COALITION AGENTS EXPERIMENT (COAX)
BINNI 2002 (30-MONTH) DEMONSTRATION DETAILS

AIAI, BBN, CMU, Dartmouth, CMU, DSTO,
GITI, LM-ATL, UMD, UMichigan, NRL, Potomac Inst.,
QinetiQ, USC/ISI, UT-Austin, UWF/IHMC.

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Contents.

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COAX BINNI 2002 APPROACH

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[NB: Page numbers are hyperlinks].

A. COAX BINNI 2002 OVERVIEW

1. The CoAX Binni 2000 and 2001 demonstrations were anchored in a rich Binni Coalition operations scenario. These demonstrations featured a linked path of events illustrating some of the issues in the use of agents in such settings, and highlighting emerging coalition-oriented agent services developed by CoAX participants. The aim in CoAX Binni 2002 is to tell a richer agent and technology contribution story, focusing on new aspects of coalition problems and new technologies demonstrating the ability of coalition-oriented agent services to function in an increasingly dynamic environment. As in the previous demonstrations, a challenging and militarily plausible scenario will provide application context. However, unlike previous CoAX Binni demonstrations, it will not be necessary for all components to connect concurrently, and different parts of the time line in the scenario, or vignettes off the core storyboard, can be used.

B. AIMS OF COAX BINNI 2002 DEMONSTRATION

2. The aims 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" [1] (such as the Global Information Grid[2]) 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.

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.

The draft architecture for this demonstration is shown in Figure 1.

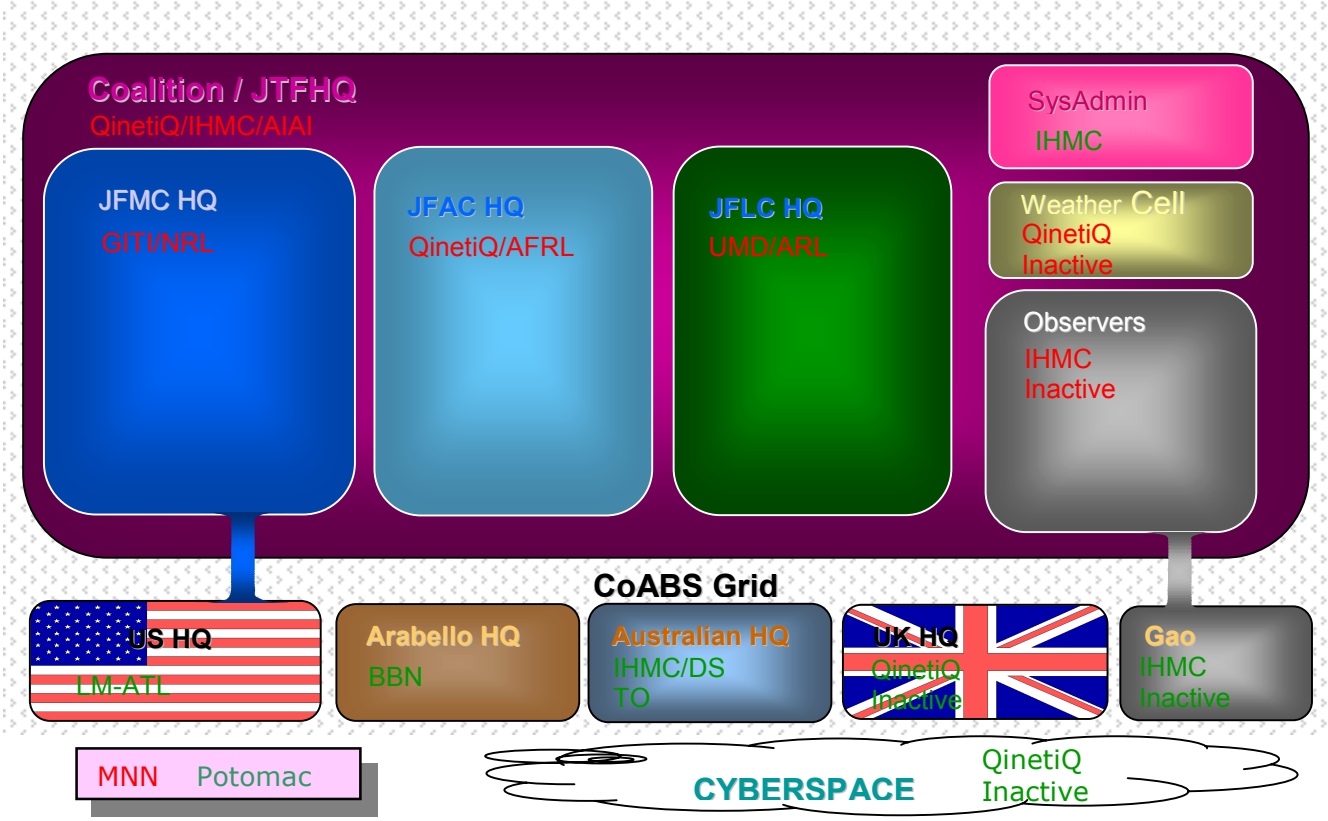

Figure 1 - CoAX Binni 2002 - Agent Domains

C. PARTICIPATION IN COAX BINNI 2002

3. Because of the increasing size of the team and the need for demonstration platform flexibility, and in contrast to previous Binni demonstrations, we will need to decentralise the integration of demonstration elements is decentralized and participants themselves will determine how their technologies can best be demonstrated in an appropriate coalition context. This is made easier by the fact that a rich scenario has been prepared in which participants should be able to find a niche or invent a scenario vignette that serves their purpose.

