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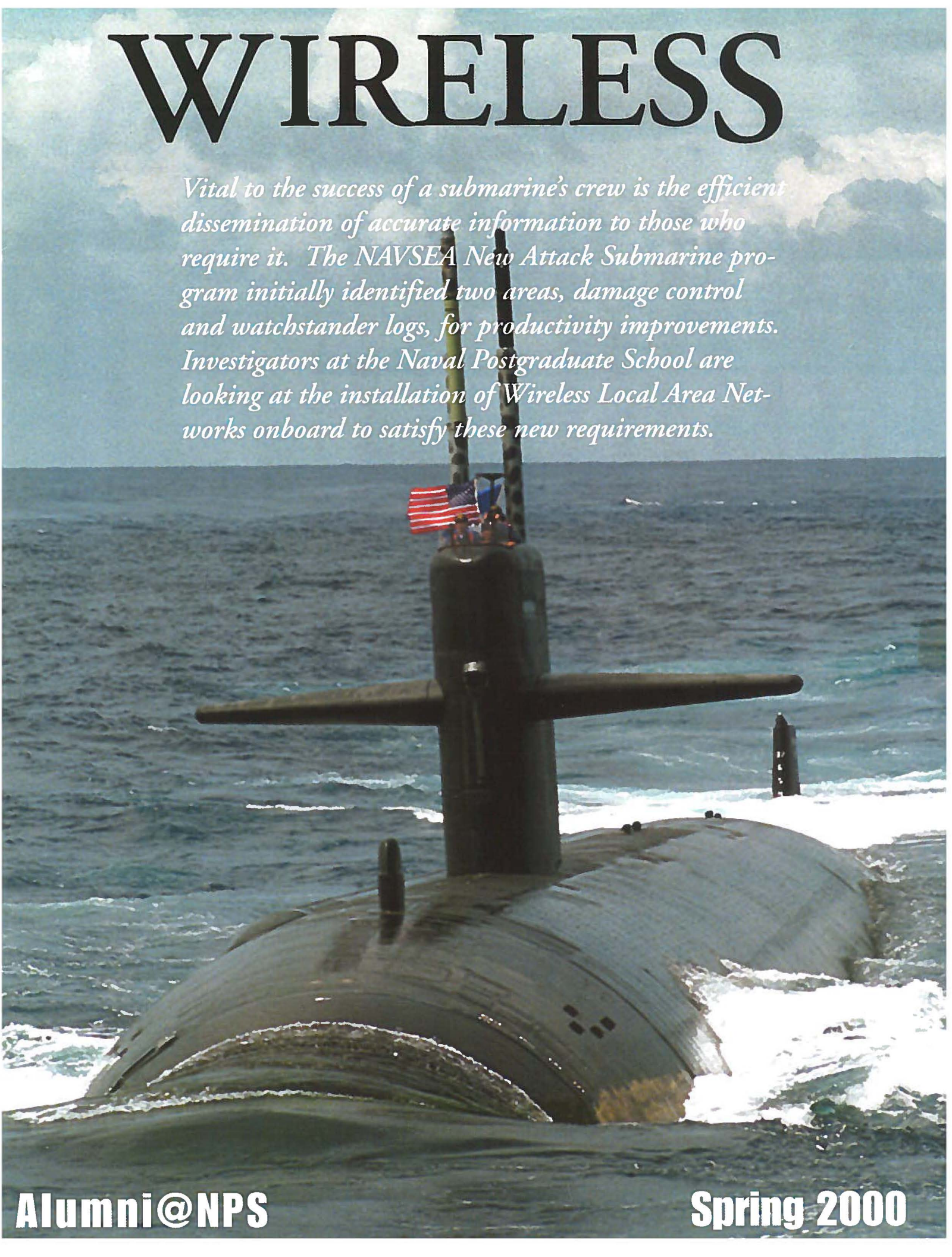
WIRELESS

Vital to the success of a submarine's crew is the efficient dissemination of accurate information to those who require it. The NAVSEA New Attack Submarine program initially identified two areas, damage control and watchstander logs, for productivity improvements. Investigators at the Naval Postgraduate School are looking at the installation of Wireless Local Area Networks onboard to satisfy these new requirements.



