

# **AUSTRALIAN COLLABORATION WITH USN BATTLE FORCE TACTICAL TRAINING PROGRAM**

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## **ABSTRACT**

Australian Navy Project SEA 1412 is integrating a set of team trainers using Distributed Interactive Simulation (DIS) to develop the Maritime Warfare Training System (MWTS). The US Navy has a similar Program - Battle Force Tactical Training (BFTT) System, which will eventually include 158 major surface ships and five shore sites, providing training for individual and multiple ships, using distributed interactive simulation. This technology enables a number of ships and shore units to participate in the same virtual battlespace even though they may be geographically dispersed; eg one fleet unit could be at San Diego and one in Sydney, Australia, and they could participate in the same exercise through electronic linkages. DIS is the current mature standard for simulator interoperability and is used by BFTT. The US DoD has mandated that M&S projects be High Level Architecture (HLA) compliant. BFTT is currently migrating to HLA.

It is in both Australia's and the United States' interests to collaborate, since this will ultimately ensure that Australian Navy training systems both in the ships and ashore will be able to communicate with their US counterparts. The RAN could then participate in coalition training exercises with the USN in a series of exercises which might be termed Virtual RIMPAC. Through these two similar Programs, Australian and US researchers are sharing their experiences with DIS for naval training, including various difficult technical issues. This paper will discuss the issues from both the Australian and USN perspective, and outline a proposed collaborative R&D effort in the area of migrating to the newer HLA. Australian researchers have suggested a migration path for SEA 1412 which is similar to the BFTT migration path. At the higher level, both Australian and USN researchers are interested in investigating whether their systems will prove effective both from a cost and training perspective in delivering training to the RAN and USN, and how they endeavour to measure it.

## AUTHORS' BIOGRAPHIES

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**Mr Jim Brewer** recently retired from Naval Surface Warfare Center, Port Hueneme Division, where he served in engineering and management positions spanning Combat Systems through Joint Operations including serving as the BFTT Technical Direction Agent. In 1999, he joined the NOVONICS Corporation where his focus has been on distributed training and team learning.

## INTRODUCTION

Advanced Distributed Simulation technologies are changing the way in which military forces train and conduct mission rehearsals. By connecting multiple simulators to create a shared virtual world, technologies, such as Distributed Interactive Simulation (DIS), increase training effectiveness [1].

The Royal Australian Navy (RAN) is moving toward the use of distributed simulation through its Maritime Warfare Training System (MWTS) which will integrate a set of team trainers. Concurrently, The US Navy (USN) is developing the Battle Force Tactical Training (BFTT) system that also uses distributed simulation to provide training for individual and multiple sets of ships.

This paper discusses these similar projects and the potential benefits of international collaboration. Using a BFTT-MWTS coalition-level simulation, features of the multinational joint exercise "RIMPAC" could be rehearsed prior to RAN and USN ships leaving port.

## ROYAL AUSTRALIAN NAVY PROJECT SEA 1412

Through Project SEA 1412, the RAN is seeking to develop the Maritime Warfare Training System (MWTS) which will initially link several shore-based operations room trainers to provide enhanced command team and tactical training for the RAN into the 21st century [2].

This system will provide training for the two-ocean based Navy (Sydney and Perth) without requiring expensive collocation of assets. The MWTS would provide manned assets, instructor supervision, and game control and debriefing, for exercises involving both live and simulated assets across a large synthetic operating area, as depicted in figure 1.

In later phases of the Project, an Australian wide-area maritime simulation network will be established. This system could include ships alongside at Fleet Base East in Sydney and Fleet Base West in Western Australia, linked via their on-board training systems with the wargaming system and ship models at HMAS WATSON in Sydney. Other ADF simulators, such as RAN helicopter simulators and RAAF P3C, FA-18 and

Airborne Early Warning & Control (AEW&C) simulators, may also be able to participate in a common virtual scenario on an opportunity basis.

In time, there is potential to extend this environment to include ships at sea, although this requirement will create various communication challenges. Further in the future a DIS/HLA capability will enable the RAN to participate in international simulated exercises.

