Aircrew Mission Training via Distributed Simulation Progress in NATO

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Summary

Mission Training via Distributed Simulation (MTDS) exploits modern simulation technology to provide a new concept in aircrew collective training for air operations. MTDS has been the subject of NATO RTO activities since 1998. The MTDS Task Group is working to create a prototype NATO synthetic MTDS environment, conduct a multi-national COMAO exercise and assess its potential to support training to enhance NATO's operational effectiveness in multi-national air operations. This activity is known as "Exercise First WAVE" (Warfighter Alliance in a Virtual Environment), the first ever multi-national wide area networked real-time simulation of Combined Air Operations conducted in NATO. This paper reviews the work of the NATO MTDS Task Group, examines the nature and potential of Aircrew Mission Training via Distributed Simulation and reports progress with "Exercise First WAVE". It summarises lessons learned so far about defining and creating a distributed training environment and about the technical and training issues which need to be addressed in order to implement and exploit MTDS in NATO and the nations.

1 Introduction

1.1 MTDS – the Background

MTDS – Mission Training via Distributed Simulation – is the NATO name for a new concept in aircrew mission training. MTDS exploits modern simulation technology to improve operational readiness and contribute to mission success. Over the past five years MTDS has been the subject of several NATO RTO activities (Tomlinson, 2000, 2002, Van Geest & Tomlinson, 2002, 2003). A Military Applications Study (SAS-013) was undertaken from 1998-2000 to "assess the potential of advanced distributed simulation to complement live flying training in order to enhance NATO capability to conduct combined air operations". The MTDS Task Group was then initiated in May 2001 to build on this preliminary work. A NATO RTO Symposium (SAS-038), held in Brussels, Belgium, in April 2002, was devoted to "Air Mission Training Through Distributed Simulation (MTDS) – Achieving and Maintaining Readiness".

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MTDS focuses on “collective training” and inter-team skills and applies to aircrew and mission crew - pilots, navigators, and all weapons and mission system operators. They are assumed to possess the basic individual and team skills needed to be categorised as "combat ready". Such aircrew must then master the collective skills necessary in multinational air operations as part of a larger unit involving two or more teams from two or more countries. The definition of collective training applicable to the air domain, composed by the initial SAS-013 study, is

> ***“Collective training involves two or more ‘teams’, where each team fulfils different ‘roles’, training to interoperate in an environment defined by a common set of training objectives.”***

Collective training is thus concerned with multi-role, multi-platform interactions, co-ordination and communication.

MTDS is about creating a distributed training environment which immerses aircrews and mission crews in a realistic operational scenario and enables them to conduct collective mission training for air operations. MTDS exploits modern advanced computing and networking technologies to bring together a federation of crewed aircraft and mission simulators in a synthetic environment. Crews perform the end-to-end COMAO (Composite Air Operation) processes of planning, briefing, mission execution and debriefing in the distributed training environment surrounding the federation. MTDS is feasible technically and has the potential to offer expanded training opportunities for development of collective skills.

1.2 The NATO MTDS Task Group

The NATO MTDS Task Group combines the SAS-034 Task Group sponsored by the Studies, Analysis and Simulation (SAS) Panel and the MSG-001 Task Group sponsored by the NATO Modelling & Simulation Group. This Task Group is currently working to create a prototype NATO synthetic MTDS environment, conduct a Multi-National COMAO exercise and assess its potential to support training to enhance NATO's operational effectiveness in multi-national air operations. This simulation-based aircrew training exercise, known as “Exercise First WAVE” (Warfighter Alliance in a Virtual Environment), will be the first ever multi-national wide area networked real-time simulation of Combined Air Operations conducted in NATO. The exercise, planned for September 2004, explores issues of matching training requirements and technical capability, and exposes the need for a multi-national exercise development team to address these aspects.

The overall objectives of the current MTDS Task Group are:

- To demonstrate, investigate and assess the potential of MTDS to enhance aircrew mission readiness for NATO coalition operations, including training, simulation technology and management aspects;
- To increase awareness of MTDS capabilities amongst national and NATO military staffs;
- To establish a set of guidelines, procedures and standards based on experience and lessons learned;
- To propose further actions needed to implement and exploit MTDS in NATO and the nations.

1.3 Organisation

Members of the task group are Air Forces, Industry and Research and Technology organisations from Canada, France, Germany, Italy, the Netherlands, the United Kingdom and the United States of America.