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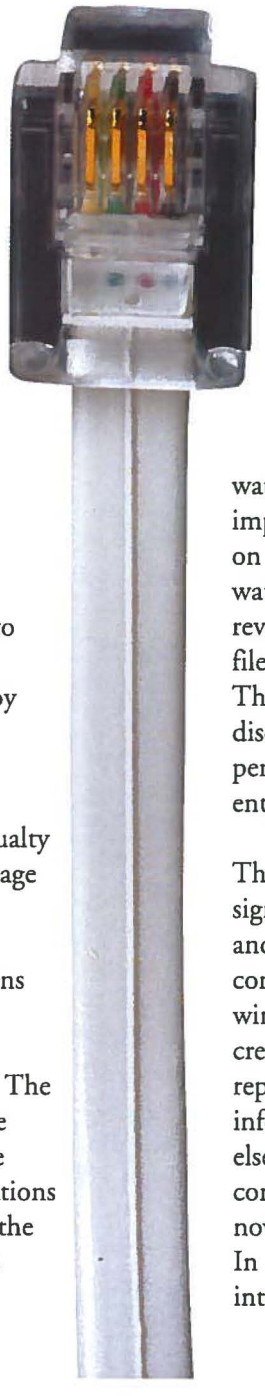
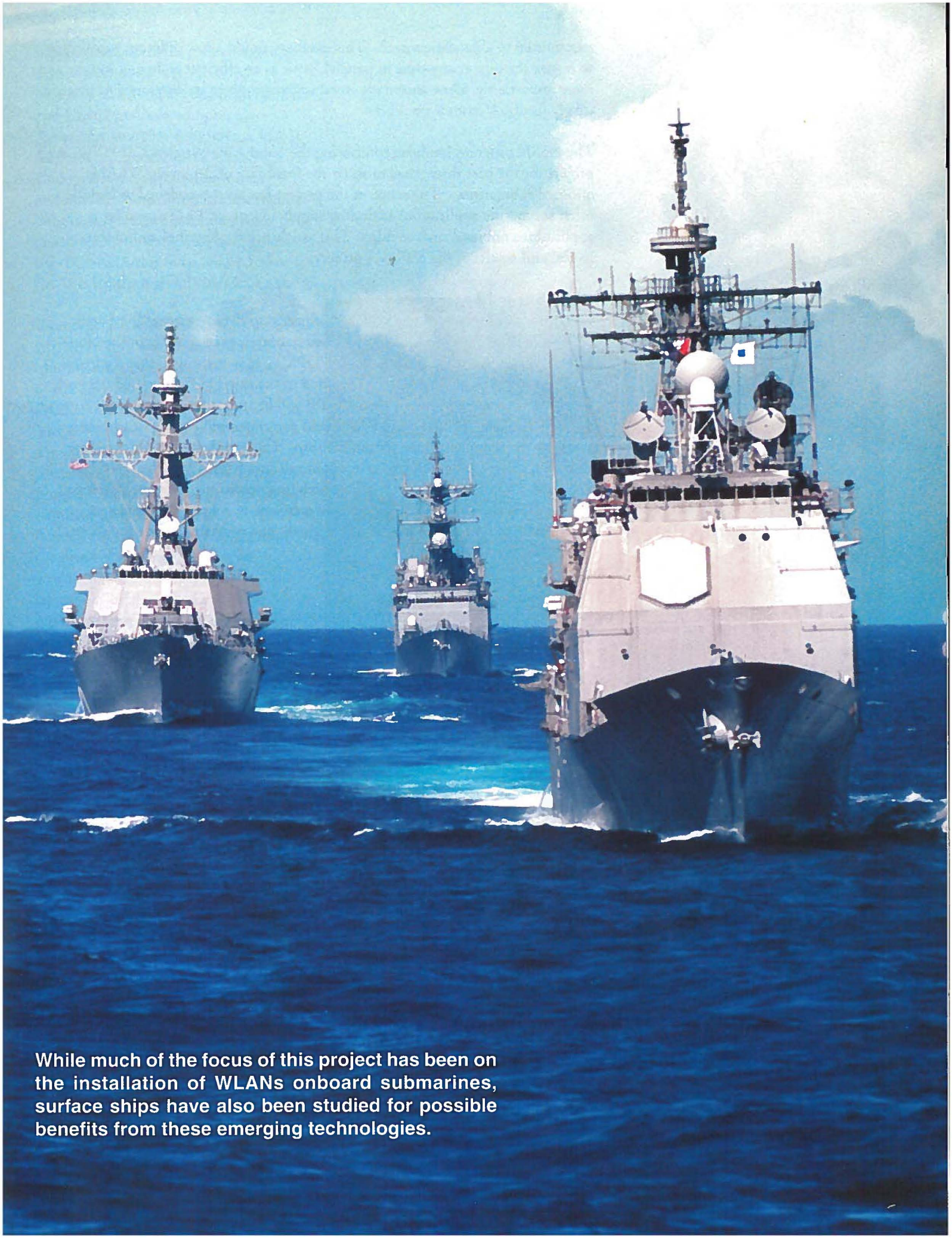