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

4. Everyone will be responsible for the integration and running of their own components. Pairings or other larger grouping of participants is encouraged by the CoAX PI Team as useful to put together a cohesive demonstration and to stay within the limited number of computers we will wish to use in the final demonstration. Components that are not shown live, if the participants cannot attend any specific demonstration, will be replaced with screen movies. The integration will come via the CoAX Binni scenario story line described below. Screen movies can be used to show the context of the 2000 and 2001 demonstrations where that is useful. PowerPoint slides or other descriptions can be used to fill in gaps between the demonstrated capabilities to tell the integrating Coalition scenario story.

5. Each participant will be required to produce the following:

   a. The demonstration itself to be run live on XGA (1024x768) screens with file or event feeds appropriate to its stand-alone use.

   b. A screen movie of the component in TechSmith Camtasia TSCC format at XGA resolution using the approved desktop backgrounds—see additional detail below.

   c. Screen snapshots at XGA resolution in GIF or JPG format as appropriate.

   d. A short writeup, in Microsoft Word format, of the component and its message in terms of agent technology, Coalition relevance, and what it does for some human participant or participants in the process. This can include screen snapshots where helpful.

   e. Three or four slides to allow a five-minute Microsoft PowerPoint briefing on the technical details of the contribution. Screen snapshots and diagrams are encouraged as part of this slide set, as they make for a much more understandable and memorable contribution for most non-technical audiences rather than using only lists of bulleted text items.

   f. Documents and other materials exchanged within the TIE will utilise Microsoft Office 2000 formats (principally Word, PowerPoint and Excel).

D. DEMONSTRATION SETUP

6. The demonstration setup will allow for up to 9 computers as follows:

   a. One presentation laptop (provided by AIAI).

   b. One laptop acting as a server running the CoABS Grid, Jini and KAoS services as necessary for shared functions (provided by GITI). It's screen will not be seen during the demonstration. Any participant is also free to use a stand-alone version of the services they require for their demonstration where linking is not necessary.

   c. Up to 7 other computers provided by participants as required for their components of the demonstration. Participants may reserve one or more of these available demonstration positions in their proposal for involvement. If more than 7 computer connections are needed, the CoAX PIs will encourage pairing up.

7. An 802.11b wireless LAN will be available to connect any systems that need to communicate. Participants should provide their own wireless card. The access point will be provided by GITI. No link to the Internet is guaranteed to be available, so any web pages should be served locally where needed for demonstration purposes.

8. A video switching system will support up to 8 computer inputs with outputs to 2 XGA resolution projectors. As an alternative, it will be possible to support a 3-projector demonstration by directly connecting the presentation laptop to one projector. Each participant will provide one female-to-female video cable for each laptop they connect. The switching system and extra necessary cables will be provided by GITI. The projectors will be provided by local arrangement at the demonstration venue.

E. POLICY FOR VISUAL APPEARANCE AND USER INTERFACE

9. To improve the cohesion of the demonstration, each Coalition participant featured in the demonstration will be given a unique desktop background image (XGA) and some legend or logo as appropriate. This will be used consistently for demonstrations; screen movies and screen snapshots, even when demonstrations are not connected together live. Participants will be asked to reduce desktop material not related to the demonstration to a minimum to improve the demonstration and recorded material.

F. COAX DEMONSTRATION SCENARIOS

10. The events take place in the context of a demonstration scenario defined for international co-operative research purposes by the 5-nation Technical Co-operation Program (TTCP). This involves Coalition operations in the fictional country of Binni in the year 2012. Binni is in North East Africa and borders the Red Sea. Climate change has made this into a fertile area that is known as the “Golden Bowl of Africa". Binni is situated in an area of land annexed by Gao, a country to the North that has set up a puppet government in the region. Agadez to the South is disputing the territorial claims of the new government. The UN has built a Coalition force to keep the warring factions separated. A summary is provided below:

11. **CoAX Binni 2000 Scenario**. The events of the CoAX Binni 2000 (9 month) demonstration focused on the initial planning phase as follows:

a. After exploring a number of options to separate the opposing forces and restore the peace in the region, the deployment of a large ground observation and peace enforcement force and other courses of action have been rejected, and a "Firestorm" mission code-named "Operation Flash" has been decided upon. This will clear land to enable simpler remote and ground observations with less risk to the Coalition peacekeepers. The events of the 2000 demonstration showed the Coalition doing initial information gathering and planning. The Coalition participants are the USA, UK, Australia and Gao. Gao has host nation status but its intentions are unclear and it is distrusted. Special steps are taken to monitor the information passed to and from Gao within the Coalition.

b. During the demonstration, misinformation feeds by Gao (intended to displace the firestorm to allow Gao to take an advantage and move forward) are detected and thwarted. Gao becomes belligerent and launches a denial of service attack against the Coalition's C^3I infrastructure. This is automatically detected and thwarted using the advanced agent capabilities available to the Coalition.

