

NUWC-NPT Reprint Report 11,341
11 January 2002

SPARTAN: A Distributed Mobile USW Sensor and Weapon System

Vittorio Ricci
Mark Allen
Joseph M. Monti
Alan L. Goodman
Surface Undersea Warfare Department



Naval Undersea Warfare Center Division Newport, Rhode Island

Approved for public release; distribution is unlimited.

Reprint of a paper presented at the Undersea Defence Technology (UDT) Hawaii
2001 Conference and Exhibition, 30 October – 1 November 2001, Waikiki, HI.



011341 001N

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 11 JAN 2002	2. REPORT TYPE Reprint Report	3. DATES COVERED 30-10-2001 to 01-11-2001	
4. TITLE AND SUBTITLE SPARTAN : A Distributed Mobile USW Sensor and Weapon System		5a. CONTRACT NUMBER	
		5b. GRANT NUMBER	
		5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Vittorio Ricci; Mark Allen; Joseph Monti; Alan Goodman		5d. PROJECT NUMBER	
		5e. TASK NUMBER	
		5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Undersea Warfare Center, Division Newport, 1176 Howell Street, Newport, RI, 02841-1708		8. PERFORMING ORGANIZATION REPORT NUMBER 11341	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Naval Undersea Warfare Center, 1176 Howell Street, Newport, RI, 02842-1708		10. SPONSOR/MONITOR'S ACRONYM(S) NUWC	
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited			
13. SUPPLEMENTARY NOTES NUWC2015 Reprint of a paper presented at the Undersea Defence Technology (UDT) Hawaii 2001 Conference Exhibition, 30 October - 1 November 2001, Waikiki, HI.			
14. ABSTRACT NavSea Undersea Warfare Center Division, Newport in consort with Raytheon Corporation, Northrop Grumman Corporation and TEAM ONE USA has, under development, a mobile system capable of various undersea warfare (USW) missions. These missions include, but are not limited to, antisubmarine warfare (ASW) and intelligence, surveillance, and reconnaissance (ISR). The system includes a small manned/unmanned surface craft that can be reconfigured to carry personnel and/or mission modules. The SPARTAN system can be carried aboard a host ship, pre-deployed, or air dropped into the theater of operations. This paper will describe SPARTAN characteristics, potential payloads, and future plans.			
15. SUBJECT TERMS USW; ASW; ISR; SPARTAN; antisubmarine warfare; intelligence, surveillance, and reconnaissance			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	Same as Report (SAR)
			18. NUMBER OF PAGES 8
			19a. NAME OF RESPONSIBLE PERSON

UDT HAWAII 2001

SPARTAN: A DISTRIBUTED MOBILE USW SENSOR AND WEAPON SYSTEM

AUTHORS:

VITTORIO RICCI

Naval Undersea Warfare Center Division
1176 Howell Street
Newport, RI 02841-1708
Email: ricciv@npt.nuwc.navy.mil

MARK ALLEN

Naval Undersea Warfare Center Division
1176 Howell Street
Newport, RI 02841-1708
Email: allenma@npt.nuwc.navy.mil

JOSEPH M. MONTI

Naval Undersea Warfare Center Division
1176 Howell Street
Newport, RI 02841-1708
Email: montijm@npt.nuwc.navy.mil

