Situation Awareness in the Maritime Domain

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INTRODUCTION

Central to enabling safe and unrestricted maritime trade around the world, the need to ensure security of ports, harbors and shipping continues to emerge as an increasing challenge for government agencies and commercial entities in the 21st century.

Whether it be the threat of attack by small surface vessels, divers or autonomous underwater vehicles (AUVs) from the sea or unmanned aerial vehicles (UAVs) and ground assault from ashore, ports and harbors must be equipped with next-generation technologies capable of providing authorities with advanced warning and necessary levels in situation awareness (SA).

Problem Sets

According to NATO's Center for Maritime Research and Experimentation (CMRE), both commercial and military ports and harbors can be difficult to protect due to their significant size; amount of sea- and land-based traffic; and proximity to urban areas.

Describing how small boats have been used to attack docked ships in the past (USS Cole attack, 12 October 2000), CMRE doctrine warns how the threat of attack can come from a variety of "small [and] hard-to-detect sources" which can complicate the task of port protection.

"This complex environment makes it difficult to monitor ports for hostile intent and even more challenging to develop a response that is non-lethal to the many people who are at the port and who may live, work, and recreate in the surrounding area," CMRE doctrine describes.

Protective measures available to government agencies and port authorities include a layered approach to cyber security; groundbreaking electro-optical and infrared (EO/IR) camera and radar solutions; as well as command and control (C2) software designed to network defensive capabilities into a Common Operating Picture (COP).

Technologies must satisfy minimum standards for both onshore and offshore critical national infrastructure (CNI) as stipulated in the Safety of Life at Sea Convention's 2004 International Ship and Port Facility Security (ISPS) Code.

According to the ISPS Code, which was created following the 9/11 terror attacks in the United States in 2001, government agencies and port authorities must be able to "detect security threats and take preventative measures against security incidents affecting port facilities used in international trade".

The ISPS Code describes a series of escalating Maritime Security (MARSEC) levels, which include MARSEC Level 1 (the employment of surveillance equipment to monitor restricted areas) and MARSEC Level 2 (the employment of persistent surveillance technologies).

As a result, government agencies and port authorities around the world are identifying and investing in next-generation technologies to not only satisfy emerging port and harbor security requirements but also the development of 'Smart Port' concepts featuring levels in automation, artificial intelligence, big data and the Internet of Things.

The importance of port and harbor security was clearly outlined by the U.S. Department of Homeland Security (DHS) in its Fiscal Year 2020 Notices of Funding Opportunity that identified $100 million for the Port Security Grant Program.

This particular effort not only covers the protection of critical port infrastructure from terrorism, but also enhanced maritime domain awareness; improved port-wide maritime security risk management; and finally, maintenance or the re-establishment of maritime security mitigation protocols to support port recovery and resiliency capabilities.

As a DHS statement reads, "The paradigm has shifted. Today's DHS programs must improve our readiness in preventing, preparing for, protecting against, and responding to today's evolving threats."

L3Harris Solutions

According to Keith Muir, Senior Director, International Sales and Business Development for L3Harris WESCAM, ensuring SA across shore-based CNI including ports, harbors and other maritime entry points continues to be driven by events arising out of the contemporary operating environment.

Describing a series of emerging concepts of operation, tactics, techniques and procedures associated with the maritime security, he explained, "Government agencies are looking at the threat of terrorism in particular. This includes the use of fixed and mobile SA solutions comprising intelligence, surveillance, reconnaissance systems networked to a command and control capability. This sort of facility, properly deployed allows for the collection, collation and rapid dissemination of information about emerging threats and for effective action to be taken in rapidly developing and dynamic situations."

The L3Harris WESCAM MX-10MS marinized sensor system is specifically designed to support the protection of surface vessels and CNI ashore, including ports, harbors and maritime entry points.

WESCAM MX-10MS payloads comprise a fully digital and high definition solution featuring a small, multi-sensor and multi-spectral imaging system in a single LRU configuration, designed to support the conduct of wide field-of-view coastal surveillance and threat detection missions from towers, rooftops and mobile platforms including surface vessels.

Whether operating in a standalone capacity or as part of a networked, system-of-systems approach, the WESCAM MX-10MS provides end users with a rugged solution that is protected against wind, saltwater, high humidity levels and the maritime environment in general.