12. **CoAX Binni 2001 Scenario**. The events of the CoAX Binni 2001 (18-month) demonstration move on from this initial planning and information gathering phase to a specific day and time in the execution phase, involving the monitoring, battle management and short-notice replanning associated with Coalition operations as follows:

a. The firestorm mission has been planned and aircraft are being prepared for their missions. However the news media breaks a story that wildlife in an important safari park in Binni may be at danger as the park overlaps the firestorm area. With only an hour to go, the UN Secretary General's Special Representative to Binni asks the Joint Task Force Commander to consider the wildlife risk aspects of the planned approach. Dynamic information gathering and information feeds using agent technology are employed to create a real time feed of the position of some at risk large mammals. After consideration it is decided to continue with the firestorm mission, but to replan as necessary to avoid risk to wildlife. Firestorm targets are adjusted in time or secondary targets selected as necessary for the first wave of firestorm bombing. The impacts of these changes on the coalition's medical and humanitarian operations are automatically detected, and unintended conflicts between disjoint coalition operations are avoided.

b. Agadez seeks to use this complication to seize the initiative and launches fighter attacks against Coalition airborne high value assets that are monitoring the operation. This is detected and important monitoring agents are moved to alternative computational platforms as the monitoring aircraft regress.

13. **CoAX Binni 2002 Scenario**. The 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.

G. SHARED DATA AND MESSAGE FORMATS

14. Interoperability, not standardisation, is the principle, so XML will be used for process, product and message interchange where possible. DAML+OIL semantic annotation will be encouraged. Domain management and conversation policies, process libraries and plans will seek to employ a shared content model where feasible. Completion and progress report formats will be regularised where possible. FIPA, NIST PSL and other nominated content standards will be employed as bases where appropriate. An effort will be made to enter into a dialog with C-CINC21, FBE-J and other relevant national and international programs and to transfer or share experience and develop aspects of a shared Coalition ontology. In all cases exceptions to these guidelines will be possible within CoAX Binni 2002, but the reason should be documented to guide future research.

H. TIMETABLE FOR COAX BINNI 2002 WORK

15. The timetable of work is as follows:

a. December 2001. Refinements of the approach document along with short sections describing each participant's proposed contributions, their agent technical interest and their relevance to supporting the Coalition operations or a military participant in such operations. [Completed: 17-Dec-2001]

b. January 2002. CoAX Team meeting at CoABS workshop in US to refine this document. [Completed: 17-Jan-2002]

c. April 2002. Production of contributions and team discussions to ensure the parts tell an integrated story. CoAX Team meeting to review progress following the KSCO-2002 conference on 23rd and 24th April in Toulouse, France [To be held: 25-Apr-2002]

d. June 2002. Finalisation of the contributions and production of initial screen movies, screen images and presentation. CoAX Team workshop at a suitable venue.

e. July to August 2002. The period July to August is being avoided for CoAX Binni 2002 work to allow team members seeking to transition CoAX results into FBE-J to engage in those activities.

f. September 2002. Finalisation of all material. CoAX Team workshop at a suitable venue.

g. Fall 2002. Demonstration at a suitable US-based workshop or meeting (preferably involving TTCP members).

I. SPECIFIC OFFERS OF INPUTS FOR THE COAX BINNI 2002 DEMONSTRATION

16. The following contributions have been offered to date by the CoAX participants:

a. IHMC: Domain Management and Mobile Agent Support:

- Dynamic changes to coalition domain structure (new domain on-the-fly, new country with minimal fuss), GITI grid security services, and representation of complex domain structures. Enhanced packaging of KAoS domain management grid services and reimplementation on top of Sun's new Java Agent Services (JAS, aka JSR 87).
- DAML-based KAoS Policy Representation (KPR) and initial policy conflict resolution engine.
- Visual enhancements to KAoS Policy Administration Tool (KPAT) to allow the Coalition structure to be defined and amended on the fly via graphical manipulations. Moving agents from one host to another will be able to be initiated by graphical gestures.
- Dynamic reconfiguration of agents through mobility in order to accommodate changes in the environment (e.g., moving agents from one platform to another (scram) to accommodate a change in conditions, deploying new agents (mobile) in response to change in circumstances (interesting links to mobility policy).
- Dynamic reallocation of resources based on changes in mission priorities or some other event.

b. AIAI: Task, Process and Event Support via I-X Process Panels (I-P^2):

- Amended JTFC and Combat Ops process and event panels with improved legends, process models and other changes that are of assistance to other aspects of the overall demonstration.
- To show how a new process panel can be offered to Arabello as it joins the Coalition with suitable Coalition processes in the library that help it integrate and communicate with the JTFC and the information gathering functions more rapidly.
- Inclusion of Process Library Editor to allow the standard operating procedures to be maintained.
- Inclusion of logged messaging between participants ranging from a free format messaging facility to structured command and control.
- Demonstration of use of the CoABS Grid logging facility to monitor and report on coalition activity without the need to alter agents to be made "process panel aware".
- AIAI with Michigan - Improved progress, status and completion reporting from MCA to a panel.
- AIAI with GITI - Link ServiceUI with a process panel for JFMC HQ.
- AIAI with BBN - AIAI provides BBN (Arabello) with new process panel as the new coalition partner joins the coalition and relates this to existing coalition panels.
- AIAI with UT-Austin - JTF HQ panel to note discovery of ASW related capabilities from Arabello (BBN, information gathering) and US (UMD, position prediction).

c. Michigan: Co-ordination Agent:

- Plan deconfliction triggered by new plans emanating from multiple sources: MBP and others.