ALAN L. GOODMAN

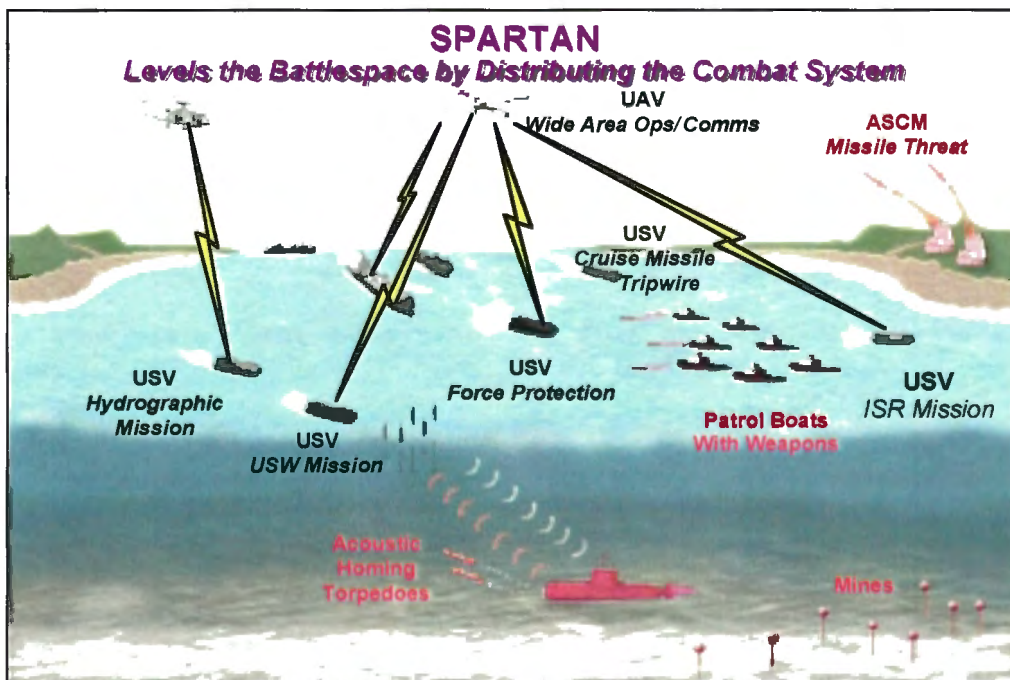
Naval Undersea Warfare Center Division
1176 Howell Street
Newport, RI 02841-1708
Email: goodmanal@npt.nuwc.navy.mil

Abstract

NavSea Undersea Warfare Center Division, Newport in consort with Raytheon Corporation, Northrop Grumman Corporation and TEAM ONE USA has, under development, a mobile system capable of various undersea warfare (USW) missions. These missions include, but are not limited to, antisubmarine warfare (ASW) and intelligence, surveillance, and reconnaissance (ISR). The system includes a small manned/unmanned surface craft that can be reconfigured to carry personnel and/or mission modules. The SPARTAN system can be carried aboard a host ship, pre-deployed, or air dropped into the theater of operations. This paper will describe SPARTAN characteristics, potential payloads, and future plans.

Introduction

As a result of a changing National Military Strategy, the focus of undersea warfare (USW) is moving from the deep, open-ocean *blue* waters to the shallow, congested, and noisy *brown* waters of the littorals. With this move to the littorals comes a new set of challenges and threats. These threats include Diesel submarines (including mini and midget subs), mines, small boats, and shore launched anti-ship cruise missiles. To add to the confusion of the littorals are the commercial shipping, fishing, and other non-military vessels operating in these areas.



The proliferation of relatively inexpensive advanced technology across the globe provides potentially hostile countries or other entities (e.g. terrorists) with the capability to challenge the national interests of the United States. This advanced technology can be used to develop relatively inexpensive weapon systems and platforms (e.g. mines and small boats) which can threaten combatants as well as large deck and sealift ships of the U.S. military and its allies. This type of conflict has been called *asymmetric* warfare and is illustrated in Figure 1.

Figure 1. SPARTAN addresses the growing asymmetric threats in the littorals.

The SPARTAN core system is capable of carrying payload modules from approximately 2,800 to 5,000 lbs on 7-meter and 11-meter crafts, respectively. Without a mission module installed, it can be operated in both manned and unmanned modes. Manning with a mission module installed is dependent upon the specific module design and mission requirements.

Based on the state of existing system technology, SPARTAN can continuously operate for up to 48 hours and has the ability to loiter if necessary, which can extend its time on station. SPARTAN can operate in inclement weather, around the clock, and in environments hazardous to humans such as those containing chemical and biological agents.

Mission Modules

Although the core system provides SPARTAN with a basic mission capability, the true enabler is the mission module. The mission module consists of two primary groups of payloads: sensors and weapons. Each mission module is designed and equipped to perform a particular mission. For example, an ASW mission module might include sonobuoys and a dipping sonar originally designed for helicopter deployment. As mission needs change, the mission module can be removed and a new mission module installed.

Missions

Using the sensors and weapons built into the core system and the installed mission module, SPARTAN can perform a variety of missions during both peacetime and conflict (Figure 4). These missions include USW, ISR, Force Protection, Precision Strike, Battlespace Preparation, and Meteorology/Oceanography, to name a few. By performing these missions, SPARTAN provides an added layer of protection to the manned, high value assets.