Within the MTDS task group, Exercise First WAVE is managed by a Steering Group, supported at the working level by five specialist task teams:

- Operations and Training
- Technical
- Security
- Assessment
- Awareness

Experienced military officers lead the Operations and Training team, to ensure that objectives appropriate to the operator community are defined and met. The steering group is made up of the National representatives

of the participating countries, and the leaders of the task teams. A full-time programme manager, sponsored by the USA, helps the Task Group chairman manage the entire effort. More information about the technical aspects of First WAVE is given in a companion paper (Cerutti & Greschke, 2003).

2 Training Need

2.1 Air Operations

In modern air operations, a mission package typically employs platforms of many kinds, not only in the essential strike and escort roles, but also in such other crucial support roles as electronic warfare (EW), suppression of enemy air defence (SEAD), command & control (AWACS) and air-air refuelling (AAR). They all contribute collectively to mission success, and their crews need to train together.

A further feature of modern air operations is that the balance between flying skills and weapon system operation is evolving to place greater emphasis on sensor manipulation, information management, situation awareness, decision making and communication. Such a change in emphasis generates new training requirements for a complex tactical context in which sensor and weapon suites can be fully employed in association with other aircraft. Future operations will employ a “system of systems” in which single aircraft will themselves be part of an operational network, in what is referred to as “network-centric warfare” or “network-enabled capability”. To ensure that aircrew can employ their systems effectively, and be well co-ordinated with others, they need opportunities to train with all appropriate and relevant assets.

2.2 Live Flying Training and the Training Gap

NATO training for combined air operations is accomplished today solely through live flying training, such as the Tactical Leadership Programme (TLP), and through exercises, such as the NATO Air Meet (NAM).

Opportunities for NATO aircrews to participate in TLP and complex air exercises are limited. NAM takes place only once a year, and then only for a relatively small number of crews. An individual crew or pilot may participate only rarely in Red Flag. As mission complexity increases, and as the trend towards network-centric, and network-enabled, operations gathers momentum, there is an increasing need for combat assets to practise operational integration with ISTAR and other support assets. A training gap is developing and new training methods are needed to provide increasingly complex scenarios.

This increasing complexity means that the full range of mission training requirements cannot be fulfilled in the air. Among the many factors limiting the capability to conduct realistic mission training during live flying training exercises are:

- Increasing pressure to reduce training costs
- Restrictions on airspace and lack of adequate training ranges
- Operational factors such as improved weapons system performance capabilities, and security constraints on the use of electronic warfare systems
- Mission complexity and rules of engagement (ROE)
- Environmental and safety restrictions, including the inability to fire weapons or use chaff/flare
- An unrepresentative mission environment, with no threats that fire back

Modern weapon system performance capabilities and the growth of data links are extending the "tactical reach" of an air package. Thus, aircrew combat training in the 2000-2010 time frame will need to change from the training of the 1990s, with emphasis now on higher order weapons system employment skills requiring co-ordination, communication, and complex judgement.

Developments in simulation technologies, and in the ability to simulate an immersive and convincing mission environment, offer ways to fill this emerging training gap. Some initiatives equivalent to NAM and Red Flag, but based on simulation and MTDS, will need to be established.

3 Technical Capability

3.1 Simulation technologies

Simulation technologies have advanced substantially over the past 5 years: computing power continues to improve, communication networks have become widely available (and also more affordable) and satellite imagery has enabled enhanced terrain databases for (almost) anywhere in the world to be created. Computer generated forces also are available (and, indeed, are necessary) to augment piloted platforms to provide additional Blue force assets, as well as the reactive Red air and ground-based defence necessary for tactical realism. These developments have made it possible to build a realistic and stressful synthetic battlespace in which numerous participants, no matter where they are located, can operate together in a shared mission. Such technology has been evolving steadily, and has now reached the stage where it is being used regularly in some nations for squadron training (e.g. the US DMT programme). Multi-national experiments have also been conducted in a research context.

Modern advanced simulation is very different from the traditional kind. The new generation of simulators can offer mission-related capability that enables them to participate in MTDS. To be able to join an MTDS exercise, simulators need to be both "mission-capable" and "network-capable". However, it must be realised that not all today's "legacy" simulators are suitable for use in MTDS.

Mission-capable means manned simulators must have sufficient fidelity to allow pilots to "train as they intend to fight" and perform their mission tasks in a realistic manner. This requires that the aircraft cockpit, flight performance, sensors and weapons be simulated to an appropriate (moderately high) level of physical and functional fidelity, and that the mission environment provides a sense of "immersion".

