facilities,

CHAPTER 5. LESSONS, ISSUES AND CONCLUSIONS

Document_Structure, Links to the Chapters: Chapter_1, Chapter_2, Chapter_3, Chapter_4

LESSONS

1. After each demonstration, this text will be updated to summarise the lessons learned to date.

2. The 1 and 6-month Demonstrations. The lessons are as follows:

- Basic agent framework based on KAoS and the Grid is sound.
- 1 planning agent, 1 monitoring agent and 3 information agents can be combined successfully using this framework.
- Agent domains can be used to represent coalition functional units and coalition member countries, with agents being assigned to a single domain.
- A basic process model based on a plan representation can be used, but this only captures some aspects of the coalition C2 process.
- The coalition process involves a single coalition plan which is worked on and bought into by all coalition partners, rather than coalition partners working on delegated tasks.

3. The CoAX Binni 2000 (9-month) Demonstration. The lessons are as follows:

- The extended agent framework based on KAoS, NOMADS and the Grid is sound.
- The 'agent conversation' and 'conversation policy' metaphor is adaptable at run-time.
- There were no problems with the number of agents and domains.
- Legacy application wrapping is low risk and technically straightforward if the applications expose enough internal interfaces / use external messaging.

4. The CoAX Binni 2001 (18-month) Demonstration. The lessons are as follows:

- The agent framework based on KAoS, NOMADS, EMAA / CAST, eGents etc is now even more diverse, yet that and the Grid continue to be sound.
- On-the-fly / run-time wrapping and addition of services / information feeds into C4I systems (even if they are on the Internet) is feasible if a certain minimum set of translation / system admin tools are available.
- The concept of event panels which dynamically evolve their content during execution monitoring is sound.
- Reading information from diverse sources and displaying the 'shared situational awareness' using a Coalition-wide situation viewer agent is feasible and adds useful functionality.
- The notion of asynchronous wireless / email agents works well and supports ad-hoc interoperability among heterogeneous and dispersed elements well.
- Plan deconfliction services work well, provided that plans / events are structured to agreed criteria - however, this can be restricting.

5. The CoAX Binni 2002 (30-month) Demonstration. The lessons are as follows:

- TBN.

ISSUES

6. After each demonstration, this text will be updated to summarise the issues raised to date.

7. The 1 and 6-month Demonstrations. The issues are as follows:

- More agents and domains required to demonstrate generality of approach, with similar types of agent negotiating/competing for tasks and/or resources.
- Control and monitoring of agents: controlled resource allocation and exception handling.
- Better organisation of agent domains to reflect coalition structure.
- Better and richer representation of the coalition C2 process is required.
- All CoAX partners: need to achieve a common understanding of the coalition process and how the coalition partners have a stake in the single coalition plan (see Annex_B6_Command_Model).

8. The CoAX Binni 2000 (9-month) Demonstration. The issues are as follows:

- Inter-agent messaging needs a more generic ontology.
- Legacy application wrapping is low risk and technically straightforward if the applications expose enough internal interfaces / use external messaging.

9. The CoAX Binni 2001 (18-month) Demonstration. The issues are as follows:

- Provision of agent-orientated System Admin tools (eg: translation tools) is important.
- The structuring of pre-agreed plans / event formats can be unrealistic and restricting. The use of run-time modifiable ontologies / negotiation languages is important.
- Achieving true 'come-as-you-are' technical interoperability is not trivial - especially if applications / services do not expose internal interfaces / methods or provide easy ways of sharing information / intercepting messaging.

10. The CoAX Binni 2002 (30-month) Demonstration. The issues are as follows:

- TBN.

CONCLUSIONS

11. This document has described a scenario and a set of demonstrations being used by the partners participating in the CoAX TIE in 2000 / 2001 / 2002. The scenario is based on a peace-enforcement operation in "Binni" (a mythical state in Africa) which requires a mix of Coalition forces to work together in 2012. The scenario is associated with a Command Model, Force Structure, C2 Process and Timeline and a set of threads which trigger the need for the agents to carry out certain

tasks. The aim of the CoAX TIE is to demonstrate that an agent-enabled infrastructure will significantly aid the construction of a coalition command support system / infrastructure from a diverse range of components. There are a number of technically challenging problems, including:

- Dealing with the need to share systems and information.
- Dealing with different levels of trust.
- Providing mechanisms to translate information between systems.
- Dealing with the integration of systems that were developed with particular nations' processes and doctrine in mind.

12. The major technical goal is to research, design and implement a framework that will support a coalition of agent organisations. The key idea that we shall be investigating is to base the framework on agent domains. Each domain will represent a community of agents that has its own secure communications, capabilities and information spaces. Explicit management of domain and agent policies is to be supported. The aim of our research is to show that these communities are able to work together effectively to produce a coherent virtual organisation with capabilities representative of those required by a military coalition command structure. The TIE will include demonstrations of progressively larger numbers and different types of system and human agents. A realistic Coalition scenario and inclusion of actual advanced military system components will ensure validity of the approach.

13. Scientific and Technical Expertise. Between them, the CoAX TIE partners have the skills and expertise to address the key scientific issues as follows:

- Agent coalition framework – AIAI, Boeing and IHMC;
- Domain formation, policies for information sharing/hiding, security – Boeing and IHMC;
- Shared models for agent activity – AIAI and UMICH;
- Activity planning, process management and workflow – AIAI, UMICH and MIT;
- Execution monitoring and repair – AIAI and MIT;
- Recognising and resolving data inconsistencies – USC/ISI;
- Agent capability representation and matching – AIAI, QinetiQ and USC/ISI;
- Command system execution and visualisation – AFRL, AIAI and QinetiQ.

14. Research Issues. The coalition TIE provides a very rich environment to research and assess agent technology and will address the following research issues that are of relevance to the CoABS program:

- The creation, monitoring and reorganisation of multiple domains on the agent grid.
- Policy and authority management.
- Creating and managing organisational structures of agents.
- Scalability via autonomous bounded domains of agents.
- Enabling coherent action aimed towards achieving objectives.
- Shared and personalised visualisations.

- Investigation of different control strategies: policy-based (Boeing / UWF/IHMC) vs authority-based (AIAI) vs teamwork-based (QinetiQ) vs …
- Security and accountability.
- Run-time adaptable ontologies.
- Plan deviation detection.
- Data inconsistency detection and resolution.
- Exception monitoring, handling and repair.
- CoABS Agent Grid integration.

15. Coalition-specific Issues. The coalition TIE will address the following issues which are of relevance to supporting effective Coalition operations:

- Rapid creation of virtual organisation(s).
- Creation of shared view/understanding.
- Negotiation of information sharing between coalition partners.
- Respecting autonomy of partners.
- Change of organisation and policies due to current imperative of the plan.
- Provision of command agility using a dynamic reconfigurable dispersed component architecture(s).
- Aggregation and sharing of coalition capabilities.
- Enabling unity of command.

16. In summary, this Chapter has described what was learned / happened in each stage of the CoAX TIE and what could still be researched further.

CHAPTER 6. (ANNEX A)

Links to: Document_Structure, Annex_B, Annex_C, Annex_D, Annex_E

DEFINITION, GLOSSARY AND ACRONYMS

DEFINITIONS

1. For the purposes of this paper the following definitions are used:

- Agent: A software entity acting on behalf or, or mediating the actions of, a human user. The agent / Grid concept is designed to support the aspiration for Command Agility described below. NB: There are various 'strengths' of agent (Strong: intelligent, mobile, adaptive and self-aware to Weak: rule-based and controlled). Also, in some context the humans themselves are agents.
- Coalition Operations: These are Multi-national operations, lead by a nominated nation (the Framework Nation), taking place Out-of-Area, based in a country (the Host Nation) which provides the basic infrastructure and Host Nation support and involving an unspecified number of allies (some of whom may not have been involved in the past and with whom there may not be specific agreements / MOUs).
- Command Ethos: The ethos and structure of military activity activated to meet a particular political aim. In a Coalition Operation the dominant Command Ethos will (probably) be that of the Framework Nation and all Allies will have to align their ethos and processes to the dominant ones. It is possible for the ethos to be technology driven (humans adapt to the technology) or 'command-led' (technology is adapted to support the human). The declared UK preference (as stated in the Joint Battlespace Digitisation programme) is to be command-led.
- Command Process: Is the process which follows from the Command Ethos used by the Commanders and their staffs. The process consists of 'threads' which can vary from tightly characterised (formal and deterministic) to ad-hoc, informal, evolutionary or naturalistic. In reality, the process varies depending on the situation, level of command and type of activity.
- Command Agility: Command Agility is achieved when a commander can adopt any form of decision-action process as required to meet the circumstances. This Command Agility must not be constrained by any Command Support Applications which are being used.
- Command Support Applications: Command Support Applications provide the functionality which supports the Command Process being employed. The Applications might be customised in advance (Bespoke) or assembled from software components at short notice (Task Customised) or be 'Process Neutral' (General Purpose).

GLOSSARY / ACRONYMS

AAF	Agadez Air Force*
ACE	Air Command Element
AFRL	Air Force Research Labs
AIAI	Artificial Intelligence Application Institute
AMSL	Above Mean Sea Level
AOC	Air Operations Centre
AOR	Area of Responsibility
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
BBN	Bolt, Beranek and Newman
C2	Command and Control
C3	Command, Control and Communications
C4I	Command, Control, Communications, Computers and Information
CAO	Chief Administration Office (of UN)
CIS	Command Information System
CNA	Computer Network Attack
COA	Course of Action
CoAX	Coalition Agents eXperiment
CoABS	Control of Agent-based System
DACT	Dissimilar Air Combat Training
DARPA	Defense Advanced Research Projects Agency
DERA	Defence Evaluation and Research Agency (now split into two organisations: DSTL (government owned) and "QinetiQ" (privatised) in July 2001).
DMPI	Desired Mean Point of Impact
DREV	Defence Research and Evaluation (Canada)
DSTL	Defence Science and Technology Laboratory (government - formerly part of DERA)
DSTO	Defence Science and Technology Organisation (Australia)
EMAA	Extendible Mobile Agent Architecture
FLOT	Forward Line of Own Troops
FOB	Forward Operating Base
FOCAL	Future Ops Centre Analysis Laboratory (part of DSTO)
GAF	Gao Air Force*
GAT	Guidance, Apportionment and Targeting

GCI	Ground Control Intercept
GITI	Global InfoTek Inc
IAW	In Accordance With
IHMC	Institute of Human and Machine Cognition, UWF.
IO	Information Operations
ISX	???
JACL	Joint Air Command Laboratory
JBD	Joint Battlespace Digitisation (UK programme)
JFACC	Joint Force Air Component Commander
JTFC	Joint Task Force Commander (sometimes just referred to as the Force Commander)
LM-ATL	Lockheed Martin - Advanced Technology Laboratories
MAAP	Master Air Attack Plan
MBNLI	Menu-based Natural Language Interface
MBP	Master Battle Planner
MIATA	Mixed Initiative Agent Team Administration
MIT	Massachusetts Institute of Technology
MOM	Measure of Merit
MOP	Measure of Performance
NBC	Nuclear, Biological and Chemical
NGO	Non-Government Organisation
OGD	Other Government Departments
OMP	Outline Management Plan
OOTW	Operations Other than War
PVO	Private Voluntary Organisations
SAM	Surface to Air Missile
SEAD	Suppression of Enemy Air Defence
SF	Special Forces
SOC	Sector Operations Centre
SOFA	Status of Forces Agreement
SRSG	Special Representative to the Secretary General
TTCP	The Technology Co-operation Programme
TEZ	Total Exclusion Zone
TIE	Technology Integration Experiment
TLAM	Tomahawk Land-attack Missiles
UI	User Interface

UMD	University of Maryland?
UMICH	University of Michigan
UNMO	UN Military Observers
UNSG	UN Secretary General
UNSCR	UN Security Council Resolution
UNWAFB	UN War Avoidance Force for Binni (*M)
USC/ISI	University of Southern California / Information Sciences Institute
UWF/IHMC	University of West Florida / Institute of Human and Machine Cognition
WEF	With Effect From
WFPW	World Foundation for the Protection of Wildlife (*M)
WMD	Weapons of Mass Destruction
WOE	Weight of Effort (amount of military force applied)
WOH	World Organisation for Health (*M)
WTN	World Television News (*M)

*M = Mythical Organisation / Acronym

CHAPTER 7. (ANNEX B1)

BINNI FLASH - SCENARIO DETAILS

Links to: Document_Structure, Annex_A, Annex_C, Annex_D, Annex_E
Annex_B2_Military_Situation, Annex_B3_Civilian_Situation, Annex_B4_Environment, Annex_B5_Updated_Intelligence, Annex_B6_Command_Model

POLITICAL SITUATION

1. The overall history of how the Binni crisis came about (and details of the resulting political situation) have been described fully in http://www.aiai.ed.ac.uk/project/coalition/binni/. In December 2011, as a result of the dangerously unstable situation that had developed in Binni, the UN Security Council passed Resolution 955 to create and deploy a UN War Avoidance Force for Binni (UNWAFB). This is composed of the military resources and personnel from five UN member nations (Australia, Gao (mythical), Netherlands, USA and the UK) supplemented by advisors and personnel (e.g. language / dialect and cultural specialists' etc.) from the international community. The resulting mandate is to conduct OPERATION FLASH to:

- Enforce a no fly zone in the region of conflict.
- Stop the Gao forces taking advantage of the rout of the Agadez forces.
- Stop the Agadez forces from reaching their re-supply areas and then to negotiate the dispersal of additional forces and supplies.
- Rescue hostages from Agadez forces by negotiation or by forceful means (if reasonable negotiation tactics fail or hostages are further threatened).
- Survey the area contaminated by an unknown toxin, identify its source and dispersion characteristics and assess population / wildlife environmental effects.
- Establish a total exclusion zone (TEZ) between opposing forces.
- Attend to the sick / injured and arrange safe enclaves for the displaced in the local population. Prepare the way for medical and humanitarian aid organisations.
- Negotiate a settlement between the warring factions.
- Collect evidence for subsequent international criminal proceedings and reconciliation of the distressed population.

2. Despite considerable debate, the UN could not agree on the order in which the items in the mandate should be conducted and it was therefore left to the UN Joint Task Force Commander to establish priorities for the operation in accord with the prevailing circumstances (see the Joint Task Force Commander's Guidance and Intent in Annex_B2_Military_Situation).

3. However, the UN Secretary General's provided specific instructions and other political guidance to the UN's Special Representative to the Secretary General (SRSG) and the UN Refugee High Commissioner (UNRHC). This is included below.

THE UN SECRETARY GENERAL'S DIRECTIVE

TO HIS SPECIAL REPRESENTATIVE Mr. Ezekiel Ngebengo (SRSG)

SITUATION

4. The continuing conflict between Agadez and Gao is perceived as a clear threat to the international peace and security. Thus, the protection and future independence of the newly constituted State of Binni is seen as a key goal in the establishment of peace on the region.

5. At the request of the Government of Gao, the Security Council, by UNSCR 955, has authorised the establishment of a UN War Avoidance Force for Binni (UNWAFB) to:

a. Monitor the Cease-fire between Agadez and Gao, including the operation of a border buffer zone.

b. To establish protected areas in Salisbury, Kingtown and St Andrews (see the Binni FLASH maps at http://www.aiai.ed.ac.uk/project/coalition/binni/) until a formally agreed definition of the Southern Binni border can be established.

c. To use all possible means to facilitate the delivery and provision of humanitarian relief.

d. To assist with the transition from the provisional arrangements for civil control in Binni to the establishment of a mature and democratically elected government to ensure individual freedoms and representation for all ethnic and cultural elements of Binni's citizens. This assistance could include: support to a peace plan, support to elections and the restoration and confirmation of the civil infrastructure.

STRATEGIC CONSIDERATIONS

6. The principal dilemma facing the UN in Binni is that the belligerence in the intra-state conflict is based upon deeply held values which are rooted in history and concern issues of sovereignty, territory and racial integrity. On the other hand, the UN's involvement is based upon perceived interests concerning issues of international stability, humanitarian welfare and collective conscience. It is, however, fundamental that the UN tries to remain non-combatant in the conflict. This war is a people's war and has many complex origins and consequences. Therefore a formula needs to be found to reconcile the belligerent parties' values with the UN's and the World's community interests. With this in mind my direction for the conduct of peacekeeping operations in Binni is as follows:

a. End State. The desired end-state in this campaign is peace, security and creating the conditions for economic renewal for all the peoples of Binni, prior to the withdrawal of UN forces.

b. Strategic Goals. The end-state will be realised by the achievement of the strategic goals in the campaign. These are:

(1) To **contain** the conflict within the boundaries of Binni, while recognising that success in achieving peace in Binni may assist the resolution of related conflicts in Gao, Agadez and the neighbouring states.

(2) To **ameliorate** the adverse humanitarian consequences of the conflict.

(3) To **create** the conditions for a lasting peace agreement brought through step by step negotiation, not war.

(4) To **assist** the people of Binni in promoting the conditions for internal reconstruction and economic renewal, and to live together in conditions of relative peace and security.

c. Centre of Gravity. The strategic centre of gravity in this campaign is the **popular will of all parties -** to fight or to make peace.

d. Strategic Policy. In order to transform the attitude of the people and achieve the strategic goals, action will be co-ordinated in the following areas:

(1) Diplomatic and Political Pressure. Towards a negotiated settlement with the parties in conflict.

(2) Military. Activities to support the above initiatives.

(3) Economic. Sanctions to influence the negotiation process.

(4) Environmental. Actions to protect the wildlife and the environment.

(5) Humanitarian. Efforts to relieve the worst effects of the conflict. Aid cannot be used as an overt tool / lever in the resolution of conflict, but the linkage is clear.

(6) Protection of Historic Artefacts. Ensure that the many important sites of antiquities and valuable artefacts (such as the "Lion of Africa" mask in Figure B1-1 below) are protected from military activity.

Figure B1-1 - "Lion of Africa" Mask

e. Levels of Command. Strategic guidance on the overall objectives, resourcing and limitations of the campaign is the responsibility of my Special Representative - Ezekiel Ngebengo who, while retaining personal control of diplomatic initiatives will delegate the conduct of military operations in theatre to the Joint Task Force Commander. The co-ordinator and focus for the humanitarian aid operation is the UN Refugee High Commissioner (UNRHC) Special Envoy – Sig. Dino Silvestri.

f. Assumptions:

(1) Political:

(a) That no external power will unilaterally provide significant aid to, or directly intervene on behalf of, one or more of the belligerent parties.

(b) That the current UN mandates remain in force. No further mandates are expected unless there is a major deterioration of the situation.

(2) Economic:

(a) That economic sanction remains in force and may be extended to assist containing the conflict and to exert political pressure on the belligerent parties and providers of support.

(3) Humanitarian. That the pressing requirement is for humanitarian relief until there is a comprehensively accepted peace, and most likely for some time after that.

(4) Military:

(a) The execution of UNWAFB's mission is to be firmly based on **overall consent for its activities, achieved ideally through negotiation and mediation** in preference to such achievement through the use or the threat of force, thereby preserving the non-combatant and impartial status of UNWAFB.

(b) Where negotiation and mediation fails, UNWAFB should be prepared, within existing mandates, to adopt a robust stance. ROE can be developed to allow this.

(c) NATO airpower, if approved by the Security Council, will only be used as a measure of last resort to provide protection to UNWAFB forces and to support its mandated activities.

MISSION

7. UNWAFB will fulfil the following terms of the Mandate for Binni:

a. Secure designate UN Safe Areas.

b. Be prepared to implement military activities in support of an agreed peace plan. (Specific Guidance is provided in Annex_B2_Military_Situation).

c. Provide military assistance to UNRHC and approved organisations and agencies involved in humanitarian activities and repair of infrastructure facilities in Binni.

d. Monitor the cease-fire between Agadez and Gao, including the operation of a border buffer zone.

e. Assist the people of Binni in promoting the conditions for internal reconstruction and economic renewal and to live together in conditions of relative peace and security.

RESOURCES

8. Details of the UNWAFB are as follows:

a. UNWAFB Organisation. The authorised organisational elements of the UNWAFB are shown in Figure B1-2 below:

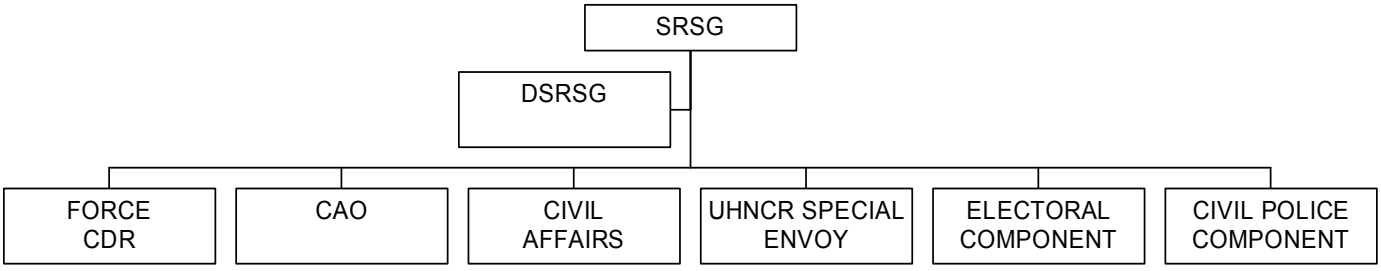


Figure B1-2 - UNWAFB - High-level Organisation

b. Non-combatant Forces. The UN military forces (see Figure B1-3 below) are not directly involved in the conflict and are therefore properly described as Non Combatant Forces. These forces are assigned to the operational control of the Force Commander (also known as the Joint Task Force Commander (JTFC)) and consist of:

(1) Military aid to the civil power for law enforcement and peacekeeping.

(2) Military aid to the humanitarian relief organisations for the protection and well being of refugees and displaced persons.

(3) Neutral Organisations. In addition to UNRHC, the lead humanitarian agency, the following agencies are present in Binni:

(4) World Programme for Food Provision (WPFP).

(5) World Organisation for Health (WOH).

(6) In addition there are over 100 NG0s and PVOs in the mission area (details provided to approved authorities - see also Annex_B3_Civilian_Situation).

Figure B1-3 - UN Peace-keeping forces in Africa

SUSTAINABILITY

9. Sustainability. Planning assumptions remain under review, but in the interim plan should assume that forces will be deployed in Binni for up to 12 months.

a. All contingents are to deploy self sufficient for 60 days to allow the Chief Administration Office (CAO) from the Division of Management and Administration to establish the logistic arrangements for the Force.

b. Logistic resupply will be negotiated with Host Nation and Commercial Organisations in Theatre.

STATUS

10. Legal Status. See Status of Forces Agreement (SOFA). [Not included with this document]

11. ROE. See ROE for UNWAFB. [Not included with this document]

SPECIAL DIRECTIONS

12. Information Initiative. The SRSG is directed to develop an information initiative to replace doubt, rumour and uncertainty with clear and truthful information made available to all. **[Task for QinetiQ - Provide Coalition-wide situational awareness** Annex_D_QinetiQ**]** The purpose of this initiative is three-fold:

a. To make it clear to the international community the true nature of the conflict and its consequences.

b. To promote the peaceful and consensual activities of UNWAFB amongst the people of Binni and the belligerent groups.

c. To create unity of purpose in the force.

13. Command and Control. The SRSG is directed to ensure that:

a. Command and control is a s flexible, adaptive and responsive to the situation / unfolding events **[Task for AIAI - execution event handling** Annex_D_AIAI**]** as possible and is to ensure that;

b. The UNWWAFB deploys with the latest, personalised decision-aids **[Task for QinetiQ - provide run-time adaptable decision-support** Annex_D_QinetiQ**]** and collaborative working tools which can exploit the diversity of information provided by the Coalition Partners.

14. Media. The SRSG is directed to ensure that information is provided to the world media in line with UN Guidelines.

CHAPTER 8. (ANNEX B2)

BINNI FLASH - MILITARY SITUATION

Document_Structure, Annex_B1_Political_Situation, Annex_B3_Civilian_Situation, Annex_B4_Environment, Annex_B5_Updated_Intelligence, Annex_B6_Command_Model

COMMAND ARRANGEMENTS

1. The Military Command of the UNWAFB is centred on the Joint Task Force Commander (a 2*) UK Officer who is responsible to the SRSG as shown in Figure B2-1 below.

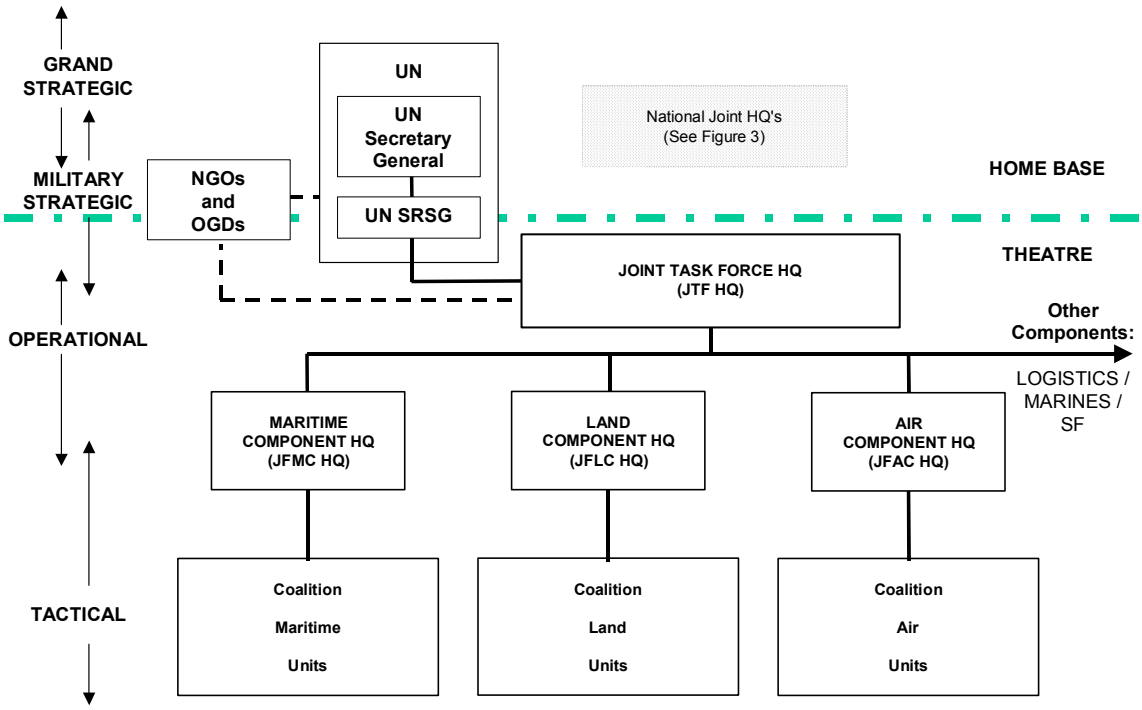


Figure B2-1 - Binni Coalition - Command Structure and Organisation

2. The Military Command Structure and procedures being employed for the UN War Avoidance Force for Binni (UNWAFB) is shown above (a detailed briefing on the military context and military operations is at Annex_B6_Command_Model) and participating nations are:

- The United Kingdom (Lead Nation): Contributing Headquarters Staff and Equipment, Offensive and Defensive Airpower, Naval Support, Special Forces units.
- Gao (technically the Host Nation): Contributing port, airport and assembly-area facilities as well as Host Nation infrastructure, logistic support and accommodation within Binni. NB: that the UNWAFB are mostly based at Forward Operating Bases (FOBs) in Binni (at Bandar and Costa Del Maria), onboard a Carrier Battle Group in the Red Sea or out of area in Cyprus and so don't use any facilities on Gaoan soil - only in Binni.

- United States of America: Contributing Headquarters Staff and Equipment, Offensive and Defensive Airpower, Naval Support, Ground Force and Special Forces units.
- Netherlands: Contributing Headquarters Staff and Equipment, Defensive Airpower.
- Australia: Contributing Headquarters Staff and Equipment, Offensive and Defensive Airpower.

The friendly and opponent's force structures are summarised below at Annex_B2_Force_Structure and described in more detail at Annex_B5_Updated_Intelligence.

JOINT TASK FORCE COMMANDER'S MISSION AND INTENT

3. Joint Task Force Commander's Mission. IAW the requirements established by UN SRSG for Binni OPERATION FLASH conduct, on order, military operations (including combined offensive air and ground operations in Gao, Agadez and other allied countries) in support of the provisions of UNSCR 955. Also, conduct co-ordination and deconfliction of plans of subordinate and supporting Commanders and of non-military forces in the AOR **[Task for UMICH - deconfliction of military and 'non-military' plans** Annex_D_UMICH**]**. The Force Commander's Mission (given to him by the UN SRSG) is to **[Task for AIAI Process Panel - monitoring whether or not each of these objectives have been achieved** Annex_D_AIAI**]**:

- Enforce a no fly zone in the region of conflict.
- Stop the Gao forces taking advantage of the rout of the Agadez forces.
- Stop the Agadez forces from reaching their re-supply areas and then to negotiate the dispersal of additional forces and supplies.
- Rescue hostages from Agadez forces by negotiation or by forceful means (if reasonable negotiation tactics fail or hostages are further threatened).
- Survey the area contaminated by an unknown toxin, identify its source and dispersion characteristics and assess population / wildlife environmental effects.
- Establish a total exclusion zone (TEZ) between opposing forces.
- Attend to the sick / injured and arrange safe enclaves for the displaced in the local population. Prepare the way for medical and humanitarian aid organisations.
- Negotiate a settlement between the warring factions.
- Collect evidence for subsequent international criminal proceedings and reconciliation of the distressed population.

4. Joint Task Force Commander's Intent:

a. Objectives:

(1) Enforce a no fly zone in the region of conflict.

(2) Establish a total exclusion zone (TEZ) between opposing forces.

(3) Identify, and when required, destroy WMD capabilities.

(4) Carry out Non-combatant Evacuation Operations (NEOs) to rescue hostages from Agadez forces. Arrange safe enclaves for the displaced in the local population and prepare the way for medical and humanitarian aid organisations.

b. End State: All Agadez forces are withdrawn from Binni, the legitimate democratic government of Binni is restored, Agadez's ability to wage offensive military operations is contained, Agadez and Gao's WMD capabilities are set back by a minimum of 5-10 years and peace and mutual security are restored in the region.

c. Concept of Operations: In support of the provisions of UNSCR 955 and guidance from National Command Authorities, conduct a five-phase campaign:

(1) Phase 1. First, prevent further incursion by Agadez forces into Binni while establishing military superiority and conducting offensive air operations against Agadez centres of gravity which have been established in Binni. Objectives are:

- Enforce a no fly zone in the region of conflict and establish military superiority.
- Stop the Gao forces taking advantage of the rout of the Agadez forces.
- Stop the Agadez forces from reaching their re-supply areas.
- Negotiate the dispersal of additional forces and supplies.
- Carry out offensive air operations against Agadez centres of gravity which have been established in Binni.
- Survey the area contaminated by an unknown toxin, identify its source and dispersion characteristics and assess population / wildlife environmental effects.
- Attend to the sick / injured and arrange safe enclaves for the displaced in the local population.
- Prepare the way for medical and humanitarian aid organisations.

(2) Phase II. Create a total exclusion zone between the combatant forces and destroy WMD, and associated, facilities (to be known as Mission 'A'). Objectives are:

- Carry out recognisance of the area of conflict.
- Establish a total exclusion zone (TEZ) between opposing forces.
- Prevent fighting / skirmishing between opposing forces.
- Destroy the WMD facilities near Suthertown.
- Destroy fuel storage facilities at Salisbury military airbase.

(3) Phase III. Monitor violations of the total exclusion zone / extract non-combatants. Objectives are:

- Monitor the activity of opposing forces.
- Intervene with military force as required to ensure maintenance of TEZ.
- Rescue hostages from Agadez forces by negotiation or by forceful means (if reasonable negotiation tactics fail or hostages are further threatened).

(4) Phase IV. Engage in stabilisation operations within Binni to facilitate elections, provide humanitarian assistance if needed, and return control of all Binni territory to effective civilian control. Objectives are:

- Negotiate a settlement between the warring factions.
- Collect evidence for subsequent international criminal proceedings and reconciliation of the distressed population.
- Arrange for / assist with the establishment of a legally-constituted democratic authority within Binni.