Introduction

Since ships have limited personnel assets, it is important to increase the productivity of every crewmember aboard. The NAVSEA New Attack Submarine (NSSN) program initially identified two areas, damage control (DC) communications and watchstander logs, for productivity improvement by deploying wireless local area networks (WLANs) onboard submarines.

Accurate, timely communications between the casualty scene, different stations around the ship, and Damage Control Central (DCC) have always been of the utmost importance when combating shipboard casualties. Current damage control communications practices onboard submarines rely on a slow, error prone process involving sound powered telephone talkers and a grease pencil annotated white board. The transcription of the status information to the white board is limited to the rate and accuracy of a single person receiving and writing the voice communications and is only available to those personnel in view of the white board. There is a great need to improve DC communications. The current practice of watchstander log taking has similar needs for improvement. Logs on today's submarines are taken on paper forms, collected daily, and stapled with other watchstander logs in a large bundle. This bundle is reviewed sequentially by responsible supervisors and filed in cabinets. It is usually never looked at again. The biggest problem of this procedure is that it discourages trend analysis. If a trend analysis is to be performed, data must be either hand plotted or entered into a computer.

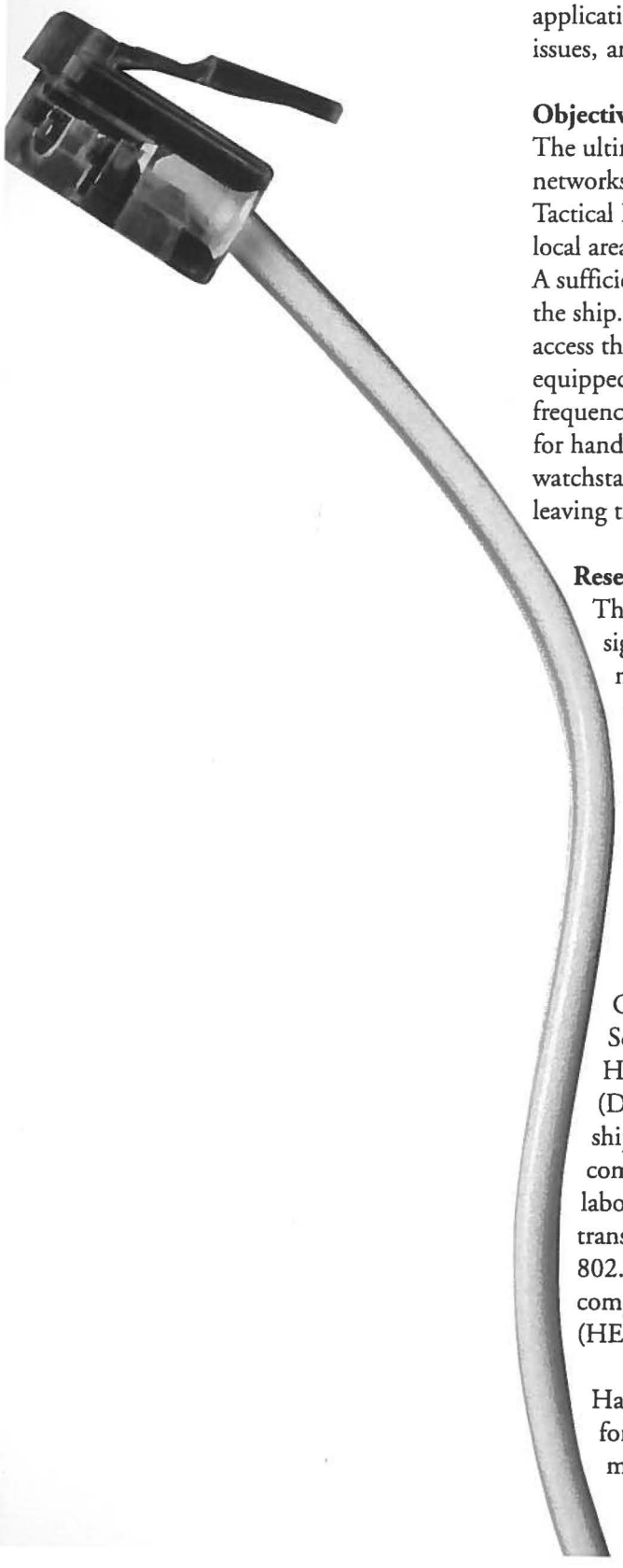
The productivity in these and other areas can be significantly improved by deploying wireless networks and mobile computing devices. In the damage control case, handheld computers connected to a wireless network could be used around the ship for the crew members at the casualty scene to make their report directly and electronically to DCC. The information would be displayed at DCC and elsewhere for situation awareness. Voice communications would still be available but could now be reserved for the most time critical messages. In the log taking scenario, log data could be entered into a handheld computer and then wirelessly