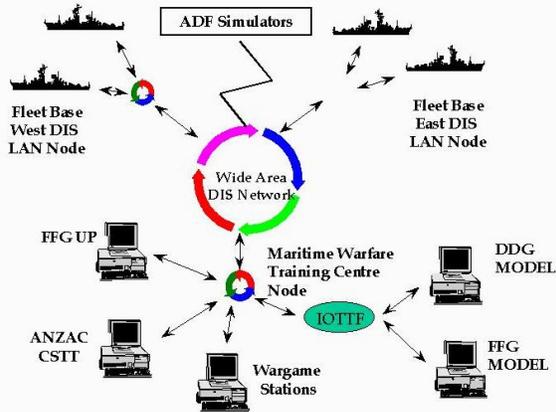


Figure 1: Maritime Warfare Training System

## BATTLE FORCE TACTICAL TRAINING (BFTT)

Peacetime constraints have limited funds available for mission training/rehearsal using live forces. In order to maintain an adequate level of military readiness, the U.S. Department of Defense (DoD) is exploring the increased use of simulation to support operational training. When fully developed, BFTT will provide shipboard training across the full spectrum – from small team training, to unit level, to multiple ship, to theatre level joint and coalition training.

The BFTT system is primarily an in-port, shipboard, combat system team training capability which provides realistic team training across all warfare areas [3]. BFTT integrates on board trainers and operates by stimulating/simulating shipboard sensors and by introducing virtual non-shipboard forces such as friendly, neutral and hostile aircraft, surface ships and submarines. BFTT will eventually provide stand-alone on-board training for all 158 major surface ships and Virginia Class submarines, and will also connect “sets” of ships using distributed interactive simulation. For ships not scheduled to receive a permanent installation, BFTT will be available in a stand-alone carry aboard system - the Carry On Combat System Trainer (COCST) configuration to allow non-BFTT ships the

opportunity to participate in Battle Group level BFTT exercises.

Using existing technology, BFTT enables ships and shore units to participate in the same interactive virtual battlespace while they are geographically dispersed; e.g. one fleet unit could be in-port San Diego and one fleet unit could be in-port Pearl Harbor, HI; both immersed in the same virtual battlespace, interacting via a wide area network (WAN). Using this WAN, the ships may be joined by shore-based training centers who may act as problem control, or may function as the Battle Staff Organization (Red and/or Blue Cell) in complex scenarios. BFTT also provides tactical data and voice communications both for realism and problem control. While BFTT currently uses DIS architecture to create and distribute the battlespace, a migration from DIS to HLA is planned.

## COALITION TRAINING

“Whether in traditional military engagements, asymmetrical engagements, or in a variety of operations other than war, the United States will be working in coalition environments. Basic to the conduct of these operations is the ability to develop and maintain a shared perception of the situation, develop coherent plans that leverage the available resources, and execute them. This requires a level of information exchange, systems that can understand one another, a coalition-based planning process where all may participate, a common concept of operations, and a set of compatible procedures to carry out operations.”[4].

Preparing to meet this coalition requirement, the United States Navy has an initiative to provide coalition forces interoperability training and combined mission rehearsal capability. U.S., Allied and Coalition commanders have expressed the philosophy that we must “Train How We Fight” and “Train Where We Fight” to improve our combined force readiness and effectiveness. The later goal demands a shift of focus from schoolhouse facilities to in-situ/on-board training where combat teams train in the real shipboard environment and any number of platforms could be networked to achieve joint force or coalition force training.

This initiative is centered around BFTT. It is designed to present an “on-demand”, coherent mission space “picture” to each participant (including geographical areas, friendly, unknown and hostile forces) that stimulates or simulates each of the indigenous sensors for a “total immersion”, realistic experience. Emerging

learning methodologies, knowledge management and objective based training techniques have been engineered into the system. Scheduled releases of BFTT software will produce automated measures of performance/measures of effectiveness (MOP/MOEs), multiple after-action-review (AAR) products and mission rehearsal scenario generation capability. Future BFTT developments include the capability to exercise through a single integrated system tying open architecture simulators/stimulators shipboard C4ISR, combat system, damage control, propulsion, HM&E and associated systems to provide “one stop shopping” for equipment status, team/individual performance and current operational readiness.

Within the USN, the BFTT Program Office, PMS430, has embarked on a migration plan to fully incorporate and leverage the Defense Modeling & Simulation Office’s (DMSO) High Level Architecture and Run-Time Infrastructure (HLA/RTI) development and Defense Applied Research Projects Agency’s (DARPA) Synthetic Theater of War (STOW) semi-automated forces (SAF).