(5) Phase V. Finally, reconstitute and redeploy Coalition Forces from the theatre of operations. Objectives are:

- Orchestrate a withdrawal of UNWAFB forces.
- Ensure the economic recovery of materiel and equipment.

d. Briefing and Reporting. Reporting on the progress of the Phases of the Operation are to be made using the following Briefing Aid:

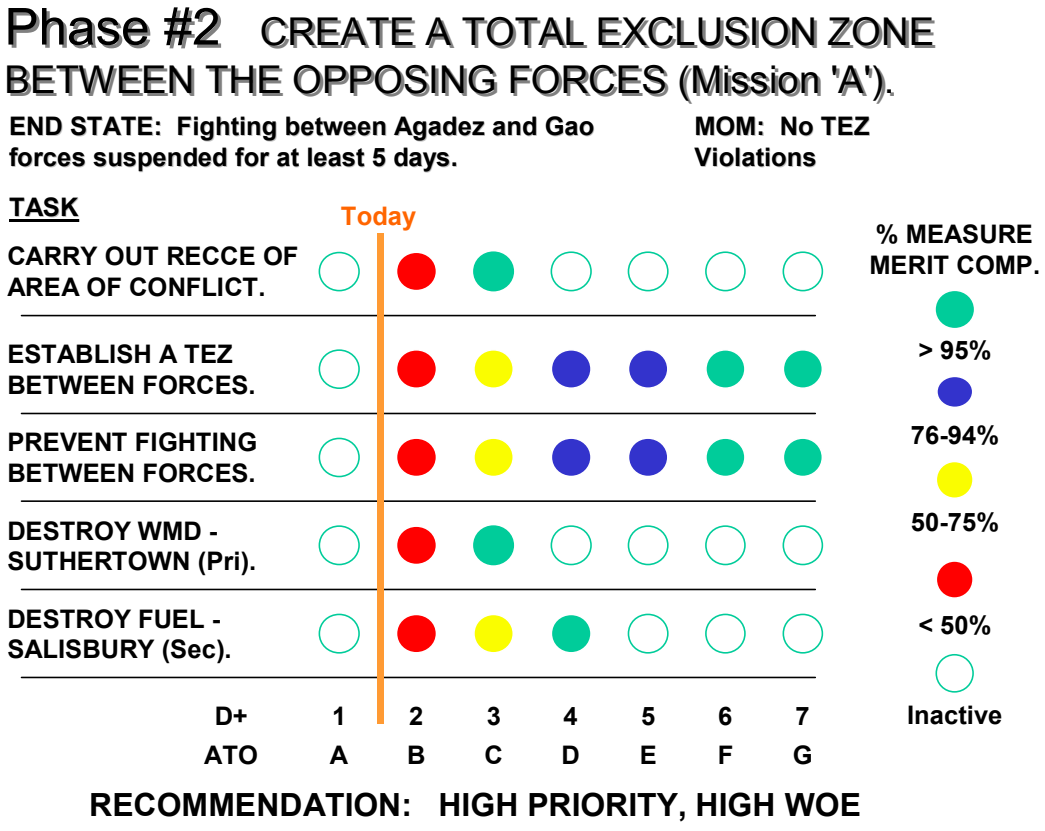


Figure B2-2 - Recommended 'Traffic Light' Briefing Format

e. Command Information Systems (CIS) and Signal. Coalition partners are to harmonise their CIS to ensure maximum coherence and synergy of procedures and information. A Coalition-wide network is to be established at an agreed level of classification and Coalition procedures are to be employed. Gateways to national or other compartmented information are

to be provided. **[Task for LM-ATL - gateway to US information** Annex_D_LMATL**]**. Suitable measures must be in place to protect the Coalition CIS from Computer Network Attack and to assist with the maintenance of OPSEC **[Task for Boeing / UWF/IHMC - security** Annex_D_Boeing**,** Annex_D_UWFIHMC**]**. The CIS should be robust and should 'degrade gracefully' and measures should be in place to detect and classify abnormal behaviours which might jeopardise Coalition Operations **[Task for MIT - detect abnormal behaviours** Annex_D_MIT**]**.

JFACC'S MISSION AND INTENT

5. JFACC Mission. On order, the JFACC conducts theatre joint air operations with Coalition Forces to gain and maintain air superiority, destroy Agadez and Gao's ability to employ WMD and isolate Agadez and Gao forces in Binni. Conduct integrated air reconnaissance for joint forces and Allies. Be prepared to support humanitarian relief operations. On order, redeploy forces.

6. JFACC Intent. The Joint Force Air Component Commander's task is to plan the activities required to perform Mission 'A' using the resources available.

a. JFACC will continue air and combined arms operations to prevent further incursions into Binni by Agadez forces. Our air force ratio still does not favour sustained combat operations. We must continue to minimise losses and capitalise on key weapons systems by selectively targeting high priority targets. Since our resources are still limited, we must focus on the latest guidance from the Joint Task Force Commander to execute Phase II, Mission 'A' and be prepared to execute Phase III (monitoring / NEO) on short notice. The key objectives now are stated below. End state of this operation is achieved when Binni's internationally recognised borders are intact, Agadez forces have withdrawn from Binni, and stability is achieved in the area IAW UNSCR 955.

b. This guidance will cover all ATO's until shifting into Phase IV or until further guidance from the Force Commander. Shifting to Phase III will still occur only on order of the Force Commander. Air Superiority weight of effort will be low and focus only on countering any remaining Agadez threats directly affecting our operations. Phase IV ends when all Agadez forces have been ejected from Binni and preconditions for stability operations are achieved.

7. Phase II - Mission 'A' - Situation.

a. The UN Forces are required to establish and enforce a Total Exclusion Zone (TEZ) between the Agadez and Gao forces and have three days in which to achieve this objective. If the mission can't be achieved in the allotted time there is an unacceptable risk that the Gao troops will be drawn into an Agadez trap (from which the probability of escape is minimal) and which will result in widespread fighting.

(1) Measure of Merit. Fighting between Agadez and Gao forces suspended for at least 5 days. No TEZ violations.

b. A WMD threat has emerged with clear (but not yet widely known) evidence of a weapons storage facility which has been established within Binni by Agadez forces. The facility is associated with a particular power generation source. It has been decided that these facilitates must be disabled as a 'demonstration of intent'.

(1) Measure of Merit. WMD Facility at least 80% destroyed and no longer in operation. Power supply transformer near Suthertown destroyed.

8. Objectives and Tasks. These tasks have been designated Mission 'A' and there are three Objectives **[Task for QinetiQ / MBP - Air Battle Planning** Annex_D_DERA**]** as follows:

a. Objective One: Air Recce of the Area of Conflict. Recce the area of conflict from the Upper Region of Binni to Laki to determine the situation of the opposing forces and the likely course of the conflict as the Agadez element retreats.

(1) The recce task is Priority One.

(2) Intelligence estimates indicate that over the next five days opposing forces may range over a region of some 250km by 100 km.

(3) The JFACC estimates that this requires three high level and thirty low level sorties of three hour duration to perform the air reconnaissance activity but this will be verified during Air Operations Planning.

(4) Target and DMPI Information. The main target area (to be called RECCE_FLASH) extends in a rectangle from Lat: 15°30'00"N, Long: 33°00'00"E to Lat: 16°55'00"N, Long: 35°00'00"E to Lat: 16°00'00"N, Long: 35°40'00"E to Lat: 14°40'00"N, Long: 33°35'00"E. There are no DMPIs.

b. Objective Two: Create a Corridor between the Gao and Agadez forces. In order to achieve Mission 'A' it is necessary to create an exclusion zone corridor between the Gao and Agadez forces in the Upper Region of Binni between Langford and St Andrews (approx 100 km long and 2km wide). Target Selection has advised the use of a ‘firestorm’ between the opposing forces. Note:

(1) The firestorm task is Priority One.

(2) The firestorm cannot be closely controlled and may rage out of hand if the prevailing climatic circumstances change or if the targeting is poor. This is deemed an acceptable risk for this Mission because the more separated the opposing forces are, the better the TEZ.

(3) Keeping the forces physically separated is essential because simply halting the Gao side by using a natural feature (e.g. a river) would not be effective when the Agadez forces are trying to ‘egg the Gao forces’ into a trap. Agadez will not try to ‘run away’ but rather will remain in close contact to encourage the Gao forces to follow the ‘bait’. The meteorological predictions suggest that the prevailing wind could drive a ‘fire break’ between the opposing forces. This will leave a ‘temporary’ corridor that can be more effectively monitored for violations of the TEZ.

(4) The plan involves tactical bombing using a new class of incendiary weapon (ADM-162c). The tactical use of ADM-162c in the Binni environment is somewhat problematic as it has only been in the operational inventory for six months. However, in the prevailing circumstances it is estimated that each weapon should be capable of devastating an area of $2km^2$. Each strike aircraft is capable of carrying four ADM-162c weapons.

(5) This plan needs to take account of terrain and meteorological factors in order to clear a corridor at least 5km wide and 100 km long in order to effectively separate the opposing forces for long enough to initiate cessation of hostility discussions.

(6) The actual 'firestorm' task will take place on day three of the phase and must be completed within 24 hours. It will consist of a sustained 12 hour bombing campaign followed by 12 hours for the resulting firestorm to produce an effective ‘zone of separation’ which can be policed by continuous air surveillance using helicopters and strike aircraft.

(7) The JFACC estimates that some thirty sorties of two hours duration will be required to initiate the firestorm and that a further five sorties will be held in readiness to ‘saturate’ any difficult terrain during the actual campaign but this will be verified during Air Operations Planning

(a) Target and DMPI Information. The main target area (to be called TARGET_FLASH - location yet to be finally confirmed and sections partitioned amongst the tasked forces) extends in a rectangular area reaching from Lat: 15°25'00"N, Long: 33°43'00"E to Lat: 16°25'00"N, Long: 35°14'00"E to Lat: 16°16'00"N, Long: 35°19'00"E to Lat: 15°16'00"N, Long: 33°48'00"E. There are no DMPIs.

c. Objective Three: Destroy WMD Facilities and Disable Associated Power Supplies. Destroy the WMD facilities and the power transmission transformer near Suthertown (in the Eastern Region).

(1) The WMD facilities are Priority One.

(2) Destroying the Suthertown transformer causes the minimum disruption to the civilian population in eastern Binni. The transformer is Priority Two.

(3) Target and DMPI Information. The main target (to be known as TARGET_EASTERN_PROMISE) is a sprawling complex of single-story industrial buildings near Lat: 15°57'00"N, Long: 37°38'00"E. There are two DMPIs as follows:

(a) DMPI Three-1. WMD Manufacturing facility to the west of the Suthertown / Anguiba road at Lat: 15°52'00"N, Long: 37°32'00"E

(b) DMPI Three-2. Power transformer buildings just to the south of a junction between the Kutci / Polia and Anguiba / Polia roads at Lat: 16°02'00"N, Long: 37°45'00"E.

d. Secondary Objective One: Destroy Fuel Storage Facilities at Salisbury Military Airbase. Destroy the fuel storage facilities (to be known as TARGET_OLD_SARUM) at the military base at Salisbury currently being used by Agadez Forces as a FOB.

(1) Opportunist attacks on other targets are denied.

(2) The fuel storage facilities are one of the few constant features of the base. Destroying them is the simplest way of denying use of the base.

(3) Target and DMPI Information. The target is an area to the north-west of the base with heaped up earthen mounds in a grid pattern housing the fuel storage tanks at Lat: 15°55'00"N, Long: 35°55'00"E

9. Friendly Forces. The friendly forces (including UN Force Elements, Host Nation and Neutral) are summarised below and are detailed at Annex B5 Updated Intelligence Own.

a. UN Force Elements. The UN Force Elements consist of maritime, air, land, special forces and other units based both in and out of the AOR. The forces are detailed below by location by country and are as follows:

(1) Maritime: Coalition Partner's contributions are:

- UK: HMS INVINCIBLE II plus 8 escort vessels.
- USA: USS H CLINTON (Nimitz Class (CVN84) with TLAMs) plus 11 Escort vessels.

(2) Land: Coalition Partner's contributions are:

- UK: UK 16 Air Assault Brigade deployed from carrier to Costa Del Maria.
- USA: 400 marines plus 25 SF deployed from carrier to Costa Del Maria.

(3) Air: Coalition Partner's contributions are:

- Australia:
  - At Bandar: 8 x F/A-18 Hornet Strike Fighter / Bombers;
  - On Cyprus: 2 x C130H Transport aircraft;
- Netherlands:
  - At Costa Del Maria: 12 x F16 Air Defence Fighters;
- UK:
  - On Carrier: 12 x FA2 Sea Harrier Fighter / Attack and 12 x Harrier GR7 Ground Attack aircraft;
  - At Bandar: 3 x Apache Attack Helos and 24 x Support Helos (Chinook and Gazelle); 12 x Tornado GR1 Ground Attack, 4 x GR1A Recce, and 2 x Falcon EW aircraft;
  - At Costa Del Maria: 8 x Tornado F3 Air Defence Fighters, 18 x Typoon Fighter / Bomber aircraft;
  - On Cyprus: 2 x E3A/D AWACS and 4 x VC10 Tankers;
- USA:
  - On Carrier: 24 x F/A-18 Hornet Strike Fighter / Bomber, 24 x F-14 Tomcat Fighter aircraft and 48 x TLAMs;
  - At Costa Del Maria: 12 x F15C Fighter / Bomber and 2 x KC135 Tankers;

- On Cyprus: 2 x KC135 Tanker, 1 x E3C AWACS, 2 x C5 Transport aircraft and 4 x C130H Transport aircraft;

b. Host Nation Force Elements. The Host Nation is technically Gao, but Gao will not allow any UNWAFB forces on its soil. However, some Gao forces occupy parts of Binni and use Binni facilities and equipment. Hence, determining the exact composition of Gao forces is difficult. As the Gao forces play no offensive part in the UN operations they are not listed here.

c. Neutral Force Elements. The other nations in the AOR (other than Agadez, Binni and Gao) have declared themselves neutral and their territory is sovereign and is not to be violated without authority. There is currently little intelligence on their forces other than that in the usual country assessments.

10. Enemy Forces. The enemy forces are summarised below and are detailed at Annex_B5_Updated_Intelligence_Agadez.

a. Agadez Force Elements. The Agadez Forces consist of air, land and irregular units based both in Agadez and the southern parts of Binni. The force composition is variable and the ***Gaoan*** assessment is as follows:

(1) Navy: Irregular forces only.

(2) Army: 5 Infantry Divisions; 2 Mechanised Infantry Divisions; 2 Armour Divisions; 2 Rapid Reaction Battalions plus irregular forces.

(3) Air Force: Consists of some 200 aircraft including Mig-29 Fulcrum Fighter / Bomber and the Su-27 Flanker Fighter aircraft. The AAF can field some 100 SAM units including SA-2, 3 and 5 and are believed to own SA-10C units.

(4) Special Forces: None.

(5) Other: Agadez is believe to have a short-range Ballistic Missile capability.

11. Logistics. Planning assumptions remain under review, but in the interim plan should assume that forces will be deployed in Binni for up to 12 months.

a. Critical Weapons. Critical Weapons status is to be tracked and reported twice daily at the JFACC Daily Briefings. [Task for AIAI Process Panel Annex_D_AIAI - monitor the daily 'Battle Rhythm' see Annex_B6_Timeline]

b. All contingents are to deploy self sufficient for 60 days to allow the Chief Administration Office (CAO) from the Division of Management and Administration to establish the logistic arrangements for the Force.

c. Logistic resupply will be negotiated with Host Nation and Commercial Organisations in Theatre.

d. Detailed Plans are at http://www.un.org/Operations/Binni/UWAFB/Logistics/ [Mythical URL].

12. Admin Support. Administrative support will be as per UN SOPs: UNAP 1-00/23. [Mythical]

THE JFACC - A PEN PICTURE

13. The Mission A Commander is a tough talking Airforce Officer with considerable experience in planning and executing both strategic and tactical air campaigns. His bravery under fire is unquestioned and he commands the respect of his staff. However, he has a tendency to be uncompromising once he has an objective clearly established in his mind.

14. The exact location for the 'fire break' for Mission 'A' has yet to be finalised and there is some high-level dispute about the approach and whether it can be defended politically. Against this background the Mission 'A' Commander has a difficult task as certain decisions must be in place if the deadlines are to be met.

15. His strategy for Mission A is driven by the need for urgency and the consequent ecological implications have been given low priority. This has caused some concern amongst the UN observers and has excited Press interest. After one particularly vigorous exchange along the lines of, "…….. s** the elephants, I just want to get those b******s apart for long enough to let the Army wring their necks!!", the media dubbed him 'Bomber Harris'.

CHAPTER 9. (ANNEX B3)

BINNI FLASH - CIVILIAN SITUATION

Document_Structure, Annex_B1_Political_Situation, Annex_B2_Military_Situation, Annex_B4_Environment, Annex_B5_Updated_Intelligence, Annex_B6_Command_Model

1. Involvement of civilian organisations and their (if you're lucky) legacy computing facilities.

   NOTE: Each of these would require extra domains (some organisational, some functional) would be *essential* in a real Coalition operation, but which would be too complex for the our current CoAX capabilities. Hence only the Weather functional domain is being activated:

   a. National (Host Nation) Government:

      (1) Disaster: co-ordination and rescue services

      (2) Economic: taxes, census, economic,

      (3) Transportation:

      (4) Infrastructure: utilities,

   b. OGDs / Local Government:

      (1) Disaster: co-ordination and rescue services

      (2) Economic: taxes etc,

      (3) Transportation: rail, air traffic etc

      (4) Infrastructure: utilities,

      (5) Environmental: Met reporting **[Task for Ariadne agents** Annex_D_USCISI**]**

   c. NGOs:

      (1) World Programme for Food Provision (WPFP),

      (2) World Organisation for Health (WOH),

      (3) In addition there are over 100 NG0s and PVOs in the mission area (details provided to approved authorities:

         (a) Media,

         (b) Charities / refugee agencies,

         (c) Local interest groups,

d. Commercial:

(1) Multi-national corporations,

(2) Trade groupings,

CHAPTER 10. (ANNEX B4)

BINNI FLASH - ENVIRONMENT

Document_Structure, Annex_B1_Political_Situation, Annex_B2_Military_Situation, Annex_B3_Civilian_Situation, Annex_B5_Updated_Intelligence, Annex_B6_Command_Model

1. The Geography and infrastructure of Binni is shown on a number of maps in the PowerPoint file: http://www.aiai.ed.ac.uk/project/coalition/binni/. The sections below describe some of the geographical and cultural features of the area.

2. Infrastructure:

a. Road: The roads in Binni are as follows:

(1) Surfaced Roads. The eastern part of Binni has a number of roads with a waterproof (Tarmac) surface. These roads are mostly single-track. The main routes are between Sikasso, Bandar, Costa Del Maria and Laki. All other tarmac roads are subject to seasonal damage by flood water. The route to Ugwulu is broken by an old ferry (of variable reliability) at Sagiba / Kamongo.

(2) Rolled Stone Tracks. The majority of roads are made of rolled stone and are of variable quality and often damaged by rainwater.

(3) Dirt Tracks. The rest of the country has numerous dirt tracks which are almost impassable in wet weather.

b. Rail:

(1) There is a 1067mm (42") narrow gauge railway between Sikasso, Bandar, Costa Del Maria and Laki with branch lines to mines in the hills near Adaido and Suthertown.

(2) The trains are all old, mostly steam driven and very unreliable.

c. Air: The Airport facilities are as follows:

(1) Civilian (alphabetical):

(a) Bandar (close to, but separate from, the military base) - At 135 feet (41 metres) AMSL, Lat: 19°22'00"N, Long: 38°02'00"E, Runways: Two (3500' - tarmac, 120° / 300° and 4500' - tarmac, 30° / 210°), ATC: Tower Approach and En-route, Hangars: Several, ranging in size from approx 60' wide and 70' long to 100' x 200'. Facilities: Fuel (AVGAS, AVTUR), range of engineering.

(b) Bave - At 1155 feet (352 metres) AMSL, Lat: 20°11'00"N, Long: 36°25'00"E, Runways: One (1500' - tarmac, 110° / 290°), ATC: Tower Approach, Hangars: Two, each approx 60' wide and 70' long. Facilities: Fuel (AVGAS), basic engineering.

(c) Brongo - At 561 feet (171 metres) AMSL, Lat: 19°08'00"N, Long: 34°51'00"E, Runways: One (800' - dirt, roughly E / W), ATC: None, Hangars: None. Facilities: Fuel (AVGAS), no engineering.

(d) Costa Del Maria (combined with the military base) - At 26 feet (8 metres) AMSL, Lat: 16°57'00"N, Long: 39°21'00"E, Runways: Three (3000' - tarmac, 170° / 350°, 5000' - tarmac, 70° / 250° and 6200' - tarmac, 120° / 300°), ATC: Tower Approach and En-route, Hangars: Several, ranging in size from approx 60' wide and 70' long to 100' x 200' plus. Facilities: Fuel (AVGAS, AVTUR), range of engineering. Customs facilities.

(e) Kwanabouri - At 931 feet (284 metres) AMSL, Lat: 16°58'00"N, Long: 31°03'00"E, Runways: One (1200' - dirt, roughly E / W), ATC: None, Hangars: None. Facilities: Fuel (AVGAS), basic engineering.

(f) Masembi - At 1023 feet (312 metres) AMSL, Lat: 18°51'00"N, Long: 32°56'00"E, Runways: One (1800' - tarmac, 40° / 220°), ATC: Air Traffic Information Service (ATIS) only, Hangars: One (approx 60' wide and 70' long), Facilities: Fuel (AVGAS), basic engineering.

(g) Salisbury (limited civilian facilities on military base) - At 1650 feet (503 metres) AMSL, Lat: 15°50'00"N, Long: 36°00'00"E, Runways: Two (2800' - tarmac, 65° / 245° and 1000' - dirt, roughly N / S on eastern side of airfield), ATC: Tower Approach, Hangars: Several small (approx 60' wide and 70' long). No hardened aircraft shelters. Facilities: Fuel (AVGAS, AVTUR), limited engineering.

(h) In addition there are other dirt strips which are associated with the larger farmsteads. However, the status of these airstrips cannot be guaranteed.

(2) Military: (alphabetical - see also in Annex_B5_Updated_Intelligence for weapon / fuel storage information):

(a) Bandar (close to, but separate from, the civilian airport) - At 135 feet (41 metres) AMSL, Lat: 19°24'00"N, Long: 37°51'00"E, Runways: Two (3000' - tarmac, 80° / 260° and 4500' - tarmac, 80° / 260°), ATC: Tower Approach and En-route, Hangars: Several, ranging in size from approx 60' wide and 70' long to 100' x 200'. No hardened aircraft shelters. Facilities: Fuel (AVGAS, AVTUR), range of engineering.

(b) Costa Del Maria (combined with the international airport) - At 26 feet (8 metres) AMSL, Lat: 16°57'00"N, Long: 39°21'00"E, Runways: Three (3000' - tarmac, 170° / 350°, 5000' - tarmac, 70° / 250° and 6200' - tarmac, 120° / 300°), ATC: Tower Approach and En-route, Hangars: Several, ranging in size from approx 60' wide and 70' long to 100' x 200' plus. No hardened aircraft shelters. Facilities: Fuel (AVGAS, AVTUR), range of engineering. Customs facilities.

(c) Laki (no civilian facilities) - At 1794 feet (542 metres) AMSL, Lat: 16°59'00"N, Long: 36°45'00"E, Runways: Two (3500' - tarmac, 60° / 240° and 2500' - tarmac, 120° / 300°), ATC: Tower Approach, Hangars: Several small (approx 60' wide and 70' long) and two approx 100' wide x 200' long. Many

dispersal areas. No hardened aircraft shelters. Facilities: Fuel (AVGAS, AVTUR), range of engineering.

(d) Salisbury (shared civilian facilities) - At 1650 feet (503 metres) AMSL, Lat: 15°50'00"N, Long: 36°00'00"E, Runways: Two (2800' - tarmac, 65° / 245° and 1000' - dirt, roughly N / S on eastern side of airfield), ATC: Tower Approach, Hangars: Several small (approx 60' wide and 70' long). No hardened aircraft shelters. Facilities: Fuel (AVGAS, AVTUR), limited engineering.

(e) Ugwulu (no civilian facilities) - At 692 feet (211 metres) AMSL, Lat: 17°30'00"N, Long: 32°52'00"E, Runways: One (2500' - tarmac, 95° / 275°), ATC: Tower Approach, Hangars: Several small (approx 60' wide and 70' long) and one approx 100' wide x 120' long. No hardened aircraft shelters. Facilities: Fuel (AVGAS, AVTUR), range of engineering.

(f) In addition, the military forces (of both sides) have created drop zones / clearings.

d. Sea: Port facilities etc are as follows:

(1) Costa Del Maria (commercial port connected to the military air base) - Lat: 17°02'00"N, Long: 39°24'00"E - Dockside areas and berthing for six (600 feet / 180 metre) container ships (two berths with RoRo cranes as well as container lift facilities) plus mooring / ramps for smaller ships. Cranes up to 100 tonne lift capacity. Some protection from the open sea and anchorage also available off the port. Entrance channel depth 60 feet (18 metres) with a tidal range of 12 feet (3.6 metres). Warehouses: several, ranging in size from approx 80' wide and 50' long to 100' x 200' plus. Facilities: Commercial refuelling, fresh water, commercial tugs, range of engineering. Customs facilities.

(2) Sikasso (run down local port) - Lat: 19°31'00"N, Long: 37°57'00"E - Dockside areas and berthing for three (400 feet / 120 metre) container ships (one RoRo crane / berth combined with one set of container lift facilities) plus mooring / ramps for smaller ships. Cranes up to 50 tonne lift capacity available. Good protection from the open sea and fixed anchorage also available off the port. Entrance channel depth 40 feet (12 metres) with a tidal range of 10 feet (3 metres). Warehouses: several, ranging in size from approx 80' wide and 50' long to 100' x 150' plus. Facilities: Limited refuelling, fresh water, commercial tugs, limited engineering. Customs facilities.

(3) In addition there is berthing / marina facilities for small boats (60' or less), channel 12 feet (3.6 metres) at Dado Lat: 20°31'00"N, Long: 37°39'00"E and Diplombo Lat: 17°49'00"N, Long: 38°54'00"E.

(4) For a description of beaches / potential landing areas see in Annex_B5_Updated_Intelligence.

e. Waterways:

(1) Navigable waterways reach inland as follows:

(a) River Ankobra - From Sonara (Lat: 16°21'00"N, Long: 39°26'00"E) inland for approx 50 nm towards Sagotown.

(b) River Caca - From Dado (Lat: 20°31'00"N, Long: 37°39'00"E) inland for approx 160 nm to Libretto Lat: 17°05'00"N, Long: 33°26'00"E.

(c) River Tana - From Aby Lagoon (Near Deanville, Lat: 15°23'00"N, Long: 39°18'00"E) inland for approx 40 nm towards Akimbo.

(d) There are a number of other small inlets and rivers along the coast.

(2) Other Water Features:

(a) Binni's major water feature is Lake Caca which covers an extensive area behind the Caca Dam. The dam was only completed 5 years ago and was paid for with money from the World Development Fund. The lake provides fishing and irrigation and the dam provides hydro-electric power. As yet there has been no increase in illness in the local population owing to the presence of the water - though there have been fears of pollution from the mines in the east and from the small industrial complex near Higgville. Also, there have been threats by Agadez to contaminate the Black Caca which runs into the Lake from the south.

(b) The coastline of Binni borders the western side of the Red Sea and is extensively populated with many small towns and villages. There are also long stretches of 'golden sands' which would be attractive to tourists and numerous small lagoons - many of which are used to evaporate sea water for sea-salt extraction.

3. Climate:

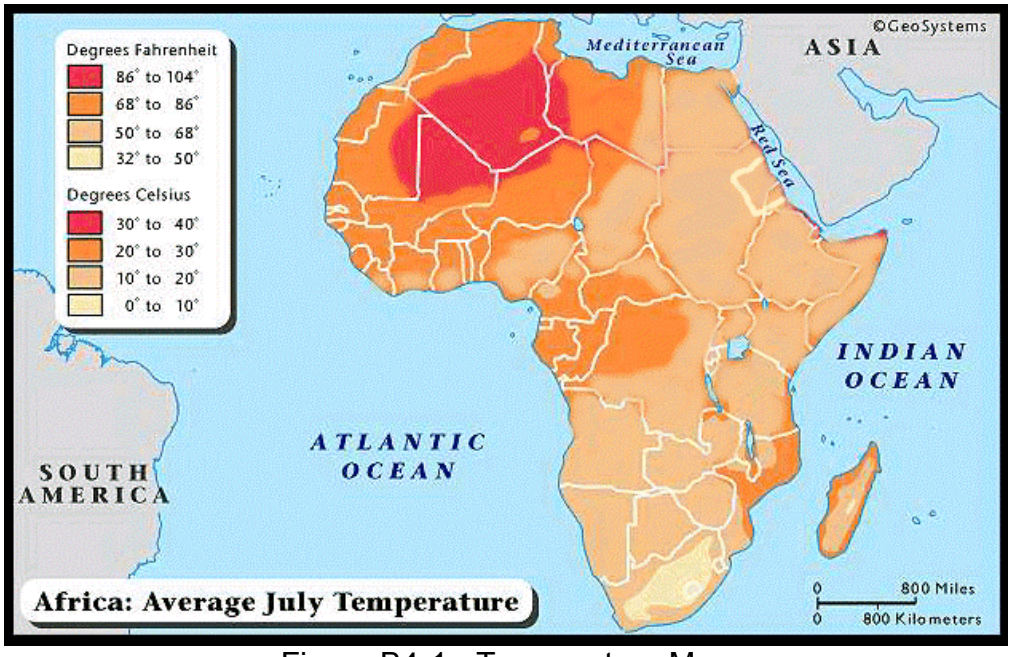


Figure B4-1 - Temperature Map

a. Temperature: Since the climate changes in Africa in the last 10 years Binni's climate has become more temperate. Even though Binni is a relatively small state there are marked variations between the eastern plain, the mountains and the western region. Figure B4-1 above shows the average (over 24 hours) temperatures:

b. Precipitation: Rainfall in Binni has increased over the last ten years enabling the increase in agriculture. Even though Binni is a relatively small state there are marked variations between the eastern plain, the mountains and the western region. Heavy thunderstorms are common. The current average rainfall is as shown in Figure B4-2 below:

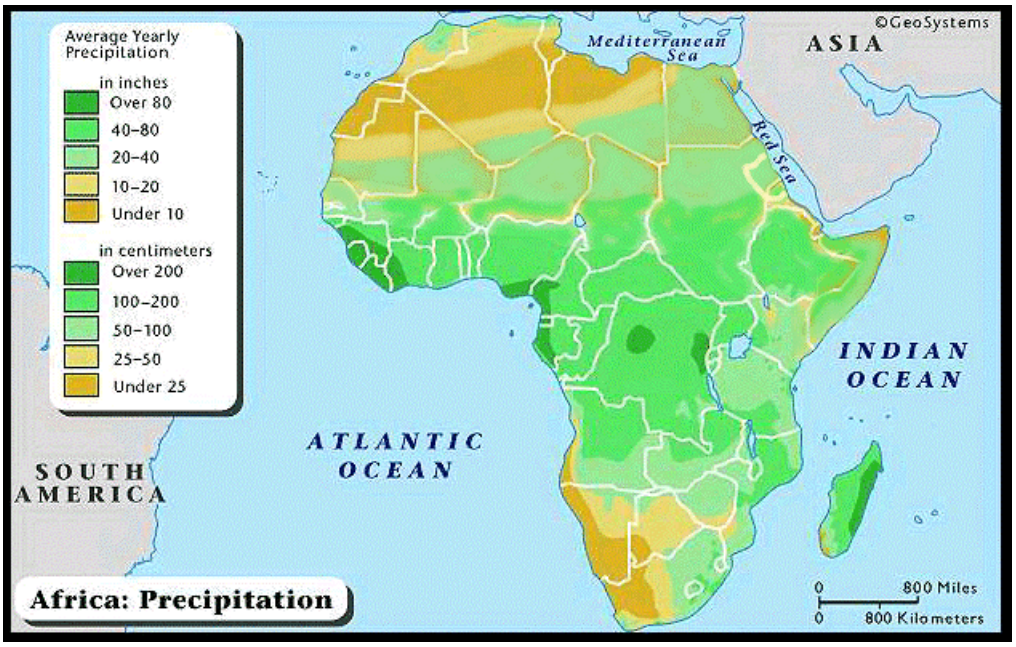


Figure B4-2 - Rainfall Map

c. Wind: Binni's prevailing wind comes from the North-east and is usually light to moderate and always stronger on the coast than inland. However, the winds become increasingly unpredictable from June to August when the heavier rains come - though the climate change has resulted in less extremes than before.

d. Sea States: As Binni's eastern coastline is the Red Sea the sea states are usually very moderate, however the conditions can be very bad during the occasional violent storms which occur (especially in June to August).

4. Geography:

a. Geology: Binni is on the edge of the African Rift valley an the Ashanti region (In the east) has mountains to 800 metres (2600') which are the eroded roots of volcanoes and the remains of uplifted sedimentary material from the Cretaceous period. There is some mineralisation and lead, silver and copper have been mined. Some fine marbles are found in limited areas - but these have never been commercially exploited. The area is criss-crossed by many faults and there are often minor earthquakes.

b. Rock / Soil: Most of the soil is derived from volcanic debris and is now very fertile, though past erosion has created areas of soil poor in humus. The soil is mostly sandy, though there are areas of montmorillonite which makes the building of large structures difficult. The

land to the south and west of Lake Caca and the plains of the central region are fertile and extensively exploited.

c. Vegetation: Binni is essentially a savannah region (though very drought prone in the recent past) covered with grassland and scrub. However, small areas of preserved ancient forest have survived and these are beginning to expand as climatic succession occurs. Figure B4-3 below shows the overall vegetation in the region:

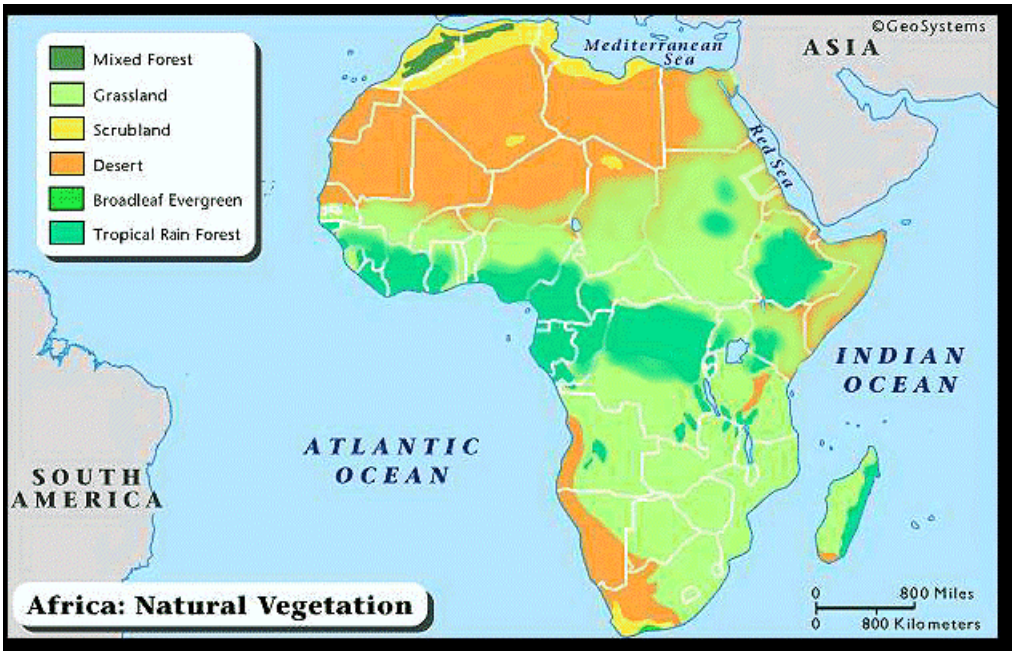


Figure B4-3 - Natural Vegetation

d. Wildlife: Binni's wildlife is now mostly found in the western part of the country as pressure from farming and population expansion has driven the animals out of other areas. The Caca Gorge area (south and west of St Andrews) is part of the Laki Safari park and is where the largest concentration of animals are found. **[Task for OBJS, monitor wildlife** Annex_D_OBJS **]** Indeed, the Gorge is the location of a spectacular annual antelope migration.

