| Report Documentation Page | | *Form Approved* *OMB No. 0704-0188* |
|---|---|---|

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

| 1. REPORT DATE **2008** | 2. REPORT TYPE | 3. DATES COVERED **00-00-2008 to 00-00-2008** |
|---|---|---|
| 4. TITLE AND SUBTITLE **NRL Global Vessel Tracking Project (VTP)** | | 5a. CONTRACT NUMBER |
| | | 5b. GRANT NUMBER |
| | | 5c. PROGRAM ELEMENT NUMBER |
| 6. AUTHOR(S) | | 5d. PROJECT NUMBER |
| | | 5e. TASK NUMBER |
| | | 5f. WORK UNIT NUMBER |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Research Laboratory,4555 Overlook Avenue SW,Washington,DC,20375** | | 8. PERFORMING ORGANIZATION REPORT NUMBER |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | | 10. SPONSOR/MONITOR'S ACRONYM(S) |
| | | 11. SPONSOR/MONITOR'S REPORT NUMBER(S) |

12. DISTRIBUTION/AVAILABILITY STATEMENT
**Approved for public release; distribution unlimited**

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT **unclassified** | b. ABSTRACT **unclassified** | c. THIS PAGE **unclassified** | **Same as Report (SAR)** | **2** | |

**Standard Form 298 (Rev. 8-98)**
Prescribed by ANSI Std Z39-18

## NRL Global Vessel Tracking Project (VTP)

D.J. Bielecki
*Space Science Division*

**Introduction:** In 2003, a call for Maritime Domain Awareness (MDA) architectures was issued by the Honorable John Young, then Assistant Secretary of the Navy for Research, Development and Acquisition (ASN RD&A). The Naval Research Laboratory's Space Systems Development Department (SSDD) responded with a global architecture and estimates of resource requirements. The response featured a layered defense approach, incorporating support from sensors, databases, and information feeds ranging from National Technical Means (NTM) to Open Source Intelligence (OSINT). Essential elements of the system were funded. A Modular Sensor System (MSS) provided protection for a port, harbor, or key infrastructure element. A highly automated virtual database and information extraction capability was provided at the GENSER level. At the NTM level, a fully automated vessel tracking system provided tracks and updates for the Atlantic Ocean.

**Innovative Technology (IT) Development:** One of the key developments in this architecture was a major subsystem designated as the Common Distributed Virtual Database with Information Extraction (CDVD/IE). NRL engineers in SSDD rose to the challenge of creating an enterprise, web-based, client-server architecture that could aggregate and fuse the many disparate databases and feeds that are needed for MDA. Among other challenges, the engineers had to conceive and implement an innovative architecture that balanced the need to access over 200 distinct and different sources of information, without massive federation of databases that could create network bottlenecks and require massive storage resources. In solving this and other challenges, NRL engineers created a new way of employing spatial database features to fuse multiple candidate sources into integrated maritime vessel tracks; more information can be found in the *2006 NRL Review*.[1]

**Layered Defense Approach:** Although the cost of the entire global system for vessel tracking was beyond the funding available, a meaningful project was devised that required tracking as many vessels as could be done automatically in the Gulf of Mexico and Atlantic Ocean. However, it was NRL's global vision that convinced Department of Defense (DoD) seniors to place this work at the laboratory, and follow-on Joint Concept Technology Demonstrations (JCTDs) have achieved much of the original vision such as global coverage. Figure 9 shows the vision that intrigued DoD thinkers.

**Modular Sensor System:** The philosophy of global situational awareness must provide solutions for key infrastructure elements such as specific local resources of high value that must be afforded even higher levels of protection. The MSS could provide such protection for a key military base, port, harbor, or other installations that are susceptible to maritime threats, combining innovative subsystems from both industry and internal NRL development sources. The MSS design provides a remotely controllable automatic collection command center for multiple sensors including a track-while-scan (TWS) radar, an advanced electronic support measure (ESM) system to provide electronic intelligence (ELINT) data, a precision direction finder (PDF), a UYX-4 RF characterization system for Specific Emitter Identification (SEI), an Automatic Identification System (AIS) receiver, and an acoustics measurement and signal processing suite. The MSS also pro-
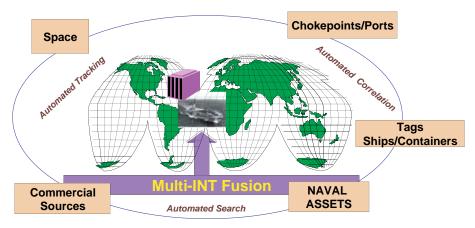


**FIGURE 9**
NRL's global vessel tracking architecture.

vides an independent global positioning system (GPS) and synchronous timing system, local and wide-area communications connectivity, and a Data Distribution System that can provide data to CDVD/IE for VTP within the MSS sensor coverage area (nominal 20 nmi). Although costs dictated commercial options for most sensors, readers should note that the UYX-4 SEI algorithm techniques were originated at NRL's Tactical Electronic Warfare Division. The acoustic sensor suite was developed for VTP by NRL's Acoustics Division. The full MSS complement of capabilities is shown in the block diagram of Fig 10.

**Web-Enabled Application:** MSS needed to fuse a large number of sources for MDA data specific to what is termed the "point defense" of a critical location. VTP also needed to respond to the needs of the operational military to do more with less by automating as many manual processes as possible. For this reason, the entire operation of MSS is fully automated and can provide 24/7 situational awareness with no staff at all. For routine functional checks or an occasional reset of a subsystem, the entire system can be maintained via a series of simple Web pages that not only provide situational awareness, but also allow the user to check on instrument and equipment status and health. These

capabilities are available over a network connection from the user's Web browser, leveraging the popular Google Earth™ visualization software.

**Summary:** The Vessel Tracking Project was initiated after September 11, 2001, when national-level priorities on Maritime Domain Awareness were increased by a presidential directive stipulating higher levels of preparedness and situational awareness. Fortunately, VTP was able to respond to these national priorities and has transitioned functional elements to both the U.S. Coast Guard (USCG) and the Office of Naval Intelligence (ONI) enterprise at the National Maritime Intelligence Center (NMIC) in Suitland, MD. The system has been well received at the flag level within the DoD, Navy, and USCG. Two JCTDs at NRL were subsequently awarded, building on VTP technologies to provide truly global capabilities and even more sophisticated MDA solutions, keeping NRL at the forefront of this crucial national endeavor.

[Sponsored by ONR]

**Reference**
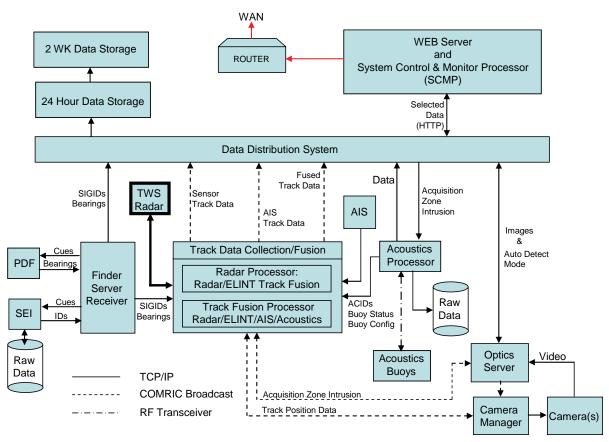1 M.D. Bell, S.M. Elliott, T.Y. Yang, and P. You, "Multi-Source Maritime Vessel Tracking," *2006 NRL Review*, pp. 144-146.  ★



**FIGURE 10**
NRL's modular sensor system (MSS).