Network-capable means each manned simulator must be capable of exchanging data in a secure manner with other participating simulations, using an agreed, standard protocol. The participating simulators must also be interoperable with one another within a common synthetic environment such that the cause and effect relationships (interactions) in the synthetic world correspond to the cause and effect relationships in the real world.

3.2 Training environment

A training environment to exploit MTDS needs more than just capable simulation assets, in the form of operational multi-ship training facilities provided by the nations. It needs an extensive "MTDS training system", with facilities to support the training audience (the crews) in all phases of the complete operational cycle, from issue of the Air Tasking Order, via planning and briefing, to flying the mission (in simulators) and finishing with post-mission debriefing. In addition, the simulators must be capable of meeting the exercise management and data capture requirements identified by the training manager.

Key elements of the distributed training environment are illustrated in Figure 1. All these elements are directed at supporting the training objectives for a particular exercise.

Tactical Environment

The Tactical Environment defines the characteristics of, and performance for, all tactical entities which interact with each other and with the Synthetic Natural Environment. The tactical environment consists of manned (virtual) simulators and computer-generated forces. With some exceptions, the blue forces are manned simulators, and the red forces are CGF.

Synthetic Natural Environment

The Synthetic Natural Environment (SNE) represents the geophysical environment of the mission space, i.e. terrain and natural features, as well as 3D cultural features, together with the atmosphere and the weather. The SNE has to be represented sufficiently well, in the visual system and in how it influences sensors and

weapons, to serve the training objectives of the exercise, and to provide a maximum sense of immersion to the pilots.

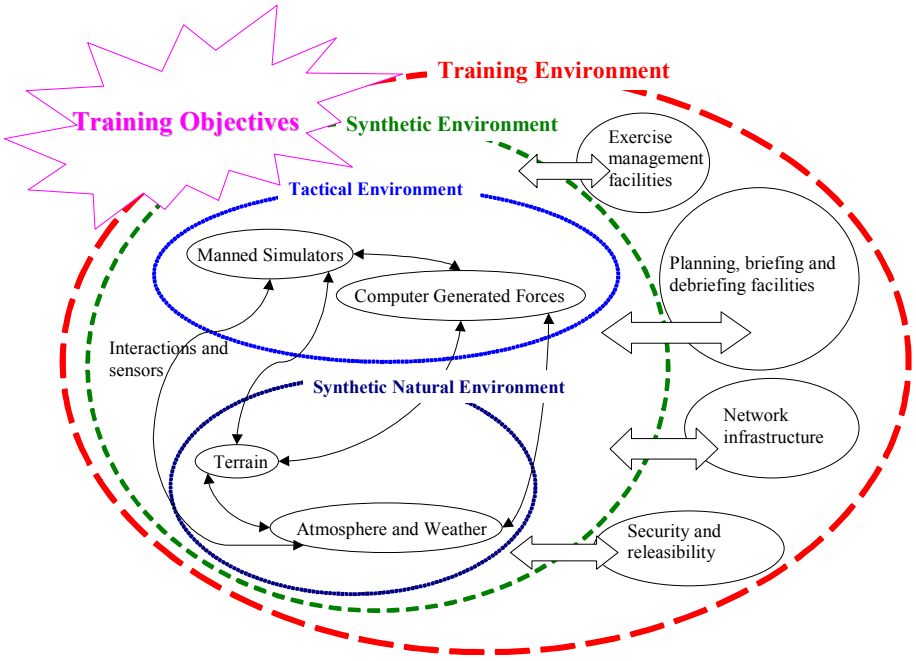


Figure 1 Elements of the multinational mission training environment

Interactions and Sensors

Interactions and sensors are a fundamental element of the distributed training environment. They provide the mechanism that enables one entity to know about the existence and behaviour of another entity. Interactions exist between the different tactical entities, and between a tactical entity and the geophysical environment. Achieving "fair play" and realistic interactions are crucial to the success of a networked training exercise. Simulators will differ in the level of modelling and simulation of their sensors and weapons. The capabilities of each networked simulator will determine its role and degree of participation in an exercise. False results must be avoided.

Exercise management facilities

Setting-up, controlling and using a network of simulations as a training tool are significant activities. An exercise scenario that facilitates the training objectives has to be designed, implemented and tested. The personnel that assure that the training process proceeds according to the requirements are often referred to as the White Force.