5. Economic / Political / Cultural:

Figure B4-4 - Traditional Binni Prayer Mat

a. Political: Traditionally, Binni's politics have polarised on tribal lines and the electorate is unsophisticated. This state of affairs has been exploited by Agadez and military and political 'education' has been going hand in hand. Stability and time would be required for real political and democratic processes to develop.

b. Economy / Industry: Binni's economy is essentially agrarian through some limited commercial exploitation of fishing, mining and manufacturing skills has occurred. Of these, textiles are the most notable - an example is shown in Figure B4-4 above. The Bandar / Sikasso region is an ancient trading capital and there are many rich and ornate buildings. However, this glory has faded. Attempts to encourage tourism have had mixed fortune - though there is much untapped potential.

c. Agriculture: After the relatively recent climate changes Binni's traditional grain and cattle farming have surged ahead and for the first time in many years there is surplus to export to neighbouring states. In addition, other cash crops have been introduced including bananas, melons and other fruit as well as attempts to grow rubber plants and there has been a reintroduction of the old 'ground-nut' peanut schemes. Methods are very traditional and 'organic' and there is scope for increased efficiency - especially in distribution and storage.

d. Religion / Culture: Binni's population is essentially Islamic (both Sunni and Shia), though there is the usual mix of minority religions reflecting Binni's turbulent history.

Figure B4-5 - Binni - Wedding Carnival

This history has provided a rich cultural heritage from which many traditions and festivals are extracted (see Figure B4-5 above) but, despite this diversity, Binni has been a tolerant and stable society where village elders are held in high regard and the prevailing attitude is against technology for the sake of it - indeed such developments as television and phones are rarely seen. Handicrafts and the skills of carving, weaving and metalworking are esteemed.

CHAPTER 11. (ANNEX B5)

BINNI FLASH - UPDATED INTELLIGENCE

Document_Structure, Annex_B1_Political_Situation, Annex_B2_Military_Situation, Annex_B3_Civilian_Situation, Annex_B4_Environment, Annex_B6_Command_Model

1. Intelligence Gathering. Note: Intelligence gathering has been by the usual SIGINT, IMINT, HUMINT **[Task for Dartmouth 'observers'** Annex_D_Dartmouth**]** etc and these activities will not be highly developed in the CoAX scenario for security reasons. All the information below will be updated during Phase I of the UNWAFB Operation.

INTELLIGENCE ASSESSMENT OF AGADEZ FORCES

Links to Annex_B5_Updated_Intelligence_Own

2. Characteristics of the Area of Operations – Agadez Issues:

a. Military Geography (see also Annex_B4_Environment)

(1) Topography:

(a) Situation and Effects on Opponent's Capabilities. The Agadez forces occupy the region in the south of Binni which is mostly plains and savannah. This gives them good mobility on the ground giving the Agadez forces an advantage.

(2) Hydrography:

(a) Situation and Effects on Opponent's Capabilities. Though Binni borders the Red Sea Agadez lacks maritime forces (except for irregular 'gunboats' which operate in coastal waters and on Lake Caca). This threat is assessed as being insignificant. However, these boats could be used a general transports for the irregular forces and their tactical importance should not be underestimated.

b. Climate and Weather:

(1) Situation and Effects on Opponent's Capabilities**.** Binni is in the equatorial region. The tropical conditions often provide substantial cloud cover and limited visibility. Mudslides are frequent, causing complications for logistic operations in the southern region. Heavy rains occur in the June to August timeframe. Agadez troops are familiar with the terrain and vegetation. Maritime, land and air operations are affected by the summer rains.

c. Transportation:

(1) Situation and Effects on Opponent's Capabilities. Road, water and air transportation is available in the Agadez area of operation. The infrastructure is poor and of low quality. Agadez uses a varied assortment of ground, water and air vehicles (many are low technology) which makes its forces highly flexible.

d. Telecommunications:

(1) Situation and Effects on Opponent's Capabilities. Both Agadez and Gao forces use Binni's public telecommunications system which is now controlled and operated by the Gao government. HF/UHF is also integrated into military planning. The system is neither modern nor efficient with an average of 2 fixed telephones, 10 radios, and 1 television receiver per 100 persons. Cellular devices are still almost unknown among civilian personnel. The Agadez military uses SW radio and does not have a force-wide communications system. The Agadez government relies on the telecommunications infrastructure to support military operations in the region. There are no fixed satellite ground stations - though signal monitoring indicates that there are thought to be several portable facilities in use.

e. Politics:

(1) Situation and Effects on Opponent's Capabilities. Agadez has an authoritarian government which constantly faces a leadership succession problem and a strong desire to preserve the political system. The political leadership is jointly shared by the party and military. The organisational framework of the regime is rapidly decaying. Corruption is endemic at all levels of bureaucracy. The government has sought to mobilise nationalism to justify its authoritarian rule, resulting in a more assertive and aggressive foreign policy and a determination to retain hegemony over the Binni region.

f. Economics:

(1) Situation and Effects on Opponent's Capabilities. Agadez has a rapidly evolving economic program, despite the totalitarian form of government. The country has a fundamental regime which provides a good basis for economic growth. It has a largely agrarian economy with a rich natural resource base and a large domestic market. Its labour force is relatively diligent.

g. Sociology / Culture:

(1) Situation and Effects on Opponent's Capabilities. The Agadez society is struggling to maintain control in the Information Age. State controlled work units still prevail but are not as dominant as a result of increasing channels bringing in outside influences such as the internet and the media. Conflict in the region would serve as an opportunity to divert the Agadez population from internal problems. Religion is an important influence in the region with Islamic societies predominant. Birth rate is 17.78/1,000 population. Death rate is 7.63 deaths/1,000 population. Life expectancy is 58 years for males, 63 years for females.

h. Science and Technology:

(1) Situation and Effects on Opponent's Capabilities. Agadez has aspirations to enhance its military and military-industrial base. Hardware and technology in the areas of aerospace and nuclear fields are being acquired from foreign nationals working in Agadez. Agadez is also pursuing a strategy of close political and economic ties to nations that can offer, or pay, the right price for goods and services of potential military value.

3. Overall Adversary Military Situation (Ground, Naval, Air, Other Service):

a. Strength:

(1) Agadez has no ability to project forces in combined operations at any distance from its borders. Agadez maintains a significant portion of its army along its northern border. Agadez air operations make sporadic combat air patrols across the south of Binni.

b. Composition:

(1) Navy: Irregular forces only.

(2) Army: 5 Infantry Divisions; 2 Mechanised Infantry Divisions; 2 Armour Divisions; 2 Rapid Reaction Battalions plus irregular forces.

(3) Air Force: Consists of some 200 aircraft including Mig-29 Fulcrum Fighter / Bomber and the Su-27 Flanker Fighter aircraft. The AAF can field some 100 SAM units including SA-2, 3 and 5 and are believed to own SA-10C units. The assessed location of these units are shown in Figure B5-1 below:

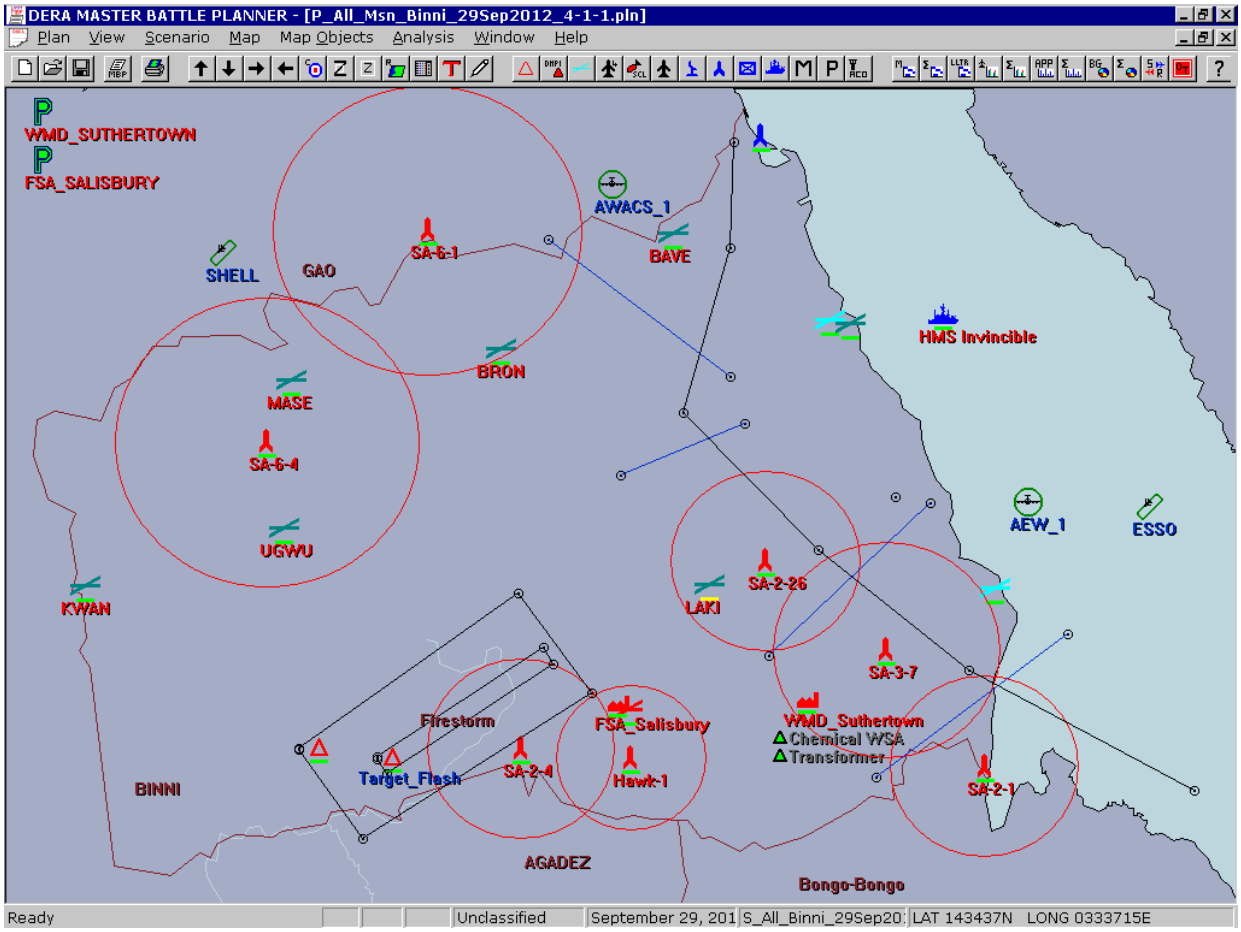


Figure B5-1: Agadez (and Gao) SAM Dispositions

(4) Special Forces: None.

(5) Other: Agadez is believed to have a short-range Ballistic Missile capability. This threat is being continually monitored and an updated assessment will be provided during Phase I of the UNWAFB Operation.

c. Location and Disposition:

(1) Agadez command and control is accomplished at the National Command Headquarters at Accaba in Agadez. This provided redundant C3 capability in support of senior civilian governmental leadership. Military command for the operations in the southern region is deployed in the field and thought to be based south of Salisbury in Binni and exercises operational control over all services within their area of responsibility.

d. Availability of Reinforcements:

(1) Agadez possesses rapid reaction forces which can be called upon to support any effort. However, there are limited capabilities to deploy them any distance and these forces are hampered by the old local infrastructure - though the determination of these forces should not be underestimated.

e. Logistics:

(1) Rail and road networks are in place in Agadez to reinforce the Binni front.

f. Operational Capability to Launch Missiles:

(1) Surface to Air Missiles are in use by Agadez and there are reports of the launch of short-range Ballistic Missiles.

g. Serviceability and Operational Rates of Aircraft:

(1) Agadez Air Force missions are air defence and air support to the army. They possess ageing fighter aircraft capable of ground attack as well as air defence capabilities. Agadez air defence is accomplished by Fishbed etc and has been observed uploaded with AA-10 AAM's. Fighters play a secondary role in the Air Defence system; as long as radar-guided SAMs are operational, fighters are normally used along the threat axis, but behind the SAM envelopes. Fighters may be employed for point defence of high value targets. Fighters rely heavily upon accurate and timely GCI information for effective employment of their weapon system. Fighter forces are heavily dependent upon Command and Control. The principal battle management node in the air defence system is the Sector Operations Centre (SOC), which is responsible for mission co-ordination of SAMs and fighters.

(2) Air support to the army is accomplished by Close Air Support Ground attack aircraft. Most of Agadez wartime tactical air operations focus on close air support. The aircraft conduct attacks from very low to medium altitudes using various tactics and ordnance. Basic formation is two sections in trail. Prior to entering target area sections, aircraft separate for weapons release in the mission area. Mission success is marginal due to pilot training deficiencies, inadequate pilot involvement in mission planning and inappropriate tactics.

h. Technical Characteristics of Equipment:

(1) The majority of Agadez equipment is indigenously produced. Some 'western' weapons and electronics have been acquired through the marketplace. The availability of weapons in the open marketplace has become the determining factor in Agadez's military abilities to wage war in the region. Agadez has established several commercial fronts to acquire technology from leading weapons technology firms. Additional sources of technology came from Agadez reverse-engineering several weapons technologies. The technicians employed for reverse engineering were hired from industries in Europe and parts of Asia.

i. Electronic Intelligence:

(1) Agadez possesses some electronic intelligence capability. SIGINT / Radio Electronic Combat (REC) have been upgraded through commercial purchase. SIGINT operations are conducted from Accaba. Communication intelligence focuses on UHF/VHF/HF command and control, naval and aircraft communications. Many SIGINT stations are found along the northern Agadez border.

j. Space: No capability.

k. Nuclear, Biological and Chemical (NBC) Weapons:

(1) No fielded capability - though chemical warfare developments are underway at a site near Suthertown which utilises some underground (old mine workings) facilities. The nuclear and biological capability is thought to be negligible - though there are unconfirmed reports of a recent outbreak of the Ebola virus near Sagotown (down river from Suthertown).

l. Significant Strengths and Weaknesses:

(1) Agadez possesses one of the strongest military capabilities in the region - though it is considered 'low technology' by modern standards. Also, its strategies and high-level planning techniques are still based on the outdated fixed-cycle approach. Their tactical agility, however, is very good.

4. Adversary Unconventional and Psychological Warfare Situation:

a. Guerrilla:

(1) Agadez possesses a dynamic network of guerrilla cells in place throughout its territory.

b. Psychological:

(1) Agadez assets continue to mount aggressive collection and disinformation operations against Binni and Gao and exploit a subtle mix of terror tactics, reward, coercion and food and medical assistance against the local populations in Binni.

c. Subversion: Agadez can demonstrate a capability.

d. Sabotage: Agadez can demonstrate a capability.

5. Adversary Information Operations (IO):

a. Psychological Operations (PSYOPs):

(1) Global communications are creating a market for providing a twist to the broadcast medium, effecting both allies and adversaries.

b. Operations Security (OPSEC):

(1) Agadez military security has traditionally been very effective and infringements have been punished ruthlessly. Agadez conducts intelligence collection through several means, to include recruitment of target country nationals, support to dissident groups, assassination and other violent means. In addition, Agadez conducts telephone intercepts, microphone plants and radio intercepts.

c. Military Deception:

(1) An elite corps of military personnel are trained according to traditional Soviet *maskirovka* (deception) operations.

d. Physical Destruction:

(1) Agadez's traditional means to put an adversary at risk. The marketplace is providing limited numbers of precision guided munitions.

e. Electronic Warfare:

(1) Agadez has acquired some state-of-the-art equipment from commercial-off-the-shelf purchases as well as through the global weapons industry black market.

f. Computer Network Attack (CNA):

(1) Agadez does not have an indigenous network of computer network attack personnel. However, through the market place Agadez has acquired a viable threat which could be used against information infrastructures. Agadez has sponsored computer hackers from sources through out the globe over the past four years. Their efforts have been covert, developing strategies to penetrate established national information infrastructures and defence information infrastructures.

6. Conclusions: The Agadez leadership and population see their country as an emerging great power and measure their capabilities against the great western powers. They consider Gao to be weak.

INTELLIGENCE ASSESSMENT OF OWN FORCES

Links to Annex_B5_Updated_Intelligence_Agadez.

7. Characteristics of the Area of Operations - UNWAFB Issues:

a. Military Geography: (see alsoAnnex_B4_Environment)

(1) Topography:

(a) Situation and Effects on UFWAFB's Capabilities. The UNWAFB forces will be deployed from a Carrier Battle Group in the Red Sea or will be flown in from Cyprus. Amphibious landings would be on the east coast of Binni and then up through the mountains. Though this region has a good transport infrastructure the topography tends to restrict movement to roads etc causing potential chokepoints and making forces open to ambush. All this puts the UNWAFB at a disadvantage.

(2) Hydrography:

(a) Situation and Effects on UFWAFB's Capabilities. Binni borders the Red Sea and there are beaches which could be used as potential landing areas and they have been surveyed separately (not in this document); the most promising sites are near Cape Vincent and between Sonara and Deanville. Lake Caca is navigable up to Libretto and Inflatable speedboats should be deployed from the Caca Dam area to give the UN Forces a military presence on the Lake.

(3) Climate and Weather:

(a) Situation and Effects on UFWAFB's Capabilities**.** Binni is in the equatorial region. The tropical conditions often provide substantial cloud cover and limited visibility. Mudslides are frequent, causing complications for logistic operations in the southern region. Heavy rains occur in the June to August timeframe. Maritime, land and air operations will be affected by the summer rains. UNWAFB Forces should be protected against the tropical infections in the area and Forces should receive some acclimatisation and training in a similar area.

(4) Transportation:

(a) Situation and Effects on UFWAFB's Capabilities. Road, rail, water and air transportation is available in the UNWAFB area of operation. The infrastructure is poor and of low quality and this will mean that UNWAFB must make allowances for the delays and uncertainties that this will cause. The poor nature of the roads will have a particularly detrimental effect on vehicle serviceability.

(5) Telecommunications:

(a) Situation and Effects on UFWAFB's Capabilities. UNWAFB could use Binni's public telecommunications system (now controlled and operated by the Gao government) but this system is unreliable and insecure. The UNWAFB will need to use independent comms facilities (including SatCom) – though these

could be based on commercial mobile phone technology. To provide reliable comms either ground-stations will have to be installed or sat-phones should be used. Forces should not rely on ready availability of power from the Binni infrastructure and therefore generators and batteries should be deployed. Reliability of such equipment in the Binni environment will be low unless active measures are taken to avoid contamination by dirt and dust from the local clay which forms a fine, invasive powder when dry which easily penetrates machinery / seals / containers etc.

(6) Politics:

(a) Situation and Effects on UFWAFB's Capabilities. Authoritarian governments are typical of this region and political leadership is jointly shared by the party and military. Corruption in Binni is endemic at all levels of bureaucracy and governments have sought to mobilise nationalism to justify authoritarian rule. The UNWAFB will find that its aims and deeds will be often misrepresented and this will lead to the Forces having to work under severe political constraints on many occasions. Consequently, it is highly likely that military effectiveness will be compromised.

(7) Economics:

(a) Situation and Effects on UFWAFB's Capabilities. The region typically has fundamental regimes which leads to the people being highly disciplined which provides a good basis for economic growth. There is a largely agrarian economy with a rich natural resource base and a large domestic market. The labour force is relatively diligent. As noted before, corruption is rife and it will often be necessary to 'oil-the-wheels' to achieve UN goals.

(8) Sociology / Culture:

(a) Situation and Effects on UFWAFB's Capabilities. State controlled work units still prevail in Binni but are not as dominant as a result of increasing channels bringing in outside influences such as the internet and the media. Conflict in the region would serve as an opportunity to divert the local populations away from their internal problems. Religion is an important influence in the region with Islamic societies predominant. Hence, many of the values of the UNWAFB personnel will seem alien to the local population and personnel must be educated in local traditions and accepted behaviours (especially the importance of the opinions of village elders, religious sensitivities, the need to avoid provocative clothing and an understanding of the Binnians' reverence for wildlife) otherwise serious incidents may occur.

(9) Science and Technology:

(a) Situation and Effects on UFWAFB's Capabilities. Though a relatively backward region, enhancements to the military and military-industrial base are occurring in the area. Hardware and technology in the areas of aerospace and nuclear fields are being acquired from foreign nationals working in UNWAFB. UNWAFB is also pursuing a strategy of close political and economic ties to nations that can offer or pay the right price for goods and services. UNWAFB

personnel must be on the alert for attempts by local people to take UN equipment (often this may occur by subterfuge or force) which would be considered to be a great prize.

8. Overall Own Military Situation (Ground, Naval, Air, Other Service):

a. Strength:

(1) UNWAFB has been provided with the ability to project forces in combined operations into the Binni AOR. The mix of forces deployed by the UN is designed to enable Peace Enforcement Operations (where there will be a limited need to carry out offensive operations or deny the opponent use of certain capabilities), but not to support large-scale occupation of the ground.

b. Composition:

(1) Maritime: Coalition Partner's contributions are:

- UK: HMS INVINCIBLE II plus 8 escort vessels.
- USA: USS H CLINTON (Nimitz Class (CVN84) with TLAMs) plus 11 Escort vessels.
- Australia: ASW vessels (detail TBN for CoAX Binni 2002).

(2) Land: Coalition Partner's contributions are:

- UK: UK 16 Air Assault Brigade deployed from carrier to Costa Del Maria.
- USA: 400 marines plus 25 SF deployed from carrier to Costa Del Maria.

(3) Air: Coalition Partner's contributions are:

- Australia:
  - At Bandar: 8 x F/A-18 Hornet Strike Fighter / Bombers;
  - On Cyprus: 2 x C130H Transport aircraft;
- Netherlands:
  - At Costa Del Maria: 12 x F16 Air Defence Fighters;
- UK:
  - On Carrier: 12 x FA2 Sea Harrier Fighter / Attack and 12 x Harrier GR7 Ground Attack aircraft;
  - At Bandar: 3 x Apache Attack Helos and 24 x Support Helos (Chinook and Gazelle); 12 x Tornado GR1 Ground Attack, 4 x GR1A Recce, and 2 x Falcon EW aircraft;
  - At Costa Del Maria: 8 x Tornado F3 Air Defence Fighters, 18 x Typoon Fighter / Bomber aircraft;
  - On Cyprus: 2 x E3A/D AWACS and 4 x VC10 Tankers;
- USA:

- On Carrier: 24 x F/A-18 Hornet Strike Fighter / Bomber, 24 x F-14 Tomcat Fighter aircraft and 48 x TLAMs;
- At Costa Del Maria: 12 x F15C Fighter / Bomber and 2 x KC135 Tankers;
- On Cyprus: 2 x KC135 Tanker, 1 x E3C AWACS, 2 x C5 Transport aircraft and 4 x C130H Transport aircraft;

(4) Host Nation Force Elements. The Host Nation is technically Gao, but Gao will not allow any UNWAFB forces on its soil. However, some Gao forces occupy parts of Binni and use Binni facilities and equipment. Hence, determining the exact composition of Gao forces is difficult. Though the Gao forces play no offensive part in the UN operations an assessment of their forces will be provided during Phase I of the UNWAFB Operation.

(5) Neutral Force Elements. The other nations in the AOR (other than Agadez, Binni and Gao) have declared themselves neutral and their territory is sovereign and is not to be violated without authority. There is currently little intelligence on their forces other than that in the usual country assessments.

c. Location and Disposition:

(1) UNWAFB Joint and Maritime command and control (C2) is accomplished on the carrier USS H. Clinton. The Marine forces will move their HQ from afloat to ashore as required. Owing to lack of accommodation on board the JFACC has elected to set up the JFAC HQ on Cyprus where there is an extensive support infrastructure. Command, control, communications, computers and information (C4I) systems among the Coalition partners are dissimilar and dispersed and this has caused problems in the past. Flash will be the first UN operation to employ a software-agent enabled infrastructure which aims to provide facilities to quickly build a coherent Coalition capability providing common visualisation, campaign command agility, integration of 'applications' (capabilities) and information, domain-based security etc **[Task for ALL - see** Annex_D**]**.

d. Availability of Reinforcements:

(1) UNWAFB can call upon almost unlimited reinforcements. However, reinforcements could take some time to arrive as, firstly, agreement has to be reached at the UN Security Council and, secondly, it will take time to assemble and deploy the forces.

e. Logistics:

(1) In Binni, Sikasso and Costa del Maria are being used as port staging facilities and agreement has been reached with Gao to use the military bases there as Forward Operating Bases (FOBs) for the UNWAFB marine and air forces. Air, rail and road networks are in place in Binni to reinforce UNWAFB once elements are activated. Resupply into the AOR will need to be by heavy lift from the appropriate countries into Cyprus and then from Cyprus into the AOR (to the FOBs once established) **[Task for CAMPS** Annex_D_GITI**]**.

f. Operational Capability to Launch Missiles:

(1) The UNWAFB has a limited, but potent, capability to launch Tomahawk Theatre Land-attack Missiles (TLAM).

g. Serviceability and Operational Rates of Aircraft:

(1) UNWAFB air defence is accomplished by Typhoon, Tornado F3, F16 with Aim-9 AAM's. Ground attack provided by Harriers. FBA by Tornado GR1 and F/A-18. Final capabilities will be updated during Phase I of the Operations.

(2) Serviceability and mission success is expected to be excellent as all air forces have been regularly involved together in Dissimilar Air Combat Training (DACT) and have harmonised tactics, procedures and equipment.

h. Technical Characteristics of Equipment:

(1) The UNWAFB's equipment is mostly robust, reliable and modern and (mostly) conforms to the standards of interoperable capability agreed amongst the UN nations in 2006. The C4I systems are deliberately diverse as an anti IO tactic. UNWAFB must not become over-reliant on its advanced technical capability and must be able to exploit low-tech capabilities if they are all that is available in a particular location.

i. Electronic Intelligence:

(1) UNWAFB possesses significant electronic intelligence capability. However, as Agadez uses relatively low-tech equipment there is an asymmetric warfare threat (makes some opponent's forces almost 'invisible') which not be forgotten.

j. Space:

(1) The UNWAFB can call upon certain space assets available through Coalition partners as necessary.

k. Nuclear, Biological and Chemical (NBC) Weapons:

(1) Protective capability for NBC will be deployed.

l. Significant Strengths and Weaknesses:

(1) UNWAFB possesses a strong (though limited) military capability which can (through 'reachback' and reinforcement) be expanded to be totally dominant. The Coalition partnership is strong but there will be attempts to weaken it politically or through the media. Also, there may be too much reliance on high-technology to the exclusion of human cunning.

9. Own Unconventional and Psychological Warfare Situation:

a. Special Forces:

(1) UNWAFB possesses special forces which can be deployed if required.

b. Psychological:

(1) UNWAFB should commence a 'hearts-and-minds' programme to persuade all local people that the UN forces are there to help them.

c. Subversion: UNWAFB can demonstrate a capability if required – though there is no mandate for this task.

d. Sabotage: UNWAFB can demonstrate a capability if required – though there is no mandate for this task.

10. Own Information Operations (IO):

a. Media Operations:

(1) SRSG has placed a special emphasis on the need to establish and maintain robust media operations to ensure that the truth about all operations and activities are known as widely as possible. Key to this is a robust and speedy information infrastructure (with appropriate equipment – at least as good as the commercial reporters) capable of moving information throughout all levels of command and to all units so that opportunities and incidents can be dealt with authoritatively, credibly and as quickly as possible **[Task for ALL - see** Annex_D**]**.

b. Operations Security (OPSEC):

(1) As the opponent actively conducts intelligence collection through several means, UNWAFB personnel must be extremely vigilant about OPSEC. The wide distribution of information in a Coalition is a specific risk and monitoring of information distribution must be carried out. Mechanisms should be in place to quickly deny information should this be required to ensure OPSEC **[Task for Boeing** Annex_D_Boeing**]**.

c. Military Deception:

(1) A deception operations capability exists.

d. Physical Destruction:

(1) UNWAFB can only destroy facilities when approved.

e. Electronic Warfare:

(1) UNWAFB has an excellent EW capability. However, the asymmetric nature of the threat needs special assessment and appropriate strategies, procedures and tactics be employed.

f. Computer Network Attack (CNA):

(1) UNWAFB does have computer network attack personnel. However, through the market place Agadez has acquired a viable threat which could be used against UNWAFB's information infrastructures. As the Coalition's infrastructure is heterogeneous and widely dispersed its vulnerability is assessed as high. Hence, part of the Coalition security features must include capabilities to deny access from the outside or, if hostile access is achieved, to minimise it's effect. Systems should 'degrade

gracefully' and all should be able to maintain a 'spartan' (minimum) set of services **[Task for Boeing / UWF / IHMC** Annex_D_Boeing**,** Annex_D_UWFIHMC**]**.

11. Conclusions: UNWAFB is a strong and capable force which is well able to cope with the demands of a Peace Enforcement Operation in Binni. However, the greatest threats to success come from any undermining of the political determination of the UN or the Coalition Partners, from media activities and from incidents sparked by cultural, religious or other misunderstandings between the UN Forces and the local population. Tactical threats to success come from the dispersed 'irregular' nature of much of the opponent's forces and their dispersal across a wide area where they can hide among the local community.

CHAPTER 12. (ANNEX B6)

BINNI FLASH - COMMAND MODEL

Document_Structure, Annex_B1_Political_Situation, Annex_B2_Military_Situation, Annex_B3_Civilian_Situation, Annex_B4_Environment, Annex_B5_Updated_Intelligence

PART ONE: BACKGROUND AND MILITARY OVERVIEW

BACKGROUND

1. This section is a 'tutorial' (known as the "Command Model") on the military and command context used in CoAX. The model is based on current doctrine and does not fully reflect how future operations might be conducted - or might be changed by CoAX (which could be a separate study) - but the model is adequate for the CoAX demonstrations. This section is structured as follows:

- Part One: Background_and_Military_Overview: an overview of Coalition Organisations and Processes with pointers to detail provided in the rest of the document;
- Part Two: Coalition_Organisations_and_People: a description of how a Coalition is organised and the names and roles of the people in the organisations.
- Part Three: Coalition_Processes_and_Terms: explains the main stages that occur in a Coalition Operations and gives some detail of the processes involved. This part is not exhaustive - but does cover the exacting (and often overlooked) Execution environment.
- Part Four: Coalition_CoAX_Technical_Issues: summarises technical issues raised by using software agents in a Coalition Operation - some of which are dealt with by CoAX.

2. The tutorial is needed because the CoAX TIE aims to have demonstrations which tell a 'militarily valid' story and it was felt that it would be helpful for there to be some overview of the military issues.

[PLEASE NOTE: The information is as US / UK generic as possible but as there are subtle national differences, there may be items that are too UK-centric.]

MILITARY OVERVIEW

3. The basic organisation, function and processes within a Coalition are summarised below:

a. Coalition Command and Control (C2) Organisation: (see Part Two for more Detail)

- Coalition Operations are Multi-national operations, led by a nominated nation (the Framework Nation), taking place Out-of-Area, based in a country (the Host Nation) which provides the basic infrastructure and Host Nation support and involving an unspecified number of allies (some of whom may not have been involved in the past and with whom there may not be specific agreements / MOUs on how to interoperate).

- There is only ONE C2 structure in a Coalition (which is agreed as part of the Coalition setup) and which enforces legal lines of Command responsibility - the so-called 'command chain' (shown as a solid black line on Figure 1, page 2-1).
- The Coalition formation process will vary depending on which partners are involved. Some countries will be part of organisations such as NATO which already have agreements and standards in place as to how they will interoperate. Some countries will have bilateral agreements. Others will have none.
- The Levels of Command are as follows: the top level of command is the Political (or Grand Strategic), the next is called Strategic (or Military Strategic), next down is Operational and the lowest level is Tactical.
- Each military HQ at each level (known as a 'command HQ') has its OWN commander (responsible to a higher authority and with his own subordinate HQs). Also, each Commander is supported by a set of people and in the JTFHQ these are known as the 'J-staffs'. For a particular conflict, a senior military commander (usually the JTFC) is nominated with overall responsibility for the activities 'in Theatre' (ie within the Area-of-Responsibility (AOR)) and all other Coalition HQ Commanders are subordinate (no matter which country they're from - see Figure 2).
- Coalition partners contribute forces to the Coalition as agreed and the forces come under the command of the appropriate Coalition Commander.
- Each nation will have its own representative(s) in each of the appropriate HQs and these National Representatives report back through their OWN NATIONAL command chain (this is shown in grey on Figure 3 (in Part Two below)) with its own command structure repeated FOR EACH OF THE COUNTRIES IN A COALITION! That's why Coalition is so complicated ...

b. Coalition Tasks and Processes (see Part Three for more Detail):

- The Command Ethos is the structure of military process activated to meet a particular political aim. In a Coalition Operation the dominant Command Ethos will (probably) be that of the Framework Nation and all Allies / partners will have to align their ethos and processes to the dominant one. It is possible for the ethos to be technology driven (humans adapt to the technology) or ‘command-led’ (technology is adapted to support the human). The declared UK preference (as stated in the Joint Battlespace Digitisation programme) is to be command-led.
- The Coalition Commanders agree ONE set of processes which will be used in all the appropriate Coalition HQs and which will be co-ordinated through the legal (shown by the solid black lines in Figure 1) command chain.
- Command processes are not sharply defined nor delineated and they overlap the HQs / levels of command in varying degrees depending on nature of the operation and size of forces involved. A key military aim is to retain flexibility and to be able to adapt to circumstances / exploit opportunities - so-called 'command agility' - hence processes are not applied mechanistically. Also, a set of related processes are carried out by a nominated group of people who form a 'functional area' such as weather forecasting.
- The planning tasks are cyclic and iterative and proceed IN PARALLEL and consensus is reached through a great deal of negotiation which occurs horizontally and vertically throughout the command structure and through the sharing of 'common visualisations'.

