

SSC SAN DIEGO - THE WORLD IS OUR PLATFORM

Robert L. Wernli
Space and Naval Warfare Systems Center San Diego
Code D7405
San Diego, CA 92152
wernli@spawar.navy.mil

Abstract

Technology is changing the future for the U.S. Navy, and Ocean Engineering will play a major role. In the past, navy research concentrated on platforms such as surface ships and submarines, but the future will be driven by communications between bases and platforms whether on shore, afloat, submerged or in the air. Immediate access to tactical information will be critical for successful mission planning and execution; and much of this information will be acquired and communicated by ocean based systems. This paper will present on-going ocean engineering research at SSC San Diego and how that research will play on the “world platform.”

1. Background

Previous papers presented at the UJNR meetings have provided updates on the organization of the Navy laboratories (1) and the changing directions in ocean engineering and unmanned undersea vehicle research and development (2). This change continues and with the advancement of technology, the role of ocean engineering and unmanned systems is also changing.

The Space and Naval Warfare Systems Center (SPAWAR) San Diego (SSC SD—formerly NRaD, NOSC, and NUC) is the latest in a long series of name changes for the Navy’s San Diego research and development (R&D) center. Although the names have changed, the R&D at the center remains much the same. The vision of the center is “to be the Nation’s pre-eminent provider of integrated C4ISR solutions for warrior information dominance.” C4ISR is defined as Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance. Or, in other words, our mission is to provide the right people the right information at the right time in the right context to have a positive impact on the outcome of an operation.

Within the C4ISR mission are several leadership areas assigned to SSC SD by the Navy. One such area is Ocean Engineering. The significant role ocean engineering will play in the future is discussed later in this paper.

As described at the UJNR in 1997 (2), the Secretary of the Navy approved a plan in 1991 to consolidate existing Navy laboratories and facilities to form a corporate community. Today the community consists of the following:

A single Corporate laboratory,

- Naval Research Laboratory (NRL) under the Office of Naval Research (ONR)

And four warfare-oriented centers,

- Naval Air Warfare Center (NAWC) under Naval Air Systems Command (NAVAIR)
- Naval Undersea Warfare Center (NUWC) under Naval Sea Systems Command (NAVSEA)
- Naval Surface Warfare Center (NSWC) under Naval Sea Systems Command
- Space and Naval Warfare Systems Command (SPAWAR), which is the parent command of SSC San Diego.

This reorganization focused the R&D at the centers toward different platforms: NAWC-air platforms, NUWC-underwater platforms, and NSWC-surface platforms. The one variant from this pure platform philosophy is SPAWAR, which has the mission of command, control, communications and ocean surveillance that overarches multi-platforms. In essence, the role of SPAWAR is to obtain information from any source and get it to the user—anywhere on earth. Thus, *the world is our platform*, and ocean engineering will play an important role in the success of our mission.

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 MAY 2000	2. REPORT TYPE N/A	3. DATES COVERED -	
4. TITLE AND SUBTITLE SSC San Diego - The World Is Our Platform		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) Space and Naval Warfare Systems Center 53406 Woodward Road San Diego, CA 92152		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 The original document contains color images.			
14. ABSTRACT			
15. SUBJECT TERMS			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	UU
			18. NUMBER OF PAGES 6
			19a. NAME OF RESPONSIBLE PERSON

2. The Role of Ocean Engineering

The most significant impact on today's military is the speed with which it must plan and/or respond. Timely information is a necessity. And in today's post cold war environment, conflicts will probably increase in number and involve smaller, and possibly multiple countries, which will accelerate the need for accurate situation awareness and understanding. This forces a change in the paradigm of having several large platforms, whether air, land or sea, as the primary method of providing information to the decision makers and warriors.

Future acquisition of data will involve extended sensor grids that will have the ability to acquire immediate or long term data. Whether these sensors are positioned by larger platforms such as submarines or aircraft, or transit to their mission location on their own, they will provide critical information that will impact the ultimate outcome of the situation being addressed.