The USN’s NavySAF builds on the technology developed in the DARPA Synthetic Theater Of War (STOW) project to give simulations the ability to inject simulated forces that behave realistically, respond to actions by operators, and interact with other objects in the simulation without human operator input. This makes it feasible to run complex scenarios with a minimum of trainer personnel to "drive" the simulations. This is of significant interest to coalition partners and should be the focal-point for managing the interface protocols and interoperability application development.

This approach is significant in that it changes the way the USN conducts combined team training, performs force mission rehearsal and fulfills a long standing requirement for joint and allied training interoperability. The BFTT program office is actively engaged in interfacing the BFTT system with other services and joint training systems. An inter-service interoperability exercise demonstration, eg. Virtual RIMPAC is being assessed for early FY02.

## **BFTT/MWTS TECHNICAL FEATURES**

### **BFTT Technical Features**

BFTT is based on a fundamental concept that the best way to train naval crews is on board properly equipped ships using their tactical equipment to “*train like they fight.*” As stated previously, BFTT provides training

in-port and at sea for single ships, and in-port for multiple ships. BFTT is based on a validated learning methodology [5] that immerses the trainees in a realistic, interactive training environment controlled by On Board Training Systems (OBTS). The training environment can be controlled by the ship and/or from the shore facilities (in-port only). Performance and ground truth information is collected during the training event to facilitate relevant, timely products that support the debrief process.

BFTT design precepts include:

- Open system architecture,
- Maximum use of off-the-shelf hardware and software,
- Training connectivity across services,
- Support of Joint and Combined training,
- DIS with migration to HLA compliance,
- Single ship and Multiple ship training,
- Realistic, stressful training environment,
- Transparent, non-intrusive environment for the trainee (Stimulation, Simulations and Data Collection), and
- Relevant, timely feedback. [6]

BFTT use of a DIS architecture throughout the BFTT system, except for legacy OBTS and the Air Management Node (AMN), is fundamental to its success. BFTT is based in part on a concept of linking together existing OBTS so legacy systems not only retain their functionality, but their training value is increased due to networked interoperability with other (formerly stand-alone) training devices. Most of these legacy OBTS such as the AWS Trainer (SQQ-89 OBT), were pre-DIS systems that required LAN Access Units (LAUs) to provide a translation gateway between DIS and their respective internal protocols. Several legacy OBTS, such as the AEGIS trainer and MK 50, have migrated to DIS. AMN which incorporates SOAR (State Operator And Result) intelligent agents, uses HLA with the STOW RTI and FOM (Federation Object Model) and uses a gateway to translate between DIS and HLA [7]. BFTT does not use third party software to provide a DIS interface – since the number of licenses, on the order 1000 – 2000, would be prohibitive. Instead, BFTT uses a government owned software translation that has matured markedly since its introduction in 1995.

To provide standardization and flexibility, BFTT implements a workstation centric, VME and single board computers (SBC) architecture. The embedded SBCs use the VxWorks operating system, and the

workstation display system uses the HP/UX operating system (however, it is migrating to a LINUX and Windows NT environment).

Today, BFTT is fully operational as an in-port training tool at the unit and multi-ship level; and it is used at sea, as an organic training system in a single ship environment. Multi-ship BFTT capability is being studied, as are requisite changes in operational doctrine that will allow the concurrent use of live and simulation in the same battle-space.

### MWTS Technical Features

The MWTS will initially be based around shore-based operations room trainers linked on a LAN at HMAS WATSON. These systems comprise:

- Integrated Operations Team Training Facility (IOTTF) which provides linked DDG and FFG operations room trainers together with a set of asset cubicles;
- ANZAC Combat System Tactical Trainer (CSTT) which provides training for the ANZAC ship operations room team.

These systems will be provided with a DIS 2.1.4 interface to provide initial connectivity across a LAN at HMAS WATSON in Sydney. These systems have significant differences with the main difference being that the IOTTF employs an emulation methodology with emulated combat system functionality while the CSTT uses the real combat system stimulated from a synthetic scenario [8]. Further the IOTTF, employs a flat earth representation of the world, whereas the CSTT employs a spherical earth representation.

The MWTS will provide command team and Principal Warfare Officer training for DDG, FFG, and ANZAC class ships.