- Coalition HQs have certain 'interfaces' between each other (where they pass information they know they must make available for each other in a 'customer / supplier' sense). They also have pre-determined times for 'rendezvous events' such as the dissemination / receipt of formal 'documents' or for having briefings / meetings when they must co-ordinate decisions because of certain dependencies (see Figure 8 for a diagram illustrating this and Figure 12 for an example timeline). These are all co-ordination and synchronisation mechanisms.
- Each set of National HQs and reps MAY use alternative procedures. However, at the 'interface' with the Coalition (usually through the human rep themselves) the procedures must interoperate with the agreed Coalition ones.
- J-Staff - Tasks and Responsibilities. An overview of the main military processes carried out by each of the functional areas follows (only the numbers for the 'J-Staffs' - J1 to J9 in the Joint HQs - are shown). [NB: To decode the reference to "Stages" see Figures B6-9 and B6-10 - which also show the processes in time / dependency order]:
    - Personnel and Admin (J1). This Functional area is responsible for tasks as varied as pay and general administration, medical, casualty reporting, typing and filing etc. Not specifically part of CoAX.
    - Information Operations and Intelligence (J2 and J3 Targets). Information operations are related to the offensive and defensive use of information. Intelligence activities are carried out continuously at all levels and throughout the conflict. The intelligence process is complex and varies greatly from nation to nation, but basically involves the following:
        - Raw Data and Information are always being gathered and processed into Intelligence and then stored for future use.
        - Once a conflict starts, existing intelligence is moved into the Theatre and then updated by the activation of the basic 'intelligence cycle' involving:
            - Direction:
                - managing requests for information (RFIs),
                - planning and directing collection of information,
            - Collection: collecting any data or information available or required by whatever means available - the "exploitation of sources",
            - Processing: changing information into intelligence, involving:
                - Collation - the bringing together of similar strands / themes / types of information so that one subject at a time can be analysed - brings order to a pile of information;
                - Fusion / Integration - bringing together information on the same subject from different sources and means of collection so enabling the development of themes; and
                - Analysis - (includes Evaluation) looks at data to establish a true meaning and draw deductions),
            - Dissemination: producing 'intelligence products' (in the form required) and disseminating the products / making them available.

        - The intelligence teams also support the selection of objectives / targets and,
        - after execution, carry out 'combat assessment' and 'battle-damage assessment'.
    - Operations - Execution and Execution Monitoring (J3): Execution of tasks happens continually at the Tactical Level and the progress of the execution (and the associated opponent action) is always under scrutiny. CoAX deals with the (exacting) challenges of execution from the 18-month point onwards. The execution environment is where there is **most scope for a pay-off from agent technology** as it is the most demanding in human terms; some issues:
        - Execution / execution monitoring is a real-time / near-real-time task - it is not cyclic (like planning is currently) and its aim is to monitor for deviations from the expected plan(s) where the situation is *always changing* and nothing is certain or constant.
        - It is about managing a *'trajectory of change'* and is a challenging environment for humans and machines where the visualisation of the expected plan in relation to the actual situation is of *crucial importance*. It relies on a good understanding of the mind of the opponent.
        - As the process is simply "execute and then monitor for deviations" this task is about putting in place the personnel, procedures and techniques for effective monitoring and then having a large number of contingencies in place which can be activated to achieve the appropriate 'repairs'. It is event driven.
        - There is an important balance between just being reactive or seizing the initiative. It is about guiding and shaping execution (being adaptable and flexible) and is about using delegated initiative in unexpected situations and 'exploiting fleeting opportunities' to the benefit of, and within the overall intent of, the Coalition activities.
        - Effective interplay between the planners and the execution / execution monitors (especially in the mutual understanding of the intentions behind the phases / components of the plan) is vital to the success of a conflict and harmonising this activity is as much about human factors, concepts, visualisations and procedures as it is about tools and technology.
        - This execution monitoring happens throughout the command chain with commanders at different levels carrying out different kinds of adjustments which have impacts in different timescales.
        - It relies on real-time / near-real-time sensors and information feeds and excellent communication throughout the battlespace.
    - Force Protection (J3). Force Protection is concerned with the measures to reduce damage inflicted by the opponent and it concentrates on protecting personnel and infrastructure. It includes items from camouflage and concealment to physical protection from blast, chemicals etc to procedural techniques, medical provision etc etc. Not specifically part of CoAX.
    - Sustainment and Logistics (J4). This deals with all elements of supply and maintenance (including engineering and medical elements) and is about managing the provision of resources as well as dealing with the short-notice

requests for re-supply during operations. A large part of this task relates to consignment tracking from demand, through to production and on to the point of use. It also includes transportation: eg airlift operations and the planning and execution of deployment and recovery of forces.

- Planning (J5 and J3): Planning is currently a cyclic activity, with the length of the planning cycles and 'look-ahead' factors varying throughout the Levels of Command (shown in Figure 1):
    - Political / Military strategic planning (Strategic Estimate) happens at the top levels (UN / National Commands / Joint HQ); The planning is for the whole crisis (and generates a Strategic Guidance document), but is reviewed regularly with a 5 - 30+ days look-ahead (Pre Stage 1).
    - The (Joint) Operational Estimate (Stage 1, 3) and Campaign Planning (Stage 2, 4) happen at the Operational Level (JTFHQ) assisted by lower commands - based on the Strategic Guidance; The plan is for the whole Campaign but is reviewed daily with a 3 - 7+ days look-ahead. A Campaign Plan will have a number of Phases and the sequencing / branching of the Phases is reviewed.
    - The 'components' (Army, Navy, Air force etc) then do their own planning - based on the Campaign Plan and the JTFC's Guidance. There are two types of plan at this level:
        - Operations Plans (Stage 4) are for a Phase of the Campaign (eg: an Air Ops Plan would be produced by the USAF / RAF) and are produced at the Operational Level (JFAC HQ, JFMC HQ, JFLC HQ etc) assisted by Tactical Level HQs. The Operations Plans are briefed to the Higher Command for approval and are reviewed about once a day with a look-ahead of 1 - 3 days.
        - Tasking Orders (OpOrd - Stage 5, 6) are produced (currently) at the Operational Level for a specific day of the conflict. The Tactical Level HQs are closely involved, as are the other Component HQs (to ensure Joint Co-ordination). The orders are reviewed continually up to their formal release (as a legal tasking) with a look-ahead of 12 - 36 hours.
    - Mission Planning (Stage 7) is done at the Tactical Level by the units in response to the Tasking Orders and are reviewed continually up to execution starting with a look-ahead of a few hours.
- Command Information Systems (J6). The CIS activities relate to providing and maintaining the appropriate Information System infrastructure to support operations. CIS is also concerned with Information management, controlling networks, security issues etc. The CoAX research will affect this functional area.
- Doctrine and Training (J7). This group review standing doctrine and oversee training. Not specifically part of CoAX.
- Resources and Finance (J8). This group oversee financial issues. Not specifically part of CoAX.
- Civil / Military Co-operation (J9). The J9 branch provides a source of civil-military consultation and advice to the JTFC. It is likely to include augmentees specialising in Civil-Military Co-operation (CIMIC) and legal affairs:

- Military and civilian specialists in critical civilian functional skills may also be co-opted if appropriate. Not specifically 'played' as part of CoAX - though has an impact on the scenario we've chosen.
- The Legal group advise on all matters relating to the conflict where there may be a legal dimension. Legal staff are usually found in J3. Not specifically 'played' as part of CoAX - though has an impact on the scenario we've chosen.
- Media Operations. Media operations are a very important part of any modern conflict and are concerned with projecting certain 'messages' to the general public / politicians etc or with counteracting the 'spin' on unfavourable messages. Media Operations ARE NOT part of Information / Intelligence Operations, but may be found within J3. Not specifically 'played' as part of CoAX even though it is one of the key parts of the UN Directive in the Binni Flash scenario.

NB: The Intelligence staff in the Air (JFAC) HQ are A2, in the Land (JFLC - Ground) HQ are G2, in Naval HQ are N2 etc etc for the other staffs: A3, G3 and N3 are Operations etc etc.

4. If you wish to study these issues in more detail, please read Parts Two and Three, otherwise you may wish to look at Part Four which examines the mapping of the military issues to CoAX technical ones.

COALITION CONTEXT AND COAX MILITARY AIMS

5. The nature of Coalition operations implies the need to rapidly configure incompatible or foreign systems into a cohesive whole. Several key principles apply, that:

- the issues relate to those involved in the creation and maintenance of a coherent Coalition organisation (with real and virtual parts) from the diverse and disparate 'come-as-you-are' elements provided by the Coalition Partners (people, processes and systems),
- all Coalitions are a dynamic (ever-changing) mix of heterogeneous and disparate elements and that maintaining the cohesiveness of the Coalition requires a continuous, pro-active readjustment process,
- multiple Coalitions may be active at any one time ('competing' for resources etc) and a decision in one may affect another concurrent operation,
- partners may be part of a Coalition - but their contributions may be anonymous (to protect sources etc),
- Coalition elements should be supported by appropriate IT in achieving 'unity of action',
- "interoperability of the mind" is as, if not more, important than interoperability of systems,
- the difficulties are compounded in the virtual organisation of the Coalition since there will be a mix of doctrines equipment, operational procedures, languages, etc,
- most Coalitions will have commercial / civilian elements - appropriate interoperability will have to be provided with their infrastructures,
- the Command Process is ‘command led’ and is characterised by a mix of deterministic and naturalistic decision-making styles,

- Coalitions consist of loosely connected elements working semi-autonomously, and within their delegated authority, towards a common goal (as defined in the Commander's Intent). Elements need to rendezvous (and synchronise) only occasionally and must be free to optimise locally / snatch fleeting opportunities etc,
- supporting the achievement of command agility (working in a flexible, unpredictable manner - where the decision-maker is the only thing on the critical path - leading to decision-dominance over the opponent) is vital. This is especially so in the crucial (and often overlooked) part of conflict - that of Execution and Battle Management,
- enabling commanders to access relevant Coalition-wide information ***as and when they demand it*** to support their decision-making is crucially important to a successful outcome. Information should not be pushed according to some rigid, pre-determined process.
- there is a pressing need to set up Coalition organisations / systems rapidly (in order to respond decisively to emerging crises),
- systems provided to support the humans must be robust, secure, dynamic and adaptable and must not constrain human actions,
- there must be no single point of failure in the Coalition and performance must 'degrade gracefully' and / or systems must self-heal.

DEDUCTION: Coalition operations are complex, heterogeneous and change dynamically and it is difficult to achieve and maintain coherent operations, with shared information and battlespace visualisations.

GENERAL COAX IMPLICATIONS: Our aim is to focus the TIE on these coalition-specific issues, particularly the fact that we are embracing heterogeneity, not excluding it. In doing this, we wish to use a Coalition scenario which will provide a suitable stimulating framework for the research into agent technology which would support an enhance operations in these complex real and virtual organisations.

PART TWO: COALITION ORGANISATIONS AND PEOPLE

Links to: Document_Structure, Background_and_Military_Overview; Coalition_Processes_and_Terms; Coalition_CoAX_Technical_Issues;

6. Please read para 3a in the Overview (above) first. This section contains the diagrams which show the organisations and people involved in more detail and aims to show the differences between:

- organisational (command) 'domains',
- individual commanders' responsibility 'domains'.
- country domains.

These are three separate things with different overlaps depending on the viewpoint. I would define domains as "bounded objects (which can interoperate via intermediate structures) with clear identities and ethos. Each domain contains entities and organisational structures working collaboratively and sharing information, processes and 'control' procedures such as security regimes and policies".

ORGANISATIONAL DOMAINS

7. Organisation, Levels of Command and Command Chain. A Command Organisation chart was provided in Binni_Flash_Scenario_4-0-3.doc, Annex B2, page B2-1, but it has now been superseded by the information below. Firstly, Figure B6-1 shows the Coalition structure on its own - this is a single organisational 'domain' and information would be shared across the domain at a common security level.

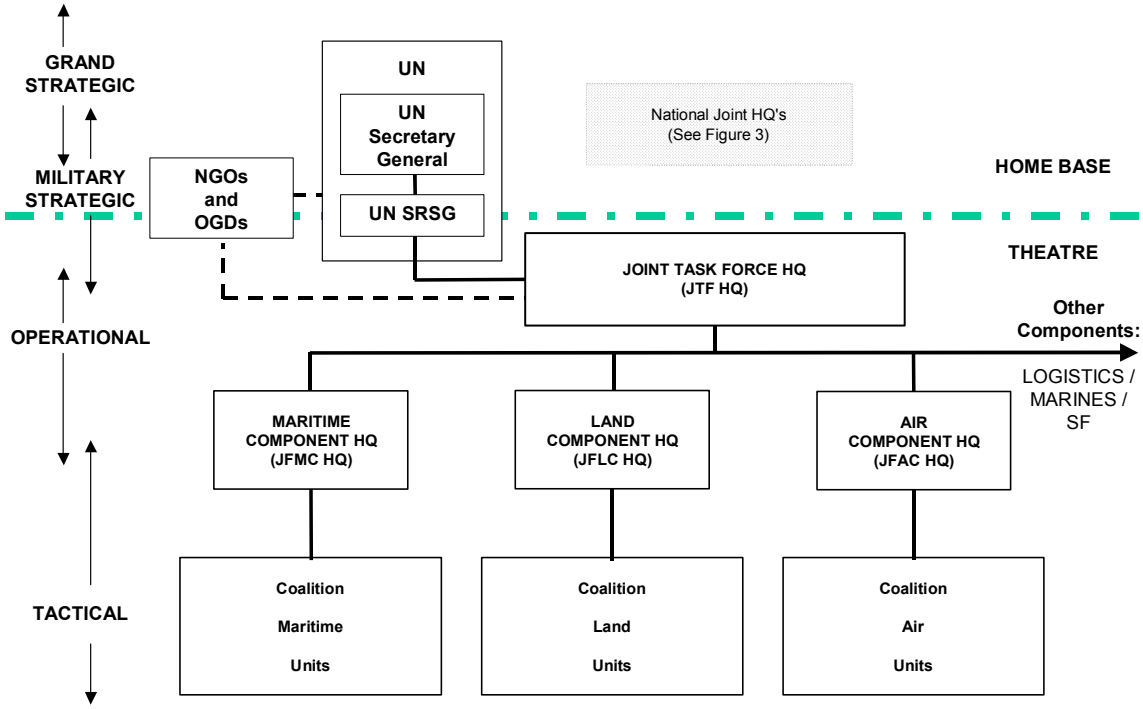


Figure B6-1 - Binni Coalition - Command Structure and Organisation

8. The solid black lines on the diagram show the legal lines of command authority (the 'command chain') and accountability. Dashed lines show an advisory / negotiating role. This is the kind of Coalition structure which would be agreed by the participants and no part of it is 'owned' by any specific country. The higher levels of Command (Strategic and Operational) deal with the task of Campaign Plan formulation and maintenance, whereas the lower levels of command (Operational and Tactical) deal with Battle Management and the execution of operations. The Execution environment is a particularly crucial and difficult one where software agents can make a significant contribution - it worth whole spending time studying this often-overlooked aspect of Command.

9. Not shown are the other Components (Logs, Special Forces (SF) etc) - NOTE that if there were no air forces in a conflict then there would be no JFAC HQ etc. Also note that the 'Levels of Command' overlap - the boundaries are not rigidly fixed. The JTFHQ and Component HQs span the critical operational / tactical boundary which can *roughly* be equated to the planning / execution boundary.

INDIVIDUAL'S DOMAINS

10. Scope of Commander's Responsibilities . In Figure B6-2, the Commanders have been added to show the scope (extent) of their responsibilities and the title given to their staff. In simple terms Commanders have responsibility for the effective running of their own HQ AND all their subordinates - in practice they delegate the authority to their subordinates. Hence the 'domains' of individual influence overlap - shown with the 'blob' shapes on Figure B6-2.

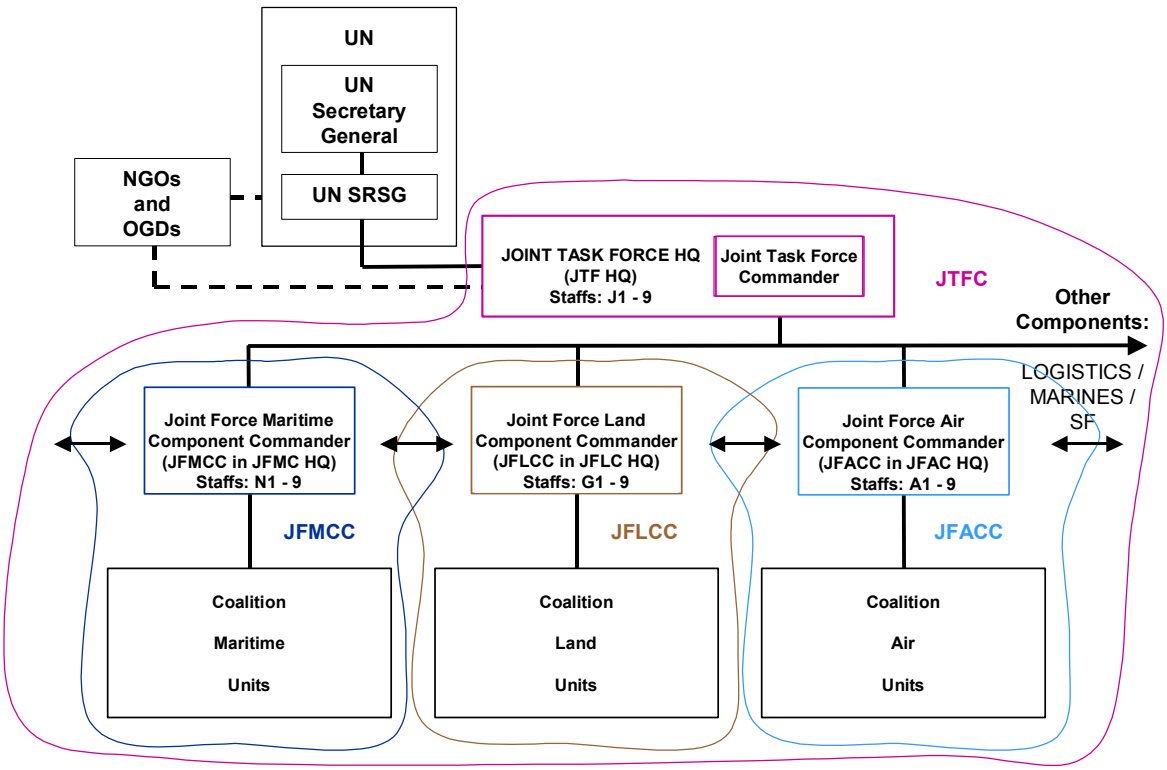


Figure B6-2 - Binni Coalition - Commanders' Responsibilities

Up until recently each HQ at each level of command tended to organise themselves as they wanted. Now that Joint Operations are commonplace there is much more commonality in the way the HQs are organised and in the way that they negotiate and co-ordinate their actions. The overlapping Component domains (with the double-headed arrows) indicate that active co-ordination occurs between ALL the components and specific types of functional teams ('operations co-ordination centres') exist to do this task.

COUNTRY DOMAINS

11. Relationship to Coalition Partners. The picture at Figure B6-1 is further complicated when the Nations making up the Coalition are considered. Each nation will have their own representative(s) in each of the appropriate HQs and, as well as working within the Coalition structure, these National Representatives report back through their OWN NATIONAL command chain (this is shown in grey on Figure B6-3) with its own command structure which is repeated FOR EACH OF THE COUNTRIES IN A COALITION! This is shown in the diagram by the overlapping grey boxes.

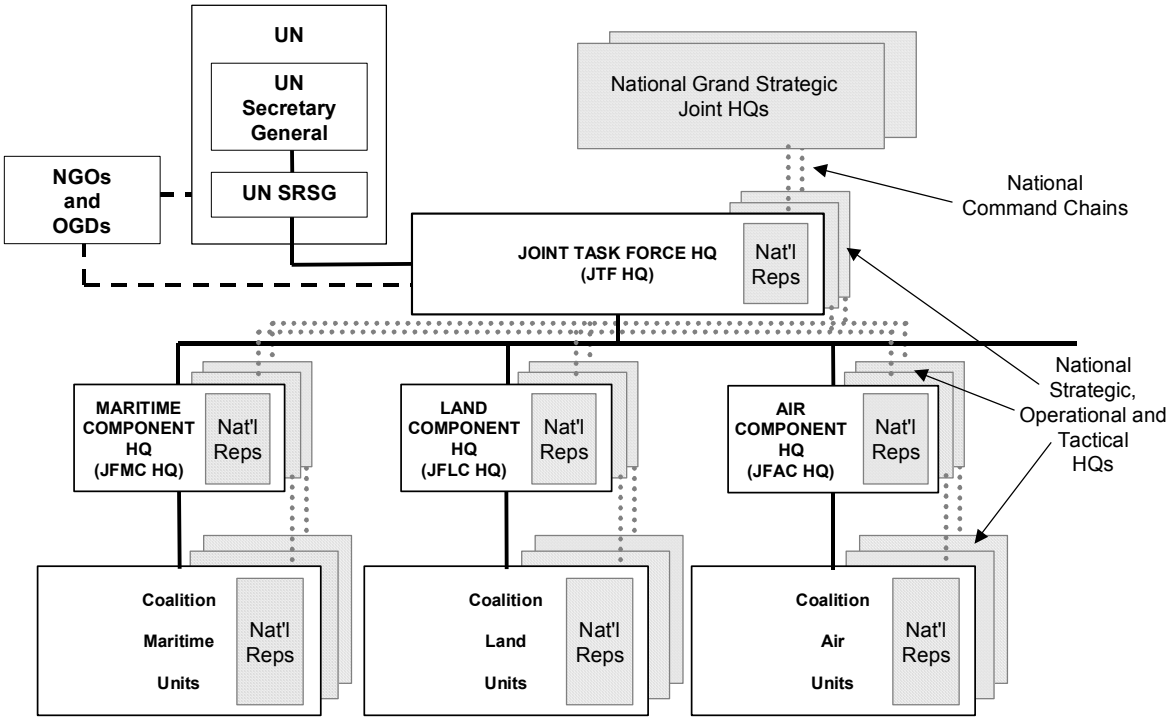


Figure B6-3 - Binni Coalition - National Command Structures and Organisations

Each of the National command chains would be a separate, self-contained 'domain' with its own processes, information, security regime etc. The interface with the Coalition is often through the National Reps (liaison officers) who carry out any necessary 'translation' - they also often act as a safely gap for security reasons. Figure B6-3 shows each Nation 'ghosting' all of the Command HQs - in practice each Nation will provide different degrees of command 'presence'. The UK has a 'National Contingent Command Structure' which does not necessarily provide UK HQs at all levels - it depends on the size of the conflict and the amount of UK forces committed.

12. The final complication would be that certain countries agree to share certain facilities and information and they create special 'compartments' where information is shared between them - these extra entities are not shown on Figure B6-3! Also, Commanders themselves come from different countries (NB: this does NOT make them a National Rep), however, it will give them access to various pieces of information: eg: A UK JTFC would 'exist' at the intersection of a number of organisational, individual and country domains as shown in Figure B6-4 and discussed further below (NB: I have NOT shown the mapping to Agent Domains on this diagram - another type of notation will need to be used - see Part Four for a discussion of this mapping to technical domains).

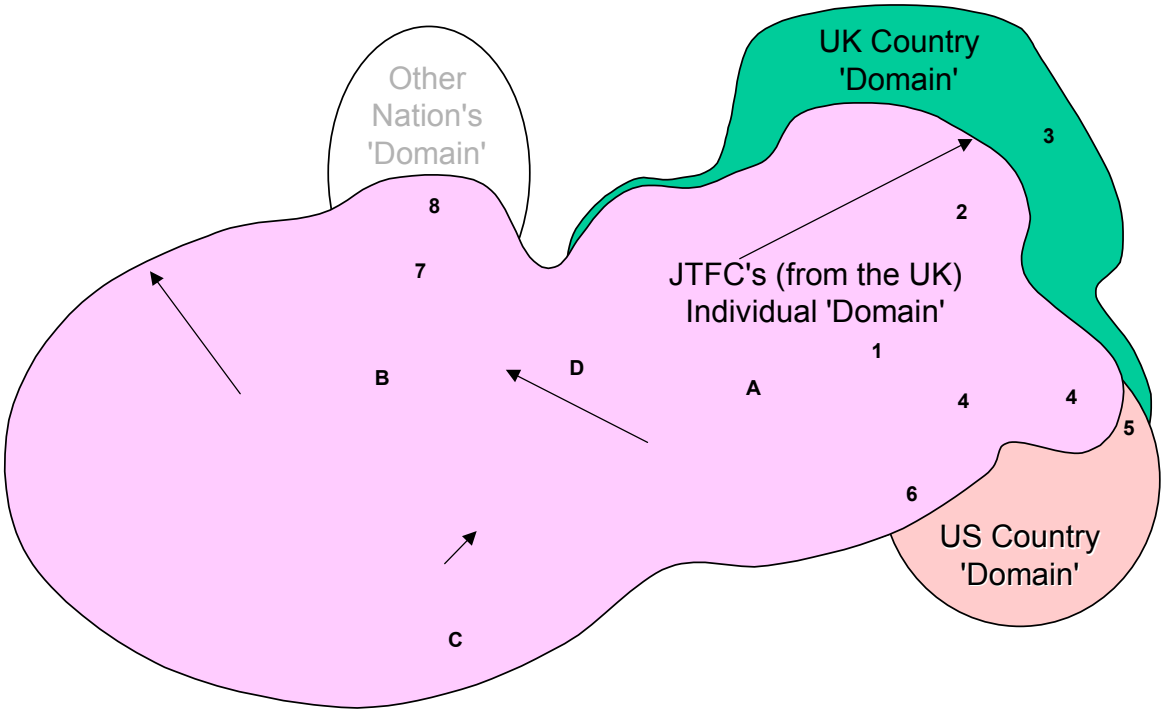


Figure B6-4 - Binni Coalition - Example 'Domain' Intersections

13. Figure B6-4 then shows intersections of the JTFC's individual domains with organisational, national and functional domains as follows (please note that these intersections are quite realistic):

- The JTFC is able to access Coalition information:
  - in the JTFHQ (A), the JFAC HQ (B) and Tactical HQs (C).
  - Also, UK information (1, 2 and 4) but not all of it (3 and 5) as there may be highly sensitive National secrets,
  - US information (4) that's being shared with the UK - but not all of that (5), and in addition the JTFC knows some US info which hasn't been passed on to the UK (6),
  - and information within the scope of his authority which overlaps with other Nations (8) but which may not be available to the wider organisation. Simple isn't it!

Figure B6-4 also shows some intersections between organisational domains: the JTFHQ shares some information with the JFAC HQ (D); between countries: UK / US (segments 4, 5 and 6 collectively); between countries and organisations: UK with JTFHQ (segments 1 and 4), US with JTFHQ (segments 4 and 6); Other nations with the JFAC HQ: segment 7.

PART THREE: COALITION PROCESSES AND ASSOCIATED TERMS

Links to: Document_Structure, Background_and_Military_Overview; Coalition_Organisations_and_People; Coalition_CoAX_Technical_Issues;

14. Please read para 3b in the Overview (above) first. Hopefully the Overview above will have cleared up confusions about what we mean by the coalition C2 / military C2 process / mission planning / execution, ie, that:

- Military C2 plan co-ordination is part of the Coalition C2 process and not a different thing;
- the process panel would be used by J5;
- also, as MBP sits at the Operational Level it is not a mission planner (which plans the detailed profile of individual missions), but is an 'air battle planner' and would be operated by A5 and A3 in producing the Air Operations Plan / Directive;
- domain security and exception monitoring would be handled by J6 in association with J3;
- much of the observer reporting would support J2;
- and, that as CAMPS does air mobility planning it is part of J4 and not part of J3 or J5 (how are you doing so far?).

Please remember that much of the co-ordination in a military Coalition is done procedurally through the way that doctrine, concepts of operation and processes are aligned and agreed among the Coalition Partners and there is NO REQUIREMENT for an extra co-ordination process (run autonomously / unilaterally by the agents). However, they certainly will ASSIST and support the planning, visualisation, execution, monitoring, co-ordination and information exchange activities described in the Overview.

COALITION PROCESSES

15. The Coalition military C2 process will be essentially the same as the Joint Process already described as there is spreading common understanding of it. It would be different in very small or specialised scenarios where it may well be 'hand crafted'. For the purposes of CoAX the Joint process is satisfactory.

16. The description and diagrams on the following pages show a high-level representation of the Joint Process and its intersection with the Air Component. The intersection with the Land and Maritime Components is very similar and needs to be provided in due course.

THE JOINT PROCESS AND MAIN STAGES

17. In the future the fixed-cycle nature of the command Process will become much more dynamic and 'agile', however, for CoAX, the 'enterprise model' shown below is adequate and is heavily based on current doctrine. I do not intend to describe the process in great detail in this document, but the following gives some feel for the issues. The overall view of the process at the Grand Strategic Level (with a breakout of the Campaign Planning process at the Operational Level) is shown in Figure B6-5 below.

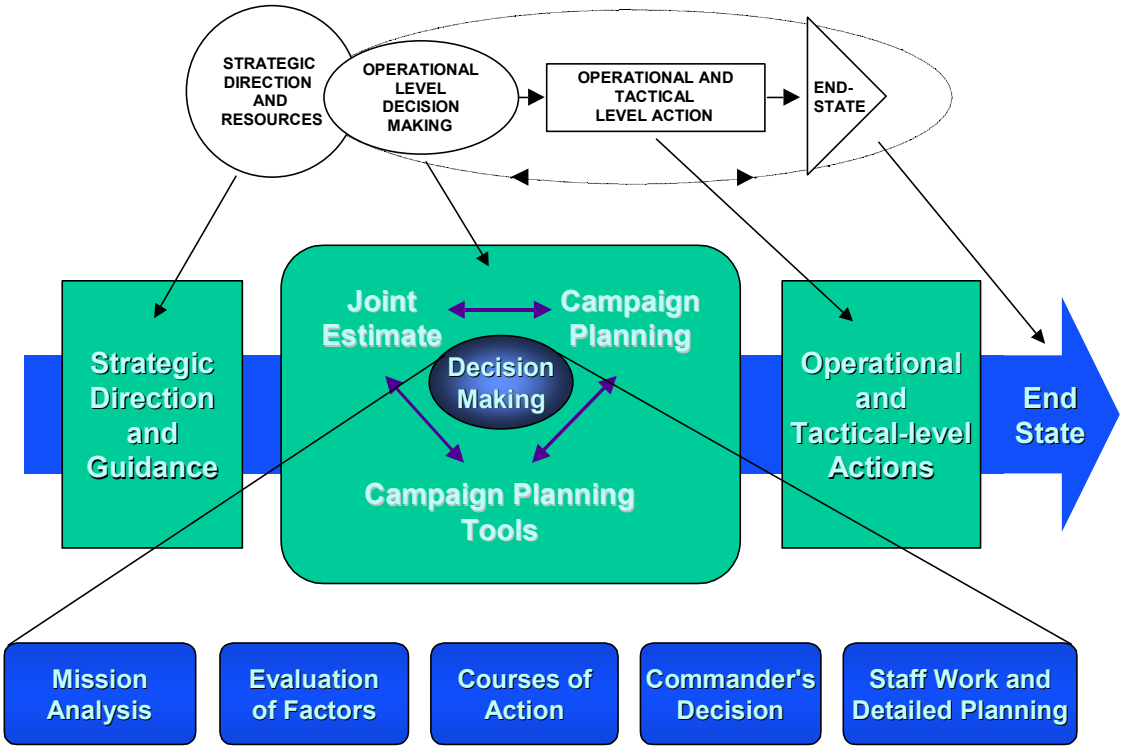


Figure B6-5 - Binni Coalition - Grand Strategic Process - 'Operational Art'

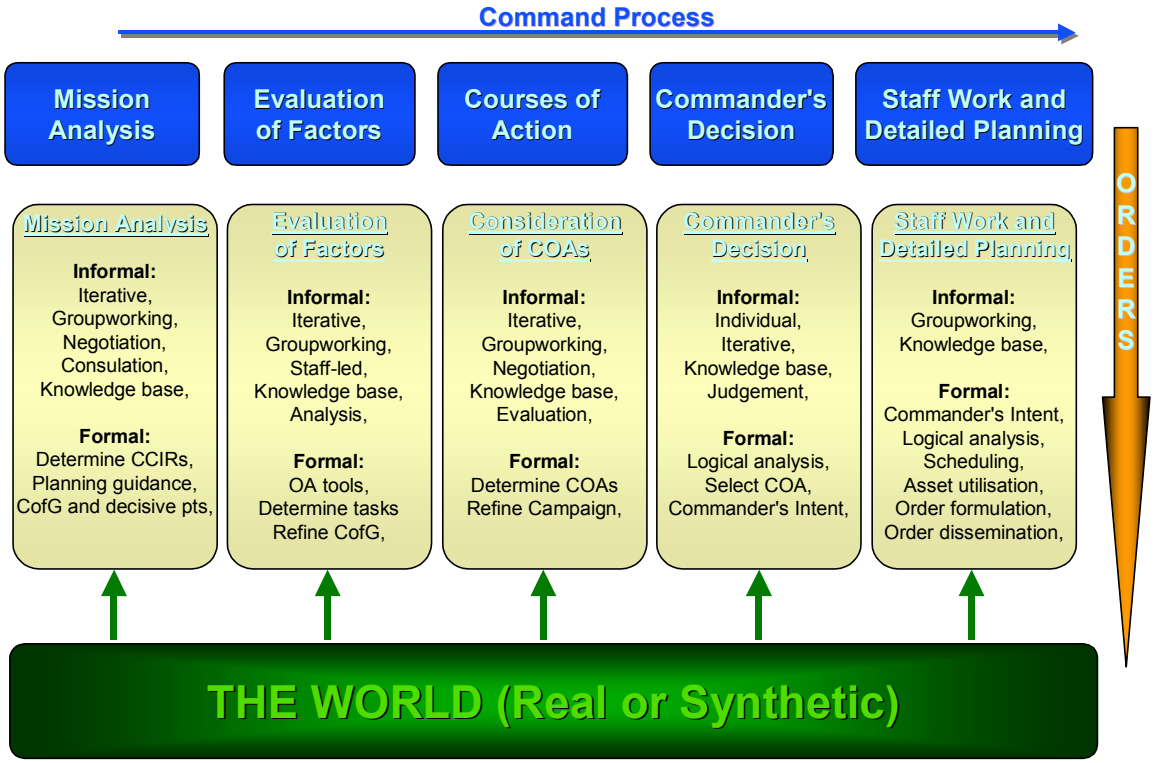


Figure B6-6 - Binni Coalition - Command Process - Operational 'Tools'

Figure B6-6 above is a representation of the 'tools' used at the Strategic / Operational Levels and the next diagram, Figure B6-7 below, is a generic Model of Command for a Headquarters, it shows that there are two parts: one informal (where all the liaison and negotiation occurs) and the other formal (ie the legal command and reporting chain). This model maps on to the J-numbers (see the description of the J Staff Tasks above) as follows: J2, J3, J4, J5 and J9 are involved in the informal process (planning) and J2 and J3 in the formal process (issue of orders and execution monitoring). J6 are involved in the provision of C2 support.