The C4ISR expertise and tools resident at SSC SD will ensure that the data is acquired, transformed into useful information and moved

to the location where it is needed. The ocean engineering expertise at SSC SD will ensure the sensors and systems are developed that will support these data acquisition requirements and efficiently begin the transmission process. As shown in Figure 1, these sensors can range from individual stationary sensors or fully autonomous unmanned underwater vehicles (UUVs) up to interconnected arrays. They will also range from the ocean onto the land with unmanned ground vehicles (UGVs) and into the air as unmanned aerial vehicles (UAVs). These sensors and various delivery platforms, when interfaced to other major platforms, will interconnect the user's world to whatever extent is necessary. For SSC SD, the world then becomes our platform of operation.

3. Examples of On-going Programs

A. Land and Air

The future of remote or autonomous sensors will see land, air, undersea and hybrid systems used in the field. UUVs that transform into UAVs and vice versa, or that swim to the shore and crawl out of the water to deploy on land will all play a

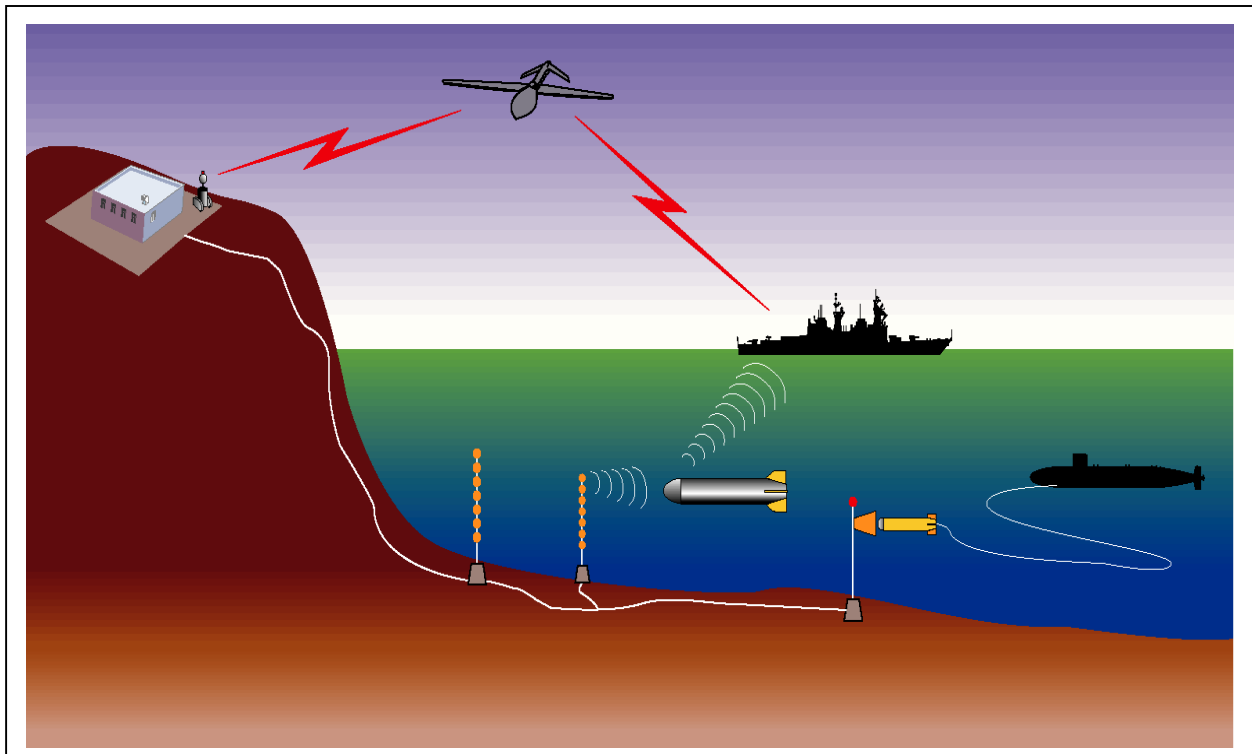


Figure 1. Sensor Grids of the Future

role in the future net-centric sensor grid. Although this paper will not expand in detail into the air and land robotic activities, it should be noted that such projects are a critical component of future C4ISR operations and are ongoing at SSC SD. Thus, a few of these projects will be highlighted.

Ground-based robotic technology is being advanced by systems such as the Mobile Detection, Assessment and Response System (MDARS) used for automated intrusion detection. MDARS exists in both interior and exterior versions (Figures 2 and 3).