While much of the focus of this project has been on the installation of WLANs onboard submarines, surface ships have also been studied for possible benefits from these emerging technologies.

transmitted to a database server. This database would allow different supervisors to review the logs at any time in parallel, serve as an efficient archiving source, and most importantly, allow automatic trend analysis tools to be developed to provide timely feedback to crew members.

The NSSN program has been sponsoring the Submarine Wireless LAN (SWLAN) project for the past three years to study the feasibility of deploying WLANs onboard submarines. The scope of the project has been broadened to include other submarine applications including supply inventory, PMS as well as applications onboard surface ships. This article briefly describes approaches, issues, and results of the SWLAN project.



Objectives and Approaches

The ultimate objective of the SWLAN project is to deploy wireless local area networks (WLAN) onboard Virginia Class Submarines in support of the Non-Tactical Data Processing Subsystem (NTDPS). It is envisioned that a wireless local area network will be installed and tied to the ship's NTDPS wired network. A sufficient number of Access Points (APs) will be utilized to cover every corner of the ship. A crew member with a handheld computer will be able to wirelessly access the network anywhere within the ship. The handheld computer will be equipped with a PCMCIA card that communicates with APs at the 2.4 GHz frequency. Application software with a web browser interface will be developed for handheld computers that allows crew members to submit DC data and watchstander log data, view technical manuals, and order repair parts without leaving the repair scene.

Research Issues

The above approach of using wireless technology has the potential for significant improvements in shipboard operations. Nevertheless, there are many issues that must be studied. The SWLAN project team focused its efforts in the following three areas:

- Investigate the feasibility of deploying commercial-off-the-shelf (COTS) wireless networks in mostly metallic shipboard environments.
- Evaluate COTS handheld computers and wearable computers for shipboard use in connection with wireless networks.
- Develop prototype software for damage control, watchstander log taking, and other applications.