The FFGs will have (BFTT) OBTS installed as part of the FFG Upgrade Program. Later the ANZACs may also have similar OBTS installed. This will enable training on board ship following the BFTT philosophy.

### Comparison of MWTS with BFTT

Table 1 compares key technical characteristics of the MWTS and BFTT programs.

Table 1: Comparison of MWTS and BFTT Characteristics

	MWTS	BFTT
<b>Shore sites</b>	5	5
<b>Ship sites</b>	14 (6 FFGs and 8 ANZACs)	158
<b>Networking Architecture</b>	DIS 2.1.4	DIS 2.1.4
<b>Coordinate System</b>	Various representations	Geocentric; WGS 84
<b>Play Area</b>	1024 x 1024 nm	4000 x 4000 nm
<b>Ocean depth</b>	2000m (IOTTF); 50000 ft (CSTT)	16000 ft
<b>Altitude</b>	100 000 ft (IOTTF); 100 000 m (CSTT)	750,000 ft
<b>No. of Entities</b>	Up to 500	2600
<b>Databases</b>	Various	Naval Emission Reference File (NERF); Terrain and various
<b>Application</b>	Command team training	Spectrum of unit level to theatre level

### COLLABORATION BETWEEN SEA 1412 AND BFTT PROGRAMS

Initial discussions have been held between the Program Managers of both the Royal Australian Navy's SEA 1412 Program, and the United States Navy's BFTT Program to initiate collaboration on the technical development of both Programs. The ultimate aim is to have full interoperability, in order to conduct Coalition training in what might be termed a Virtual RIMPAC exercise.

Potential areas for collaboration include:

- Standards for Interoperability
- Common approach to migration towards HLA – common FOM development
- Compatibility of On-Board Training Systems
- Development of a joint training scenario (Coalition Interoperability Training Capability)
- International site-to-site testing
- Planning for Virtual RIMPAC in 2002-2003 (using DIS 2.1.4 initially)

These will be discussed in the following sections.

## STANDARDS FOR INTEROPERABILITY

A key issue in promoting interoperability between different systems is the choice of standards. Both DIS and HLA provide the means of inter-operating but have significant differences as discussed in the following sections.

### Distributed Interactive Simulation

DIS is a *networking protocol standard* that provides a method of communicating entity state and other information such as electronic warfare through Protocol Data Units (PDUs). DIS has been under development for about 10 years progressing through IEEE versions 1278, 1278.1 1278.1a (final version) [9 - 11].

Since DIS is an IEEE standard, any simulator connected to the network and implementing the same version of the DIS protocols can participate in a DIS exercise. However, DIS has resource issues, both in terms of network bandwidth, and simulator computational impact, because of the broadcast technique applied across many computers in a DIS exercise.

Third party software products can interface a simulation to the DIS network allowing it to send and receive correctly formatted PDUs [12]. DIS is most suited for connecting real-time human-in-loop simulators.

### Advantages of DIS

DIS provides a standard means of interconnecting simulators. With its 'plug and play' philosophy, many tools have been developed such as scenario generators, viewers, data loggers, and analysis toolkits. One such tool, ModSAF, is a scenario generator used at hundreds of sites world wide [13].

### Disadvantages of DIS

Whilst a standard protocol, DIS is sometimes viewed as rigid and inflexible. In response to this criticism, functionality has been added by creating new PDUs rather than by redesigning its architecture to provide more flexibility. The final standard contains up to 67 PDUs, most of which contain redundant data fields. However, for compliance with the DIS standard, all PDU fields must be correctly populated even if they are not required. The PDU packet structure has a fixed format that cannot be changed, thus resulting in higher than necessary bandwidth requirements. DIS also has limited support for entity aggregation and is designed

for real-time platform level systems such as a manned flight simulator.

Finally, DIS compliance does not in-and-of itself guarantee interoperability. The fidelity of the models may differ significantly between participating simulators, resulting in unfair fights; and DIS may lack a desired level of security because PDUs are a published standard – any player can eavesdrop on the exercise network.

### High Level Architecture

HLA is a *methodology* designed to support distributed simulation exercises [14]. It has been mandated by the US Department of Defense as the replacement for both DIS and Aggregate Level Simulation Protocol (ALSP) (a networking protocol used for connecting wargames) [15].