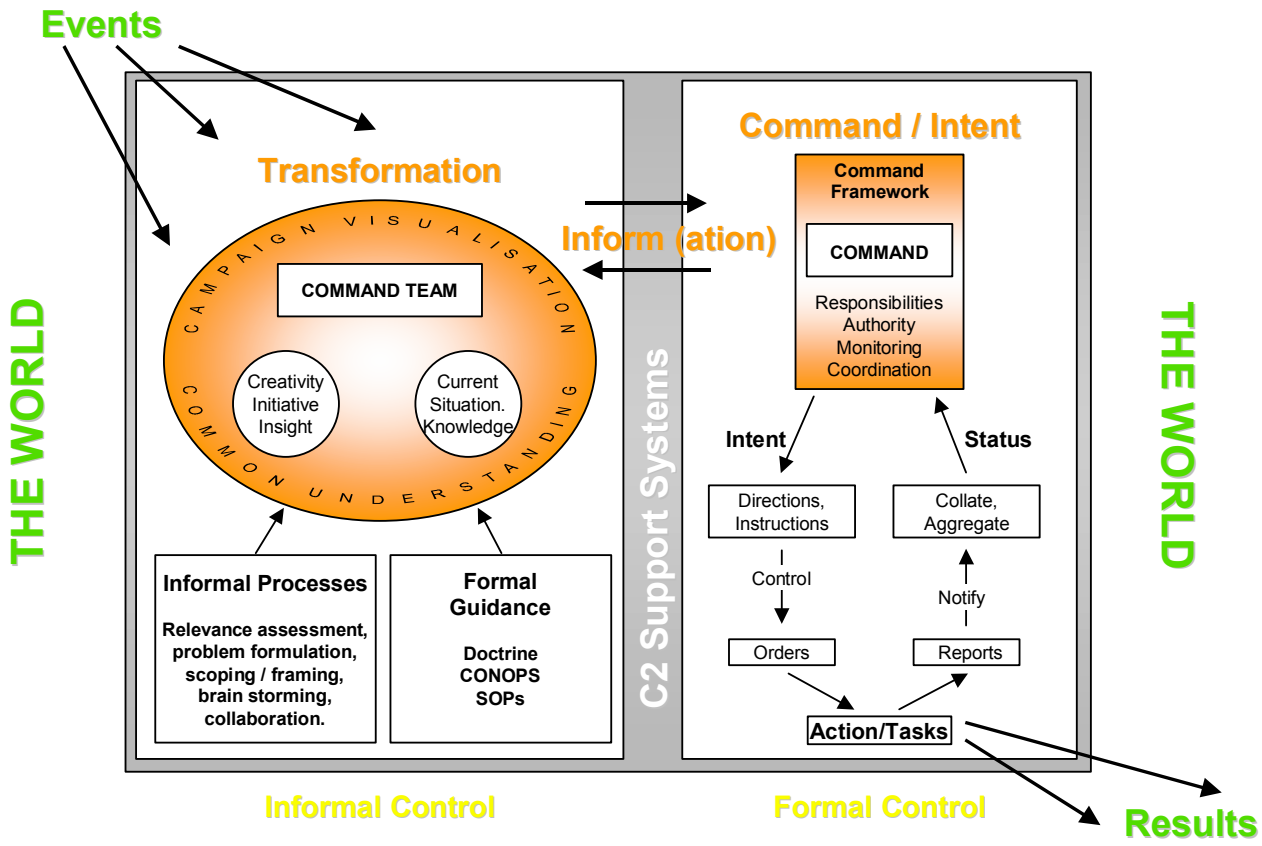


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Figure B6-7 - Binni Coalition - Generic Model of Command for an HQ

PHASES OF AN OPERATION

18. There are three basic Phases in any operation (illustrated in Figure B6-8 below):

- Initial Planning - is where the political aims are translated into military objectives, a suitable force structure is selected and deployed and an initial Campaign Plan is developed. This activity is process-driven and is relatively orderly and linear (though with many concurrent elements).
- Execution and Battle Management - is where the forces engage with an opponent and an outcome will be determined. This activity is very event-driven and 'fractal' with loops-within-loops of delegated decision-making activity cascading down to the lowest level. This activity should not be controlled centrally (a Soviet model), but authority to act on initiative (within the Commander's Intent) should be seen as the way to success.

- Recovery - is where the conflict is resolved and forces return home. Again, this is a more linear and orderly activity.

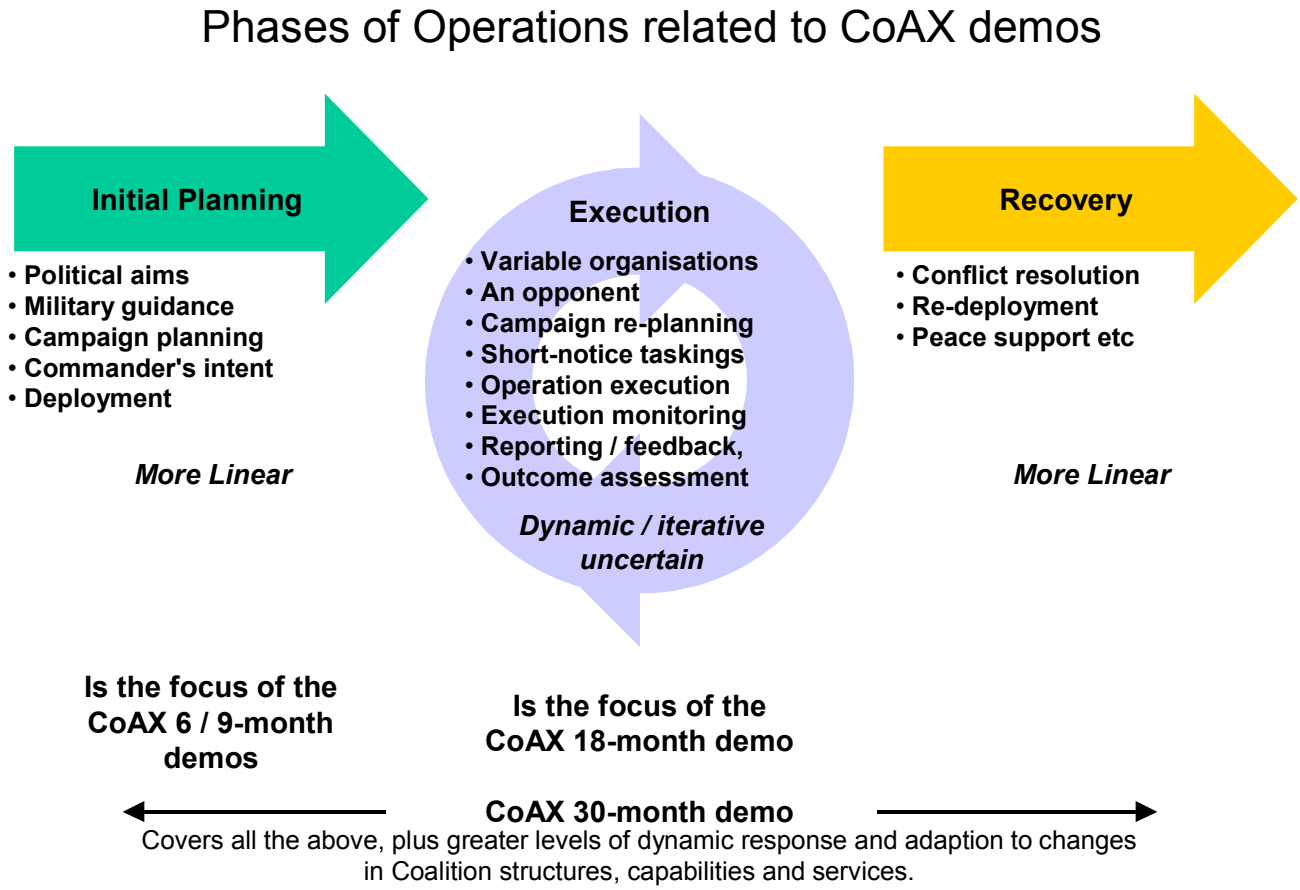


Figure B6-8 - Characteristics of Operational Phases

THE EXECUTION ENVIRONMENT

19. The Execution Phase of conflict is a crucial (and often overlooked) one - it is after all where the battle is won or lost. So, how can the execution environment be characterised? Firstly, **and most importantly, there is an opponent** whose actions will impose unpredictable events / outcomes on the 'Battlespace'.

20. Col Hugemark of Sweden sees conflict as the maintenance / influencing of a dynamic tension between opposing 'forces' which try to cause a shift between states to the benefit of one of the participants. It is the achievement and maintenance of a state of "interoperability of the mind" beneficial to the Coalition (despite the opponent's attempt to disrupt it) which is the most difficult of military tasks during execution and consequently **this is an area where the CoAX TIE could provide most benefit**. The Conflict Model (Figure B6-9 below) has four basic states:

- Stable, but watching out for indicators of impending imbalance through renewed conflict,
- Changing and preparing for next attack,

- Transitioning to next conflict, defending first till offensive action is required,
- In conflict and looking for a resolution / return to an advantageous stability.

Conflict Model - Col Hugemark, Sweden

Figure B6-9 - Military Operations - Conflict Model - State Changes

21. At all times there's a balance between committing forces too early or missing the signs / opportunity and being crushed. Are we forcing the change - or is the enemy? Once a change is apparent, can we get to the next state first to gain an advantage? Hence, most of the potential military benefits come **during the phase transition** not when the system is 'at rest'.

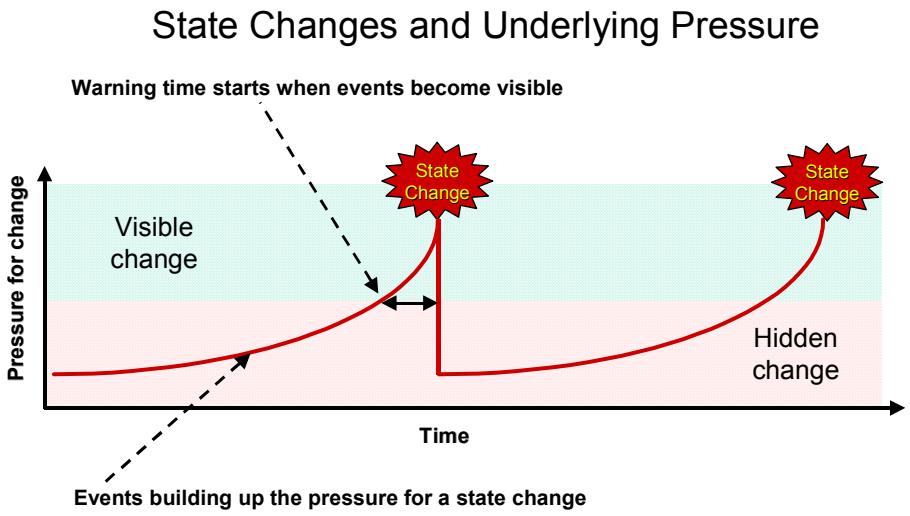


Figure B6-10 - Transition Characteristics

The model for the state changes appears to be binary, but it is not - the (hidden) pressure increases till a change is observed. One key point here is that the states appear to change suddenly, but that actually an underlying pressure may build up for some time before a state change is observed. This is illustrated in Figure B6-10 above.

22. If the current state is favourable to a military force (and there are no indictors that change is about to occur) then there is little to do but to get on with executing the plan and keeping an eye out for unexpected occurrences. **Software agents could provide a *very significant contribution* in carrying out this 'background monitoring' of the states shown above** and of filtering reports / issues and propagating though the system to a level where they can be dealt with. In effect the agent are helping reduce the size of the 'hidden' area and so making more of the pressure for change visible and so increasing our warning time for decisive action.

23. However, the real work starts when things begin to go wrong and / or the states change unfavourably. Now a number of new tasks are generated - *entirely dependant upon the events which have occurred* and probably not identifiable in advance. There is no 'process-model' for problem-solving during this real-time battle management, just 'principles' / heuristics to apply based on experience, training etc, and this problem-solving is largely not 'rational' but is often intuitive and decisions are always taken on incomplete even minimal information.

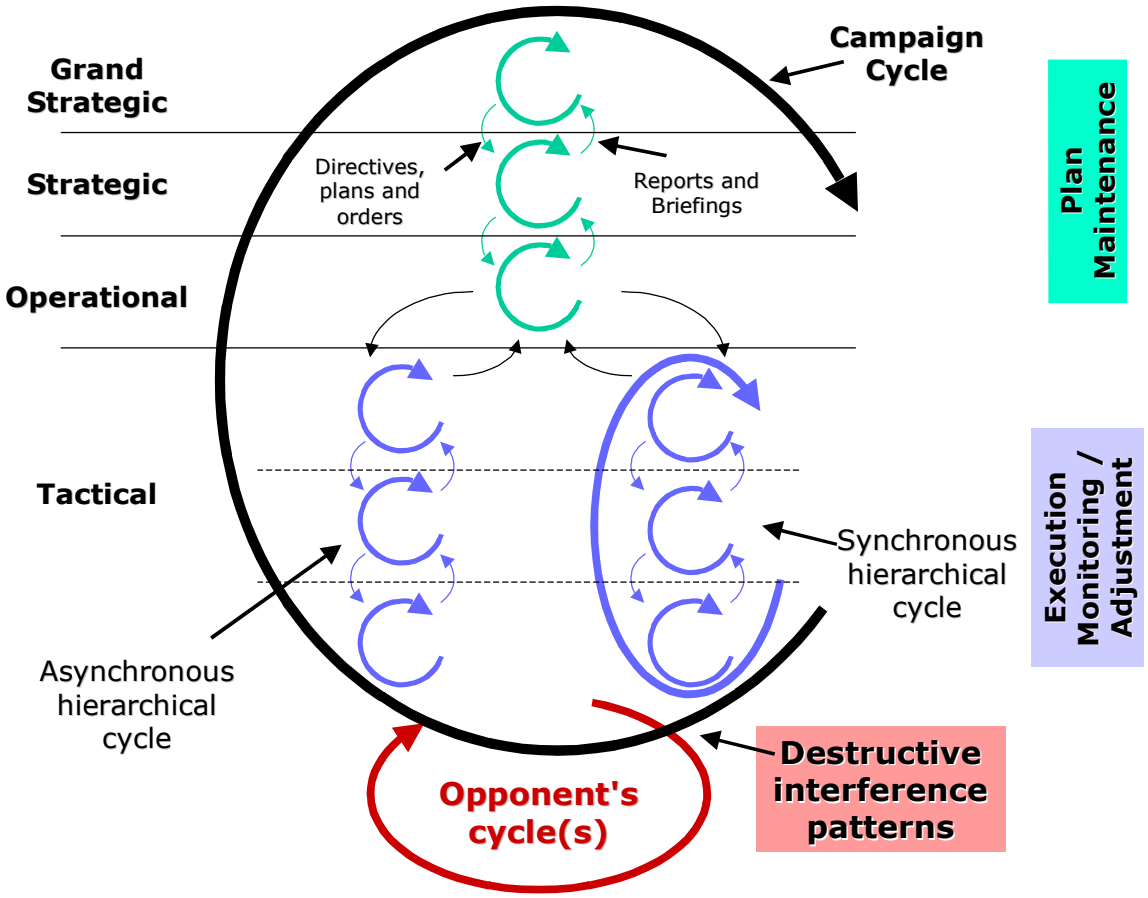


Figure B6-11 - Operational Tempo - Decision-Loop Harmonics

Activities for which principles have to be developed include: execution; execution monitoring; dynamic plan review, maintenance and update (time-scale hours); combat assessment and battle damage assessment; 'information operations', media ops and support activities (logistics, medical personnel admin etc). The bottom line here is that there is lots of complexity, intense dynamics etc and that small tactical events can have strategic effects. Also, the environment is now composed of iterative and 'fractal' decision loops within loops (see Figure B6-11 above).

DEDUCTION(S): This leads to the fundamental deduction about execution - that there are essentially two conditions: stability and change. During stability, monitoring the state of the 'systems in conflict' and identifying the underlying pressure for change / significant events towards an undesirable state is the task that the agent-enabled environment could assist significantly. During change, events have occurred which were not expected and now action has to be taken to mitigate their effects. So, once problems occur the activities become much more 'human-centred', short time-scale, uncertain and dynamic and the agents would need to take a more subordinate role.

24. GENERAL COAX IMPLICATIONS: The execution environment can be characterised as event-driven, high-tempo, short-timescale, high-bandwidth, uncertain, dynamically varying and very demanding. Software agent technology can assist with supporting the following generic sub-tasks which are likely to include:

- **decision-makers demanding information to support brainstorming / re-assessment of options (agents assist with providing on-demand' information),**
- **'ad-hoc' problem solving involving creative / novel use of existing tools in a way that was probably never intended (agents assist in the 'composition' of applications from software components),**
- **sudden increase in 'network traffic' as humans / machines struggle to understand what is going on, to issue modifications of orders / new ones etc (agents assist with monitoring patterns of activity) / resource control,**
- **reconfiguration of systems to support unexpected changes - eg: systems may be destroyed, forces may be withdrawn, new capabilities / policies may be activated / added (agents assist with activity monitoring, reconfiguration etc). This may involve mobile code (eg: move away from area of threat or bring new capabilities,**
- **activation of 'dynamic routing' as humans / organisations / functions move to new locations / swap command centres etc / change roles (someone may be killed etc) in response to the current imperatives (agents assist with network monitoring, management, reconfiguration etc) including cloning of agents,**
- **shortening of timescales for response from hours to minutes / seconds as the pressure to defend a beneficial 'state' mounts (agents adjust their processing demands as the resources in the environment become more scarce and as their constraints activate),**
- **activation of more secure / assured techniques for communication and the discarding of all non-essential messages as bandwidth availability is compromised - agents will now have to work with incomplete information (agents adjust their information demands / security strategies as the resources in the environment become more scarce. Malicious behaviour detection becomes more crucial),**

there will be increased demand for robustness and the maintenance of levels of service or, if degradation is to occur, that it should be 'graceful' not system-wide and catastrophic (agents have recovery / reconfiguration techniques at their disposal),

PHASES SPLIT INTO STAGES

25. The stages of the joint and air parts of the Coalition enterprise which have been selected for the CoAX demonstrations are as follows:

a. Initial Planning Phase. The initial planning occurs as a conflict is starting and relates to formulating an initial plan and receiving approval for it:

- Stage 1 - The Joint and Air Estimate,
- Stage 2 - The Joint Campaign Plan and Air Operations Plan,

b. Ongoing Operations - Execution Phase(s). The ongoing operations phase(s) relate to maintaining and developing the plan in the light of developing circumstances and to monitoring execution:

- Stage 3 - Maintenance of Estimate / Cyclic Strategy Development,
- Stage 4 - Current Joint and Air Planning / production of the AOD,

- Stage 5 - Master Air Plan development,
- Stage 6 - Air Tasking Order production,
- Stage 7 - Execution and Battle Management of Current Operations,
- Stage 8 - Combat Assessment of completed operations.

The two diagrams showing the Stages in more detail are at Figures B6-12 and B6-13 below.

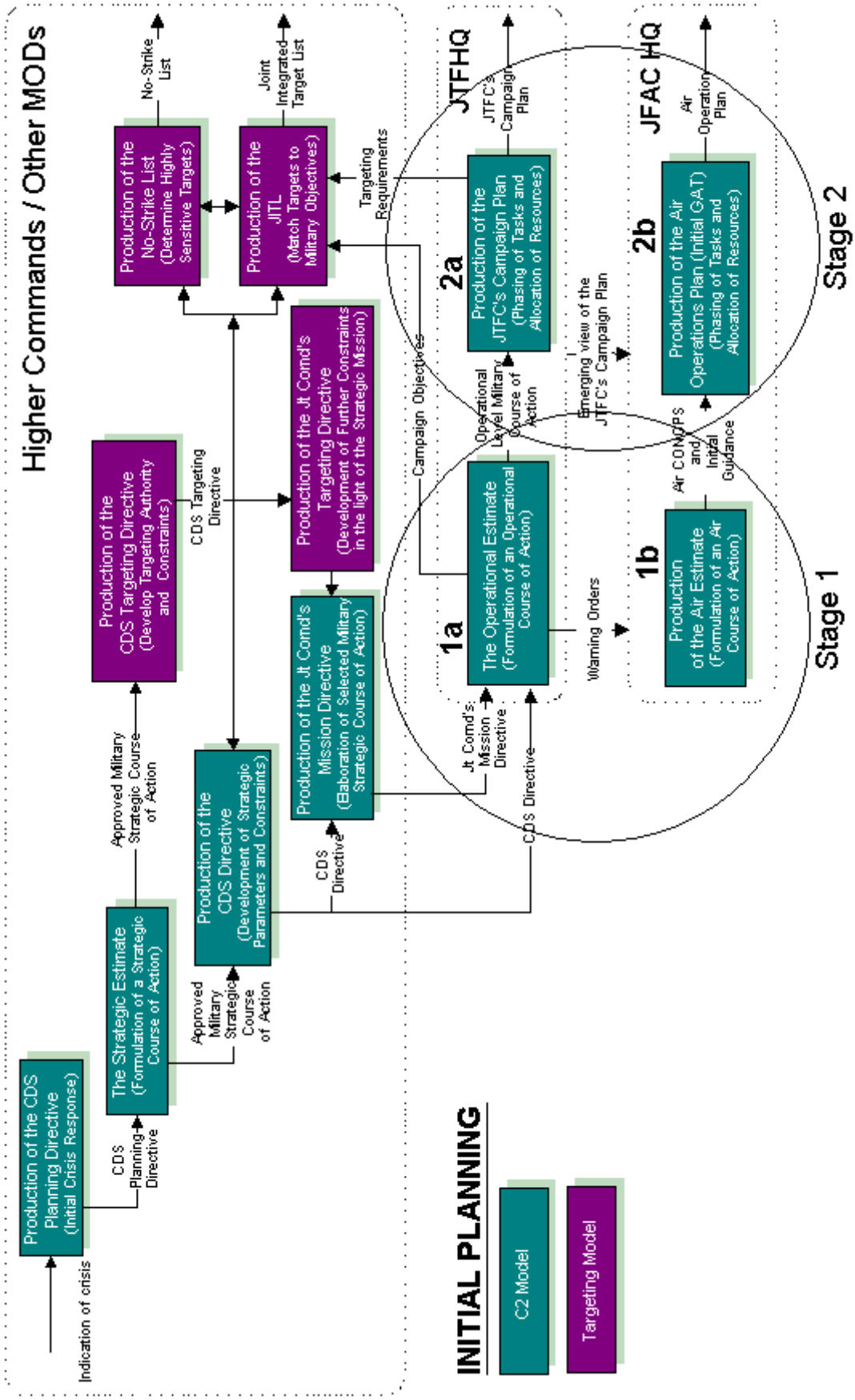
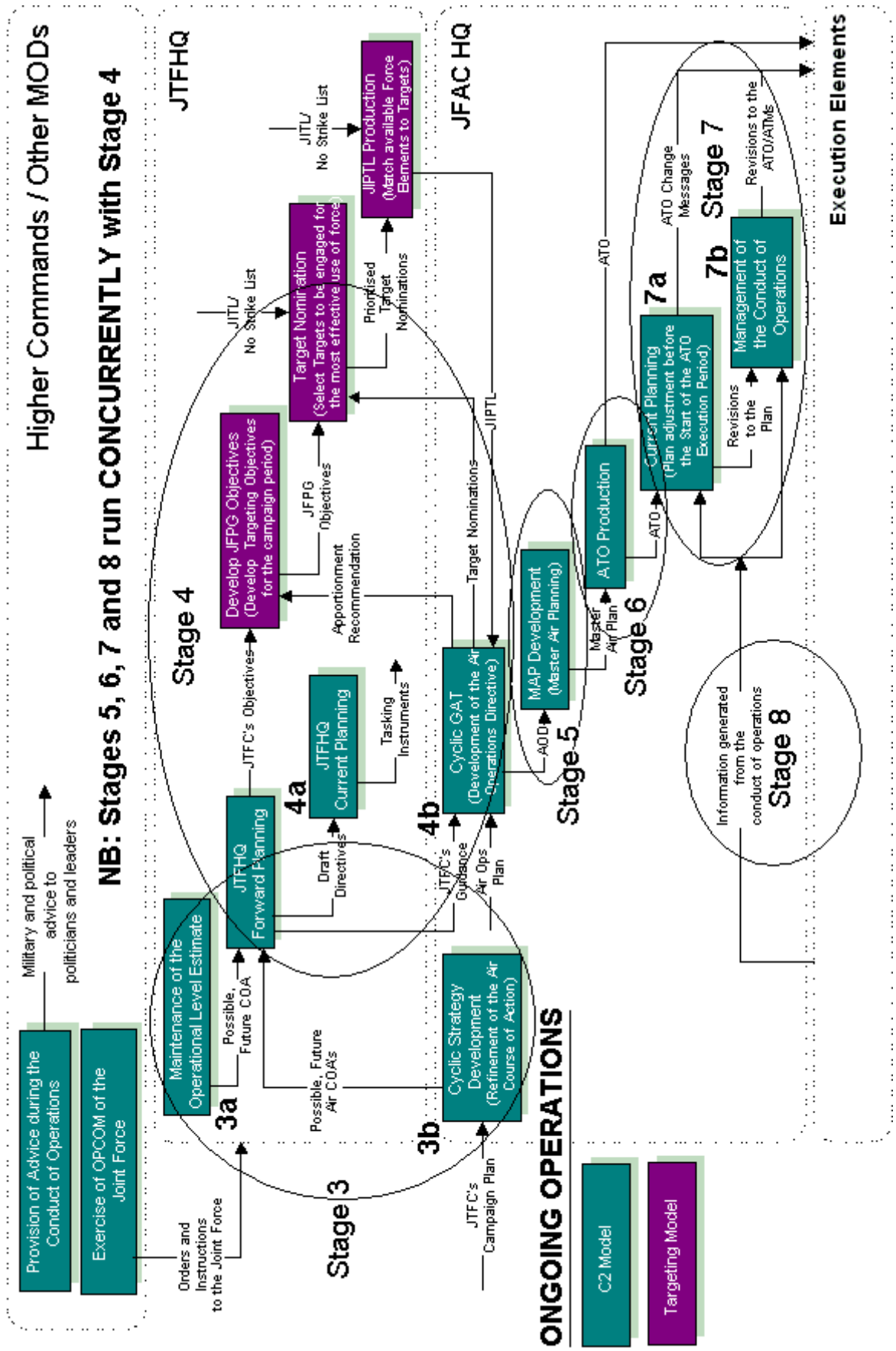


Figure B6-12 - Initial Joint Planning

Figure



B6-13 - Conduct of Ongoing Operations

DETAIL OF THE EIGHT STAGES

26. The expanded detail of what occurs each of the eight stages with some example CoAX messages (a full 'storyboard' for each demonstration is at Annex C) is as follows:

INITIAL PLANNING

a. Stage 1: The Joint and Air Estimate. Part of "Initial Planning" - these activities would normally be carried out (over weeks / days) pre-operation start. Sub-stages 1a and 1b are concurrent and iterate:

(1) Stage 1a: Carry out the Joint "Operational Estimate". Formulation of an Operational Course of Action - this is one of the main tasks which the PP supports. There will be some sub-sub stages here:

(2) Stage 1b: Carry out the "Air Estimate". Formulation of an Air Course of Action. There will be some sub-sub stages here:

(a) (S1M[7]-1a and b). Transmission and confirmed receipt of UNWAFB Mission (Scenario v3.1 Chap 3A-4, para 7), **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC about the onward transmission of a text file from SRSG, via JTFC to JFACC - equivalent to the "CDS Directive" links in Initial Planning - for 6-month demonstration messages are "Confirm receipt of UNWAFB Mission" and "UNWAFB Mission received"]**,

(b) (S1M-2a and b). Transmission and confirmed receipt of Jt Comd's Mission Directive (Scenario v3.1 Chap 3C-2, para 4a), **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC about the onward transmission of a text file (which provides the JTFC with his objectives) from Other MODs via the JTFC to the JFACC - equivalent to the "Jt Comd's Mission Directive " in Initial Planning - for 6-month demonstration messages are "Confirm receipt of Jt Comd's Mission Directive" and "Jt Comd's Mission Directive received"]**,

(c) (S1M-3a and b). Transmission and confirmed receipt of the JTFC's Intent (ie: a warning order - Scenario v3.1 Chap 3C-2, para 4 in total), **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC about the transmission of a text file from the JTFC to the JFACC to feed "Production of the Air Estimate" in initial planning - for 6-month demonstration messages are "Confirm receipt of JTFC's Intent" and "JTFC's Intent received"]**,

(d) (S1M-4a and b). Request for, and provision of, the JFACC's draft plan for Phase II, Mission 'A' (Scenario v3.1 Chap 3C-3, para 7 in total) as a result of "Production of the Air Estimate" in initial planning. **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC about the transmission of a text file from the**

[7] For "Stage 'n' Message

JFACC in response to a request from the JTFC - for 6-month demonstration messages are "Confirm JFACC's draft Air COAs available" and "JFACC's draft Air COAs are available"],

b. Stage 2: The Joint Campaign Plan and Air Operations Plan. Part of "Initial Planning" - these activities would normally be carried out (over weeks / days) pre-operation start. Sub-stages 2a and 2b are concurrent and iterate:

(1) Stage 2a: Produce the JTFC's "Campaign Plan". This phasing of tasks and allocation of resources is another major task which the PP supports. There could be some sub-sub stages here:

(2) Stage 2b: Produce the "Air Operations Plan". This phasing of tasks and allocation of resources ("Initial GAT") is partly supported by MBP. There could be some sub-sub stages here:

(a) (S2M-1a and b). Request for, and provision of, information on the availability of assets for Phase II, Mission 'A' (Scenario v3.1 Chap 3C-4 / 5, para 8a3 and 8b7 etc). **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC - for 6-month demonstration messages are "Confirm Asset availability" and "Asset availability is confirmed" - actual data could also be passed - it would be from MBP's list of entities (airbase, air unit) and their status]**,

(b) (S2M-2a and b). Request and provide an apportionment recommendation for Phase II, Mission 'A' (Scenario v3.1 Chap 3C-4 / 5, para 8a3 and 8b7 etc). **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC - for 6-month demonstration messages are "Provide Apportionment Recommendation" and "Apportionment Recommendation Provided" - actual data could also be passed - it would be from MBP's apportionment graph]**,

ONGOING OPERATIONS

c. Stage 3: Maintenance of Estimate / Cyclic Strategy Development. Now move on to "Ongoing Operations" - these activities would normally be cyclic over a week / days. Sub-stages 3a and 3b are concurrent and iterate:

(1) Stage 3a: Produce Joint "Future COAs". This refinement of the Joint COAs would be supported by the PP. For the demonstration, one sub-sub stage here:

(2) Stage 3b: Produce Air "Future COAs". This refinement of the Air COAs would be partly supported MBP. For the demonstration, one sub-sub stage here:

(a) (S3M-1a and b). Request for, and provision of, candidate future COAs for Mission 'A' (nothing currently in the scenario). **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC - for 6-month demonstration messages are "Provide future COAs" and "Future COAs provided" - actual COAs would be in a text file]**,

d. Stage 4: Current Joint Planning. Part of "Ongoing Operations" - these activities would normally be cyclic over days / hours. Sub-stages 4a and 4b are concurrent and iterate. Also, note that Stage 4 iterates concurrently with Stage 8 till the end of the operation and spawns a set of Stages 4b, 5 and 6 for each day of operation and that Stage 7 runs continuously (managing the set of operations tasked for each day) - this is illustrated in Figure B6-14 below:

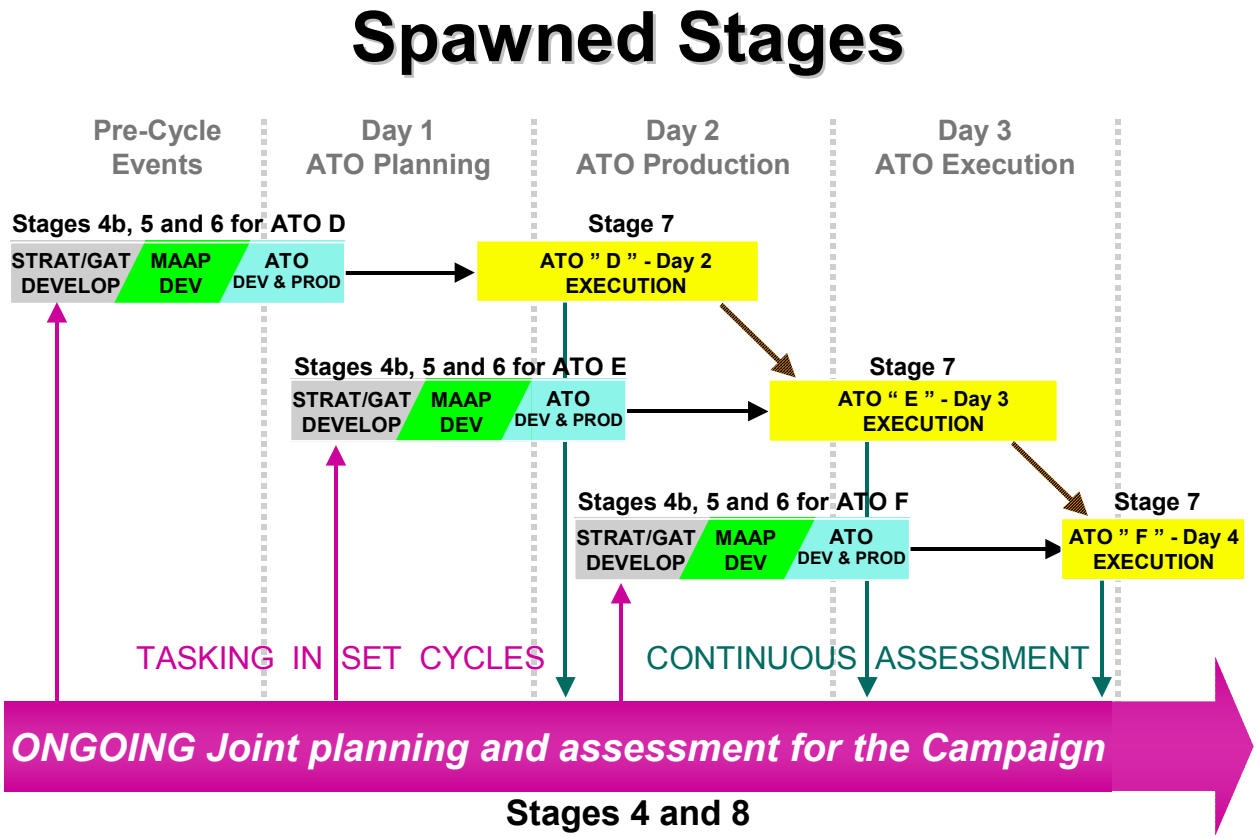


Figure B6-14 - Spawning of Stages for Separate Days of Conflict

(1) Stage 4a: JTFHQ "Forward and Current Planning". This involves the generation of plans for future days of the conflict and would be supported by the PP. For the demonstration, one sub-sub stage here:

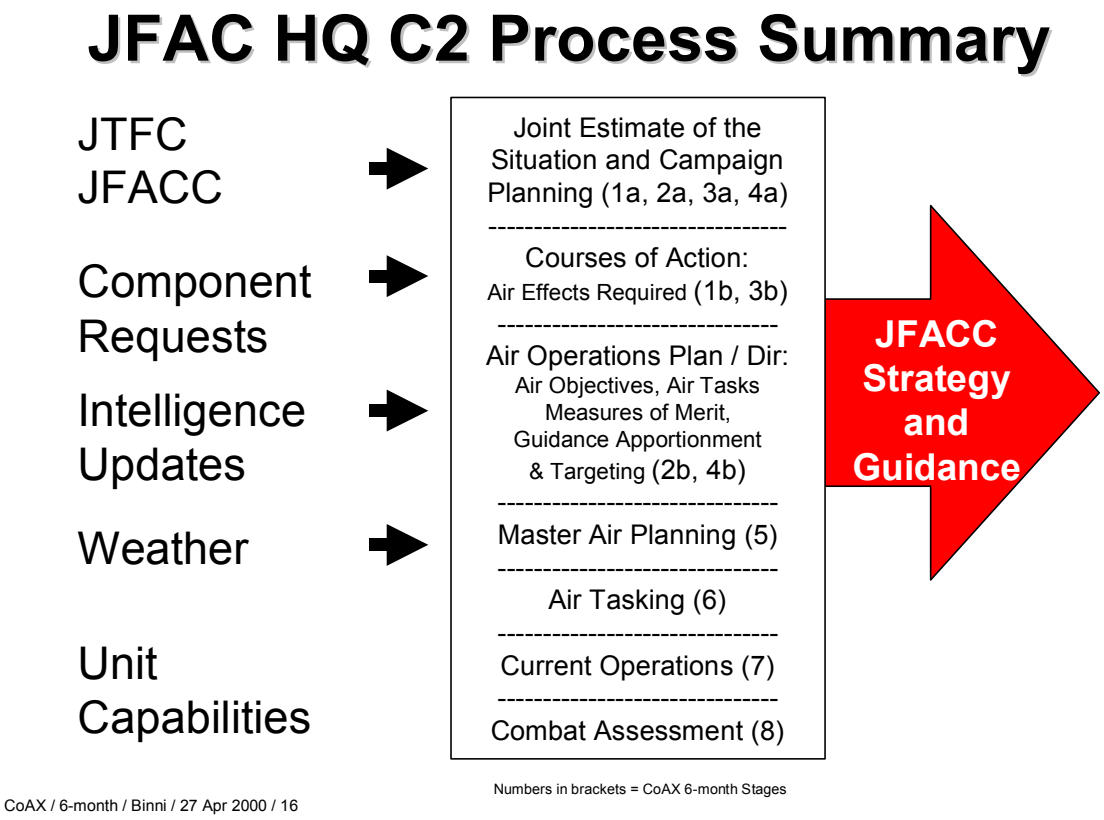
(a) (S4M-1a and b). Request and provide an apportionment recommendation for Phase II, Mission 'A' (Scenario v3.1 Chap 3C-4 / 5, para 8a3 and 8b7 etc). **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC - for 6-month demonstration messages are "Provide Apportionment Recommendation" and "Apportionment Recommendation Provided" - actual data could also be passed - it would be from MBP's apportionment graph],**

(2) Stage 4b: JFAC HQ "Cyclic GAT". This involves the generation of the Air Operations Directive for a specific day of the conflict - based on the Air Operations Plan for the Campaign - and is partly supported by MBP (see Figure B6-15 which shows the

Air element of the process and Figure B6-13 which shows a representative timeline) is as follows. For the demonstration, one sub-sub stage here:

(a) (S4M-2a and b). Request confirmation of the dissemination of the Air Operations Directive for Phase II, Mission 'A' (Scenario v3.1 Chap 3C-4 to 9, paras 5 to 12 in total). **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC - for 6-month demonstration messages are "Confirm AOD has been disseminated" and "AOD disseminated" - the actual AOD would be a text file],**

Figure



B6-15 - A representation of the JFAC HQ process.

e. Stage 5: Development of the Master Air Plan. This involves the generation of the Master Air Plan for a specific day of the conflict and is fully supported by MBP (it's the specific task for which MBP was designed). For the demonstration, one sub-stage here:

(1) (S5M-1a and b). Request production and approval of the Master Air Plan for Phase II, Mission 'A'. **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC - for 6-month demonstration messages are "Confirm MAP has been produced and approved" and "MAP produced and approved" - the actual MAP would be a number of spreadsheets / worksheets (even a map from a wall!) - though it could be MBP Plan and Scenario files]**,

f. Stage 6: Production and dissemination of the Air Tasking Order. This involves the generation of the Air Tasking Order for a specific day of the conflict and is partly supported by MBP. For the demonstration, one sub-stage here:

(1) (S6M-1a and b). Request confirmation of the production and dissemination of the Air Tasking Order for Phase II, Mission 'A'. **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC - for 6-month demonstration messages are "Confirm ATO has been produced and disseminated" and "ATO produced and disseminated" - the actual ATO would be a text file though it could be disseminated as MBP Plan and Scenario files],**

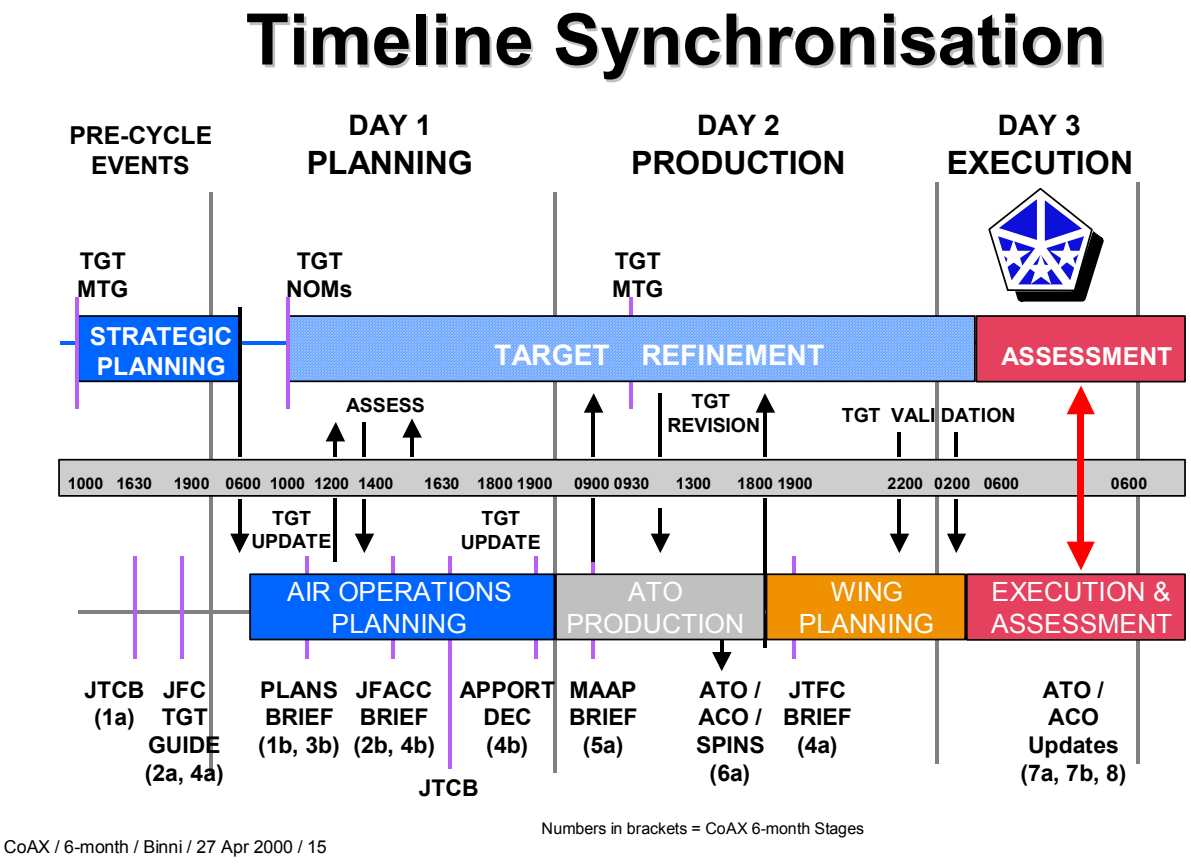


Figure B6-16 - JTFHQ / JFAC HQ Timeline Synchronisation

g. Stage 7: Execution and Battle Management of Current Operations. This task runs continuously (managing the set of operations tasked for each day) throughout the conflict and is almost entirely event driven and the ordering and triggering of tasks is almost impossible to predict. However, for the demonstration, there could be one sub-stage here:

(1) (S7M-1a and b). Request confirmation that Objective Two "TARGET_FLASH" for Phase II, Mission 'A' has been completed. **[This would be the transmission of agent message(s) from the JFACC in response to the request(s) from the JTFC - for 6-month demonstration the messages are "Confirm Phase II, Mission 'A',**

Objective Two has been completed" and "Phase II, Mission 'A', Objective Two is completed"],

h. Stage 8: Combat Assessment of completed operations. This task runs continuously throughout the conflict and is part of the usual set of Intelligence tasks. Combat Assessment provides information (from the Conduct of Operations) which is put into the pool of information available to decision-makers involved in all stages. However, for the demonstration, there could be one sub-stage here:

(1) (S8M-1a, b and c). Assess the effectiveness of the task Objective Two "TARGET_FLASH" for Phase II, Mission 'A' and recommend whether retasking is required. **[This would be the transmission of agent message(s) from the JFACC's Intelligence (A2) Staff in response to the request(s) from the JTFC - for 6-month demonstration the messages are "Assess outcome of attack on Phase II, Mission 'A', Objective Two and need for re-attack" and there are two possible replies: "Phase II, Mission 'A', Objective Two - re-attack required" or "Phase II, Mission 'A', Objective Two - re-attack NOT required"],**

PART FOUR: COALITION / COAX TECHNICAL DOMAIN ISSUES

Links to: Document_Structure, Background_and_Military_Overview; Coalition_Organisations_and_People; Coalition_Processes_and_Terms;

MILTARY / TECHNICAL VIEWPOINTS

27. There are a number of issues which relate to the interaction between the CoAX military and technical issues. Some relate to the 'viewpoint' taken when talking to an audience about CoAX work and some relate to our assumptions about the future technical infrastructure and environment in which agents might operate. For example:

a. CoAX Tech / Mil Balance. We need to clearly make a distinction between:

(1) demo-ing technical items which currently have direct application and which fit with current doctrine, as opposed to;

(2) demo-ing technical items which MIGHT have military significance (but which don't fit current doctrine / concepts of Ops as described above).

An example of (1) is domain-based security, an example of (2) is agent support to a completely distributed / dispersed planning, execution and execution monitoring environment as described below:

- DERA approached this issue some time ago and produced an command / execution concept called ***AGILE*** which provides a way of co-ordinating planning, execution and execution monitoring (across joint and coalition boundaries) into one approach. ***AGILE*** provides alternative viewpoints (future, near-term, present, past) and decomposes the 'plan' into components (ie there is NO single, brittle plan) based on the military / political etc effects which are to be generated. This approach is supported by control theory research into the stability of certain strategies. The follow-up to MBP (called ***FAST***) allows us to research issues related to this concept which has received strong support from US and UK Generals and Staff Officers.

b. Human Agent / Software Agent Balance. In the future some tasks will be driven / retained by human(s in teams), some will be delegated to software agents / worked on collaboratively (mixed initiative between human and software agents). We have to be careful not to assume that 'agents are doing x' / humans doing 'y' as if they are separate. Also, as there is NOT just ONE User in the Binni Flash scenario, Commanders / decision-makers at ALL levels make demands on the agents' services and this will create conflicts.

The basic point is that we must 'signpost' very clearly to our audience when we change from talking from the viewpoint of military domains to talking from the viewpoint of technical domains and from current doctrine and practices to possible future ones.

COMMAND MODEL - TECHNICAL ARCHITECTURE ISSUES

28. The architecture for the experiments / demonstration is based on that being considered for JBD (see Figure B6-17 below). MBP and the Process Panel would map on to the application layer and the CoABS Grid and KAoS would correspond with the Agent-enabled Infrastructure layer.

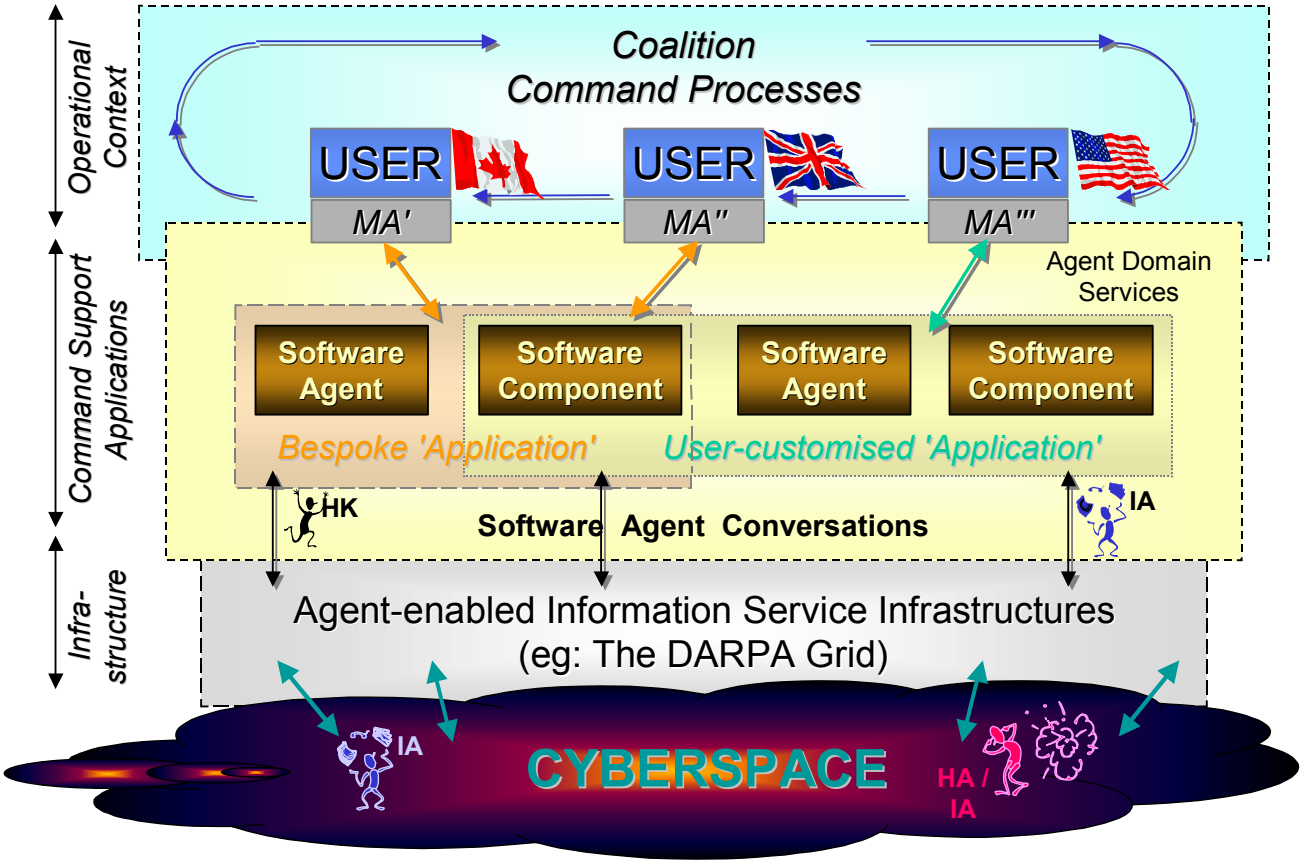


Figure B6-17 - Relationship between Process Threads, 'Applications' and Infrastructure

29. At the outset it is worth noting that solutions in the Operational Context box (Knowledge Domain) are largely ***organisational*** issues which software agents can (currently) do little to affect. Solutions in the Command Support Application box (User interface and Application Domain) are a mix of ***organisational and technical*** issues and solutions in the Infrastructure box (Information and Data Domain) are largely ***technical*** issues. Therefore when considering the involvement of software agents it must be noted that the mechanisms in place to address organisational change *must* go hand-in-hand with those to address technical change.

30. The Command Process is made up of Command Threads (parts of the process which can be characterised and described). The Command Process is Command-led (ie the User has primacy) and the aim of the process is to achieve the given (political) end-state through the use of decision dominance and by exploiting Command Agility. The Users (commanders, their staffs and subordinate units) are part of the process. The Users shown above are either individual users, teams or even the same user fulfilling different roles. In the Model shown above the layering and decomposition into User, Application and Infrastructure is the means by which the flexibility (demanded by the need to have Command Agility) is achieved by exploiting the emergent phenomena which will arise from the interactions between the various human and technical components.

31. To the User, the User Interface (UI) ***is*** the application. The UI is the expression of the process in the application domain and, as such, is owned by the User. The User knows what kind of interface is required and should be able to change the interface to support the demands of their current decision-making or problem solving task - the so-called 'Decision-Desktop' - a community of software agents. The UI could well be mobile - in the sense that it moves with Users IT (ie written on to a

smartcard, on a PDA or whatever). This is an important issue as it is vital that a Commander does not have to be physically located in a particular place to receive particular services.

32. Users may need access to various kinds of applications to assist with and support the Command Process. However, in reality the UI accesses capabilities provided by (agent-enabled) software components which give the functionality the User is looking for - the User would then call the aggregation of components an 'application'. Applications are 'aligned' in the sense that the way that they work needs to be complementary, not destructive. The Alignment will be done in response to the demands of the command process not for technical reasons. Hence the agents do not have to drive their own self organisation (at the macro-level) as the organisation is User-driven according to the Operational Context provided by the human agent. Nevertheless there is still scope for the agents to self-optimise and self-organise at the micro-level. Indeed, there is scope for co-evolution in the future.

33. The software components are 'atomic' in the sense that they support fragments of the process (line-of-sight calculations etc). Software components are grouped to form applications. They can either be grouped in advance and given to the Users (Bespoke) or can be grouped by the Users to meet their needs (Task-customised) or may be grouped purely for convenience (Process Neutral). Components may be being used simultaneously in separate Bespoke and Task-customised applications. This flexibility means that the application can be created to reflect the character of the Command Thread being supported (ad-hoc, loosely characterised, tightly characterised etc) as well as the problem solving style and mental model in use by the User. This component grouping concept is not specifically part of the CoAX.

34. Software components call for information services from the Agent-enabled Infrastructure which uses a suitable open architecture (eg: trader-broker etc). Hence, the information can be dynamic and mobile, databases can be dispersed (virtual) and this makes the information services more robust. In total, this approach:

- Supports Command Agility (the process is not 'locked-in' and can cope with uncertainty),
- Puts the User in control,
- Provides flexibility,
- Reduces the 'stovepipe' nature of current solutions,
- Allows for re-use and rapid change,
- Delivers robustness and redundancy,
- Reflects the mobile and shorter-term nature of applications,
- Reflects the more enduring nature of infrastructure.

35. As a final thought, in a conflict, friendly and enemy infrastructure becomes connected and opponent and own infrastructures become enmeshed. This approach accepts that this ***will*** happen and allows for 'graceful degradation' from 'rich' to 'spartan' levels of service. This is achieved because there is no single point of failure in the system.

Links to: Document_Structure, Background_and_Military_Overview; Coalition_Organisations_and_People; Coalition_Processes_and_Terms; Coalition_CoAX_Technical_Issues;

CHAPTER 13. (ANNEX C)

BINNI FLASH - DEMONSTRATION DETAILS (STORYBOARD / 'THREADS')

Links to: Document_Structure, Annex_A, Annex_B, Annex_D, Annex_E, Annex_C_6month, Annex_C_9month, Annex_C_18month, Annex_C_30month.

BINNI COMMAND PROCESS STAGES FOR COAX DEMONSTRATIONS

1. The CoAX TIE is to use an agreed Joint Process and Timeline which, for convenience is divided into 8 'Stages' (see Annex_B6_Command_Model for more detail). Note that this model is heavily based on current doctrine - a very fixed-cycle process - which, in the future will become much more dynamic. The stages of the joint and air parts of the enterprise which have been selected for the CoAX demonstrations are as follows:

- Initial Planning Stages:
  - Stage 1 - The Joint and Air Estimate,
  - Stage 2 - The Joint Campaign Plan and Air Operations Plan,
- Ongoing Operations Stages:
  - Stage 3 - Maintenance of Estimate / Cyclic Strategy Development,
  - Stage 4 - Current Joint and Air Planning,
  - Stage 5 - Master Air Plan development,
  - Stage 6 - Air Tasking Order production,
  - Stage 7 - Execution and Battle Management of Current Operations,
  - Stage 8 - Combat Assessment of completed operations.

2. These stages are described in more detail at Annex_B6_Detail_of_8_Stages of the command model which should be referred to as necessary while reading the notes below. The Stages will be activated in the demonstrations as follows:

a. In the early CoAX TIE demonstrations (1, 6 and 9-month) only Stages 1 and 2 are activated as this relates to the Initial Planning with takes place at a relatively low tempo.

b. For later demonstrations we will activate the Stages relating to ongoing operations - especially Stage 7 - Execution and Battle Management (which are more real time and which require a richer set of information) as this is a more demanding environment.

3. This Annex contains more detail on each of the CoAX TIE demonstrations in chronological order. However, if you require more information on the contribution of each of the participants then please refer to Annex_D.

1-MONTH DEMONSTRATION

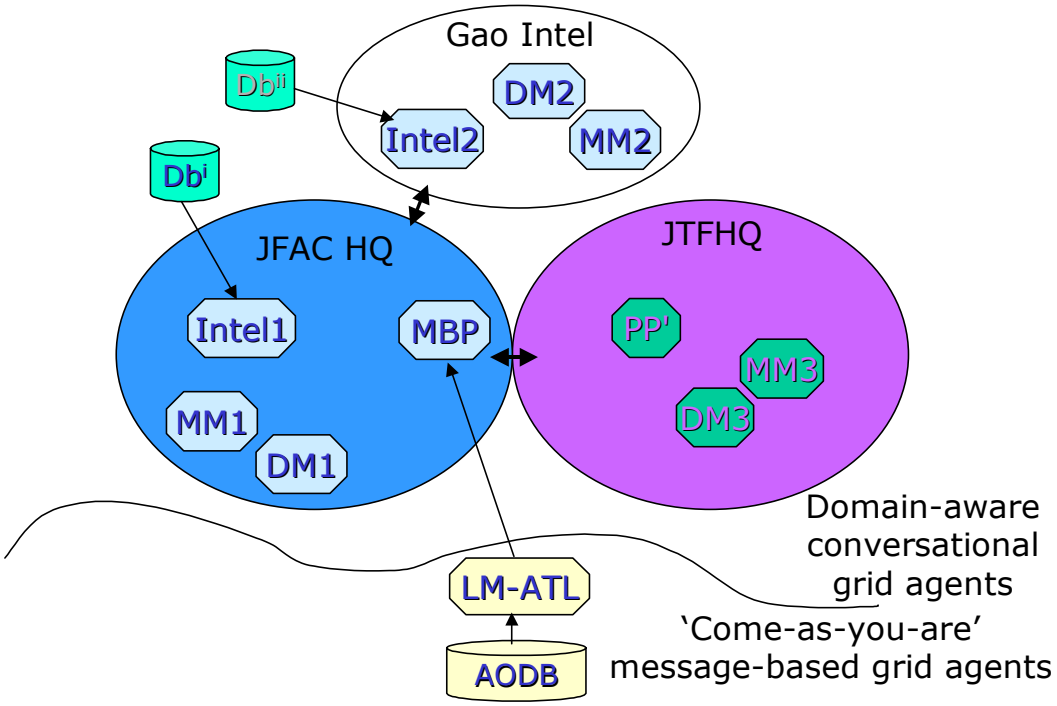
4. After 1 month (achieved on 16th February 2000), we constructed a demonstration of the framework for coalition mechanisms with MBP and an EMAA/CAST agent working together on the CoABS Grid. The specific concepts highlighted were:

- Construction of a Coalition-wide visualisation from multiple sources across the Grid,
- Update of scenario information on-the-fly (new objects, moving objects, status of objects).

This demonstration was populated with simple/surrogate agents in order to address the chosen scenario vignette and anticipate the 6 and 9-month demonstrations.

6-MONTH DEMONSTRATION: DETAILS

Figure



CoAX Six-Month Integration

C-1 - CoAX Domains at 6-months

5. The CoAX demonstration at 6 months is an internal project milestone. The aim of this demonstration is to get the agents that form the core of the 9-month demonstration working together in a Binni-related scenario on the grid, using some basic KAoS agent domain and conversation facilities. For the 6-month demonstration each agent will belong to only one domain at a time and there will be a single Air Command demonstration thread.

AGENTS AND DOMAINS AT 6 MONTHS

6. There are three agent domains (see Figure C-1 above): two of these are coalition functional units (JTFHQ and JFAC HQ), the other is a country domain (Gao Intel).

7. There are 11 agents: MBP (DERA), the Process Panel (AIAI), LM-ATL EMAA/CAST (Lockheed Martin ATL), two intelligence agents (Intel1 and Intel2) and a Boeing KAoS Domain Manager (DM) and Match Maker (MM) for each of the three domains. Excluding the DM/MM agents, the agents can be classified as follows: 1 planning agent (MBP), 1 monitoring agent (PP) and 3 information providers (LM-ATL, Intel1 and Intel2). More detail follows:

a. The Process Panel in JTFHQ domain monitors MBP's activities.

b. MBP generates the Coalition Air Operations Plan and visualisation based on:

- Db[i] in the JFAC HQ domain, information source for the Theatre, assets and their capabilities
- AODB information provided by the LM-ATL EMAA/CAST "come-as-you-are" agent
- Db[ii] in the Gao domain, which represents a 'private' intelligence source

c. Boeing KAoS Domain Managers (DM) and Match Makers (MM):

- DMs co-ordinate agent registration, policy administration and enforcement
- MMs federate to provide information about local and remote agent services

STORYBOARD AT 6 MONTHS

8. The storyboard is as follows:

a. JFAC HQ awaits orders from JTFHQ. MBP begins with an empty scenario showing Binni. JTFC's Process Panel (PP) finds MBP using referral of local KAoS matchmaker (MM3) to matchmaker in remote JFAC HQ domain (MM1).

b. PP sends UNWAFB Mission Document and JTFC's Mission Directive to MBP and MBP acknowledges.

c. JFAC HQ begins to assemble information and intelligence. MBP agent communicates with non-domain-aware LM-ATL agent to get AODB information. MBP uses local and remote KAoS matchmakers to find domain-aware Intel agents. These agents are queried and may provide occasional updates. In cases where the same information is received from Intel1 and Gao's Intel2, Gao's is preferred as being more up-to-date.

d. JFAC HQ begins air planning. The planner outlines reconnaissance and firestorm areas, and sorties.

e. An analyst at JFAC HQ discovers that Gao's Intel2 agent is deliberately providing misinformation. JFAC HQ domain administrator uses Domain Administration Tool on the Web

to block any further communication with Intel2 and other Gao agents. MBP henceforth only relies on less-frequently-updated but more reliable information from the Intel2 agent.

f. Replanning occurs in the light of the newly corrected intelligence. The reconnaissance and firestorm areas are revised. Other air sorties may be revised.

g. End of demonstration. Planning would continue until a draft estimate is provided.

THREADS FOR THE SIX-MONTH DEMONSTRATION

9. The threads for the six-month demonstration feature a small subset of the tasks which would be carried out in a Coalition. The tasks relate to a number of suitable events - set in a manageable time window - which are taken from the Binni scenario Stages described below. Hence, the 'threads' for the six-month demonstration are as follows:

a. One thread relates to following a simple Joint Command Process and set of activities to support the monitoring of the UNSG's Objectives (including Mission 'A') and the tracking of critical weapons (C2 structure etc already described in Annex_B2_Military_Situation and Annex_B6_Command_Model

b. An information gathering, collating and inconsistency detection thread where information arrives from many sources, inconsistent information is detected and OPSEC action has to be taken to exclude a data source previously thought to be trustworthy.

c. A thread for the formation and dissemination of a coherent and consistent Coalition-wide visualisation of the Air Battle Plan.

d. An air operations planning, evaluation, briefing and dissemination thread.

e. A thread related to IO / OPSEC, CNA and the partitioning and security of information.

BINNI STAGES FOR THE 6-MONTH INTERNAL MILESTONE DEMONSTRATION

10. For the 6-month demonstration only Stages One and Two will be involved and the 'storyboard' will be a simple one as follows:

a. Stage 1. A Joint Operational (Stage 1a) and Air Estimate (Stage 1b) are being carried out concurrently:

(1) UNWAFB operations are being planned and the following have to be collected, fused and collated:

(a) Higher-level guidance, (message S1M1a / 1b, message S1M2a / 2b) and

(b) Theatre intelligence - intelligence updates are available from sources of different quality (ongoing agent exchange of information Ariadne / EMAA-CAST / MBP interactions - no Process Panel stage.