Commercial WLAN products utilize the 900 MHz or 2.4 GHz Industrial, Science, and Medical (ISM) frequency bands. They use Frequency Hopping Spread Spectrum (FH/SS) or Direct Sequence Spread Spectrum (DS/SS) modulation. One of the major concerns in deploying WLANs in shipboard environments is multi-path-fading effects of radio frequency (RF) communications. The feasibility analysis is conducted by means of laboratory testing and shipboard testing, and by investigating issues of transmission range, data throughput, roaming between access points, IEEE 802.11 compliance, electromagnetic interference (EMI) and electromagnetic compatibility (EMC), Hazards of Electromagnetic Radiation on Ordnance (HERO) compliance, network security, and power consumption.

Handheld computers and wearable computers are available in many different forms. Evaluation criteria include form factor, operating system, input method (handwriting, keyboard, mini on-screen keyboard, voice), comfort,

ruggedness, and battery life. A market survey was conducted. Selected products including a Mitsubishi Amity pen-based handheld computer, a Xybernaut wearable computer, a ViA II wearable computer, and a Casio Casiopeia were acquired for further evaluation. Both Windows 95/98 and Windows CE based machines were considered, but they must have at least one PCMCIA slot to be connected to the WLAN through a PCMCIA card.

Prototype software applications were written in Java with a web browser type of interface. Java was chosen because of the distributed nature of applet architecture, and the availability of Java Virtual Machine (usually bundled with a browser) for a wide range of processors. Applets allow users to run programs from a remote server without requiring any client side setup. For damage control and other applications, the prototype control station was written in an applet and ran on a laptop or desktop computer. The reporting agent on the client side was written in both an applet and a servlet and typically ran on a handheld computer or a wearable computer. A servlet version was also developed to allow it to be run on smaller Windows CE devices that operate a light web browser and do not support Java applets.

As an example, Figure 1 shows the interface of the damage control console applet. This applet uses the Java.AWT API to support the graphical user interface and the Java.SQL API to interface with an Access database. On the top of the graphical interface is a VRML image of the submarine. The VRML image communicates with the applet to visually display casualty locations. The applet accesses the database using standard SQL commands that are tied to events in the graphical interface.