### Federation Object Models

Whereas DIS specifies fixed formatted PDUs, HLA lets the user define what data, in what format, are required to be exchanged among members of a *Federation* of participating simulations (or *federates*). To form a federation, a *Federation Object Model* (FOM), which identifies the attributes and interactions supported by the federation, must be developed.

### HLA Standardisation

Some HLA standards are nearing a level of maturity and are moving through the IEEE standardisation process:

- **Framework and Rules - IEEE Standard P1516:** HLA rules describe the responsibilities of federates and federations
- **Federate Interface Specification - IEEE Standard P1516.1:** In HLA, federates interact with a Run Time Infrastructure to establish and maintain a federation and to support efficient information exchange among simulations and other federates.
- **Object Model Template (OMT) Specification - IEEE Standard P1516.2:** The HLA object model template prescribes the method for recording the information in the object models, to include objects, attributes, interactions, and parameters, but it does not define the specific data (e.g., vehicles, unit types) that will appear in the object models.

### Advantages of HLA

HLA overcomes some of the noted DIS deficiencies by requiring the federation members to define in advance the data that must be sent to the network via HLA's publish/subscribe mechanism. It also provides greater

functionality – any attribute can be dead reckoned and any logical coordinate system can be used instead of the 3D DIS geocentric system. HLA will support both real-time and logical time management.

Another feature of HLA is that since data broadcast is FOM-specific, it will have an automatic level of security: interested parties will not be able to interpret these data on the network without knowledge of the FOM data content and formats.

### ***Disadvantages of HLA***

HLA is far more flexible than DIS – however this flexibility can also be its weakness: unless all federates agree on a FOM they will not be able to interoperate even though they are HLA-compliant. Thus HLA compliance will not guarantee interoperability. An HLA compliant simulator will only be able to interoperate with another HLA compliant simulator, if they use the same FOM and RTI.

The need for *Reference FOMs* has been proposed to assist with conversion of systems to HLA and to further promote interoperability. The Real-Time Platform Reference FOM (RPR-FOM) has been developed for real-time platform level federations to facilitate the transition for DIS compatible simulations to HLA [16]. However, the RPR-FOM, which maps the DIS PDUs to HLA only, supports DIS 2.0.4 and will not support DIS 2.1.4 until at least late 2000.

Furthermore, each FOM needs its own separate set of enumerations which are provided as standard in DIS. Dead reckoning algorithms must be developed as required instead of using the standard DIS set. Moreover, since each FOM will be unique, FOM-specific viewers, loggers, and analysis toolkits must be developed.

### ***General Issues with DIS and HLA***

Commonality of the synthetic environment is a fundamental requirement for distributed simulation. However neither DIS nor HLA ensures correlation of the different databases. A current approach with HLA [17] is to develop a run-time terrain component interface that allows a simulation to use the terrain database independent of the actual terrain representation.

## **MIGRATION TO HLA**

Increasing demands are being put on legacy simulators to upgrade to HLA. However, HLA is still a maturing technology, and to be interoperable with current

Commercial-Off-The-Shelf (COTS) products, DIS compliance is still required.

Because of the US DoD's mandating of HLA, considerable effort has been applied to provide a means of enabling DIS-compliant systems to upgrade to HLA. Migration of DIS to HLA is available via:

- a) a gateway which translates between DIS PDUs and HLA Services in both directions in real-time [18].
- b) middleware which resides in the simulator [19], or
- c) native HLA integration which entails software redesign to conform to the HLA requirements [20].

Each approach has associated costs and risks as discussed below. These approaches have been previously outlined to the RAN with respect to Project Sea 1412 [21].

### **DIS / HLA Gateway**

A DIS/HLA *gateway* converts between DIS PDUs and HLA Services in both directions in “real-time” whilst the simulation exercise is in progress. This is the easiest way to implement HLA compliance, as there is no modification required in the DIS compliant legacy simulator other than placing the gateway “box” between the legacy simulator and the HLA network. However, it is likely to result in the greatest additional latency and will always be restricted to replicating DIS. Thus it is least able to benefit from the advantages of HLA.

Where the benefits of HLA (interaction with constructive simulations, reduced broadcasting of data, etc) are not required, the gateway remains the most effective way to retain the benefits of interoperability by DIS, whilst still having the ability to connect via HLA.