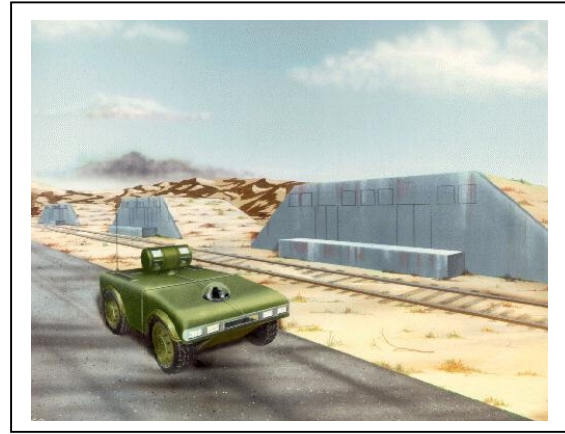


Figure 3. Exterior MDARS



Figure 2. Interior MDARS

Airborne sensors are being developed under programs such as the Multi-Purpose Security and Surveillance Mission Platform (MSSMP), which has been developed for rapidly deployable, extended range surveillance (Figure 4). In addition, the center is taking a leading role in the integration of UAV technologies into the C4ISR arena by supporting the unmanned systems initiative for the Navy's UAV Executive Steering Group. The vision is to internet all unmanned systems across all services. The future will see coordinated operations by UAVs launched from ships, submarines, aircraft and land based platforms.



Figure 4. Surveillance UAV

B. Ocean Engineering

On-going ocean engineering programs at SSC SD continue to address the development, installation and testing of advanced sensors and communication techniques. Whether the sensors are emplaced by larger systems or travel to the mission site themselves, the ultimate goal is to transmit the data obtained back to those who need it. Two standard methods of transmitting the data are via RF or direct cables to shore. Shore connected cables require infrastructure that can be costly, and in most cases such systems do not lend themselves to fast response type missions. Satellite communications is the primary method of obtaining remote data once it is provided to an appropriate transmission link.

Based on the previous constraints, the goal is to develop sensor systems that can be deployed to critical locations. Many quick response systems of the future will be expendable, however, many