Figure 2 depicts the applet version interface of the client module that uses

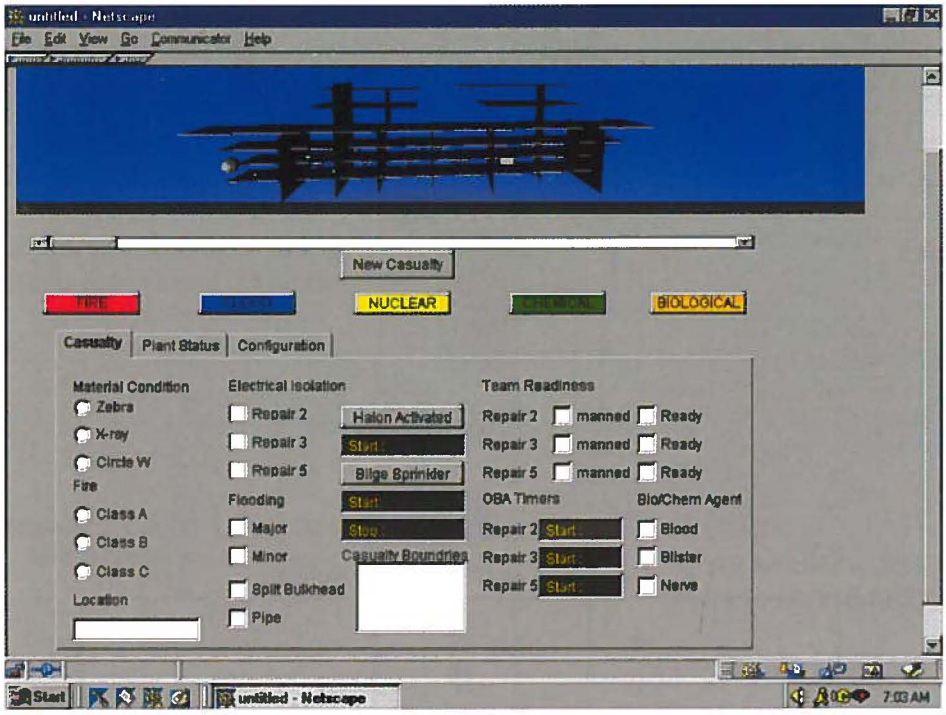


Figure 1. Damage Control Console

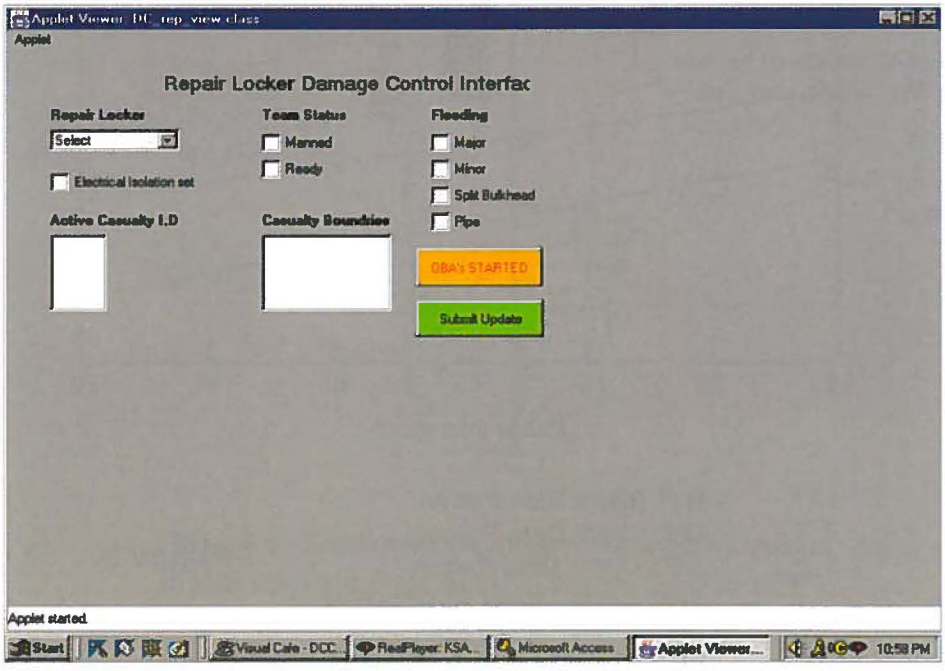


Figure 2. Client-side Interface of the Damage Control Application

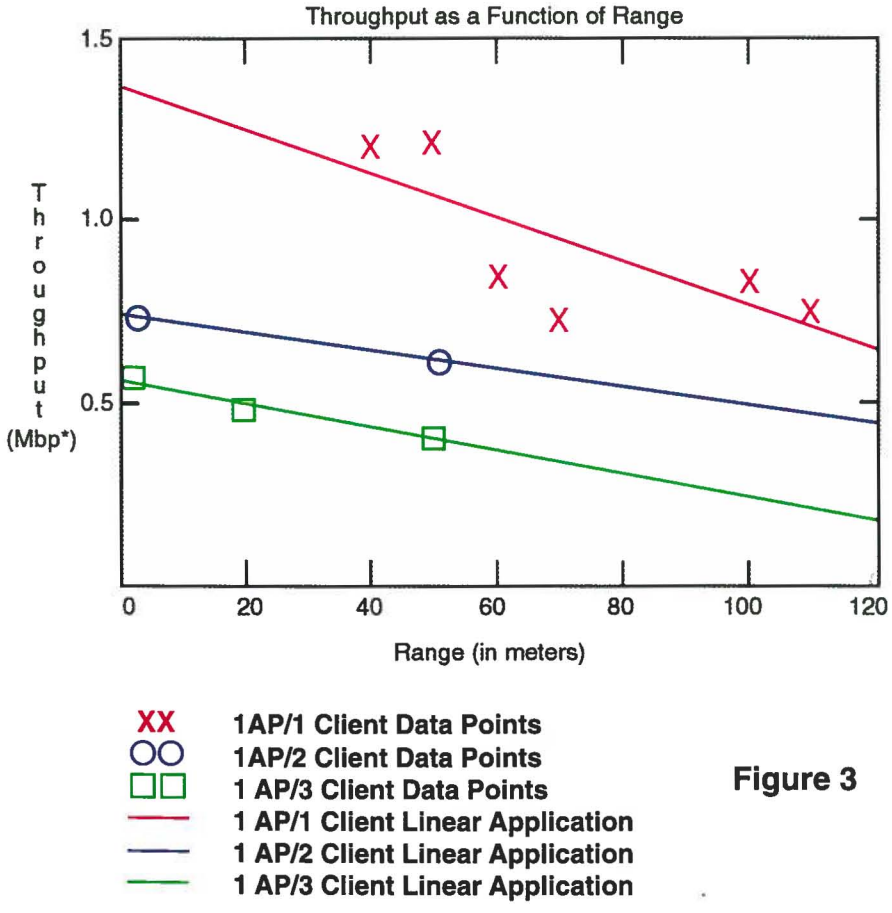


Figure 3

a series of buttons, text fields, and radio buttons to report casualty information. The interface was designed to be simple to use with a pen/stylus as the only input device. The client side module runs on a handheld or wearable computer. The crew member enters casualty information by depressing appropriate buttons. The entered information is wirelessly transmitted to the damage control command database after depressing "Submit Update" button. Similar prototype applications have been developed for watchstander log, maintenance management, supply inventory, and repair manual [1].

Shipboard Testing Results

The investigation of the above three research areas was conducted in the laboratory as well as onboard ships. An initial feasibility test was conducted onboard the USS Ohio (SSBN 726) in August 1997, followed by a test on the USS Harry S. Truman (CVN 75) in March 1999, and another test on the USS Memphis (SSN-691) in August 1999. Selected testing results are described below. Complete testing results are available from the theses listed in the references at the end of this article.