(2) JTFHQ has to monitor the Estimate and consider the joint COAs (for all the tasks given to the JTFC - see the Scenario),

(3) JFACHQ has to assemble the information to enable consideration of likely air COAs within the guidance.

b. Stage 2. Subsequently, the production of the JTFC's Campaign Plan (Stage 2a) and the JFACC's Air Operations plan (Stage 2b) are carried out concurrently:

(1) JTFHQ has to monitor the planning of Mission 'A' (could consider an alternative to Mission 'A' - no firestorm - because of fears about environmental / media reaction) as well as reviewing the other COAs for all the other tasks given to the JTFC,

(2) Information operations occur - the Gao cell proves false and access from its domain is terminated (discovery of false information is due to reports from Dartmouth 'observer' agents - triggers changes to policies and domain authorisations - denial activity - Boeing),

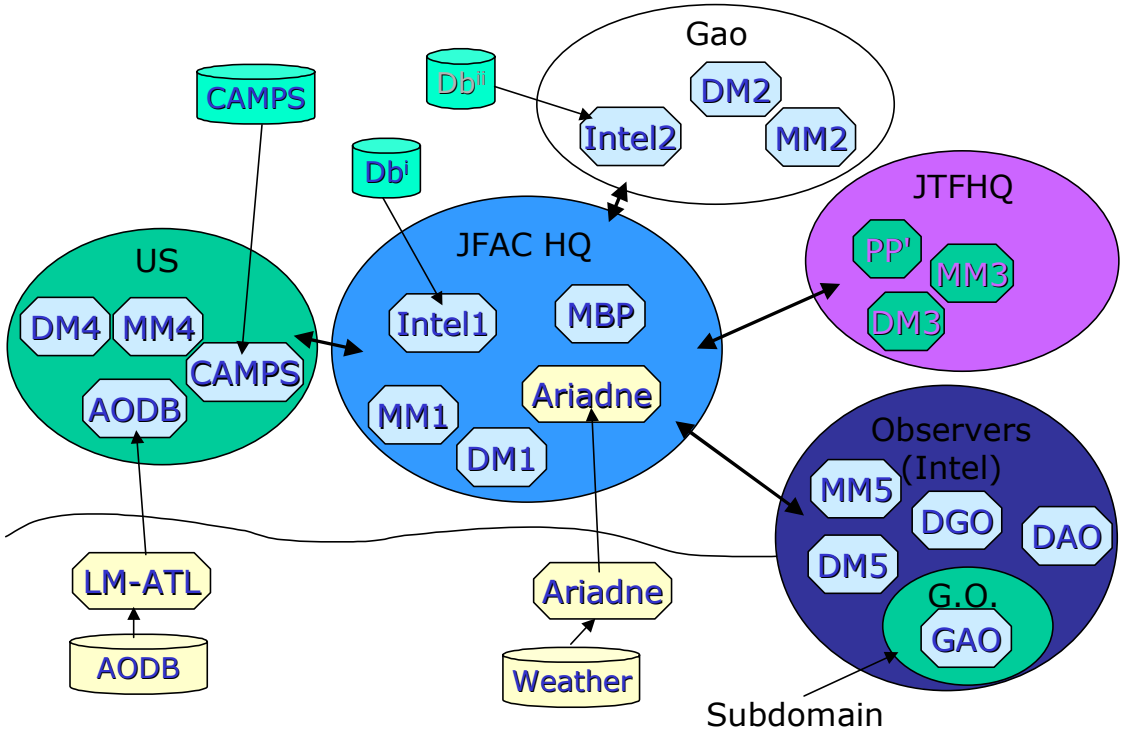
(3) JFAC HQ continues on UK / US information sources (initially of lower quality - use of existing 'Info-agents' providing data from alternative sources).

LINKS TO AGENT TASKS

11. The following links are to specific tasks (in participant order) in the scenario for the agents to carry out at 6-months:

- Task_AIAI_Monitor_Objectives,
- Task_Boeing_UWFIHMC_OPSEC,
- Task_DERA_Air_Battle_Planning,
- Task_LMATL_Integrate_US_Information,

Figure



CoAX Nine-Month Integration

C-2 - CoAX Domains at 9-months

12. After 9 months, we will give a demonstration of the framework for coalition mechanisms, which will be on the grid. This could identify potential development directions for the grid with respect to multiple agent domain management. This demonstration will address the creation of domains, tasking and control within and across domains and domain model management.

13. The 9-month demonstration will be an extension of the 6-month demonstration to include a US domain which is separate from the JTFHQ and JFAC HQ domains, an Observers domain, and agents from 3 further CoAX partners (CAMPS, Ariadne and two Dartmouth observer agents).

14. We demonstrated some elements of the 9-month demonstration at the TTCP meeting at DERA, Malvern in September 2000 (see http://www.aiai.ed.ac.uk/project/coax/demo/2000/ for the script, handout and briefings given. It should be noted that the 9-month integration is ambitious and contains risks, hence not all elements shown above may be ready for the September meeting. The following elements are to be added to the 6-month demonstration to form the 9-month demonstration:

- MBP/CAMPS link for distributed planning (with CAMPS in new US domain)
- Ariadne 'open data' weather information agent (grid-based agent)
- Dartmouth observer agents in new Observers domain
- Gao Observer agent (GAO) in new Gao Observers subdomain
- Extra steps/threads in storyboard to show functionality of new elements

AGENTS AND DOMAINS AT 9 MONTHS

15. There are six agent domains (see Figure C-2 above): three are coalition functional units (JTFHQ, JFAC HQ and Observers), one is a special subdomain (G.O. – Gao Observers) and two are country domains (US and Gao). The subdomain is used to allow the Gao agent to join the Observers domain restrict what the Gao agent can do, because there is some mistrust of Gao.

16. There are 20 agents: MBP (DERA), the Process Panel (AIAI), LM-ATL EMAA/CAST (Lockheed Martin ATL), two intelligence agents (Intel1 and Intel2), Ariadne (USC/ISI), CAMPS (AFRL), two Dartmouth observer agents (DGO and DAO), a Gao observer agent (GAO) and a Boeing KAoS Domain Manager (DM) and Match Maker (MM) for each of the domains (*except G.O.??)*. Excluding the DM/MM agents, the agents can be classified as follows: 2 planning agents (MBP and CAMPS), 1 monitoring agent (PP), 4 information providers (LM-ATL, Ariadne, Intel1 and Intel2) and 3 proxy observer agents (DGO, DAO, GAO).

STORYBOARD AT 9 MONTHS

17. The storyboard at 9 months will have the same flavour as the storyboard at 6 months, concentrating on Phases 1 and 2 of the Coalition Process (see Annex C). The main addition is that the 6-month storyboard will be augmented to show the linkage between CAMPS and MBP, with CAMPS (logistics airlift planner) providing MBP with missions to be worked around. Details are as follows:

a. Process Panel shows overall progress / tracks objectives being achieved.

b. Multiple restricted (e.g. AODB) and open (e.g. Ariadne) information feeds are shown, with Ariadne Weather data being treated as unrestricted.

(1) The LM-ATL EMMA agents support 'persistent queries' where updates are provided over an agreed timeframe.

(2) CAMPS generates and feeds airlift missions to MBP for deconfliction.

c. Dartmouth observer agents: within the CoAX scenario, a team of observers can be sent to several different locations, and can monitor several different kinds of activity.

(1) Gao/Agadez ground and air traffic in and around the Total Exclusion Zone (TEZ)

(2) Ground traffic and other activities at the suspected WMD site

(3) Air and ground traffic and other activities at the Salisbury military airbase

In all cases, the observations can include the numbers, types and locations of military equipment (especially aircraft and airbase status), deployed units, and civilian or refugee populations, as well as the current condition of roads, railroads, buildings and bridges.

NOTE: In the 9-month demonstration, the Dartmouth component will be a 'side-bar' demonstration, and will consist of an observation feed from the Total Exclusion Zone (TEZ) observers.

THREADS FOR THE NINE-MONTH DEMONSTRATION

18. The threads for the nine-month demonstration are as those for the six-month.

BINNI STAGES FOR THE 9-MONTH INTERNAL MILESTONE DEMONSTRATION

19. For the 9-month demonstration only Stages One and Two will be involved and the 'storyboard' (as before) will be a simple one as follows:

a. Stage 1. A Joint Operational (Stage 1a) and Air Estimate (Stage 1b) are being carried out concurrently:

(1) UNWAFB operations are being planned and the following have to be collected, fused and collated:

(a) Higher-level guidance, (message S1M1a / 1b, message S1M2a / 2b) and

(b) Theatre intelligence - intelligence updates are available from sources of different quality (ongoing agent exchange of information Ariadne / EMAA-CAST / MBP interactions - this is an ongoing Process Panel stage.

(2) JTFHQ has to monitor the Estimate and consider the joint COAs (for all the tasks given to the JTFC - see the Scenario),

(3) JFACHQ has to assemble the information to enable consideration of likely air COAs within the guidance.

b. Stage 2. Subsequently, the production of the JTFC's Campaign Plan (Stage 2a) and the JFACC's Air Operations plan (Stage 2b) are carried out concurrently:

(1) Mission / status and environmental reports also being provided (message S2M1a / 1b),

(2) Air transport and other proposed tasks have to be considered and integrated (CAMPS / MBP interaction),

(3) JTFHQ has to monitor the planning of Mission 'A' (could consider an alternative to Mission 'A' - no firestorm - because of fears about environmental / media reaction) as well as reviewing the other COAs for all the other tasks given to the JTFC,

(4) Information operations occur - the Gao cell proves false and access from its domain is terminated (discovery of false information is due to reports from Dartmouth ‘observer’ agents - triggers changes to policies and domain authorisations - denial activity - Boeing),

(5) JFAC HQ continues on UK / US information sources (initially of lower quality - use of existing 'Info-agents' providing data from alternative sources).

20. The demonstration shows the following events and agent activities:

- **Part 1 :**

  - JTF HQ sends UNWAFB Mission Document and MBP acknowledges.
  - JTF HQ sends Joint Commander's Mission Directive and MBP acknowledges.
- JTF HQ use the Process Panel agent to monitor Coalition-wIde processes.

- **Part 2 :**

  - JFAC HQ begins to assemble information and intelligence.
  - MBP agent at JFAC HQ communicates with non-domain-aware LM-ATL agent to get AODB information.
  - MBP agent communicates with Ariadne agent to get publicly-available weather information.
  - MBP communicates with CAMPS agent to get logistics information for air missions.
  - MBP uses local and remote KAoS matchmakers to find domain aware intel agents. These information providing agents are queried and some may provide occasional updates.

  Note: In cases where duplicate information is received from JFAC HQ's Intel and Gao's Intel, Gao's information is preferred as it is believed to be more up-to-date.

- **Part 3 :**

  - JFAC HQ begins air planning.
  - Air Battle Planner outlines proposed reconnaissance and firestorm areas using information being updated in near-real time by the agents.

- **Part 4 :**

  - Analyst at JFAC HQ discovers Gao's Intel agent is deliberately providing misinformation.
  - JFAC HQ domain administrator uses Domain Administration Tool on the Web to block any further communication with the Gao agents.
  - MBP henceforth only relies on less-frequently-updated but more reliable information from the local Intel agent.

- **Part 5 :**

  - Replanning occurs in the light of the newly corrected intelligence information.
  - The reconnaissance and firestorm areas are reviewed - denial-of-service attack is thwarted. Because there is some mistrust of Gao it is required to run under the NOMADS environment, which allows the SysAd to change and monitor the computing resources given to an agent. A denial of service attack on the DAO host machine (by writing continuously to hard disk and using up network resources) by its GAO agent within the observer domain is stopped by using the KPAT SysAd toll to change the behaviour of the malicious agent at run-time.

- **Part 6 :**

  - End of demonstration.
  - The Planning process would continue - through further iterations between JTF HQ and the JFAC HQ until a draft Air Estimate and Air Operations Directive is provided to the JTF HQ.

LINKS TO AGENT TASKS

21. The following links are to specific tasks (in participant order) in the scenario for the agents to carry out at 9-months:

- Task_AIAI_Monitor_Objectives,
- Task_Boeing_UWFIHMC_OPSEC,
- Task_Dartmouth_HUMINT,
- Task_DERA_Air_Battle_Planning,
- Task_GITI_CAMPS_Airlift,
- Task_LMATL_Integrate_US_Information,
- Task_USCISI_Weather_Reporting.

CHAPTER 14. (ANNEX D)

BINNI FLASH - PARTICIPANT DETAILS

Links back to: Document_Structure, Annex_A, Annex_B, Annex_C, Annex_E

1. This Chapter describes the specific agent functionality provided by each CoAX TIE partner, The Chapter is arranged below by CoAX partner (each contribution starts on a new page). The tasks are derived from the appropriate 'threads' described in the Binni scenario and summarised in the demonstration storyboards in Annex_C.

2. In each of the sections below the tasks are described from the partner's point of view - hence interactions with other agents are seen from 'each end' in each section. So if EMAA agents talk to MBP agents that interaction will appear twice in the lists below. There will also be an entry for each of the demonstrations that agents participate in as their contribution will be different in each one.

Follow these links to find out more about each Participant's Contributions:

Annex_D_AFRL, Annex_D_AIAI, Annex_D_BBN, Annex_D_Boeing, Annex_D_CMU, Annex_D_DARPA, Annex_D_Dartmouth, Annex_D_DREV, Annex_D_DSTO, Annex_D_GITI, Annex_D_ISX, Annex_D_LMATL, Annex_D_MIT, Annex_D_Mitre, Annex_D_OBJS, Annex_D_QinetiQ, Annex_D_Schafer, Annex_D_STANFORD, Annex_D_UMD, Annex_D_UMICH, Annex_D_USCISI, Annex_D_UWFIHMC.

Note: See the separate document describing the CoAX Binni 2002 Approach and Demonstration for the contributions which will be made by partners for the CoAX Binni 2002 (30-month) demonstration.

AFRL (SPONSOR OF CAMPS)

(Back to Annex_D links)

3. The tasks for the CAMPS agent relate to:

a. Overview.

(1) AFRL will provide the government point of contact for the Coalition TIE (Rick Metzger).

(2) AFRL will also provide technical resources to link CAMPS to the UK Master Battle Planner (MBP) within the context of the work of the TIE.

b. Triggers from events.

(1) Task_GITI_CAMPS_Airlift.

c. Resulting Agent Tasks.

(1) Provision of Air Transport plans for incorporation into MBP .

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

(1) CAMPS will be in the US domain in the 9-month demonstration. It will provide MBP with Air Transport plans to be worked around.

g. Information to be Exchanged.

h. Links to other Participants.

(1) CAMPS will provide air transport plans for inclusion in MBP.

i. Other Technical Aspects.

AIAI (PROCESS PANEL, O-PLAN, I-X)

(Back to Annex_D links)

4. The tasks for the AIAI Process Panel agents relate to:

a. Overview.

(1) AIAI's technical contributions to the Coalition TIE will include:

- Use of shared models to facilitate coalition task driven co-operation.
- Use of agent organisational structures with explicit tasking and authority management.
- Development of techniques for multiple co-operative agent domains (jointly between Boeing's KAoS, Boeing's Policy Manager and AIAI's I-X).
- User role specific task and process support panels with plug-in sub-panels appropriate to user, user role and application in use.

(2) In the CoAX demonstrations, AIAI will provide a Process Panel (PP) agent for use by the JTFC. The PP will be used to monitor the progress and status of the coalition C2 process.

b. Triggers from Events.

(1) The panel will receive process update messages from the other agents.

(2) Task_AIAI_Monitor_Battle_Rhythm, Task_AIAI_Monitor_Objectives.

c. Resulting Agent Tasks.

(1) The panel will display the current state of the coalition process.

d. Extra Tasks.

e. Issues still to be Addressed.

(1) Product visualisations, enhanced process model.

f. Domain Membership.

(1) The Process Panel (PP) will be present from 6 months onwards. It will reside in the JTFHQ domain and will function as a way for the JTFC to view the activities of the agent community.

(2) In the 6 and 9-month demonstration, it will act as a monitor of MBP's activities, with messages passing between the JFACHQ domain (where MBP resides) and the JTFHQ domain.

(3) At 9 months, the PP will be enhanced to show the status and content of process products, such as drafts of estimates being prepared.

(4) In future demonstrations, the process panel will be enhanced to include:

- Generic task and process management services
- Dynamic process creation and change
- Multiple panels for different user roles or domains

g. Information to be Exchanged.

(1) PP will receive update messages from all agents whose activities explicitly alter the status of the C2 process.

h. Links to other Participants.

(1) Initially, there will be a strong link to MBP, which will pass messages to PP about the current state of the air planning process. Later, there will be links to other planning, monitoring and information providing agents as these will directly change the status of the coalition C2 process.

(2) There will be an opportunity to demonstrate integration of stand-alone demonstrations with the main demonstration scenario at an earlier stage by using a surrogate event generator used as part of the AIAI agents test environment. This will allow the feeding in of events and issues such as could be generated by stand-alone components (e.g., from Dartmouth, MIT and UMich.).

i. Other Technical Aspects.

(1) The underlying (internal) data base of the Process Panel will allow for multiple process descriptions, multiple product descriptions, describe the issue grammar, [in future allow for multiple available capability descriptions], and show the mappings of events to process and product states.

(2) The Process Panel will support Process Views - for one or more processes.

(3) The Process Panel will support Process Product Views - for one or more products.

(4) The Process Panel will support Process Monitoring - using explicit messages, grid logs, and other potentially other external sources of process and product change information.

(5) The Process Panel will support Issue Handling - it will take in issues and initially allow them to be ticked as "handled" by the user. It will later support active aids to address issues.

(6) The Process Panel will support Process Command - initially this will be a simple "start demo" button, but this will be developed in later versions.

(7) The Process Panel design will support Process Management, Plan Generation, Repair, etc. Though these may not be demonstrated specifically within the CoAX scenarios.

(8) AIAI will provide a Surrogate Event Generator as part of its agents test suite and to allow replay and stand alone demonstration of the Process Pane. This SEG will be built so that it can incorporate events generated and issues raised by other (non-integrated) components in the CoAX demonstrations.

BBN (MIXED-INITIATIVE INTERFACE AGENTS)

(Back to Annex_D links)

5. BBN has been heavily involved in the MIATA TIE. Possible contributions to CoAX could include:

a. BBN, Mark Burstein and Dave Diller - did MIATA mixed initiative demo at Miami. Would want to put elements of their demo on 'front-end' of CoAX; ie, add an interface agent element.

b. Their role (for CoAX_Binni_2002_Overview - 30-month demo) could relate to the provision of 'embodied interfaces' to some of the CoAX agents.

6. The tasks for the BBN agent relate to:

a. Overview.

(1) ?.

(2) ?.

b. Triggers from events.

(1) ?

c. Resulting Agent Tasks.

(1) Provision of ?.

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

(1) ?

g. Information to be Exchanged.

h. Links to other Participants.

(1) ?

i. Other Technical Aspects.

BOEING (KAOS - DOMAIN-BASED SERVICES)

(Back to Annex_D links)

7. The tasks for KAoS agents relate to:

a. Overview. [Taken from the CoAX outline, 10th March]

(1) Boeing will take primary responsibility for **agent domain management services** on the grid. These services will evolve from and enhance existing services available within the Boeing KAoS agent framework. An agent domain consists of a unique instance of a **domain manager** along with any agents that are registered to it. The function of a domain manager is to: 1) manage agent registration, 2) serve as a single point of administration for policy management. That is, the domain manger could configure, re-configure, store, publish and enforce polices that exist for that domain. Domains assure those who deploy agents systems that there is policy uniformity across multiple platforms and hosts, as long as semantically equivalent monitoring and enforcement mechanisms are available across those platforms and hosts. Under these conditions, it would follows that a given domain could extend across host boundaries and, conversely, multiple domains could exist concurrently on the same host. With respect to platform independence, it should be possible for agents running on the same platform to be in different domains (for example, a resident and a visiting mobile agent running on the same platform may belong to different domains having more or less restrictive security privileges).

(2) A **policy** is a machine-readable set of statements in which some element (such as an agent) of an agent system declares a specification intended to describe or govern its interaction with other elements of the agent system. For example, an agent may declare a policy that all messages it exchanges with other agents must be encrypted, or that certain timing and message sequencing constraints must be observed when requesting a particular kind of service from that agent. The latter is an example of a **conversation policy**. A domain manager has policies such as:

- No agents registered to its domain may communicate with agents outside the domain
- No agent can consume more than a given fraction of some system resource,
- Agents must respond to messages from the domain manager within a given time frame
- Agents with “higher priority” tasks pre-empt “lower priority” ones.

The policy is expressed in a persistent machine-readable format such as text, which could be interpreted by a platform-specific policy enforcement mechanism. Policy and policy-enforcement mechanisms could be defined in multiple locations in a given implementation. The separation of policy specification from policy-enforcement mechanisms allows policies to be dynamically reconfigurable, and relatively more flexible, fine-grained, and extensible. Agent developers can build applications whose policies can change without necessarily requiring changes in source code. The rationale for using declarative policies to describe and govern behaviour in agent systems

includes the following claims: easier recognition of non-normative behaviour, policy reuse, operational efficiency, ability to respond to changing conditions, and the possibility of off-line verification.

(3) At 9 months, the demonstration will be a mixture of KAoS agents and "non-domain aware" message based Grid agents. All agents in the 18-month demonstration onwards will be KAoS agents.

b. Triggers from Events.

(1) Task_Boeing_UWFIHMC_CNA, Task_Boeing_UWFIHMC_OPSEC, Task_Boeing_UWFIHMC_CNA_1, Task_Boeing_UWFIHMC_OPSEC_1.

c. Resulting Agent Tasks.

(1) Registration of agents in domains

(a) Registration approved or denied based on agent/user credentials

(b) Simultaneous registration in multiple domains

i. Hierarchical

ii. Overlapping

(c) Agents unregistering from domains

(2) On-the-fly creation of new domains

(3) Attribute certificate configuration tools

(a) Creation of attribute certificates for agents

(4) Policy configuration tools

(a) Policies edited and enforced at domain, computing environment (e.g., VM), host, and individual agent levels

(b) Different types of policies (Sloman)

(5) Policy decision-making

(a) Use of attribute-certificate-based policy engine

(b) Policy conflict resolution

(c) User-driven vs. event driven policy changes

(6) Authentication and encryption

(a) JAAS-based authentication

(b) SSL-based message encryption

(7) Policy enforcement

(a) Different mechanisms: computing environment based (e.g., VM-level), privileged code wrapper, sentinels

(b) Enforcement across heterogeneous computing environments in a single domain (e.g., Java and Aroma VM's)

(c) Enforcement across heterogeneous OS's, communication transport mechanisms

(8) Conversation management

(a) Sequencing constraints

(b) Timing and other constraints

(9) Authorisation and access control

(a) Different kinds of information available to news media, various coalition-related domains

(b) Scoping of remote matchmaker and remote domain manager actions

(10) Grid integration across heterogeneous agent frameworks

(a) Compatibility with 'non-domain aware' agents

(b) Mix of conversation-based and message-based communications

(c) Domain-aware grid helper

(11) Defense against attacks (see 3E10f)

(a) Use of NOMADS fine-grained resource management features in conjunction with KAoS domain management features to restrict behaviour of rogue agent

(b) Use of NOMADS forced mobility feature to isolate and observe rogue agent

(c) Use of KAoS domain management mechanisms to show robustness and fault tolerance under attack (e.g., current domain policies remain in force even if selected components knocked out of service)

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

g. Information to be Exchanged.

h. Links to other Participants.

i. Other Technical Aspects.

CMU (MIXED-INITIATIVE AGENTS)

(Back to Annex_D links)

8. CMU assists QinetiQ with the provision of mixed-initiative interface agents.

DARPA COABS (THE GRID)

(Back to Annex_D links)

9. The Grid supports the agent activity involved in building a common Coalition information set. It also supports the heterogeneous agent mix (EMAA / CAST, KAoS etc). For the CoAX TIE the Grid is taken as a given and is sponsored by DARPA.

DARTMOUTH ('OBSERVER' HUMINT FEED)

(Back to Annex_D links)

10. The tasks for the Dartmouth agents relate to:

a. Overview.

(1) Dartmouth, as part of a United States Department of Defence Multi-University Research Initiative (MURI) funded under AFOSR contract F49620-97-1-03821, is working to provide soldiers in the field with networked portable computing devices. The project has two main components: (1) the wireless networking algorithms that allow the soldiers to main contact with each other (and with headquarters), and (2) techniques for accessing complex information sources across low-bandwidth and unreliable network links.

(2) Dartmouth and the other MURI participants have demonstrated this technology within several "field-observer" scenarios, where a team of observers monitors all ground traffic or other activity in a given area and feeds their observations back to headquarters for analysis.

(3) In the context of the CoAX demonstrations, the Dartmouth system should be viewed as a *large "legacy" system* that needs to be made Grid-aware at its boundary so that the observations can be fed to other coalition agents. In other words, the Dartmouth system serves as an interesting and effective test of interoperability.

b. Triggers from Events.

(1) Task_Dartmouth_HUMINT.

(2) Within the CoAX scenario, a team of observers can be sent to several different locations, and can monitor several different kinds of activity.

(a) Gao/Agadez ground and air traffic in and around the Total Exclusion Zone (TEZ)

(b) Ground traffic and other activities at the suspected WMD site

(c) Air and ground traffic and other activities at the Salisbury military airbase

In all cases, the observations can include the numbers, types and locations of military equipment (especially aircraft and airbase status), deployed units, and civilian or refugee populations, as well as the current condition of roads, railroads, buildings and bridges.

(3) In the 9-month demonstration, the Dartmouth component will be stand-alone, and will consist of an observation feed from the Total Exclusion Zone (TEZ) observers. The observations will be stored in a Grid-aware database and displayed to a military analyst via a simple "observation monitor".

(4) In the 18- and 30-month demonstrations, the Dartmouth observations will directly impact the mission-planning process, since the observations will correct false information provided by Gao. The observations will be displayed in the observation monitor for human analysis, and also will feed directly into either the Master Battle Planner (MBP) or the Process Panel. It has not been determined which of (1), (2) and (3) above the observers will monitor during the 18- and 30-month demonstrations.

c. Resulting Agent Tasks.

(1) Feed the observations into a Grid-aware database for later use (9-month demo)

(2) Feed the observations directly into MBP or the Process Panel (18- and 30-month demos)

d. Extra Tasks.

(1) The Dartmouth observation system will be part of the Coalition Forces' *observer* domain. In the current CoAX scenario, the coalition force initially allows Gao to execute some of their agents inside this domain, but then withdraws this right after Gao intentionally provides misleading information. Before access revocation, the Gao agents might examine (a subset of) the coalition observations, or apply complex coalition services to their *own field observations*. Such services could include a path predictor (e.g., where is this observed vehicle likely to go next?) and an observation collator (i.e., do these two observations correspond to the same vehicle?). Note that although Dartmouth has a path predictor, it might not be worthwhile to actually include these additional, complex components in the implemented demonstration. We merely need a realistic reason why a Gao agent might be allowed to operate inside the *observer* domain. Access to certain coalition services might be such a reason.

(2) However, the Dartmouth observation system does need to enforce coalition security constraints (certainly Gao should not be allowed to see every coalition observation even before the Gao deception is discovered), and must adapt appropriately when Gao is removed from the observer domain.

e. Issues still to be Addressed.

(1) The specific kinds of observations that will be made during the demos (i.e., which of (1), (2) or (3) in section b above is most interesting from a scenario standpoint?), and the protocol for feeding the observations into MBP and the Process Panel.

f. Domain Membership.

(1) The Dartmouth agents live entirely in the *observer* domain.

g. Information to be Exchanged.

(1) The Dartmouth agents provide an observation stream to the observation monitor, the Master Battle Planner and the Process Planner.

h. Links to other Participants.

(1) The Dartmouth component impacts five other groups: (1) AIAI, which is working on the Process Panel, (2) Boeing and UWF, which are concerned with different aspects of domain management, and (3) QinetiQ and Lockheed Martin, who are working on MBP and associated information feeds. Respectively, these groups are covered in Sections 4, 5, 16, 7, and 11 of this addendum. In addition, the Dartmouth component obviously relies on the Grid for communication with other components, and hence is linked with the Grid developers (Section 6).

i. Other Technical Aspects.

DREV (ADAPTIVE RESOURCE MANAGEMENT

(Back to Annex_D links)

11. DREV is, at present (Jan 2002), taking a watching role while they prepare to contribute to CoAX_Binni_2002_Overview. Possible contributions could include:

a. KARMA: Knowledge based Adaptive Resource Management Agent (Not software agent). Adaptive intelligent system to support tactical air mission planning - dynamic aircraft and crew scheduling at the tactical level. Legacy system (C++; combination SUN/PC). In: Helicopter mission requests (vehicle, time window, duration, crew requirement); resource unexpected events (pilot/aircraft unavailable) Out: Plan (helicopter/crew) Applicable to some Canadian resource, deal with limited unexpected events (pilot/helicopters unavailable) to repair plans (not a mobile agent) - tactical situations.

b. An alternate (more modest) agent-relevant participation, might be simply to focus (as a first step)on the use of a Vehicle Routing agent (using anytime genetic algorithms), that routes homogeneous capacitated vehicles to serve a number of clients (with known demands) in a specific time windows. As a result, that capability (seen as an agent service) might be usable by other coalition members to solve pure vehicle routing problems (if relevant) to minimize the number of routes (no-mobility, C++). We are initiating some work on a dynamic version of the algorithm. In: number of vehicles, capacity; client distribution (geographical positions, and demands) Out: routes (sequences of clients to be visited for each vehicle)

12. The tasks for the DREV agent relate to:

a. Overview.

(1) ?.

(2) ?.

b. Triggers from events.

(1) ?

c. Resulting Agent Tasks.

(1) Provision of ?.

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

(1) The DREV will be in the ? domain ?.

g. Information to be Exchanged.

h. Links to other Participants.

(1) DREV will provide ? plans for ?.

i. Other Technical Aspects.

DSTO (INFORMATION FUSION)

(Back to Annex_D links)

13. DSTO (Australia) is, at present (Jan 2002), developing a role relating to information fusion. Possible contributions could include:

a. DSTO (Dale Lambert) is involved with the FOCAL (Future Ops Centre Analysis Lab) / ATTITUDE agent work (intel and logs information fusion). They want to show how agents can improve situational awareness for intel / logs community.

b. Their role (for CoAX_Binni_2002_Overview - 30-month demo) will relate to the provision of ASW information from an Australian ship in the Red Sea.

14. The tasks for the DSTO agent relate to:

a. Overview.

(1) ?.

(2) ?.

b. Triggers from events.

(1) ?

c. Resulting Agent Tasks.

(1) Provision of ?.

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

(1) The DSTO will be in the ? domain ?.

g. Information to be Exchanged.

h. Links to other Participants.

(1) DSTO will provide ? fused ASW information for ?.

i. Other Technical Aspects.

GITI (CAMPS AND GRID INFRASTRUCTURE)

(Back to Annex_D links)

15. The tasks for the CAMPS agent relate to:

a. Overview.

(1) ASFRL / BBN / GITI are the providers of CAMPS - AFRL as originators, BBN for the system and GITI for the integration into CoAX.

b. Triggers from Events.

(1) Task_GITI_CAMPS_Airlift.

c. Resulting Agent Tasks.

(1) Provision of Air Transport plans for incorporation into MBP.

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

(1) CAMPS will be in the US domain in the 9-month demonstration. It will provide MBP with Air Transport plans to be worked around.

g. Information to be Exchanged.

h. Links to other Participants.

(1) CAMPS will provide air transport plans for inclusion in MBP.

i. Other Technical Aspects.

ISX (COAX SUPPORT)

(Back to Annex_D links)

16. ISX assists with the CoABS infrastructure and would be happy to help us as required, probably to assist with knowledge acquisition (KA) when the details we need of data sources and systems is required.

LM-ATL (EMAA / CAST AGENTS)

(Back to Annex_D links)

17. The tasks for the EMAA / CAST agents relate to: The tasks for the Extendable Mobile Agent Architecture (EMAA) / Co-operative Agents for Specific Tasks (CAST) agents relate to:

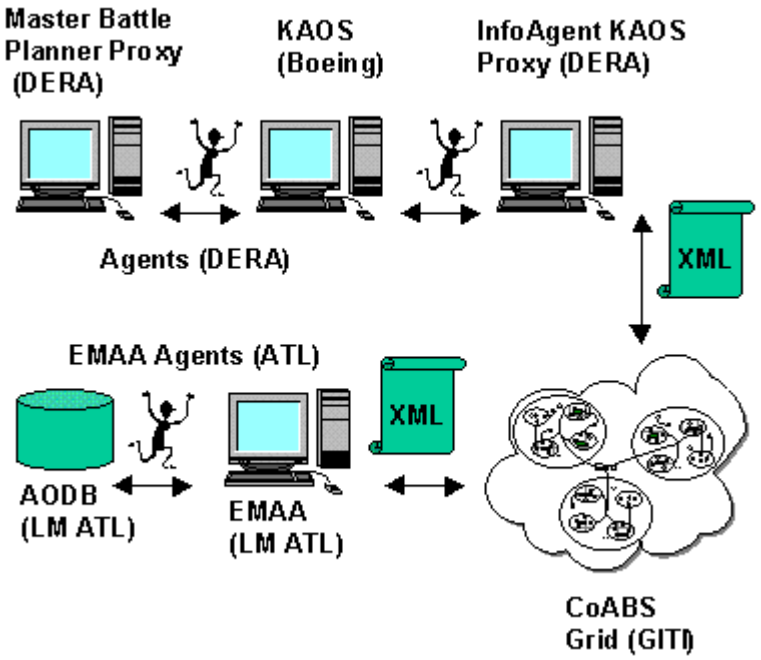
a. Overview.

(1) EMAA/CAST is an agent architecture and framework for information discovery, dissemination, and monitoring (IDDM). Customer agents can launch EMAA/CAST "InfoAgents" by specifying an XML formatted info request.

(2) LM-ATL EMAA/CAST agents are present in the 6 and 9 month demos as "come-as-you-are" agent providing MBP with access to a mocked up United States Air Operations Database (AODB). During the 9-month demo, the requests for information from AODB will be controlled by a domain aware proxy created by QinetiQ. The agents will allow other authorized coalition participants to use EMAA's IDDM capabilities to perform customized queries on US owned data sources. These agents serve as "InfoAgents" in the COAX scenario.

b. Triggers from Events.