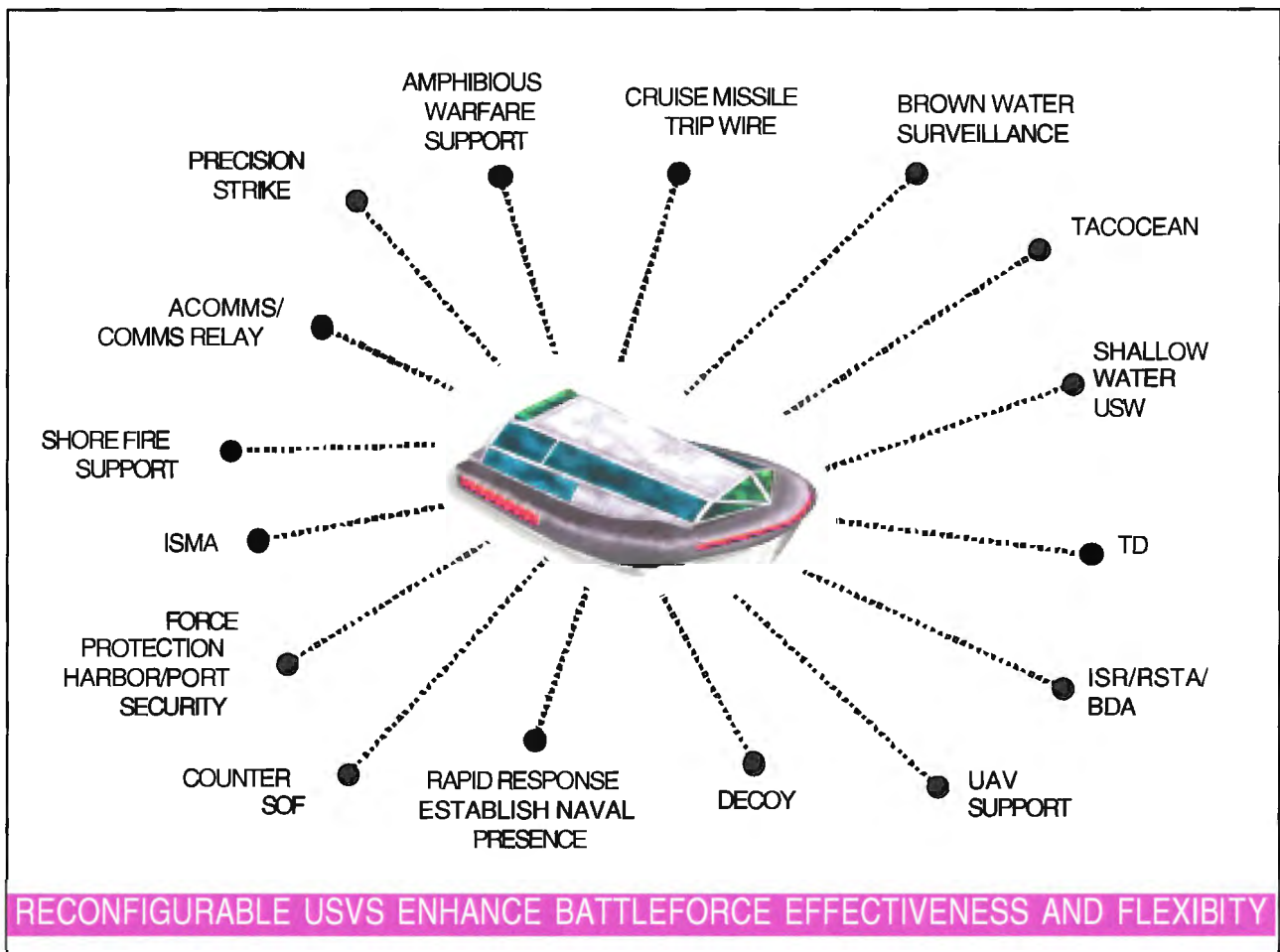


Figure 4. Potential SPARTAN Missions

ISR / RSTA / BDA

SPARTAN can perform basic intelligence, surveillance, and reconnaissance (ISR), reconnaissance, surveillance, and target acquisition (RSTA), and battle damage assessment (BDA) missions using its core system. The radar system working with the global positioning system (GPS) and inertial navigation system (INS) can track multiple surface contacts and share the information with neighboring assets. The core system also includes a forward-looking infrared (FLIR) and CCD camera, which can be used for visual monitoring and inspection.

Improved capabilities result from the installation of an ISR/RSTA/BDA-specific module. Potential component payloads include improved stabilized imaging systems and various acoustic sensors.