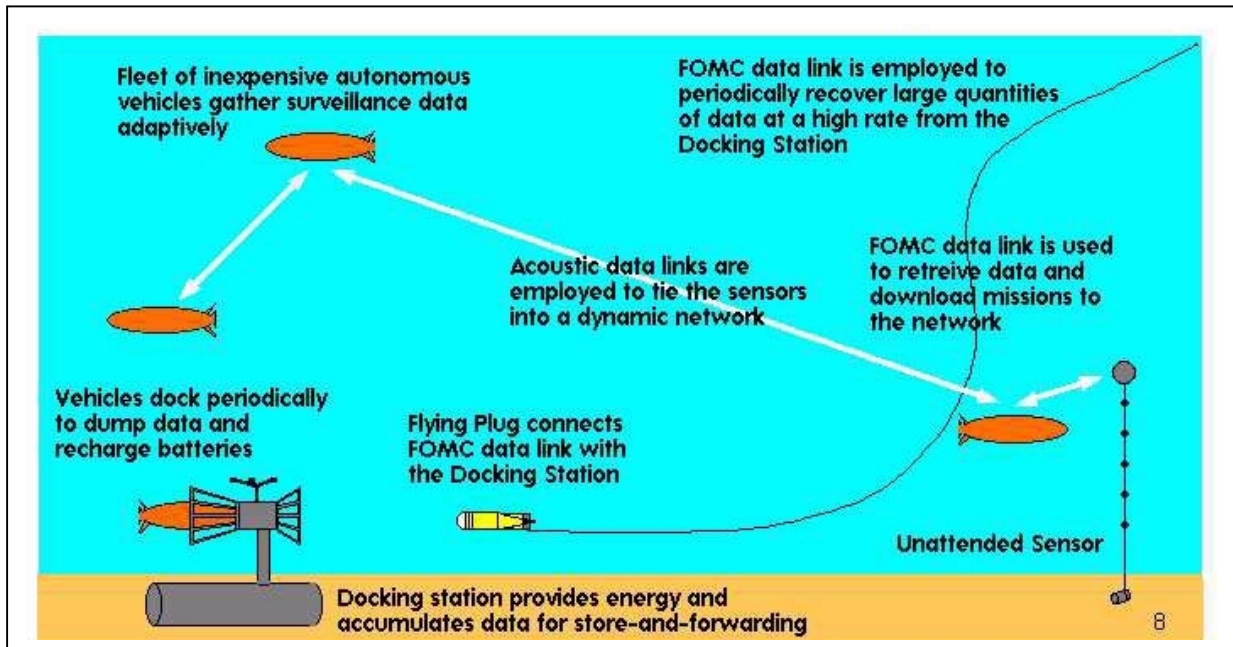


Figure 5. Distributed Surveillance Sensor Network

others will become part of an integrated network. One such example is the Distributed Surveillance Sensor Network (DSSN). The purpose of the DSSN program is to investigate the applicability of small, inexpensive undersea vehicles to surveillance applications and submarine connectivity. It is based on the concept of a fleet of autonomous underwater vehicles that gather surveillance data and communicate acoustically. Each has the ability to mate with an underwater docking station, recharge batteries, dump data, receive new instructions and continue its mission. The station would also have the ability to dock with a vehicle that is sent from another platform to retrieve the massive amount of stored data. Such a vehicle is the Flying Plug, which deploys a high-bandwidth fiber optic microcable (FOMC) (Figures 5 and 6). A Flying Plug type data retrieval system could be reusable or expendable.

The alternative to high-bandwidth FOMC communications is acoustic communications. Although the data rates are much slower, with the application of compression techniques a significant amount of critical data can be provided. Such scenarios underscore the importance of on-board processing. Luckily, the state-of-the-art of computer storage and processing technology has advanced at such a rate that a considerable amount of preprocessing of the raw data can now be

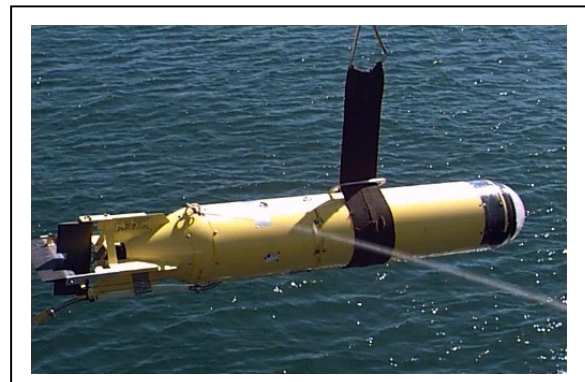


Figure 6. Flying Plug

performed—and this capability will increase in the future. This will allow the sensor to send back the answers or instructions needed without causing additional delays by providing massive amounts of unprocessed data.

An example of ongoing research at SSC SD in the area of underwater acoustics is the Telesonar Project (3). The objective is to develop telesonar technology for wireless digital communications in the undersea environment, particularly in support of distributed shallow-water systems comprising deployable, expendable, autonomous nodes. Some of the goals of the program are to obtain an understanding of the transmission channel, apply modern digital communication techniques, develop directional transducers, develop a

handshake protocol uniquely suited to wireless half-duplex networking, and combine these advancements into at-sea networks for in situ experimentation.

This paper can only touch on the direction of on-going Navy and SSC SD R&D. The reader is referred to the World Wide Web sites listed at the end of this paper for additional information.

4. Conclusion

The combination of acoustic and fiber optic communication links with remote or autonomous sensors has been demonstrated. The ability for

them to achieve their full potential will require a considerable ocean engineering effort in the future. When such undersea sensor networks are optimized and combined with UAVs, UGVs, satellite communications and other hybrid systems, the Navy will achieve an advanced and unparalleled maritime C4ISR capability.

And this level of worldwide information dominance will not be achieved without the aid of SSC San Diego's Ocean Engineering expertise. The oceans cover three-quarters of the earth—

—the world is our platform.