- Interleaved plan deconfliction with execution, where deconfliction preferences for new/revised plans reflect prior co-ordination commitments (so as to restrict disruption to others caused by an agent's plan changes).
- Detecting opportunities for co-operation (rather than only conflict) in simple cases and proposing inter-agent commitments for mutually beneficial actions when possible.

d. AIAI, Michigan: Closer connection between a process panel and MCA to allow initiation of deconfliction to come from a panel user, to show the status of processing of MCA via further progress messages, etc.

e. AIAI, IHMC: possible link between domain management/conversation policies and process panels to show how agent wrappers and creation of authorities in the process panels can be linked to offer tools for a new country joining the Coalition.

f. QinetiQ (in association with BBN and CMU): mixed initiative (agent-human) interfaces for supporting decision-making. Provide an enhanced / replacement Coalition SitViewer which employs interface-agent-enabled interrogation of shared Coalition information made available to warfighters on personalised 'decision-desktops'. These are mixed-initiative interfaces supporting the decision-making of warfighters and driven by their information requirements and preferences. This would involve the following:

- Develop a set of agent-enabled interface technologies to act as the 'back-office' to the decision-desktop (the front-end) that would allow the user to obtain the information in the most appropriate format, as and when desired.
- Enable multiple user-customisable views onto shared Coalition data, with bookmarking and sharing of these views.
- Drill-down and filtering of data according to source, time, and other metadata stored with data and reported by the agents.
- Develop supporting semantic web technologies.
- Updates (for example, allowing data updates to be undone or 'rolled-back') provided by the agents on demand.
- Presentation of options to the user based upon the nature of the objects being manipulated, and the available agents and services (for example, finding the missions or objective with which an asset is currently associated).

g. CMU: Grid Services including:

- Retsina Grid Agent Communications Visualisation (in association with IHMC and QinetiQ).
- DAML-S Matchmaker (in association with BBN).

h. BBN: Dynamic information flow messaging policies developed by BBN enable new agents joining a domain to contribute information to ongoing processes and register requests for information they need. Key issues to be addressed for CoAX:

- Integrate information sharing policies with KAoS Domain Management system to establish boundaries of information visibility trust and access. (With IHMC)

- Develop mechanisms for adding information sharing policies to agents with different levels of reasoning capability.

- Develop support agents that monitor team execution status and manage the information being presented to users during Mixed-initiative interactions. (See QinetiQ entry).

- Support dialogs with users engaged in team formation and tasking. Use a planner that considers agent capability models (represented in DAML-S) to guide users when (re)tasking agent teams.

To demonstrate these capabilities, BBN will play the role of a new country joining the coalition (Arabello). In the scenario, Arabello volunteers its ASW capability to deter expected submarine attacks. This requires:

- Development of a teaming relationship with the coalition, based on presentation of offered capabilities, acceptance of a coalition role.

- Acceptance of a Process Panel to facilitate coordination with the coalition.

- Sharing of information needs and capabilities across domains (e.g. with UMD, QinetiQ).

- Simulating the execution of the sub hunt in the red sea.

- Interactive tasking by the (human) Arabello commander of Arabello field agents (ASW ships) to collect and filter the required information. Monitor the execution of the tasked agents, prepare and forward reports to the coalition.

BBN will also support the demonstration by integrating DAML Services ontologies and tools with the GRID to enable service lookup and dynamic interoperation with advertised services.

- Provide DAML-S service descriptions of a number of CoAX services.
- Support the integration of a DAML-S Matchmaker (provided by CMU Retsina Group)
- Provide a 'grounding' that enables described services to be requested via the grid.

i. NRL: Develop an agent interface between the CoABS grid and XIS, an alternate viewer with capabilities similar to the US Navy Global Command and Control System Maritime (GCCS-M).

- Link to information feeds from coalition sources [link to BBN, UMD]

- Relate to Situation Viewers provided elsewhere in the Coalition/JTFC and possibly the JFAC domains [link to QinetiQ]

- Demonstrate this within the JFMC HQ [Link to LM-ATL]

j. DSTO: Links to work on Australian Future Operations Centre Analysis Laboratory (FOCAL) and Logistics Planning.

- FOCAL could play as a Situation Awareness/Battlespace display that provides crisis alert when the attack unfolds, and management afterwards - including access to new information feeds from Arabello and other coalition sources. Agent contribution to this would be in the back-end of the display. This would use a constrained COAX scenario. It'd be more on the lines of 'this is what the technology could look like in the future' rather than 'this is what we can do now', and a 'movie' would show this in the demo.

- Australian agents could seek to generate logistics plans for medivac, repair, and ship protection in response to attack, using Australian and coalition resources and agents.

- Australian assets could have been involved (transport, surveillance) in firestorm operation - in response to attack these may be reassigned to provide surveillance/transport for medivac and repair operations.

- Australian monitoring agents could use Arabello information feeds once available and co-ordinate operations with Arabello agents/forces.

- Australia could act as a 'come-as-you-are' participant in the coalition. The ATTITUDE agent system would be used on the Australian side, and need to make use of the services provided by others to integrate with coalition operations.

k. 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.

l. USC / ISI: can provide their Ariadne web information source wrapping technology as used in the CoAX Binni 2000 and 2001 demonstrations. It is possible that other requirements for input of web-related structured data into agent systems would be met using Ariadne if required for CoAX Binni 2002. But, no major changes are planned to their input as their CoABS project nears its end.

m. LM-ATL: will act as the integrator for the US Country HQ domain and in that role can provide the following:

- The Interoperable Intelligent Agent Toolkit (I2AT), capable of quickly integrating additional agents, such as BBN's agents providing Arabello's ASW information, and Grid services, such as UMD's probabilistic temporal prediction capability applied to ASW prediction.
- LM ATL will use I2AT to create and configure agents to accept ASW information from the BBN Arabello agents request processing of this information by UMD's prediction agents deliver the resulting predictions to the appropriate C2 system, e.g. the JFMC HQ (GITI) where specialized navy specific viewers are used (NRL) and/or QinetiQ.
- LM ATL will integrate information sharing policies provided by the CoABS Grid and KAoS Domain Management system to establish boundaries of information visibility, trust and access.