One way the white force can influence the training process is by the injection of trigger events into the scenario. Such events are intended to provoke blue force interactions and promote training in the area of mission critical or time critical targeting. An example of a trigger event is the appearance of a Surface-to-Air missile system from a hidden location in the scenario to feed a real-time targeting loop. The trigger events will be planned in advance.

A discussion of some experiences obtained from a research programme into the application of networked simulators to collective training (Smith & McIntyre, 2003) suggests there are major challenges in conducting aircrew collective training using simulators and crews at geographically dispersed sites.

Mission planning, briefing and debriefing

During the training period, the environment must allow the trainees to do all planning, briefing, execution and debriefing activities necessary to receive maximum benefit from the COMAO mission. The individual sites should therefore be connected not only during the execution, but also during the planning, briefing and debriefing activities. For planning, the sites will use their organic planning facilities. Briefing may be facilitated using interconnected interactive whiteboards and voice, so that the mission commander can brief all crews at the same time.

Network

An obvious requirement for a distributed training environment is the need for a wide area network with sufficient bandwidth and a low latency to support real-time man-in-the-loop simulation and all the data that needs to be shared. This item also includes portals or other devices that may have to be used to connect systems together that use a different interoperability standard, e.g. DIS or HLA.

Security and releasability

Most MTDS exercises will be classified. This implies that the participating sites should be accredited for the applicable classification level, and that all data exchange between the sites will be encrypted. Furthermore, a project agreement between the participating nations has to be put in place in order to be able to release classified data over the network.

Security procedures require considerable time to establish. Therefore, a sound security plan is one of the first products that has to be produced for any exercise including networked classified simulations.

4 Exercise First WAVE

4.1 Objectives

In support of the overall objectives of the MTDS Task Group listed earlier, the top-level aim of Exercise First WAVE is to create a distributed simulation environment (the Federation[1]) in which warfighters can conduct a Composite Air Operation in order to assess the potential of NATO MTDS. Exercise First WAVE will bring together national training systems and enable them to operate in the same simulated scenario.

As is usual for any exercise, a set of top level training objectives has been defined:

- To practise daytime COMAO procedures employing fighter escort/sweep, AAR, SEAD, reconnaissance and AEW in a hostile EW environment
- To exercise procedures for defensive operations with Fighter Areas of Responsibility (FAORs) and point defence tasking
- To employ EW resources in support of offensive and defensive air operations
- To plan and integrate a multi-national COMAO in a defined threat environment
- To brief a COMAO package generated from dispersed locations
- To conduct mission debriefs
- To engender efficient team-working skills between Nations and differing elements of the COMAO package
- To develop a tactical appreciation of real-world threats
- To expose aircrew to situations to which they would not normally encounter in a peacetime environment
- To establish lessons identified

[1] Federation is part of the language of the High Level Architecture, used as a basis for development of Exercise First WAVE.

These establish what needs to be included in the synthetic environment and the nature of the scenario. It is assumed that all participating aircrew and mission crews are already trained to "combat ready" status and therefore have the skills required to work together as a small team. It is the integration of individual teams with other elements of the package that is the training focus of the exercise. The work in the US on Mission Essential Competencies (Colegrove & Alliger, 2002) will be applied and extended to coalition air operations.

4.2 Scenario

Exercise First WAVE will represent a scenario which offers a geographically realistic location and a complex operational environment. A substantial Blue Force, consisting of about 30 manned simulators, together with additional assets represented by computer driven forces, will undertake strike missions, supported by AWACS and AAR. These missions are modelled on Composite Air Operations (COMAO), as illustrated conceptually in the diagram below (*Figure 2*). Most of the participating simulators will be operational training systems (such as an F-15 4-ship from the Mission Training Center at Eglin AFB in the USA), flown by operational, combat ready, crews, while a few will be R&D simulators (but also flown by operational pilots). A Red Force will consist of both manned and computer driven air defence assets, together with an integrated ground-based air defence system. The entire networked synthetic environment will operate at a classified level, open only to participating nations.