Force Protection – Port and Harbor Security

Large ships are susceptible to attack when they enter into a port or harbor (e.g., the terrorist attack on the USS Cole). SPARTAN can be equipped with biological and chemical threat detection sensors as well as explosive threat detection sensors, i.e. bomb sniffers. These sensors can be used to inspect each incoming vessel. If the incoming vessel does not stop or cooperate with the inspection, SPARTAN can be equipped with a number of non-lethal and lethal means to prevent the incoming vessel from reaching the protected ship.

SPARTAN can also contribute to the force protection mission by acting as a gatekeeper to the entrance of the port or harbor. In the gatekeeper role, SPARTAN's core system provides a picture of the surface and, if equipped with an ASW mission module, SPARTAN can also protect from the undersea threat.

Undersea Warfare (USW)

Two of the threats to surface ships in the littorals are mines and Diesel submarines. The Diesel submarine threat includes traditional submarines as well as mini and midget submarines. Technological improvements in mines and Diesel submarines are ever increasing, making the mines and submarines more capable and more difficult to detect. Within the USW spectrum, SPARTAN can address the anti-submarine warfare (ASW) mission and the mine warfare (MIW) mission. SPARTAN can operate as a gatekeeper in barrier operations, in an area search, or in-stride with transiting ships. A single SPARTAN or multiple SPARTANS can perform barrier operations depending on the size of the barrier and the capabilities of the installed mission systems.

A typical ASW module consists of a dipping sonar, sonobuoys, and potentially torpedoes. Since the ASW module can be equipped with a torpedo, it will provide the USW Commander the opportunity to prosecute a threat in real time, if necessary. A typical MIW module consists of side-scan sonar, which could be a COTS system, along with the necessary automated handling system and processing equipment. MIW missions would include area search, bottom mapping, and in-stride mine avoidance (ISMA). During ISMA missions, SPARTAN would transit ahead of the group and deploy the side scan sonar.

Payloads

Because SPARTAN is a surface vehicle and it has the ability to reconfigure using mission modules, it can contribute to a host of mission areas and carry a variety of payloads. The payloads can address areas of interest in the undersea, surface, and air environments. The two primary classes of payloads are sensors and weapons; however, SPARTAN has the capability of carrying and deploying a host of other payloads.

Sensors

Every mission area has sensors that have been developed to address the needs of the mission area. SPARTAN utilizes the sensors that have been developed for these missions and provides a platform to carry and distribute them throughout the battlespace. The list of potential sensor payloads includes:

- Dipping sonars
- Sonobuoys
- Variable depth sonars
- Side scan sonars
- Towed arrays
- Deployed Autonomous Sensor Systems

Weapons

At the heart of SPARTAN is the off-board sensing capability, however, there will be times when SPARTAN needs to defend itself and/or allied forces from threats of attack and hostile forces. There are a number of weapons that can be mounted on SPARTAN including gun systems, missiles and rockets, and torpedoes. Additionally, non-lethal threat suppression devices such as foams and high-pressure water cannons can be mounted on SPARTAN.

Other Payloads

SPARTAN can be used to deliver small unmanned vehicles (UV) including unmanned aerial vehicles (UAV), unmanned ground vehicles (UGV), unmanned underwater vehicles (UUV), and even small USVs. Capitalizing on the speed, range, and payload capabilities of SPARTAN, the smaller UVs can be delivered to their operating area allowing them more time on station. Additionally, SPARTAN can support commercial payloads and missions including oil spill clean up and recovery, fire suppression, oceanographic search and survey, and maritime security and inspection.

Communications

Line of sight (LOS) communications is limited due to the curvature of the earth. However, this limited coverage range is not a problem for a number of missions (e.g., port or harbor security, in-stride ASW and MIW) and for all operations within LOS of the control station communications antenna and SPARTAN.

For over-the-horizon (OTH) missions/operations manned and additional unmanned vehicles, including SPARTAN platforms, could be used to provide an OTH link. In the future, long-endurance, UAVs will be the preferred method for providing the OTH link. UAVs provide the altitude, or height above the earth's surface, necessary for effective OTH communications. Satellite communications may also be used in certain circumstances making SPARTAN a node on various command and control information networks.

Deployment

The specific deployment method desired will depend on who is using SPARTAN, what mission it is being used for, and where it is being used. There are a number of options available for the deployment of SPARTAN: ship deployed, air dropped, pre-positioned, and shore launched.

