Advanced ESM capabilities for shipboard applications

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Early Warning for Maritime Forces

New anti-ship missiles mean it could be later than you think

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Hostile threats against warships are neither new nor novel; traditionally they occur between rival nations. What is new (by military standards), is the concept of an unseen — and sometimes unknown — enemy. In light of today's confused worldwide geopolitical situation, the rules of engagement are quite untraditional, and a real possibility exists of a missile threat against virtually any military vessel from various — and sometimes unknown — sources not associated with any recognized government entity.

To help guard against these eventualities, sophisticated EW systems aboard modern warships — specifically U.S. aircraft carriers and Coast Guard cutters — are designed to provide early as possible warning of hostile threats so as to elicit a rapid and effective counter-offensive. ESM systems play a key role in this defensive capability. Recently, a $9.65M contract for production of AN/WLR-1H(V)7 Countermeasure Receiving Set

modification kits was awarded to replace existing Legacy (V)5 systems currently aboard Navy CV/CVN Class and Coast Guard WHEC Class vessels. The first of the new system upgrades is tentatively scheduled for installation aboard six Hamilton Class High Endurance cutters. These systems will directly support the Coast Guard's strategic goals of national defense and maritime security by increasing the cutters' Maritime Domain Awareness. In addition, the production systems will join two existing Engineering Development Models (EDM) currently aboard the USS Kennedy (CV 67) and planned for installation on the USS Ronald Reagan (CVN 76).

The operator workstation is designed to optimize situational awareness and decrease workload through an effective graphical user interface based on the Microsoft® Windows NT® operating system.

These new ESM systems are considered a "maintenance upgrade" to current (V) 5 systems, in that they retain (with some modification) existing antenna assemblies but replace all waveguides and coaxial lines with fiber optic interfaces. The WLR (V) 7 system represents the latest ESM technology for naval ELINT and COMINT applications. While it is not related to the navy's new Cooperative Engagement Capability (CEC) program, the system offers the potential to be configured for CEC, if desired, according to its manufacturer, **Wide Band Systems, Inc.** (Rockaway, NJ). In that role, the WLR (V) 7 system could be used to identify specific emitters from individual aircraft or vessels, track them, and disseminate emitter information to other members of a battle group. In its current configuration, however, the system functions passively to provide an accurate and extremely reliable electronic surveillance capability for surface weapons platforms in harm's way.

The AN/WLR-1H(V)7 Countermeasures Receiving Set Modification Kits incorporate field proven components including, from left to right, a 500-18000 MHz tuner, an IFM receiver with selectable bandwidth, and an IFM receiver that operates up to 18000 MHz.

The new system upgrade provides data in two key categories: unprocessed (raw) data, and tactical data (derived from the raw data after processing). The

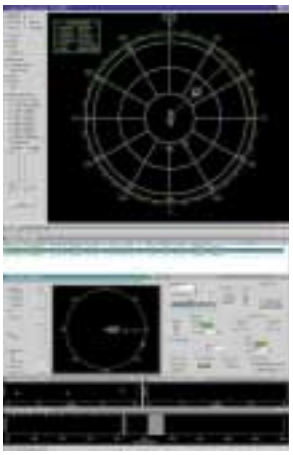
receivers (located in the antenna) produce a digital pulse descriptor word for every RF event they intercept. Digital data includes frequency, pulse width (PW), time of arrival (TOA), RF amplitude, and a variety of flags such as frequency modulation on pulse (FMOP), phase modulation on pulse (PMOP), and whether the signal is a pulse event or a CW event. This data is transmitted to the central processor which provides a variety of display capabilities to view specific raw data. For example, frequency activity vs. amplitude, pulse width, individual pulse repetition frequencies, and other raw data can be presented on one display for review and analysis.

All RF components are contained in the single package rotating DF antenna and a three band omni-directional antenna.