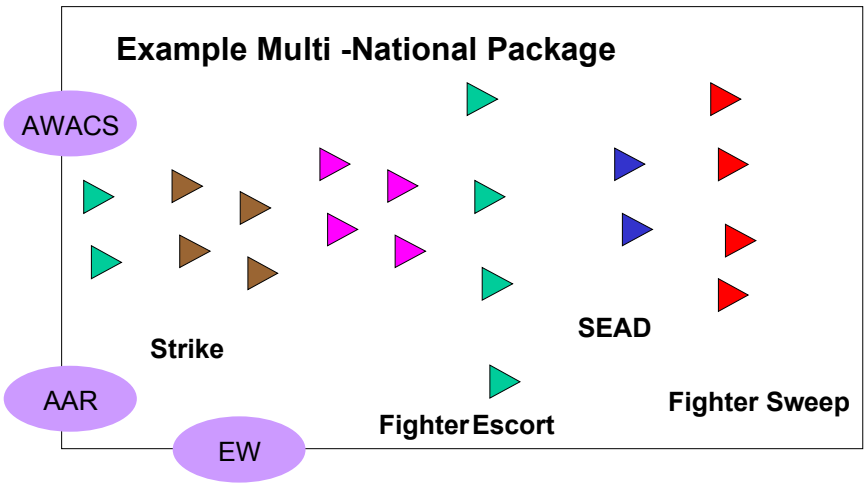


Figure 2 Example package structure

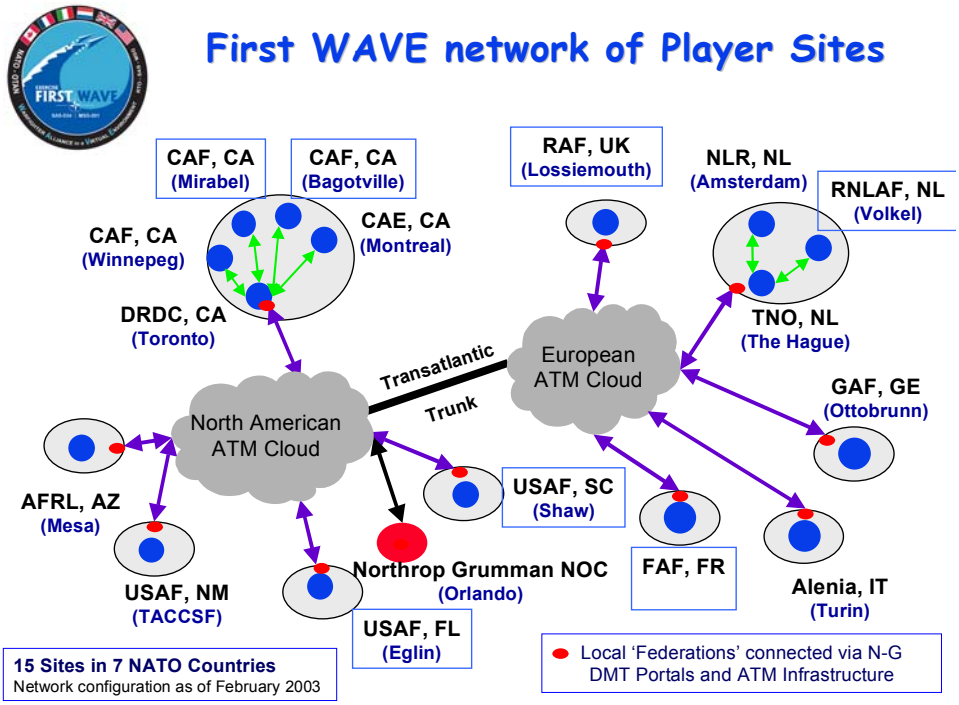
4.3 Conduct

Given that the simulated air operations will be focused on aircrew training potential, with "suitable" levels of command and control (AWACS, CAOC), they will be conducted in an operationally realistic manner. Following an initial familiarisation day, each of the three mission days will start with the release of the Air Tasking Order (ATO). Under the leadership of a Package Commander selected from the participants, each formation will then plan and brief their tasks, in co-ordination with other formations as necessary, fly their sorties and then conduct subsequent formation and mass debriefs. Ensuring crew immersion by following such a complete mission cycle is one of the key goals of the exercise, as defined in the User Requirements Document. It is also vital that all participants receive a training experience of value to *them*. From this outline, it is clear that the exercise will be much more than just a federation of simulators. In fact, it will be a Distributed Training Environment. How well crews are able to plan and brief/debrief with others at

dispersed sites will be one of the key topics to be assessed. Comprehensive and robust communications facilities are important, for both non-flying and flying phases. During the flying phase, realistic simulation of multiple radio channels is a critical element in creating a believable representation of the tactical environment.

4.4 Network

Exercise First WAVE will involve simulators and training facilities at about 15 sites in 7 NATO countries (*Figure 3*). Setting up and managing the wide area network (WAN) is itself a major activity. We are fortunate to have the support of Northrop Grumman Mission Systems to do this. They are the US contractors



already responsible for the operations and integration aspects of the US DMT programme.

