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An SH-60 helicopter incorporation the Light Airborne MultiPurpose System (LAMPS) MK III was tested using the AN/SRQ-4 UHF secure data link to AN/SQQ-28 Sonobuoy Processor at the Naval Air Test Center (NATC) Patuxent River, MD. During the time the helicopter was on the simulated mission, it "dropped" sonobuoys and received normal mission feedback. This was done during testing of a potential wide-area network, with the acoustic stimulation for the LAMPS MK III accomplished by passing control and acoustic information from an ANN/SQQ-89 On-Board Trained (OBT) at Patuxent River via an on-site data link network. A master control unit was used to drive NATC's OBT from Fleet ASW Training Center, Norfolk, over normal telephone lines. Multiple OBT connections from the master control unit are possible and will further team training by combining expertise located at another training center with all other connected assets. Other additions to the OBT interface will provide additional aircrew radar training via the AN/APS-124 Remote Radar Operator (REMRO) system and EW software upgrades. The OBT is used at NATC in evaluation of helicopter ASW subsystems as well as for training.

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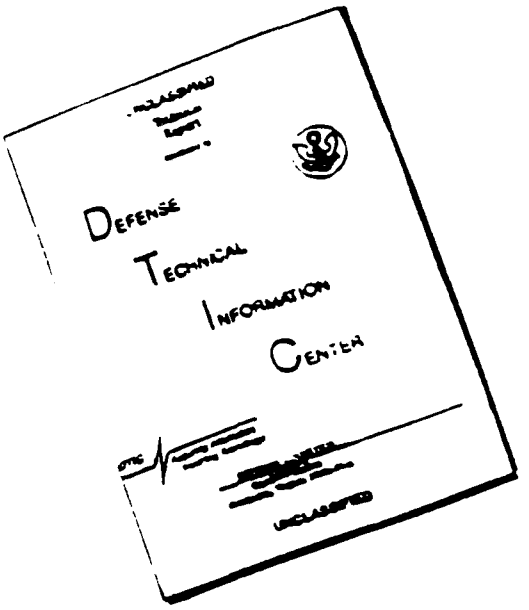

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"Embedded Training Capabilities for the LAMPS MK III System"

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Abstract:

An SH-60 helicopter incorporation the Light Airborn MultiPurpose System (LAMPS) MK III was tested using the AN/SRQ-4 UHF secure data link to an AN/SQQ-28 Sonobuoy Processor at the Naval Air Test Center (NATC) Patuxent River, MD. During the time the helicopter was on the simulated mission, it "dropped" sonobuoys and received normal mission feedback. This was done during testing of a potential wide-area network, with the acoustic stimulation for the LAMPS MK III accomplished by passing control and acoustic information from an AN/SQQ-89 On-Board Trainer (OBT) at Patuxent River via an on-site data link network. A master control unit was used to drive NATC's OBT from Fleet ASW Training Center, Norfolk, over normal telephone lines. Multiple OBT connections from the master control unit are possible and will further team training by combining expertise located at another training center with all other connected assets. Other additions to the OBT interface will provide additional aircrew radar training via the AN/APS-124 Remote Radar Operator (REMRO) system and EW software upgrades. The OBT is used at NATC in evaluation of helicopter ASW subsystems as well as for training.

Overview:

The LAMPS MK III aircrew currently benefits from an extensive embedded training capability using the AN/SQQ-89(V)-T() On-Board Trainer. This trainer provides both air and ship crew ASW training utilizing an actual SH-60 helicopter in the air or on deck as well as a simulated helicopter mode for training ship's crew. The aircrew can perform all functions necessary to prosecute a complete ASW problem including placing sonobuoys, operating with the Air Tactical Operator (ATACO), and using their Magnetic Anomaly Detector (MAD). Figure 1 shows the environmental and tactical system affected by the OBT and LAMPS MK III. The LAMPS MK III system is tied to the AN/SQQ-28 sonobuoy signal processing system,

via the data link. A complete LAMPS MK III sonobuoy inventory is available.

Recent R&D sponsored by the Surface Ship ASW Combat Systems Program Office will update the Electronic Warfare Simulation (EWSIM) program and add capability to train the AN/APS-124 Radar Operator and Remote Radar Operator on board ship. An upgrade from a single ship and single LAMPS MK III helicopter trainer to a Multi-Ship - Multi-Environment Networked Training and Operational Readiness system (MS-MENTOR) wherein multiple ships and aircraft are trained in a battle group configuration is currently underway.