### **Middleware Approach**

In the *middleware* approach, the top software layer, which handles the DIS PDU services, is replaced or joined with an alternative layer which can be used for both DIS and HLA, and which handles HLA services. The simulator continues to use the DIS philosophy and corresponding data structures. Since the topmost HLA software layer works in parallel with, or replaces, the equivalent DIS software layer, latency is reduced compared to the gateway option.

Toolkits now available support both DIS and HLA integration (including RPR-FOM). In many cases HLA/DIS support is selected via a compile time switch requiring minimal change to a simulator's source code. Utilising toolkits for HLA compliance is an attractive

proposition because they are already widely used in the simulation industry and much of the DIS/HLA code maintenance is indirectly shifted to the manufacturer.

### Native HLA Integration

A *native* integration is a tight coupling between the HLA and simulator code. Throughout the simulator the DIS paradigm is replaced by the more modern, object oriented, philosophy of HLA. This approach should provide all the benefits of HLA but at the highest initial and continuing cost – for example, considerable software modifications and associated maintenance will be required, and backward DIS compatibility may not be possible.

### DIS/HLA for the MWTS

DIS/HLA interfaces are required for the components which will make up the MWTS. Considering (a) the immaturity of HLA (b) that an upgrade path to HLA can be achieved via appropriate software, and (c) the maturity of DIS; it is expected that DIS will be implemented for the first Phase which comprises a Local Area Network at HMAS WATSON with a number of participating simulators. At a later stage this could be converted to HLA internally, or a DIS/HLA interface could be added at the gateway to the outside world to allow interoperability with external HLA-compliant systems. Thus later phases of the MWTS may run DIS internally on the WATSON LAN and communicate externally via HLA.

A similar approach could be adopted for the On Board Training Systems (OBTS) which will be added to the MWTS. By specifying a DIS/HLA interface for the OBTS, appropriate interfacing software can provide either DIS or HLA as needs require, eg the OBTS may be used to participate in exercises with US assets directly rather than through the MWTS. In this case HLA may be used in place of DIS.

### DIS/HLA for BFTT

The BFTT team has examined three options for migrating to HLA [22]: (a) via a DIS/HLA translator, (b) internal to BFTT, and (c) native implementation. They concluded the best option is to bring HLA into the internal ship network. This would free BFTT from DIS dependency and would provide a more flexible environment for future expansion with HLA-compliant OBTS systems. Although research and evaluation is an on-going effort, a BFTT HLA migration process is underway.

The first step entails capitalizing on BFTT's current DIS capability and using a DIS to HLA gateway at the 'life-lines' of the training platforms. In the first phase,

a DIS to HLA gateway is installed between the internal shipboard BFTT LAN and the external BFTT WAN as depicted in Figure 2. The BFTT WAN is HLA and the BFTT LAN remains DIS. HLA-compliant devices outside BFTT could then participate in a BFTT exercise by joining the BFTT WAN. The BFTT Federation Object Model, for this initial step, will be based on the existing RPR-FOM, with extensions to support BFTT-unique functions.

As technology and the design of the on-board trainers permit, the BFTT LAN will transition from DIS to HLA. On-board trainers and simulators/stimulators that become HLA-compliant will participate directly on the BFTT LAN. Those systems not yet HLA-compliant will have the gateway function moved into their respective LAN Access Units. As this transition occurs, HLA-compliant systems that understand the BFTT Federation Object Model will be able to participate in a BFTT exercise—either on the BFTT LAN or BFTT WAN, as appropriate.

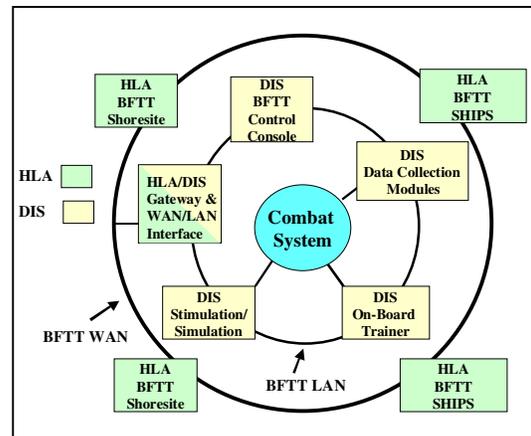


Figure 2: HLA Gateway Implementation

The final step as shown in Figure 3 provides a native HLA interface for each component touching the training network. When BFTT is fully HLA-compliant, other systems will be able to participate in BFTT exercises as needed. This participation can either be aboard ship on the BFTT LAN or off the ship via the BFTT WAN. This arrangement will allow the flexibility to configure training for specific purposes or mission areas.