Figure 3 First WAVE Network

4.5 Assessment & Evaluation

The assessment team is responsible for the assessment of the potential operational training benefits of MTDS for COMAO training and for documenting the strengths and weaknesses identified through the execution of Exercise First WAVE. The mission essential competencies mentioned earlier will be used as a foundation for identifying training gaps and for assessing the training potential of MTDS.

5 Challenges in Training & Technology, & Lessons Learned

5.1 Training

The first challenge is to define and agree a set of training objectives. These need to ensure that ***all*** participants will receive a training experience of value to them. However, the agreed training objectives also have to match the training assets available, and recognise specific national objectives as well as coalition goals. In Exercise First WAVE we had a group of participating nations, who offered assets and we had to

build a scenario to exercise them all. It would help in future to have a single NATO or coalition "General" with a requirement, who says something like "I want to bring together a coalition package from nations X, Y, Z, … in order to practise and improve capabilities P, Q, R, … in scenario F." What you want to do and who you want to do it with have major influences on the overall feasibility, from both a technical and security point of view.

How missions will be conducted and managed needs to be defined and agreed, in order to specify and scope the key features of the total distributed training environment. The exercise management team also needs to be identified. These are the people who will supervise and manage the exercise to ensure the training objectives are met. A scenario and associated trigger events need to be defined. This requires careful pre-planning and preparation. Planning, briefing and debriefing facilities and requirements also need to be identified. A large part of the training value in *co-located* live exercises has been found to stem from face-to-face planning, briefing and debriefing. The same value is needed in MTDS, with the extra challenges of being geographically distributed.

5.2 Technology

Integration of dissimilar (legacy) simulators into a distributed training environment raises several interoperability issues, including:

- Simulators need to be mission-capable: the degree to which each simulator represents the capabilities of the real aircraft, its sensors and weapons will influence the role it can play in the mission;
- Simulators need to be network-capable: each simulator must be able to exchange and interpret data in a secure manner with other participating simulators, using an agreed standard protocol;
- Simulators have to work together in a compatible manner and support the types of interaction between sensors, weapons and defensive aids required by the scenario;
- Security and releasability: the training environment has to provide a good balance between maximum training value and national data release constraints;
- Synthetic Natural Environment: in particular correlated visual and sensor databases and weather representation are not easy to achieve over dissimilar legacy simulators; however, to meet collective training objectives, these issues may have lesser importance.

While a convincing and worthwhile simulated mission environment can be created, there are still technology limitations that will constrain the range of missions that can be performed and the range of collective skills that can be fully exercised. There is a need for continuing, and co-ordinated, research in many areas:

- to improve our understanding of collective mission training needs in a multi-national context, the nature of team fluidity and the competencies that need to be trained
- to understand the balance between live and synthetic training, and how best to exploit the strengths of each type of training
- to establish effective methods and tools for the conduct of mission training exercises from a number of geographically separate locations and to help understand the relative benefits of "distributed" and "co-located" simulator facilities
- to develop methods to relate training objectives to necessary simulator functionality, to design MTDS events, to assess performance, and to evaluate multi-national training programmes for collective skill training
- to improve the capabilities of computer generated forces
- to identify the key factors in achieving interoperability among mission simulators of different design, including network issues, modelling of interactions and external control and to investigate whether a NATO Air FOM needs to be developed
- improved representation of the environment, to include effects of bad weather and night and their influence on sensors ands weapons
- representation of data links

5.3 Lessons Learned

Exercise First WAVE is still being planned and developed, so many of the lessons learned so far are about defining and creating a distributed training environment and about organisational issues. It is essential to keep at the forefront that the principal objective is about training, not technology, even though solving technical issues is essential. A key lesson is that MTDS is about more than just simulators.

The first lesson learned is that many challenges exist of an organisational nature, as well as in the training and technology areas. The scope of Exercise First WAVE is larger than any collaborative geographically distributed simulation programme attempted before. A "Memorandum of Understanding" (MOU) or similar arrangement is needed. Even there, issues arise, as one country may find MOU an acceptable label, but another seeks a "Technical Arrangement".