- If required, LM-STL can add US HQ domain data sources and agents if hepful to the demonstration.

n. UT-Austin: Dynamic Coalition Configuration and Trustworthiness Evaluations:

- Adaptive Decision-Making Organization Formation (ADMF) to determine the entrance of new players into the coalition based on needs of players (e.g. JTF HQ) within coalition and capabilities offered by a range of potential players (Australia, Arabello, US ASW interpreter). ADMF capabilities within the CoAX scenario will involve searching for potential partners, evaluating potential partners, ranking the capabilities offered by potential partners, selecting a partner(s), then determining the "best" distribution of decision-making control and execution obligations among selected coalition partners working to solving problem X.
- DAML-based representation of agent-owned capabilities (e.g. resources) considered during ADMF analysis.
- Trustworthiness by determining 1) Level of Uncertainty of the Information and 2) Reliability of Information Source for information transmitted during the scenario.

o. UMD: Offer to provide agents that are capable of efficiently storing, manipulating, and querying probabilistic temporal information.

- 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.

- A suggestion is that the output from this analysis could be fed to visualisation facilities provided by other participants.

- LM: UMD provides capability information to LM. This allows BBN to send sensor readings to UMD prediction agents.

- BBN: BBN feeds (Arabello's) sensor readings to UMD prediction agents. For each candidate location L and for each future time instant t, the prediction agents determine the probability that an enemy will reach location L at time t.

- CMU: UMD passes the most desirable intercept locations to CMU. CMU uses its route planner to determine how Coalition forces can be relocated in order to intercept the enemies.

- ARL: UMD also passes the predicted enemy locations to ARL. Based on these warnings, there may be a decision to evacuate a land asset. This can be done by

finding a safe, nearby port if there is enough time to prepare a ship for pickup at that location.

p. Potomac Institute:

- Design of desktop background colours and legends for each participating command, user or screen in the demo. Colours to be projector, screen movie and screen image capture safe and differentiatable. XGA sized. Needed by early March 2002.
- Intro movie/music. Linking movie/images for other parts of the story. Draft by June. Finished by September 2002.
- Packaging of information in the form of a CNN style report. Introduction/context setting in the form of a "CNN" style report to recap situation from 2000 and 2001 demos, and announce the sub attack. Continuity in story telling via update reports. Packaged as a DVD perhaps for repeatability, as well as smaller on-line versions (QT or AVI?) Draft by June. Finished by September 2002.
- Videotaping of October demo event and production to DVD along with demo web support and presentation material. October and November 2002.

q. Dartmouth: Mobile Agents for Medical Monitoring

- A United States medical-monitoring application sends a mobile agent to an Australian ship to monitor the condition of injured Australian sailors.
- Dartmouth will provide a simulated stream of Australian medical data, a simple United States monitoring application, and the medical-monitoring agent that filters the stream and sends only critical alerts back to the application (and optionally to CoAX planning components). The filtering demonstrates how mobile agents conserve bandwidth.
- In conjunction with [IHMC] and [Lockheed], Dartmouth will install two different mobile-agent systems, one for the United States and one for Australia, and use the Grid Mobile Agent System (GMAS) to allow the United States agent to move onto the Australian computer systems. The United States system will be NOMADS, and the Australian system will be D'Agents. The use of GMAS and the two mobile-agent systems demonstrates interoperability.

r. Infrastructure and Demonstration Integration:

- GITI: Provision of an agreed version of the CoABS Grid (currently specified as version 3.3) and related Jini and other infrastructure software.
- IHMC: assistance to participants with Grid and / or KAoS agent wrappers where needed.
- AIAI: provision of software to support event generation or message/report feeds as useful to other participants' own contributions (based on the I-TEST agent).
- AIAI: enhancements to JTFC, Combat Ops and the UN Sec Gen panels as useful for other participants. At least this should show better handling of an unforeseen event and linking manually entered task breakdown more effectively to the library of standard operating procedures in a panel.
- GITI: provision of video switching facility for 8 screens feeding 2 or 3 projectors.

- GITI: 802.11b wireless LAN facility.

s. Documentation and Scenario: All, with editing by QinetiQ: update to CoAX Binni document to assist CoAX participants, and others.

RESPONSIBILITIES

The following organizations will take the lead in specific aspects of the CoAX Binni 2002 demonstration:

17. Command-related Domains

- JTFHQ User Domain - QinetiQ
- JTFHQ Sys Admin Domain - IHMC
- JFMC Domain (and embedded Combat Ops Domain if required) - GITI
- JFAC Domain (and embedded Combat Ops Domain) - QinetiQ
- JFLC Domain - UMD (with IMHC support) if required

18. Functional Domains

- Observer Domain - not required in 2002 demo

19. Country-related Domains

- UK HQ Domain - QinetiQ - if required
- US HQ Domain - LM-ATL
- Australian HQ Domain - IHMC (with DSTO support)
- Arabello HQ - BBN
- Gao - not required in 2002 demo

20. Other Infrastructure Aspects

- CoAX Shared Ontology - QinetiQ
- Grid v3.3 and KAoS v?? Shared Service - GITI
- 9 in to 3 out video switching and XGA projection- GITI
- Radio LAN provision - GITI
- Presentation coordination - AIAI
- Web site coordination - AIAI
- Storyboard coordination - AIAI and QinetiQ