According to Michael Babec, Director, Global Maritime Systems for L3Harris WESCAM, more than 250 WESCAM MX-10MS sensors are currently fielded worldwide, providing government and commercial customers with enhanced levels in SA both afloat and ashore.

Examples of WESCAM MX-10MS deployment include integration of the sensor onboard unmanned surface vessels (USVs), such as Zyvex Marine 'Piranha' and the "Marine Autonomy Surface Testbed (MAST) 13" of the UK's Defence Science and Technology Laboratory. The Royal Australian Navy and Australian Border Force have successfully deployed the WESCAM MX-10MS sensor onboard their Cape Class Patrol Boats to provide maritime security during border protection missions.

Having proven its ability to support the maritime security requirements of surface vessels, customers are now requesting the WESCAM MX-10MS sensors be integrated on fixed installations ashore to protect CNI as well as docked surface vessels within the port or harbor itself.

"There has been success in a number of areas with customers operating WESCAM MX-10MS turrets on vessels," Babec explained. "One customer, in particular, has asked to take that same payload and integrate it ashore as part of a networked tower configuration in order to overlook the ocean. We have received very good feedback for both wireless and wired operations, all of which can be integrated into a COP for enhanced SA."

Describing L3Harris' extension of WESCAM MX-10MS applications beyond its more traditional defense and security marketplace, Babec also highlighted how the employment of the sensor could assist commercial shipping agencies and port authorities in reducing insurance premiums.

The WESCAM MX-10MS features a multi-spectral, multi-sensor payload suite that provides superior imaging under a wide range of illumination and atmospheric conditions. A high definition (HD) thermal imager provides the ability to see targets under no-light conditions and provides high target contrast in the day. A wide-angle HD color day camera provides surveillance, situational awareness, and target detection capability, while a narrow-angle camera provides long-range target recognition and identification capability. The imagers are supported by a gimbal that provides a full 360-degree field-of-regard and automatic scanning functions that service to minimize operator workload.

Stabilization performance is essential to optical range performance. The 4-axis architecture separates the inner axis, which performs the fast and fine motion required for superior range performance, from the outer axis, which provides sealing from the outside environment. The internal passive isolator protects the optical bench from shock, which supports high mean-time-between-failure operation. The gimbal provides for a full 360 field-of-regard and automated scanning functions.

Further, the WESCAM MX-10MS leverages L3Harris' investment in high-end imaging systems by providing state-of-the-art features that significantly reduce operator workload, allowing them to focus on the target, versus the equipment. An internal inertial navigation system, consisting of an embedded GPS and inertial measurement unit coupled with an internal laser rangefinder; provide accurate and stable target geo-location. The WESCAM MX-10MS also features advanced image processing algorithms, easy-to-use, and robust auto-tracker and image blending capability.

System-of-Systems Approach

As the current threat environment continues to evolve and grow increasingly complex in nature, government and commercial customers are demanding system-of-systems approaches capable of integrating a series of game-changing technologies to support the security requirements of ports, harbors, maritime entry points and surface vessels, as the image to the right suggests.

Examples include radar and L3Harris WESCAM MX-Series EO/IR sensors as well as kinetic and non-kinetic effectors, which can be networked together into a seamless COP structure also benefiting from upgrades in cyber security software, artificial intelligence and machine learning algorithms to streamline decision-making processes.

Such a concept allows a central C2 battle management system to 'slew and cue' multiple networked payloads following the identification by the WESCAM MX-10MS of threats in the air, on land or at sea.

The concept is being further extended to include WESCAM MX-10MS sensors integrated on board L3Harris UAVs, USVs and AUVs, providing an additional layer in mobile intelligence-gathering capabilities within the COP.

CONCLUSION

Following the merger between L3 Technologies and Harris Corporation in July 2019, L3Harris is uniquely positioned to support the emerging demand and challenges facing government and commercial customers in the maritime sector.

Specializing in EO/IR & radar technology, public safety and military-grade tactical communications, as well as C2 software and analytical instrumentation, L3Harris stands ready to integrate WESCAM MX-10MS sensors and distributed system-of-systems approach into existing infrastructure.