The potential "show-stopper" is security. Security and information disclosure issues need to be recognised as having a major impact on the future of MTDS. A "Security Processes & Procedures" document is essential as the basis for accreditation. Any computer-based system handling classified data has to achieve accreditation by appropriate national authorities. To be part of a multi-national network, it also has to be approved by a multi-national authority. Who this should be was not obvious when we began, but after some false starts we have found that the appropriate body is the Multi-National Security Accreditation Board (MSAB). When satisfied, the MSAB will issue a certificate enabling connection to take place. However, this does not deal with information disclosure, which is essentially a *national* decision about the data each nation is willing to release.

Among other challenges and lessons is that of finance. The Task Group has no central budget but relies on national funding. Furthermore, the parties involved include industry as well as government. Many of the actual training systems are owned by industry and used by Air Forces on a "pay by the hour" basis. Significant contributions are being made to Exercise First WAVE by industry using their own money.

5.4 Success criteria

The MTDS Steering Group has defined a set of goals and success criteria under three headings:

Training

- that Exercise First WAVE provides crews with a credible and worthwhile training experience
- that Exercise First WAVE demonstrates the ability to conduct realistic coalition aircrew training from brief to execution to debrief
- that data and experiences can be gathered to properly assess the potential of MTDS in NATO

Security

- that processes and agreements for multi-national secure real time MTDS networks can be defined and agreed
- that a secure synthetic coalition training environment can be established and delivered

Legacy/Infrastructure

- that Exercise First WAVE provides a proof of concept for MTDS and distributed mission operations that will be the cornerstone of training transformation
- that a documented infrastructure and lessons are left for future use
- that relations and links among national staffs are established for future C2 and fighter mission rehearsal/training

Achievements to date have included the preparation of the User Requirements Document, the Management Plan, and the generation of a Test Federate. The work of the Task Group has been of significant value already to Nations, in terms of both policy & technical understanding. Dissemination of the concept of MTDS is actively pursued by briefings to NATO and national organisations.

6 Future potential of Aircrew Mission Training via Distributed Simulation

6.1 MTDS in NATO

MTDS is feasible now, but all stakeholders have much to learn and need to acquire more experience in defining, setting up and running MTDS-based training exercises. Currently, it is the NATO R&D community that is exploring MTDS in terms of both training benefits and technical challenges. "Exercise First WAVE" will, hopefully, be a major milestone in taking MTDS forward. To go further, we need to "hand it on" to a clearly identified "owner" or "champion" of MTDS in the NATO operational community.

This champion would take responsibility for how best to explore and exploit what MTDS can offer, and would establish a NATO team to initiate MTDS-style exercises. Such a team needs to include and integrate expertise from the NATO Military Commands, from the NATO AEW&C Force Command (unique in NATO in actually owning relevant simulator assets), from the Tactical Leadership Programme and from national Air Warfare Centres.

We need to advance our understanding, through practical experience, of how all participants in such training exercises (exercise management team/white force, aircrew and the technical team) can effectively work together to achieve defined training objectives. Significant effort is required to define training objectives, to plan and prepare the scenario and to conduct the exercise. Experience to date suggests that every such exercise will furnish lessons learned and provide insight into fresh areas to explore. Strong liaison between the operational and training research communities will need to be maintained, to ensure that operational lessons learned and training needs are understood and that implementation of MTDS makes best use of scientific knowledge.

An evolutionary programme of MTDS exercises should be adopted, building up progressively over a few years from relatively small-scale training events to larger exercises. Issues to be considered include:

- training requirements and objectives (what needs to be trained, with whom and how often)
- representative scenarios
- suitable configurations (federations) of simulation facilities
- methods and tools to help manage distributed training exercises
- a NATO network infrastructure which is manageable and flexible
- security processes and procedures

Our experience so far with MTDS is in fast jet operations. The implications of using MTDS for training in other kinds of air operation, and in joint operations, also need to be examined.

7 Concluding Remarks

MTDS is an important application of advanced technology to military training and can potentially provide a major contribution to coalition readiness and effectiveness in future NATO air operations. The training opportunities that MTDS can offer – a complex tactical environment and few (if any) restrictions – will be increasingly vital in an era of Network-Centric Warfare and Network-Enabled Capability. The federation being developed for First WAVE, and the guidelines that emerge from the exercise, will be a basis for further implementation and exploitation of MTDS within NATO.

Many nations are acquiring training simulators which are potential participants in future MTDS exercises, and have research programmes to define national use of networked simulation for training. In some countries operational aircrew already use this type of training. National (and NATO) procurement processes need to ensure that simulator-based training systems are acquired with the appropriate mission-capable and network-capable features.