(1) Task_LMATL_Integrate_US_Information. QinetiQ's MBP requested information from all Grid components that are registered as an "InfoAgent." An EMAA/CAST agent is one of these components.



c. Resulting Agent Tasks.

(1) One or repeated series of XML queries against the AODB plus the delivery of results. QinetiQ's MBP asks KAOS for information in the AODB database via an XML information request. These requests can specify interest in all of the information in the database or information about a specific entity. The XML query can be given parameters that tell the EMAA/CAST agent to persistently monitor the database for any changes that may occur. The results from the queries are sent back in an XML document.

d. Extra Tasks.

e. Issues still to be Addressed.

(1) We would like to explore other possibilities of modifying the EMAA/CAST agents to change them from a "come-as-you-are" agent to a US domain agent. We could add a KAOS interface to our agents or connect to the KAOS Domain Management via the Grid once it becomes a Grid component.

(2) We will be evolving the EMAA/CAST technology into a reusable Grid component to persistently monitor various JDBC data sources. This technology will continue to use XML to easily allow other Grid components to launch EMAA/CAST agents that can access alternative data sources for information discovery, dissemination, and monitoring (IDDM). This will allow other Grid components to use EMAA/CAST's IDDM capability to remotely monitor their own databases or EMAA/CAST's databases.

(3) We intend to deliver an IDDM agent engine with a sample GUI and a sample database to facilitate the customized reuse of this technology. The IDDM agent engine will be a generalized version of the technology from LM-ATL's Air Mobility Command (AMC), Logistics Command and Control (LogC2), Coalition TIE, and Joint Interagency Task Force (JIATF-East) applications.

f. Domain Membership.

(1) EMAA/CAST will be a "come-as-you-are" agent for the 6 and 9-month demonstrations. During the 9 month demo, we are planning on connecting to KAOS via a proxy supplied by QinetiQ.

g. Information to be Exchanged.

(1) MBP will send a series of XML queries requesting additional information from a US AODB database to build a composite picture of the battle space. EMAA/CAST will return the results in an XML document.

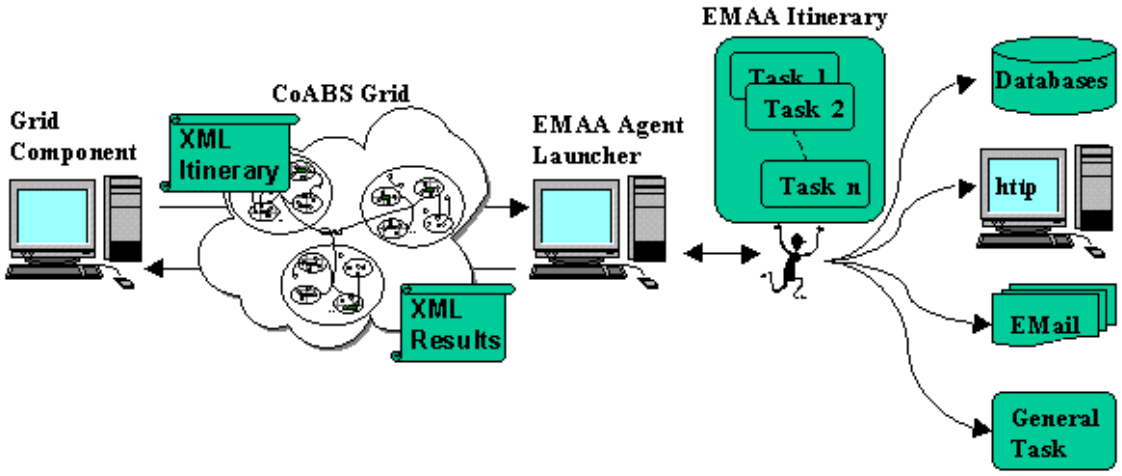
h. Links to other Participants.

(1) Provided data to MBP on request controlled by a domain aware proxy.

i. Other Technical Aspects.

(1) We are working on creating a generic EMAA/CAST Agent Launcher to create an itinerary of tasks for an agent to monitor various data sources. The Launcher will be domain aware and will launch domain aware agents.

(2) The Launcher will be able to receive an XML string containing a description of an itinerary of tasks that could perform queries on the following data sources.



(a) JDBC Database Sources. For the Coalition TIE we are concentrating on accessing JDBC sources, such as the AODB. Other databases could also be searched including the Modernized Integrated Database (MIDB). It could also be possible for the EMAA/CAST agents to monitor a database with a remote connection.

(b) Web Pages. For the US Navy Fleet Battle Experiment – Hotel (FBE-H), we have developed agents to perform web-scraping tasks. These agents search various web sites on SIPRNET for text, tables and images.

(c) EMail. For the Joint Interagency Task Force (JIATF-East), we have developed agents to search for information in email. These agents look for specific information to help build a case file.

This will allow other Grid components to create a customized EMAA agent and give it a set of tasks to monitor various data sources.

(3) The Launcher could be extended to launch other types of agents instead of only agents that monitor data sources. This would include allowing a Grid component to send a specific set of tasks written in Java to be performed via an EMAA/CAST agent. This will allow other Grid components to use other computing resources to process tasks and then return the results. We will co-ordinate this work with the CoABS Mobility TIE. They are also designing a mobile agent launcher interface.

MIT (EXECUTION EXCEPTION HANDLING / WORKFLOW)

(Back to Annex_D links)

18. The tasks for the MIT systems relate to:

a. Overview.

(1) Our mission is to develop technology that enables robust operation in open agent systems where we have, in principle, no guarantees of reliable, compliant, or even friendly agents and infrastructures, since we have no control or even necessarily any knowledge over how they are implemented. In a coalition operation, for example, we may suddenly find ourselves needing to quickly be able to work with agents from North Korea or Iraq without the luxury of first engaging in an exhaustive code review. The same kinds of issues appear, perhaps in less extreme form, in such non-military contexts as electronic commerce, virtual enterprises, disaster relief, and so on.

b. Triggers from Events.

(1) Task_MIT_Detect_Abnormalities.

c. Resulting Agent Tasks.

(1) Our strategy consists of identifying domain-independent exception handling (EH) rules for multi-agent system, embodied in the form of distinct EH services. These services including sentinels (that monitor and intervene in agent activity) and EH repositories (that store global state information such as inter-agent commitments and agent reputations). The EH services are designed to place as few as possible (and sometimes no) additional requirements on the agents, in order to maximally simplify the process of incorporating the EH services into existing agent system.

(2) CoAX Demonstration Exception Idea: "Agent Death": this exception occurs when agents that decompose and allocate subtasks amongst each other die. The EH services will:

- detect agent death via polling,
- notify customers as well as the subcontractors of the deceased agent,
- provide a reputation service that keeps track of agent reliability and can be used by agents to filter incoming bids, and
- will provide a 'result caching' capability so that results from agents whose customers have died are cached on the presumption that the agent that replaces the dead agent is likely to have the same requirements

This service will require that agents log their RFB, award and result messages, and will work more effectively if agents respond to an 'are you alive?' polling message (though it is not required). We have already implemented these handlers and shown good experimental results.

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

g. Information to be Exchanged.

h. Links to other Participants.

i. Other Technical Aspects.

MITRE

(Back to Annex_D links)

19. US military relevance checks and "overall story" (narrator for demos).

OBJS (EMAIL AGENTS AND MENU-BASED NATURAL LANGUAGE INTERFACES)

(Back to Annex_D links)

20. OBJS provides email agents / asynchronous wireless connectivity (eGents) and menu-based natural language interfaces (MBNLI), both used in the CoAX-Binni-2001-Approach.doc demonstrations. OBJS contact is Craig Thompson. OBJS eGents was also used in the MIATA mixed initiative disaster relief scenarios demo at Miami and the Y-JBI Small Unit Operations demo in Nashua. For CoAX_Binni_2002_Overview - 30-month demo, OBJS can provide their eGents and MBNLI interfaces and current elephants vignette from CoAX Binni 2001 to show that part of the scenario. No changes are planned to their input as their CoABS project nears its end.

21. The tasks for the OBJS agent relate to MBNLI and eGents:

a. MBNLI. Menu-based Natural Language Interfaces (MBNLI) make it easy for end users to query or command a target resource. The current capability supports multiple users, works well across the web and when the target resource is an ODBC relational DBMS because then we can automate generation of MBNLI interfaces else we have to write grammars manually. What MBNLI adds is not more data sources but rather a new kind of user interface to existing data sources, agents, or capabilities. Users do not have to be experts at querying a DBMS and can access data sources they have never seen before asking complex queries.

(1) Task 1 – Use MBNLI to enable web-based user to query a remote data source, in this case information on the location of the Laki Safari Park mammals.

b. eGents. Email agents (eGents) agents communicate via email, with several advantages like robust transport, less infrastructure, goes thru firewalls, portable devices, ... The eGents demo from Boston showed an eGents application where people in the field had personal status monitors (implemented with Palms running Java email) and these took location, medical and other info and communicated it to various subscribers like medical units or command posts. By itself, this could be slotted into the CoAX TIE (if we change the story a bit) so field observers used an egents based device. A vignette like this might add asynchronous messaging and device mobility to CoAX.

(1) Task 1 – Joint Force subscribes to eGents connected to mammals in Laki Safari Park to determine their current location and direction of movement.

c. Triggers from events.

(1) In the CoAX-Binni-2001-Approach.doc, some replanning of the firestorm original plan is needed to avoid endangering Laki Safari Park wildlife.

d. Resulting Agent Tasks

e. Extra Tasks

f. Issues still to be Addressed.

g. Domain Membership.

(1) The eGents monitoring Laki Safari Park mammals will be in the Cyberspace domain, accessible by a search engine over the web.

h. Information to be Exchanged.

(1) XML descriptions of Laki Safari Park wildlife

i. Links to other Participants.

(1) eGents will provide information feeds for USC/ISI Ariadne.

j. Other Technical Aspects

(1) Could also have shown egents on Palm (as was done in MIATA demo)

(2) Could also have shown discovery and generation of MBNLI interface on-the-fly.

QINETIQ (COALITION BATTLE PLANNING, VISUALISATION AND DECISION SUPPORT) [FORMERLY DERA]

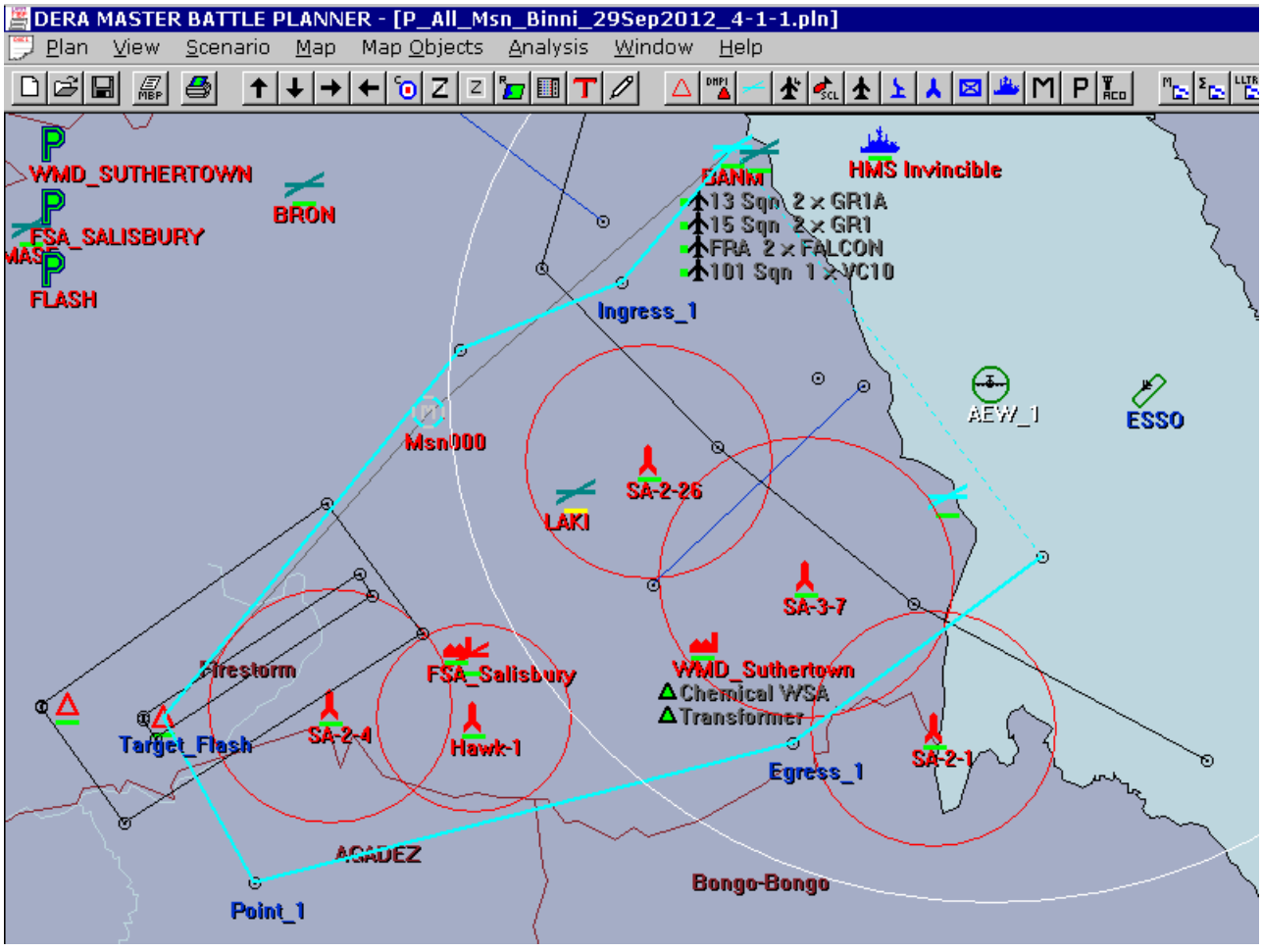
(Back to Annex_D links)

22. The tasks for the QinetiQ agents relate to:

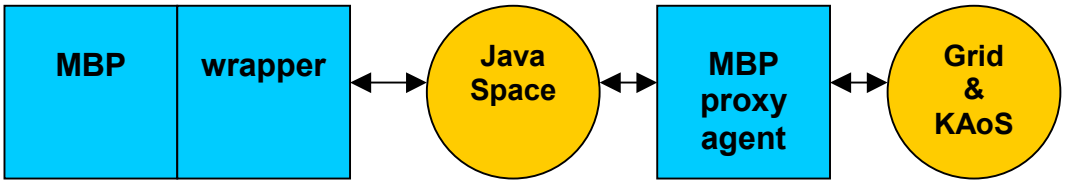
a. Overview.

(1) QinetiQ are involved in the CoAX TIE as this supports an MOD research project into "Software Agents in Command Information Systems". The overall objectives of the project are to determine and demonstrate the effectiveness of software agent technology in the context of military command systems. QinetiQ's main contribution to the CoAX TIE will be an agent-enabled version of the Master Battle Planner (MBP) to provide Coalition-wide Air Operations planning **[**Task_DERA_Air_Battle_Planning**]** capabilities which could eventually support near-real-time Current / Combat Operations. QinetiQ with also support the achievement of Coalition-wide situational awareness with the SitViewer **[**Task_QinetiQ_SitViewer**]** and support command agility Task_QinetiQ_DecisionDesktop with the provision of Decision Desktops for warfighters.

(2) MBP is a highly effective visual air battle planning tool used to develop, analyse and brief an Air Operations Plan:



(3) The non-agent MBP receives a single input of scenario data which becomes out-of-date as planning proceeds and time advances. The agent-enabled MBP will be able to receive information updates such as change of status of friendly forces, weather reports, updated intelligence on opponent activities etc. MBP has been agent-enabled by providing a software wrapper and a proxy agent using the CoABS Grid and KAoS. The wrapper and agent use the JavaSpaces distributed object framework as a buffer so that MBP code is not exposed to other agents, for security reasons:



(4) The objectives of the demonstrations are to show the Master Battle Planner interacting with other information services / command support applications. The Grid / KAoS allows MBP to request information updates and to receive unsolicited data sent by agents. In this way, the military planner is presented with a dynamic view of the assets and targets available rather than the static view previously presented by MBP.

b. Triggers from Events.

(1) MBP will receive updates from other agents (Intel agents, Ariadne) as information about assets, targets and weather change. These updates may be in response to queries by MBP, or may be unsolicited.

(2) When domain security policies are changed (e.g. the exclusion of the Gao domain) MBP will update its Air visualisation from the remaining trusted agents.

(3) MBP will receive queries from the AIAI Process Panel regarding the status of the planning process, and respond appropriately, and / or initiate conversations in order to inform the Process Panel of events.

(4) MBP will not be fully interactive until the Execution Monitoring Stages are triggered from the 18-month demonstration onwards.

c. Resulting Agent Tasks.

(1) MBP providing Coalition Air visualisation

(2) Carrying out air operations planning, evaluation and implementation:

(a) Looking up and querying other agents for information.

(b) Receiving updates from units (asset status, weather etc),

(c) Receiving air mission information from other Coalition sources, such as logistics missions planned by CAMPS, and integrating these into the Coalition Air Battle Plan visualisation.

(d) Carrying out plan briefings (for approval),

(e) Plan dissemination,

(f) Adding, investigating, monitoring issues raised by mission execution.

d. Extra Tasks.

(1) Providing domain-aware KAoS proxies for agents and systems such as Ariadne, CAMPS and the LMATL Grid agents.

(2) Providing information-providing agents (Intel agent/Info agent) for the various domains.

(3) Dynamic conflict resolution of data before display in MBP, for instance favouring up-to-date Gao information before the deception is discovered, but excluding it after the discovery.

(4) Providing Coalition-wide situational awareness with the SitViewer **[??? More detail to follow]**.

(5) Providing support to collaborative working, problem-solving and decision-making with Decision Desktops **[??? More detail to follow]**.

e. Issues still to be Addressed.

f. Domain Membership.

(1) MBP will be in the JFAC HQ domain from the 6 month demonstration onwards.

(2) The KAoS agent interface to Ariadne will also be in the JFAC HQ domain.

(3) The KAoS agent interfaces to AODB and CAMPS will be in the US domain.

g. Information to be Exchanged.

(1) For the 6 and 9-month demonstrations, MBP is the central planning agent and will need to communicate with all other agents in the demonstration.

(a) MBP receives target and asset data from the AODB via the LM-ATL agents.

(b) MBP receives target and asset data from the JFAC HQ and Gao Intel agents.

(c) MBP receives weather information from the Ariadne agents. This is requested and displayed by a KAoS weather agent before being converted and passed on for display in MBP. The weather agent can also advertise and make available its services to other KAoS agents.

(d) MBP receives Air Transport Planning information from CAMPS, consisting of transport missions for integration into the Coalition Air visualisation. This may also require information on the airbases specified in the CAMPS plan.

(e) MBP sends and receives information to/from the AIAI process panel, allowing monitoring and confirmation of the status of the planning process.

h. Links to other Participants.

(1) MBP is the central planning agent for the 6 and 9-month demos and therefore impacts and is impacted by most other participants' work. Some of the interactions with other agents are carried out by intermediary agents which gather and translate information.

(2) The interactions with the LMATL agent, the Intel agents, and AIAI's Process Panel agent are more direct; QinetiQ is working with these partners to agree on the structure and content of agent communications.

(3) QinetiQ are working with the Boeing team on some aspects of KAoS development, by providing feedback on the development of agents with KAoS. Some collaboration on specific aspects of the KAoS framework, such as conversations, is planned.

i. Other Technical Aspects.

SCHAFER (COAX SUPPORT)

(Back to Annex_D links)

23. Schafer assists with the CoABS infrastructure and with administrative support.

STANFORD

(Back to Annex_D links)

24. Stanford's role TBN.

UMD (PROBABILISTIC TEMPORAL REASONING AGENTS)

(Back to Annex_D links)

25. The tasks for the UMD agents (for CoAX_Binni_2002_Overview - 30-month demo) relate to:

a. Overview. Offer to provide agents that are capable of efficiently storing, manipulating, and querying probabilistic temporal information.

(1) For example, consider a series of sensor readings that are taken on the Agadez submarines. Here, each reading can be associated with an enemy's location, bearing, velocity, etc. Based on this information, there are a variety of models that can estimate, for each future time instant, the probability that an enemy will enter a given region (we shall supply some sample models that can easily be replaced). The probabilistic temporal data obtained from these models are potentially useful in planning interceptions of enemy units by Coalition forces, to aid in the determination of if (and when) an area should be evacuated, to help reduce information overload by focusing attention on the most probable possibilities, etc.

(2) ?.

b. Triggers from events.

(1) ?

c. Resulting Agent Tasks.

(1) Provision of ?.

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

(1) The BBN will be in the ? domain ?.

g. Information to be Exchanged.

h. Links to other Participants.

(1) BBN will provide ? human-agent interactions for ?.

i. Other Technical Aspects.

UMICH - MICHIGAN (PLAN COORDINATION/DECONFLICTION, MCA)

(Back to Annex_D links)

26. The tasks for the U. of Michigan Plan Co-ordination/Deconfliction agents relate to:

a. Overview.

(1) In a Coalition exercise, objectives and responsibilities will be distributed among numerous functional teams, such as warfighting, logistics, media relations, etc., with their own human and computational agents. Occasionally, operational choices made by one team have unintended consequences on what other teams should or can do (e.g., conflict over transportation resources, friendly fire).

(2) The non-warfighting ("blunt-end") functional teams can work with the warfighting component through agents that employ access to operation plans so that they can deconflict and advise better. Agent technologies thus can open the door to an improved concept of operation by allowing the military to work in a more dispersed way (so-called collaborative virtual working).

(3) Michigan's technical contributions to the Coalition TIE will include:

- Use of hierarchical plan representations to facilitate flexible and efficient communication and computation for plan conflict detection.
- Search algorithms for identifying candidate deconfliction strategies.
- Integration with operator interfaces (such as AIAI's Process Panel) to alert humans of potential conflicts, recommend conflict resolutions, and enact chosen resolutions.
- Run-time monitoring and enforcement of co-ordination decisions.

(4) In the CoAX demonstrations, Michigan will provide one or more instances of a Multilevel Co-ordination Agent (MCA) that implements plan conflict detection, resolution, monitoring, and enforcement capabilities.

b. Triggers from Events.

(1) The MCA will receive from different functional teams requests to analyse plans and report back (or to a higher authority) potential conflicts and resolutions.

(2) The MCA will receive runtime plan updates and monitor/enforce co-ordination decisions that adhere to resolutions previously committed to.

c. Resulting Agent Tasks.

(1) The MCA will perform deconfliction analyses and report on potential conflicts and candidate conflict resolutions.

(2) The MCA, can block pursuit of some teams' plans until sufficient co-ordination conditions are achieved, allowing runtime co-ordination enforcement.

d. Extra Tasks.

(1) Much of the logistics area involves co-ordinating with civilian suppliers/transport, which could raise extra complications (e.g., security) in Domain Management

e. Issues still to be Addressed.

(1) The CoAX scenario has so far emphasized battle planning by a single authority, and needs to be extended to include a broader array of functional teams acting semi-independently.

(2) Knowledge engineering must be done to capture a sufficiently rich set of plans for each of the functional teams to enable interesting interactions to arise.

f. Domain Membership.

(1) The MCA will be a component on the Grid before the 6-month demo.

(2) In the 9-month demonstration, the MCA will be illustrated using simplified plan sets in a fairly contrived (researcher-developed) scenario to highlight some of its basic technological capabilities and motivate its role in the CoAX TIE.

(3) In the 18-month demonstration, the MCA will interact with AIAI's Process Panel within an integrated demonstration.

(4) Beyond 18 months, the MCA will be extended to include:

- Co-ordination over plan synergies (not just conflicts) for non-episodic cases
- Guidelines for the construction of effective hierarchical plan representations
- Quantitative estimates of quality for alternative co-ordination candidates
- The ability to cache prior co-ordination strategies for future team use

g. Information to be Exchanged.

(1) MCA will communicate about plans and constraints on their execution

h. Links to other Participants.

(1) Initially, there will be a strong link to AIAI's Process Panel, as the interface between the automation for co-ordination provided by the MCA and the human user.

(2) To the extent that the plan spaces to be co-ordinated are generated on the fly (such as by Master Battle Planner, CAMPS), those plans need to be translated into f form in which MCA can reason about them.

(3) There are possibilities to tie MCA activities more closely with aspects of other CoAX TIE activities. For example, the protocol through which plans are exchanged and co-ordinated could be made more robust with MIT's exception handling technologies, and the negotiation leading to the selection of one of the candidate conflict resolution strategies discovered by MCA.

i. Other Technical Aspects.

(1) The MCA will invest appropriate effort to impose just enough constraints on activity timings and choices to ensure successful and efficient accomplishment.

(2) The MCA uses hierarchical plan representations to search abstract plan spaces more efficiently in a top-down manner, allowing agents to communicate less about each other, model less about each other, and leave themselves more room for improvisation.

(3) The MCA reasons at abstract levels using “summary information” about what might or must hold over alternative plan refinements, and interleaves planning with execution by performing dynamic analyses of temporal constraint networks.

USC / ISI (ROBUST ACCESS TO WEB-BASED DATA SOURCES)

(Back to Annex_D links)

27. The tasks for the Ariadne agent relate to:

a. Overview.

(1) Ariadne is a system for building agents for accessing data from web-based information sources. We have developed machine learning techniques for rapidly constructing wrappers that turn online sources into sources that can be queries as if they were databases. Under the CoABS program we are currently working on the ability to automatically verify that the wrappers are still functioning correctly and when problems are detected to automatically repair the wrapper as long as the required information is still available from the source.

b. Triggers from Events.

(1) Task_USCISI_Weather_Reporting. We have created wrappers for a number of online information sources including weather data from both the BBC and Wunderground. Information requests are sent from the Master Battle Planner to get specific real-time data, such as the current weather data for a specific region of the world.

c. Resulting Agent Tasks.

(1) A request spawns an agent process to access the required information source, extract the data using the wrapper, and then returning the information to the requesting agent in a specified format.

(a) Weather data and maps to be displayed in MBP,

(b) Media information / stories / incidents for the Process Panel.

(2) When the wrappers are created a background agent is spawned to monitor each of the data sources. If an agent notices a potential problem with the quality of the data from a source, it invokes a procedure to verify that the wrapper is functioning correctly and repair it as needed.

d. Extra Tasks.

e. Issues still to be Addressed.

f. Domain Membership.

(1) Ariadne is a 'non-domain aware' agent in the 9-month demonstration.

g. Information to be Exchanged.

(1) Requests can be submitted to Ariadne either via the grid or as an http string. In either case the information is returned in XML.

h. Links to other Participants.

(1) Ariadne will provide weather information and other online data for inclusion in MBP.

i. Other Technical Aspects.

(1) The verification and repair of wrappers is performed by learning a set of patterns that capture the general structure of the information returned for each data field. Extracted data can then be compared with the previously learned patterns to determine whether it matches the general structure of what was extracted in the past. When a statistically significant variation is noticed, the system uses the learned patterns to attempt to relocate the information. If the required data can be located, the system then uses the wrapper learning system to identify example and automatically relearn the wrapper.

UWF / IHMC (DOMAIN-BASED SECURITY)

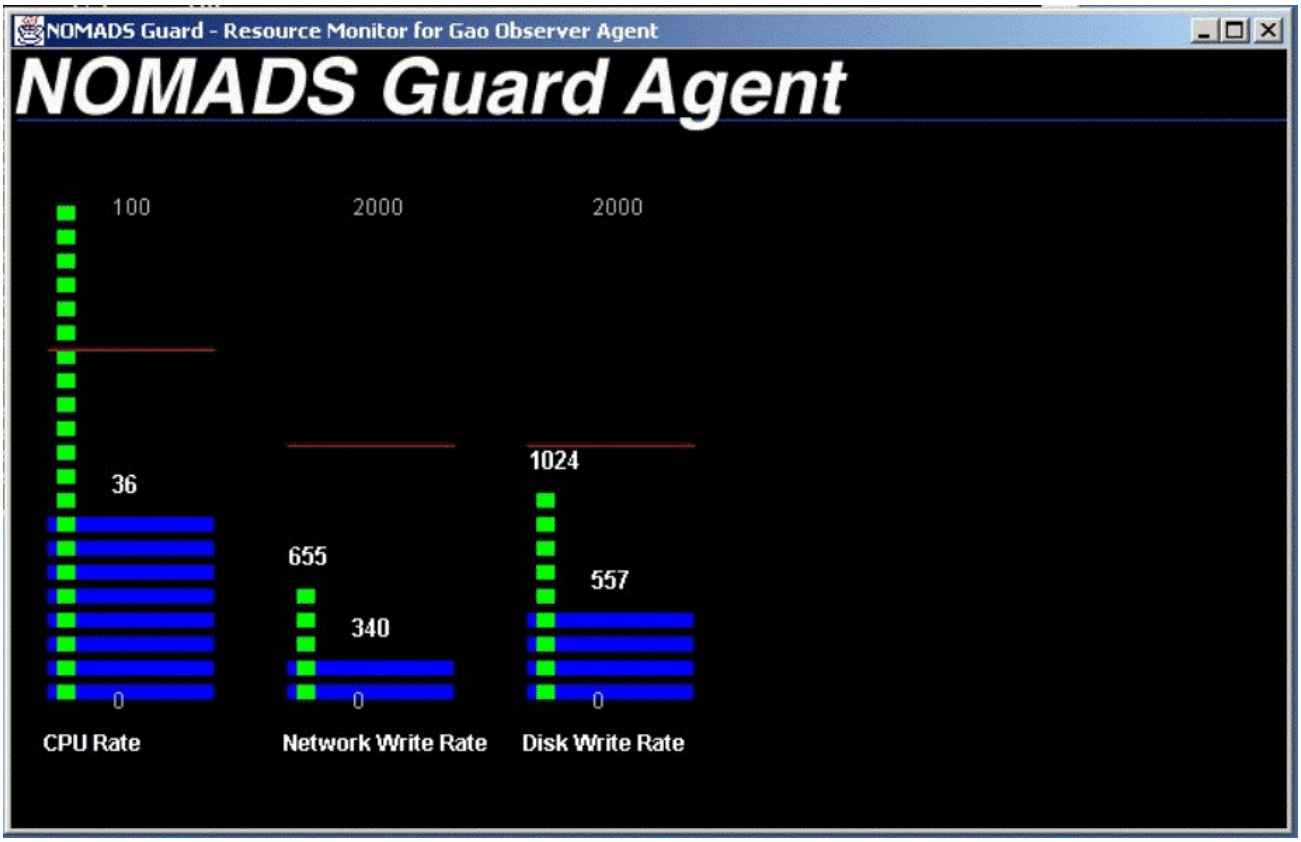
(Back to Annex_D links)

28. The tasks for the UWF/IHMC NOMADS agents relate to:

a. Overview.

(1) NOMADS is a powerful development and runtime environment for Java-based mobile agents. The two major components of NOMADS are the Aroma Virtual Machine and the Oasis agent support framework. Aroma is a Java-compatible virtual machine that offers several capabilities beyond those provided by the standard Java environment. NOMADS provides unique features such as anytime mobility, forced mobility, and fine-grained resource control.

(2) The Coalition TIE exploits the security and resource control aspects of NOMADS. In particular, the resource control mechanisms can protect hosts from denial-of-service attacks from malicious agents. Since the coalition forces do not completely trust the Gao Agadez Observer (GAO) agent, they decide to execute the GAO agent inside the NOMADS environment.



(3) The NOMADS environment includes a Guard agent that constantly monitors resource consumption of agents executing within NOMADS. The resources monitored by the Guard include the CPU rate, the disk write rate, and the network write rate. The NOMADS Guard works in conjunction with the KAoS Policy Administration Tool (KPAT) developed by Boeing and IHMC. Depending on the security policy specified by the

administrator using KPAT, the Guard can be granted permission to take action and limit resource consumption when resource overuse is detected.

b. Triggers from Events.

(1) Launching of the GAO agent,

(2) Gao starting the denial-of-service attack.

c. Resulting Agent Tasks.

(1) When the GAO agent is launched, the agent is started up inside NOMADS. At the same time, the NOMADS Guard is started to monitor the resource consumption of the GAO agent.

(2) When the Gao start the denial of service attack, the Guard detects the attack, notifies the administrator, and reduces the resource limits of the GAO agent. The resource limits changed include the CPU rate, the disk write rate, and the network write rate.

d. Extra Tasks.

e. Issues still to be Addressed.

(1) In future CoAX demonstrations, we expect to explore more ambitious resource control scenarios and situations involving the setting and enforcement of policies regarding mobility.

f. Domain Membership.

(1) The GAO agent running within the NOMADS environment is automatically registered with the domain manager of the Observers domain.

g. Information to be Exchanged.

h. Links to other Participants.

(1) KAoS Domain Manager, KAoS Policy Administration Tool, other Observer agents.

i. Other Technical Aspects.

CHAPTER 15. (ANNEX E)

Links to: Document_Structure, Annex_A, Annex_B, Annex_C, Annex_D

REFERENCES

1. A Coalition Force Scenario 'Binni – Gateway to the Golden Bowl of Africa' Dr. R A Rathmell Defence Evaluation Research Agency, Malvern, Worcs. UK. Available from http://www.aiai.ed.ac.uk/project/coalition/binni/

Also see the CoAX web page at http://www.aiai.ed.ac.uk/project/coax/

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LINKS TO THE CHAPTERS

Contents, Document_Structure, Chapter_1, Chapter_2, Chapter_3, Chapter_4, Chapter_5.

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