Ship Deployed

There is a wide array of ships that could potentially receive and support one or more SPARTANs including surface combatants, amphibious warfare ships, and military sealift command ships. As new ships are designed, handling, stowage, and retrieval systems can be design specifically for SPARTAN. There are a host of methods for recovering SPARTAN on both existing ships and future ships including single point davits, ramps, and well decks.

Pre-Positioned

SPARTAN can be deployed at pre-positioned locations and called upon as necessary within that theater. By pre-positioning SPARTAN at various forward-deployed sites, it can respond and contribute quickly to needs, perhaps searching transit lanes before additional forces can arrive.

Shore Launched

SPARTAN can be deployed from shore stations using a standard boat trailer. This allows SPARTAN to be transported overland and to inland waters as necessary.

Airlift/Airdrop

The ability to deploy SPARTAN using aircraft such as a C-130 would allow it to be rapidly transported to the operational area. Airdrop of the SPARTAN is also a potential means of delivery on station.

The Future

While the future is unknown, there are a number of developments that could play a role in the future of SPARTAN and other unmanned vehicles. The following is a brief discussion of the areas and potential areas for development of SPARTAN.

Currently, SPARTAN is using existing COTS RHIBs. As the SPARTAN system develops over time, it may be discovered that the existing RHIBs are not the optimum platforms. A boat design specifically to support the SPARTAN USV methodology may be required.

Today, there are no ships in the U.S. Navy that have been specifically designed to launch, recover, handle, and store SPARTAN (USVs in general). While existing small boat handling systems on these ships will be used to support today's SPARTAN, future ships designs will look to integrate the ideal handling system design for all off board systems.

Although it is feasible and a good approach to place one or two SPARTAN platforms on each surface ship in the near term, in the future it will be more likely that ships will be fielded with the sole purpose of supporting SPARTAN and other unmanned and manned off-board systems. With the ability to launch and recover, stow, support, and maintain 16 or more SPARTAN vehicles, this "mothership" would provide an efficient use of resources, especially manpower since a single small crew would be able to support and maintain the small fleet of SPARTANs.

Perhaps the greatest enabler of the SPARTAN concept is the development of techniques for controlling multiple vehicles or swarms of cheap and expendable USVs. The swarm approach is attractive because the loss of a handful of vehicles does not compromise the success of the overall mission. They are able to adapt, if necessary, to the loss of a member. As the number of vehicles in the swarm increases, the requirements for the sensors may decrease. Either of these factors, and certainly the combination of the two, will result in driving costs down.

Many of the current unmanned vehicle efforts are focusing on reconfigurable, modular payload capabilities. This approach provides greater flexibility and adaptation to current mission needs. Taking the modular capability one step further is the idea of mission modules that can be shared between air, ground, surface, and underwater vehicles. This creates a common infrastructure, thereby reducing logistics requirements and ultimately cost.

The opposite approach to multi-platform mission modules is to develop a platform that can operate in different environments – a so-called Hybrid Unmanned Vehicle (HUV). An example Unmanned Submersible Surface Vehicle (USSV) would have the capability to operate on the surface of the water, and then submerge taking advantage of the underwater vehicle characteristics, as needed. These hybrid vehicles could capitalize on the advantages of each environment.

Conclusion

With the proliferation of advanced technology throughout the world and the growing need to operate in the littoral environments, SPARTAN, working with other unmanned vehicles, can address the asymmetric threats that the U.S. Navy is and will be facing into the future. SPARTAN's modularity provides a platform for accepting, implementing, and adapting to the anticipated and, more importantly, the unanticipated events and developments in technology and the threats of the future.

INITIAL DISTRIBUTION LIST

Addressee	No. of Copies
Navy Warfare Development Command (G. Streimer, CDR Bergeron, CAPT Medley, CAPT Denny)	4
Naval Sea Systems Command (PMS 411 – Y. Dogrul, CAPT Haid)	2
Naval Surface Warfare Center, Carderock (W. Sokol)	1
Office of Naval Research (Dr. D. Todoroff)	1
Deputy Undersecretary of Defense, AS&C (R. Shields, C. Kimzey)	2
Office of Naval Research (ONR 32, ONR 321, ONR 321 – K. Dial, T. Goldsberry, ONR 351 – M. Deitchman)	5
Chief of Naval Operations (N764, CAPT Knouse, CDR Hogg, D. Pelletier)	4