NATO has been exploring MTDS and its potential since 1998 through an initial study (SAS-013), a major symposium (SAS-038) and now through the MTDS Task Group. It would help communication and understanding if all groups in NATO use MTDS as the appropriate label in a NATO context.

The MTDS Task Group will deliver, in September 2004, Exercise First WAVE, the first ever multi-national wide area networked real-time simulation of Combined Air Operations conducted in NATO. This will bring together more than 30 manned simulators in seven nations in a realistic and representative scenario. Apart from Exercise First WAVE itself, deliverables will include lessons learned, guidelines on implementation and a proposed plan for future exploitation. Although the exercise itself will have controlled access, for security reasons, the main results will be reported to all NATO nations.

Enabling Exercise First WAVE to happen is consuming a lot of effort, organisationally to achieve appropriate formal agreements and agree security processes; and technically to solve such challenges as the provision of a secure network, the supply of encryption devices and the integration of a variety of national training systems into a unified whole. For MTDS to be usable in a more "every day" manner in future the organisational processes must be simplified and new technical challenges resolved speedily.

Security is the potential show-stopper. To bring together any viable coalition-based collection of aircrew training systems will require a secure wide area network. Achieving accreditation for such a network involves national and international processes. Exercise First WAVE has broken new ground here and has hopefully established how such a network can be authorised in future, via the Multi-national Security Accreditation Board. Nations still have to resolve their own data disclosure policy.

To strengthen the capability and enable the full potential of MTDS to be realised in NATO (and the nations) needs continued national and collaborative research in such areas as:

- creating a distributed mission training environment which serves the whole plan-brief-fly-debrief cycle
- briefing and debriefing methods and tools
- representation of data links
- interoperability
- computer generated forces
- improved representation of the environment, to include effects of bad weather and night and their influence on sensors ands weapons

We need to sustain the momentum behind MTDS. Exercise First WAVE will take place in September 2004. Enabling this Exercise to happen has brought together the Air Forces and other agencies of seven nations, together with substantial contributions from industry. This momentum should not be lost. We would hope that the military community in NATO, at both Allied Command Operations (based at SHAPE) and the new Allied Command Transformation (formerly SACLANT), will take the concept forward and enable "Second WAVE" (or whatever it might be called) to take place soon. There are other nations who wish to participate. A steady, and evolving, sequence of exercises is needed. We all still have a lot to learn about how to create and conduct such simulator-based exercises to achieve real training benefits.

We are making good progress towards achieving Exercise First WAVE and hope it will contribute to the future success of MTDS in NATO.

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Author Biography

Barry Tomlinson was Study Director (1998-2000) for the Military Applications Study SAS-013 on "Aircrew Mission Training via Distributed Simulation" sponsored by the NATO Studies, Analysis and Simulation Panel and is at present chairman of the MTDS Task Group (SAS-034/MSG-001) on "Mission Training via Distributed Simulation (MTDS) - Concept Development and Demonstration". Currently employed at QinetiQ (formerly the Defence Evaluation & Research Agency) at Bedford in the UK, he has more than 35 years' experience in the technology and application of flight simulation and synthetic environments to aircraft and systems development and to training.

Jan van Geest has contributed to NATO MTDS activities since 1998 and currently represents both MSG-001 and The Netherlands in the First WAVE Steering Group. He is employed at the Physics and Electronics Laboratory of TNO (Netherlands Organisation for Applied Research, TNO-FEL) in The Hague, NL and advises the Royal Netherlands Air Force on the use of simulation for mission training. His experience includes organisational and technical definition of debriefing for live and simulated collective exercises.

List of acronyms

AAR	Air-Air Refuelling
AEW	Airborne Early Warning
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
C2	Command and Control
CAOC	Combined Air Operations Centre
DMT	Distributed Mission Training
EW	Electronic Warfare
FAOR	Fighter Area of Responsibility
FOM	Federation Object Model
ISTAR	Intelligence, Surveillance, Target Acquisition and Reconnaissance
MSAB	Multi-National Security Accreditation Board
MTDS	Mission Training via Distributed Simulation
NAEWFC	NATO AEW&C Force Command
NAM	NATO Air Meet
NATO	North Atlantic Treaty Organisation
NMSG	NATO Modelling & Simulation Group
RTO	Research & Technology Organisation
SACLANT	Supreme Allied Commander Atlantic
SAS	Studies, Analysis and Simulation (Panel of the RTO)
SEAD	Suppression of Enemy Air Defence
SHAPE	Supreme Headquarters Allied Powers Europe
TLP	Tactical Leadership Programme