Under an Office of Naval Research funded research project, the Naval Air Warfare Center Training Systems Division (NAWCTSD) has developed the Simulation Middleware Object Classes (SMOC). This project focused on scalable HLA/DIS architectures applied to legacy training systems. SMOC can provide

an interface simultaneously both to the HLA's RTI and a DIS network. SMOC is a set of object classes created to be configured either as a stand-alone gateway or as a layer of middleware for a simulation application (and native mode operation). The classes were designed to be reusable, adaptable, and scalable.

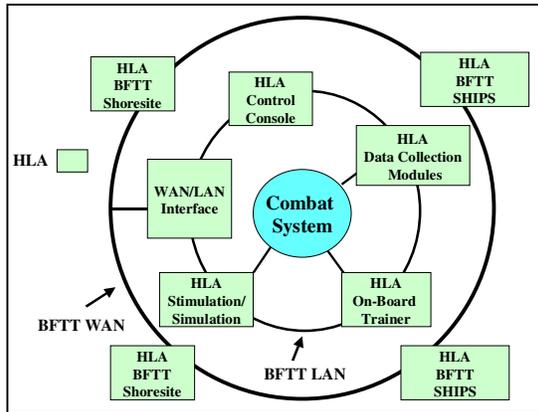


Figure 3: Native HLA Implementation

## COLLABORATION BETWEEN PROGRAMS

### FOM Development for MWTS/BFTT Exercises

To achieve interoperability under HLA, the MWTS and BFTT must use the same FOM. A USN Navy-Meta FOM which will provide interoperability among USN and Marine Corps simulations is under development [23]. When completed, this will supply a good basis for developing an additional FOM suitable for coalition exercises. Alternatively, this FOM could be modified to include RAN requirements under the proposed collaboration.

### Compatibility of OBTS

The RAN's FFGs are being upgraded to include OBTS under Project SEA 1390. These OBTS will include DIS interfaces that will enable them to operate with the BFTT system: OBTS-enabled RAN FFGs could participate in BFTT exercises.

For both the USN and RAN, AAI is the main contractor for the OBTS which ensures similarity of system capabilities/limitations.

### Development of Joint Training Scenarios

Prior to the development of a Coalition (Australia – US) Interoperability Training Capability, a number of joint training scenarios must be established. This will require interaction between the respective Naval training communities.

## International Site-to Site Testing

The MWTS under Project SEA 1412 will not be ready for operation until 2002. Consequently, the Advanced Distributed Simulation Laboratory within the Air Operations Division of the Defence Science and Technology Organisation, located in Melbourne, Australia, will initially undertake site-to-site tests with US based BFTT sites, in order to establish a technical baseline. Based on the Joint Training Scenarios developed, measurements of bandwidths, traffic rates, and latencies will be made in order to ensure successful future interaction between the MWTS and BFTT.

## Planning for Virtual RIMPAC

RIMPAC exercises, are multinational joint exercises, led by the US Navy, that are held biannually near Hawaii and have representation from many Pacific Rim nations. RIMPAC 2000, held during May – July 00, was coordinated by the US and included forces from Australia, Canada, Chile, Japan, the Republic of Korea, and the UK [24]. RIMPAC enhances skills and capabilities by exercising with other nations.

Using a BFTT-MWTS coalition-level simulation, features of RIMPAC could be rehearsed prior to RAN and USN ships leaving port.

## CONCLUSIONS

The USN BFTT program is bringing distributed simulation to the US Navy. This program has many similarities with the RAN's Maritime Warfare Training System and collaboration would be mutually beneficial. Lessons learnt from the BFTT Program will apply directly to the SEA 1412 Project and other Australian Defence Force Projects. One key goal of such collaboration would be to enable rehearsal for joint exercises such as the RIMPAC series via Virtual RIMPAC.

Initial plans are under development within Australia for a joint air/maritime networking exercise which will link key naval and air sites and simulation assets. This will be a precursor to joining with BFTT sites and ships and will evolve to a coalition Pacific scenario

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