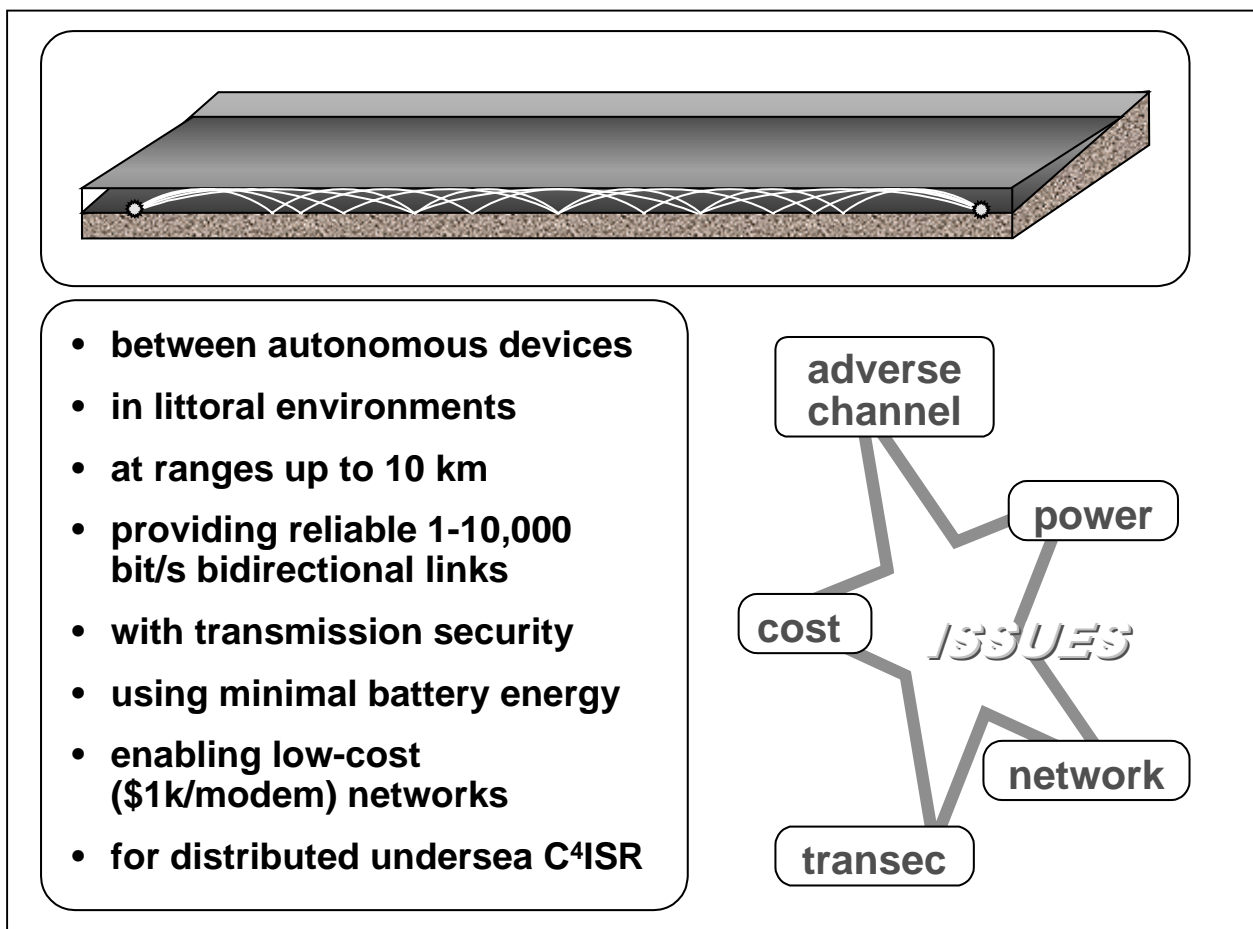


Figure 7. Telesonar I s Undersea Acoustic Signaling

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2. Wernli, R.L., "The Changing Picture of UUV Development in the U.S. Navy," Conference Record of the 21st Meeting of the U.S.-Japan Marine Facilities Panel, May 19-25, 1997, pp. 241-260.

(3) Rice, J. A., "Telesonar Technology," FY99 Annual Report submitted to Office of Naval Research.

Related Web Sites

NRL: <http://www.nrl.navy.mil/home.html>

ONR: <http://www.onr.navy.mil/>

NAVAIR: <http://www.navair.navy.mil>

NAVSEA: <http://www.navsea.navy.mil>

NAWC, Aircraft Division:

<http://www.nawcad.navy.mil/>

NSWC, Carderock Division:

<http://www.dt.navy.mil/>

NUWC: <http://www.nuwc.navy.mil/>

SSC SD:

<http://www.spawar.navy.mil/sandiego/cgi/welcome.page>

SSC SD Robotics: <http://www.nosc.mil/robots/>