Tactical level data is provided by processing software output which generates a series of tracks for display and recording. These include a plan position indicator (PPI) plot with emitter symbology overlays, and an emitter list that keeps track of both onboard as well as off board emitters. This information is then compared to identification data from the existing database; all pertinent data is then displayed for the operator. Both raw data and tactical data (via overlay) is independently — and simultaneously — displayed at the operator workstation.

The new (V)7 upgrade to the (V)5 Legacy system, effectively maintains the vessel's existing antenna (AN/AS-4122A) and replaces all other components with advanced processors, fiber optic communications, state-of-the-art art Instantaneous Frequency Measurement receiver systems, and a new tuner. To maximize system sensitivity, all RF equipment is integrated into the antenna assembly. A single composite cable incorporates fiber optic and copper conductors to transmit data and control signals from the antenna to a control display unit which is typically situated in either the Combat Information Center (CIC) or EW module.

At the control station the operator manages all system receivers and antenna functionality through a built-in graphical user interface desktop Windows® 2000 operating system. The color displays use techniques and controls similar to most desktop applications familiar to PC users.

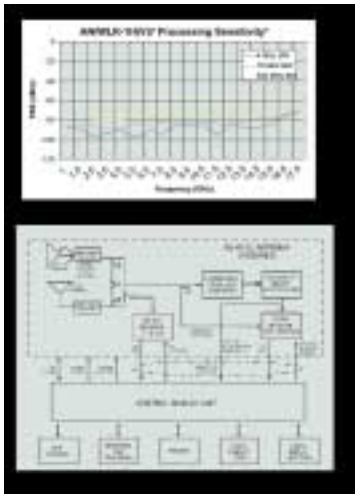


The AN/WLR-1H(V)7 operator interface includes tactical situation, analysis, and polar DF displays on two 20-inch flat panels as one contiguous desktop

A common database format is incorporated into the system to permit development on an external PC using a Microsoft Access toolset which can be put onto a CD-ROM and loaded into the system prior to mission execution. This is also a key feature with regard to the (V)5 system upgrade since it overcomes issues of maintainability of the Legacy system while

substantially enhancing system performance through introduction of new commercially available processor and receiver technology.

System Architecture



AN/WLR-1H(V)7 system architecture employs both wide band and narrow band IFM receivers, simultaneously providing 100% POI and superior sensitivity in environments with extremely high pulse densities (>4 MPPS)

The new (V) 7 system upgrade is composed of a High Probability of Intercept (HPI) Instantaneous Frequency Measurement receiver system operating from 2-18 GHz, a microwave tuner covering 0.5-18 GHz producing a 1 GHz intermediate frequency (IF), and a variable bandwidth intermediate frequency (IF) receiver that operates in coordination with the tuner. An operator console includes a Control Display Unit (CDU), dual 18-inch color flat displays, keyboard with integrated track ball, audio headphones, and color printer. The CDU incorporates a dual Pentium III single board computer with 256 MB RAM with a Windows 2000® operating system and a CD/reader/writer for archiving data. A virtual desktop spanning both displays incorporates a Windows-based graphical user interface that presents pulse descriptor word (PDW), analog video, and emitter processing results in real-time. In addition, Internet capability permits data sharing with other computers or processors aboard the vessel.

The fiber optic data links in this system permit communications between the RF components and the processor. An extensive selection of analysis displays includes PDW examination, pulse de-interleaving and emitter correlation processing, automatic recording of emitters and PDWs to the hard disk drive. Other capabilities include an emitter database utility for on-line modification and preview, automatic PRI modulation and scan pattern recognition, monopulse DF, and extensive built-in-test routines.

Conclusion

The sophisticated technology associated with this system upgrade is expected to significantly enhance the safety of tomorrow's increasingly vigilant maritime defensive forces. With its imminent installation United States Navy and Coast Guard forces (and those of other friendly nations as well) can take advantage of one of the most advanced ESM capabilities available for shipboard applications. Based on current assumptions in many political (and military) arenas, the requirements for systems with these capabilities may be more important than ever.

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