Technical Parameters:

The OBT currently simulates EW targets for both the AN/SLQ-32 shipboard EW Receiver and the LAMPS MK III AN/ALQ-142 EW Receiver. The OBT also handles acoustics such as the AN/SQS-53 hull-mounted sonar, the AN/SQR-19 towed array, and AN/SQQ-28 LAMPS MK III sonobuoy processor, which are stimulated through an inverse beamformer. The main thrust of the new development are to extend the current operational system via MS-MENTOR, partially test MS-MENTOR as the scenario controller, and incorporate added features for the SH-60 helicopter crew. In the OBT, EW and ASW targets are generated in a gaming area of 2048 x 2048 nautical miles, to an altitude of 100,000 feet and to a depth of 5,000 feet. These targets are then position-kept in the OBT, and echo/emissions become visible to the sensor operators when the signal-to-noise ratio of these targets is such that it exceeds the detection threshold of the sensor systems. The ESM Contact Generation function of the OBT has the ESM processor manage and control the injection of ESM emitter parameters into the shipboard (AN/SLQ-32) and LAMPS MK III (AN/ALQ-142) sensors. Radars, communications emissions, data links, and weapon seekers are all provided in a geo-tailored ESM library of emitters. Helicopter position data is utilized for platform visibility and angle of arrival as part of the position information. The ESM processor continuously computes (at a 4 Hz rate) for update transmission to the sensors these last

two, plus signal propagation loss, ducting values, and parameter changes.

The LAMPS Tactical Data Simulation (TDS) processor in the OBT communicates, via a standard NTDS Type A (Slow) interface, with the AN/SQQ-28 Shipboard Processor Operation Program for the purpose of exchanging sonobuoy and LAMPS MK III status information. TDS also provides for Magnetic Anomaly Detector Simulation, ordnance management, sonobuoy management, and ESM message routing to the helicopter. Were the helicopter not available, the TDS would role-play in its stead. In normal operation, the LAMPS MK III ESM air subsystem is controlled from the AN/SLQ-32 by the ESM operator, and all ESM data is downlinked for analysis and display. The data link also provides transmission of tactical instructions, weapon delivery information, and other processed data (such as digitized voice communications) back to the helicopter. Feedback to the LAMPS helicopter allows for a variety of scenarios and crew training.

LAMPS MK III AN/APS-124 and Remote Radar Operator (REMRO) Training: The AN/APS-124 Radar Operator aboard the helicopter as well as the Remote Radar Operator aboard ship manning an OJ-194 console do not receive formal training. The LAMPS MK III Fleet Project Team identified this training deficiency four years ago, and it has since been validated by OPNAV letter with an OBT requirements change to add the requirement for OBT to provide embedded training for these functions.

There is an ongoing proof-of-concept to determine the validity of the approach to add this training feature. The proposed approach is to add an APS-124/REMRO simulation unit to be temporarily installed aboard the LAMPS MK III helicopter which would feed a simulated radar picture into the output of the APS-124. This block diagram is shown in figure 2. A trade-off study done by Raytheon of whether a radar simulator located on the ship with uplink radar video or a portable radar simulator that could be mounted in either

the helicopter or ship was done in FY 91. The study found the portable system the most cost effective solution. Figure 3 shows the location of the temporary unit on the helicopter. Initially, coordinated ASW/EW/radar target features would be provided, but not radar landmass. The proof-of-concept will be completed at the Ship Ground Station at NATC Patuxent River by Feb 92. Funding to implement this feature will be dependent on the budgetary process for FY92 and outyears.

The need for coordinated team radar training, coming from air team feedback, requires an upgrade to the OBT to provide a LAMPS MK III radar training capability and integrated acoustic and ESM training. Part of the proposed functionality is the operation of the AN/APS-124 LAMPS MK III airborne search radar to detect targets beyond own ship's capability, including low flying aircraft and anti-ship missiles. Other aspects include intercommunications with other MK III tactical team members and units; operator airborne IFF interrogation to challenge unidentified contacts; correlating EW information with MK III tracks; entering target data generated for display and analysis, and updating all displays.

Electronic Warfare Simulation (EWSIM) Upgrades:
There is a special program that is part of the LAMP MK III Airborne Operational Program (AOP) called EWSIM that is loaded for the EW training mode in the helicopter. This program is currently being upgraded by the Naval Air Development Center (NADC) to add helicopter threat warning capability and to make other software improvements. This program upgrade will be tested in Feb 92, and will probably be made part of AOP fleet release 20 or 21.

OBT ASW Training Capabilities Applied to Non-LAMPS Platforms:
Directional Frequency Analysis and Recording (DIFAR) scenarios require no interface between the trainer and the receiving platform. In the currently prototyped "School House" mode, OBT generated DIFAR scenarios can be used by non-LAMPS ASW platforms. Active scenarios, however, require that the OBT receive returned

"trigger" signals to denote initiation of active sonar pings by the airborne platform. NATC engineers have conceptualized a modification which would provide a means of receiving Directional Command Activated Sonobuoy (DICAS) ping trigger signals from non-LAMPS aircraft. This modification would improve the OBT's utility by providing both passive and active acoustic training support for the P-3, S-3 fixed wing, and the SH-2F, SH-2G, SH-3H, SH-60F or non-LAMPS MK III helicopter communities. If fleet interest is found to exist, funding will be sought for development of a prototype ping trigger receiver/decoder. This modification would broaden the applicability of the AN/SQQ-89 trainer, and would further enhance its usefulness for support of integrated battle force ASW training.