J. MORE DETAILED SCENARIO

21. Part 0: [Military News Network: MNN] News from the UN peacekeeping operation in the Red Sea Area. The UN forces are maintaining a separation zone between Gao and Agadez troops who have been belligerent towards one another over the disputed territory of Binni. Binni is quiet this evening after a hectic day. This mornings reports in the media of the potential threat to wildlife in the Laki Safari Park from the proposed Firestorm mission to clear land to make observations easier have led to adjustments in the timetable, but the clearance started pretty much on schedule. The JTF HQ in the region reported misinformation from Gao intelligence earlier in the day and steps were taken to thwart their attempt to mislead the UN forces command and to take advantage of the situation. It has recently been reported that during the latter part of the day Agadez made threatening movements towards UN aircraft and JSTARS surveillance platforms. These have now been moved to safe locations, and contingency plans to maintain the necessary observation of the separation of the Gao and Agadez forces have been enacted.

Dusk falls over the Red Sea....

[MNN] Newsflash... Reports are coming in of an explosion aboard the Australian vessel HMAS Surrey. There are reports of significant damage and injury to the crew. We will bring you more news as it becomes available.

22. Part 1a: JTF HQ - Report of two submarines (believed to be from Agadez) attack on HMAS Surrey arrives at JTF HQ (AIAI Panel). JTF HQ assign immediate aid and medical assistance tasks to nearby US ship (AIAI Panel). US Ship dispatches its mobile medical monitoring agents (Dartmouth) to run on the Australian platform to monitor events and rate their urgency. It is a medium priority and current missions elsewhere do not need to be recalled at that stage. The ship begins though to manoeuvre closer to the area where HMAS Surrey is.

23. Part 1b: {should this come in later?} Medical monitoring agents detect a worsening of the situation (Dartmouth). Emergency dispatch of a paramedic flight via helicopter is ordered to address the situation. The plans are deconflicted against other coalition and regional movements (Michigan).

24. Part 2: JTF HQ - JTF HQ use tools (UT-Austin) to establish potential ways to deal with submarine threat and establish potential for Arabello to bring in its (already partially deployed, sophisticated) ASW information gathering capability (BBN). US homeland capabilities are available, but too remote, Australian resources are engaged in a Pacific mission, and US Forces in the Southern Red Sea provide some important information gathering capabilities, but are considered unsuitable for the whole task. Sophisticated secure ASW positional interpretation capabilities (UMD via LM-ATL's US HQ domain) are also highlighted as available and useful. UN discussions take place to persuade Arabello to allow its ASW facilities to be brought into the coalition. This is agreed, and work starts immediately to integrate them into the coalition (overnight). The US national HQ agrees to provide it's sophisticated interpretation agents (UMD via LM-ATL) to act on the Arabello information as it becomes available, but for national security reasons, will limit US available data provided to the Coalition to that necessary for the Binni mission (this will involve not disclosing the location of US submarines in the area, but which can be accounted for in the proposals made by the UMD systems. Work also starts immediately to integrate this capability.

25. Part 3: This involves providing KAoS domain and limited information release capabilities using mobile agents and KPAT (IHMC) and Process Panel (AIAI) support and links (to BBN acting as Arabello HQ).

26. Part 4: The UMD capabilities are linked in to the JFMC HQ capabilities using IHMC and LM-ATL tools. Arabello information feeds to the UMD facilities and elsewhere in the coalition are put in place.

27. Part 5: Dawn breaks over the Red Sea. [MNN] Update... Arabello has joined the coalition in the Binni mission and steps are being taken to protect the shipping in the area. Overnight medical evacuation of injured personnel took place. Arabello information feeds start to appear on the JFMC HQ situational and map displays (NRL via GITI acting as JFMC HQ).

28. Part 6: UMD (with CMU route planning) make predictions about possible positioning and movements of the Agadez submarines. They also propose movements of coalition shipping to get some to safer areas, and to position others (including the ASW ships from Arabello) to help counter the submarine threat. This is passed through the US HQ (LM-ATL) to the JFMC HQ (GITI) where specialized navy specific viewers are used (NRL). This may be contrasted with the Coalition overview (and possibly the JFAC air related) situation viewers (QinetiQ).

29. Part 7: The positional predictions for the Agadez submarines indicate a potential threat to land assets - the personnel in several coalition and friendly embassies in the capital on the coast, the site of the weapons of mass destruction where US, UK and Australian SOF are being positioned under cover - this information is not known to all Coalition partners (US, UK , Australia and JTFC only) and SOF positional information feeds and communications have been deliberately hidden under the "Elephants" story where possible. A NEO and SOF troop movements could be ordered. {It is not anticipated that this element of the scenario will be demonstrated, but it is available as background to possible action by the JFLC HQ).}

30. Part 8: [MNN] Update... The authorities in Agadez and Gao realize that the coalition is strengthening and that their movements, threats and attacks will have no effect. They agree to return to the UN peace talks.

K. MORE DETAIL

31. **More detail from IHMC**. To develop and evaluate capabilities for secure monitoring, management, and control of long-lived communities of agents:

a. Representation of complex domain structures. The current domain management framework can only represent agent membership in a single, simple domain with a single domain manager with a transient internal registry. We are doing a ground-up redesign and reimplementation of the KAoSGridAgentRegistrationHelper, domain manager, guards, JAAS-based and framework-based enforcers to provide a scalable and fault-tolerant framework (all elements stateless, allowing transparent replication of domain management services and domain registries external to the domain manager itself). Domain structures of arbitrary complexity will be enabled, allowing agents to be simultaneously members of multiple, hierarchical domains.

b. Enhancements to visualisation of domains and policies in KAoS Policy Administration Tool (KPAT). The current KPAT interface allows only the entry of simple policies, which are associated with given agents, VM's, and domains that are shown in an outline view. Interactive graphical panels showing these complex domains and their members, and allowing registration, unregistration, mobility, etc. to be accomplished by simple mouse gestures on the diagrams. If time and resources allow, we will undertake the technical challenge of tightly linking KPAT to the underlying policy model (see C below).

c. DAML-based policy representation and policy conflict resolution engine. The current representation of policy in KAoS is very simple. We are developing foundational ontologies containing on the order of 100-200 DAML classes representing the basic elements of policy-based control that are intended to be extended by specific application developers and users. We have been working on efficient description-logic-based representations and algorithms to allow "real-time" conflict detection for rich policies of moderate complexity.

d. Enhance packaging of KAoS domain management capabilities as CoABS grid services and comply with Java Agent Services (JAS) based standards. Until recently when the KAoSGridAgentRegistrationHelper was defined, grid agents needed to be wrapped as KAoS agents to be able to take advantage of domain management services. We are seeking to further simplify the installation and configuration of domain management services for grid agents. Additionally, the framework will implement the new Java Agent Services interfaces, recently completed by the Java Community Process (with IHMC as a member of the expert group, along with IBM, Sun, Fujitsu, HP, and one or two smaller organisations) and sent out for community review.

e. Work with GITI to make grid security services dynamic. Grid security services are currently static. We intend to support GITI's planned dynamic security services with the KAoS domain management framework. We are also working with NIST to integrate services for attribute certificates in the domain management framework.

f. Use of mobile agents to dynamically setup policy-based information release. When a country decides to give a coalition partner the ability to access an asset to gather information, the owner of the asset might want to place restrictions on the nature of the information released. Such restrictions may include resolution, time (i.e., how quickly the information is released), or suppression of specific data in the information stream. Therefore, we would like policy-driven limits to be placed on the information being sent to the coalition partner. When

Arabello joins the coalition, their agents (in the Arabello domain) are not allowed to communicate with the sensors (what kind?) on the ASW. However, the Arabello ASW capability needs to task the ASW to get up to date information about the Agadez submarines. The Australians are willing to give restricted access to their sensors, but with reduced resolution. This specialized communication channel is dynamically established through KPAT. A mobile agent is generated that is deployed to the ASW. The mobile agent encodes the necessary transformations (such as resolution reduction) that need to be applied. Then, the domain communication policies are changed to allow the Arabello agents to communicate with the mobile agent onboard the ASW ship.

32. **More detail from AIAI**. To design, develop and demonstrate the utility of intelligent aids to task and process support in a multi-agent mixed initiative environment with limited communications, air gaps between systems (for security) and partial knowledge of the role of the various agents.

a. Provision of a generic I-X Process Panel (I-P^2) toolkit which can be used quickly to build interfaces to support the handling of events and issues and the performance of activity under a range of constraints. The toolkit will comprise:

- a generic panel template which can be copied and specialised to provide as many specific panels as required;
- a process editor and librarian which can be used to maintain a library of standard operating procedures or knowledge of responses to events;
- a simple view process editor that can be used by military staff and operators to add procedure knowledge “on-the-fly”;
- a test agent which can be with multiple communications strategies to set up the panels without dependencies on specific communications software or other agents to which the deployed panels will interact;
- Documentation and quick start guides.

b. Creation of a new process panel for an unanticipated requirement. The time to create a new process panel for simpler applications is intended to be of the order of a few minutes, and for more supportive knowledge-based panels could be of the order of a few hours dependent on the quality of corporate knowledge management concerning standard operating procedures.

c. Dealing with multiple human agents where it's not obvious who is the performer of an activity at the beginning (context-dependent work assignment).

d. Dealing with multiple alternative ways of doing a task where the alternative is not selectable in advance.

e. Adding a new process by a military person (i.e., non-computing technical) on-the-fly to deal with an unanticipated event.

33. **More detail from BBN**. To develop and evaluate mixed-initiative agent team tasking and coordination mechanisms:

a. Mixed-initiative team tasking can be viewed as an interactive dialog between users and automated planning agents where user objectives and preferences are resolved to pairings of agents with (potentially interdependent) tasks. Agents supporting such dialogs can assist with capability matching, task dependency analysis and scheduling. They can then manage the interactions with potential agent team members (recruitment policies, status monitoring, retasking). We will demonstrate these user interactions as the Arabello commander tasks agents to provide ASW support to the coalition. Some of the support agents we develop may also be used to support QinetiQ's Master Battle Planner.

b. Dynamic information sharing policies enable agents that can be tasked (e.g. by users) to collect different kinds of information at different times to identify and notify potential subscribers when tasked. The technique involves the forwarding from one domain to another of messages describing information requirements (IR) and information provision (IP) capabilities. In a coalition setting, limits need to be placed on the dissemination of these messages for security and trust reasons. To address this we are integrating our IP/IR communications policies with the Domain Management policies of IHMC to limit the dynamic sharing behavior to trusted partners on a topic by topic basis.

c. DAML-S is a language for describing agent services using the web-oriented DAML representation language. We will describe a number of the agent services in the CoAX 2002 demonstration using DAML-S so that these services can be located using a DAML-S enabled matchmaker (provided by CMU Retsina group). One potential use of the matchmaker is to identify candidate ASW services (to be compared by Univ. of Texas). Agents requiring the identified services will be able to request them directly using GRID-specific grounding (message generation) software for DAML-S service descriptions that we are developing.