Non-Training Applications of the AN/SQQ-89/OBT:

Engineers at the Naval Air Test Center, Patuxent River, MD are making use of the AN/SQQ-89 On Board Trainer in areas outside the training arena. As an example, OBT Directional Frequency Analysis and Recording acoustic scenarios were transferred to tape. These scenarios were then used to support Navy evaluation of the SH-2G helicopter integrated ASW mission system. The OBT was also used to provide ASW scenarios for the SH-60B helicopter system software developmental test and evaluation. Additionally, the OBT provides acoustic stimulation during SH-2F, SH-2G and SH-60F helicopter ASW test and evaluation as well as the SH-60B.

Planning is underway to develop procedures that will permit deployed LAMPS MK III system maintenance personnel to verify integrated ship/air acoustic processing performance using the OBT as an acoustic signal source. This application will provide both ships company and embarked aircraft maintenance personnel with a means of evaluating sonobuoy receiver, acoustic processor, and display performance using signal levels which approach the detection threshold.

MS-MENTOR:

The Fleet ASW Training Center Atlantic in Norfolk, Virginia, is the evaluation testbed for the Multi-Ship - Multi-Environment Networked Training and Operational Readiness system: a Raytheon IR/IRED initiative, which controls multiple AN/SQQ-89 On-Board Trainers for ASW work. This control is set up via a network construct termed OBT-NET, and supports the Battle Force Tactical Training (BFTT) program. The Ship Ground Station at the Naval Air Test Center serves as a link to the OBT and LAMPS MK III. Battle Force Tactical Training units in the Chesapeake Bay - Norfolk area are another potential network linkage. A mobile trailer configuration for the host node which allows the MS-MENTOR configuration to be transported to other ports of opportunity has been developed by the Naval Oceanographic and Atmospheric Research Laboratory (NOARL).

The main thrust of our new development was to extend the current operational system by adding multi-ship networking, and partially test MS-MENTOR as the scenario controller. Evaluation of the last component, MS-MENTOR, is ongoing under the auspices of the Naval Underwater Systems Center (NUSC). Multiple OBT connections from this master control unit are possible and will further team training and asset coordination. Even if only utilized on a limited basis, it can provide training for crew and linked ASW team members, combined with expertise located at another training center. In this specific case, a LAMPS MK III helicopter at NATC was connected through the AN/SRQ-4 UHF data link to the OBT at NATC, and the MS-MENTOR system in Norfolk. Monitoring of the exercise, and by extension any multiple air-sea platform grouping, was done at the scenario's central control in Norfolk, as well as at NATC. The MS-MENTOR system can currently provide external control of up to eight OBT's, and can itself be slaved to an external controller through BFTT. Figure 4 shows a schematic of the MS-MENTOR test configuration to the other players.

The external control for the scenario could be another higher level training system, such as the AEGIS Combat Training System (ACTS),

which in turn would incorporate Anti-Surface Warfare (ASUW) to the Anti-Air Warfare (AAW) and Anti-Submarine Warfare (ASW). The airborne ESM system of the LAMPS MK III can be viewed as an extension of the shipboard EW system. The advantage of the MS-MENTOR unit lies in its capability to tie several OBT's and their associated network components together. A NTDS Link 11 implementation using ACTS to other OBT's would be limited to only ships having the AEGIS Combat Weapons System, whereas the MS-MENTOR approach would allow all AN/SQQ-89 ships having an OBT to participate. The OBT will contain an interface to ACTS with the release of AEGIS Baseline 4, and has an external control port for stimulation control from sources such as the 20B5 FFG7 Pierside Team Trainer. The existence of an external control port and an associated software design that allows for OBT control from an outside source will allow BFTT to interface with the OBT with no modifications required to the existing OBT.

In order to pass information within the MS-MENTOR structure and among the dissimilar components, network interoperability is required. An open system computer network architecture, which is supported by the services and industry, that uses standard protocols is nearing its' final draft form in the Distributed Interactive Simulation (DIS) protocols, and will be released as an IEEE standard. It supports the simulation devices being present in one location, interconnected by a Local Area Network (LAN), or widely distributed on a Wide Area Network (WAN). As the simulation network is expanded, each new player or functional unit brings with it all of the computational resources necessary to support itself. This fits into BFTT and the MS-MENTOR configuration.

Summary:

We have talked about the embedded training capabilities of the LAMPS MK III and OBT systems. The OBT is used for more than just training at NATC, and has not reached the end of its usefulness yet. Within the BFTT arena, initial tests of the MS-MENTOR were successful, and it was shown that resources throughout a wide area

can operate together for team training. Future additions to Navy resources will be the DIS tri-service computer interoperability protocols, EW upgrades, and REMRO capabilities.