34. **More detail from UT-Austin**.

a. Agents offering the ability to dynamically determine the best Decision-Making Framework (ADMF) to determine the entrance of new players into the coalition based on needs of players (e.g. JTF HQ) within coalition and capabilities offered by a range of potential players (Australia, Arabello, US ASW interpreter). Based on a given problem to be solved, ADMF capabilities within the CoAX scenario will involve the ability to:

- search for potential partners,
- evaluate potential partners,
- rank the capabilities offered by potential partners,
- select a partner(s), then
- determine the "best" distribution of decision-making control and execution obligations among selected coalition partners.

b. Cooperate with DAML team members to derive a capability/resource representation for agents to provide a basis for capability evaluation in ADMF analysis.

c. Trustworthiness by determining 1) Level of Uncertainty of the Information and 2) Reliability of Information Source for information transmitted during the scenario. Evaluation of

incoming information and supplying information sources for one or more of the following entities in the scenario:

- Information received by JTF commander through GITI certified network (GITI)
- Information received by temporal, probabilistic estimator, e.g. evaluating trustworthiness of ASW sensors (UMD)
- Information received at the Decision Desktops (e.g., SitViewer by QinetiQ)
- Information received by I-X Process Panels (AIAI)

35. **More detail from LM-ATL**.

a. The 2002 CoAX BINNI scenario focuses on dynamic change, exemplified by the addition of another country (Arabello) into the coalition. ATL's tools are designed to adapt agents and agent systems to such dynamic changes in system configuration and system environment. Country Arabello offers to share information from its ASW sensors. With this addition, the ASW processing capability provided by UMD becomes relevant and needs to be rapidly integrated into the coalition system.

b. ATL's Interoperable Intelligent Agent Toolkit (I2AT) lets military end users adapt and compose (depending on their level of sophistication) agent systems on the CoABS Grid. I2AT provides a GUI, a set of reusable agents and agent components, and basic agent control definition. We will leverage the agent domain services IHMC is making available via the CoABS Grid to "come-as-you-are" agents.

c. ATL proposes to demonstrate the quick and easy process a user performs to integrate the newly available information into the existing system using the I2AT. We will extend the I2AT to generate domain-aware agents and to permit configuration of the domain memberships and relations. We will add re-usable agent components to the toolkit that, when included in an agent, handle exception conditions that may result from violations of domain policies.

d. The I2AT supports a novel life-cycle model for agent-based systems engineering. This model decomposes the system development process into component creation, agent composition, agent system composition, and system configuration steps. The model with its related tools facilitates code reuse and reduces the complexity of system-of-systems construction, leveraging the CoABS Grid. The CoAX 2002 scenario allows ATL to demonstrate the benefits of our life-cycle model tools in a relevant military context.

36. **More Detail from Naval Research Laboratory (NRL)**.

a. Develop an agent-interface between the Agent grid and XIS, an alternate viewer with capabilities similar to the US Navy Global Command and Control System Maritime (GCCS-M).

b. In the demonstration, NRL will showcase the use of a US Navy-specific scenario viewer to complement the one already being used as a default in CoAX. We will accomplish this task

by developing grid-capable software agents that interact with the eXtensible Information System (XIS). Software agents will pull Navy-relevant information from the grid for display in XIS, and agents will relay basic supporting operational information from XIS to the grid. XIS is a COTS tool that is capable of displaying multi-dimensional data, and is similar to the U.S Navy Global Command and Control System Maritime (GCCS-M) in terms of information display capabilities. In fact, XIS was developed under previous DARPA funding, and is planned for deployment as a common service within the Defense Information Infrastructure (DII) Common Operating Environment (COE) version 4.0. The use of XIS will also help mitigate the risk of working with GCCS under the time constraints associated with CoAX 2002. The eventual target, though, is to interface the data from the CoAX grid with GCCS, so that advanced planning capabilities can be provided via GCCS to the other coalition participants.

37. **More Detail from Michigan**.

a. For deconfliction: Entry of Arabello introduces new conflicts -

- - over shipping lanes?
- - over LLTRs for medevac?

b. For cooperation (synergy): Entry of Arabello introduces new synergy opportunities -

- Idea 1: Initially, a coalition partner is moving into position to intercept and search ships leaving the area to find fugitives. Arabello joins to monitor for arms shipments, and similarly would search ships. Only should search ships once...
- Idea 2: Arabello joining in wants to provide humanitarian relief, but won't fly in itself. Agrees to drop off aid at ships. Now, introduces conflict for ship airport facilities, and also introduces synergies - rather than having separate flights for Arabello aid, piggyback onto planned Humanitarian Aid flights.
- Idea3: Arabello plans to move ships into monitoring positions; some ships of coalition partners already in some of those positions. Let coalition partners monitor instead, rather than redundant occupation of positions.
- Idea 4: Dartmouth mobile agents move to ship to monitor medevacuated troops who are stable. Sudden change in condition triggers a need to fly soldier to land-based hospital. Introduces conflict over airspace, and possible synergy (e.g., bring medical supplies back, rather than having separate supply delivery).

+++++ End of CoAX Binni 2002 Approach +++++