A prototype wireless local area network was assembled in early 1997. A series of tests were conducted in the laboratory environment prior to a shipboard test on the USS Ohio in August 1997. The primary objective of those tests was to evaluate the viability of WLANs on submarines. The wireless network chosen for evaluation was a Digital Ocean Grouper radio pack and its corresponding access point, the Starfish II. The radio pack was not in the form of a PCMCIA card. The handheld computer selected was an Apple Newton MessagePad 2000. These components represented the state of the art at the time. The Digital Ocean's wireless network was based on the Lucent Technologies 900 MHz DS/SS WaveLAN. The MessagePad 2000 led the way in

handheld computers by providing the most powerful processor (DEC StrongARM 110 at 162MHz), the best handwriting recognition, and rugged design. Laboratory and shipboard testing yielded the average data throughput of the WLAN from 70.0 to 90.0 Kbps , depending on the distance between the access point and the handheld computer. The maximum indoor communication range was determined to be 30m. Shipboard tests concluded that ten access points would be needed to fully cover an Ohio Class submarine: three access points for the forward compartment, four access points for the missile compartment, and three more for the engine room. The Digital Ocean Grouper radio's transmit power of 250 mW exceeded the EMI requirements of MIL-STD-461C, and one EMI occurrence was detected in the shipboard test [2].

Encouraged by the USS Ohio testing results and supported by the NSSN Program Office, more in-depth studies in the three areas listed above were followed. A wireless network composed of the latest IEEE 802.11 compliant components was constructed in late 1998 and early 1999. Two shipboard tests were conducted, one in the hangar bay of the USS Harry S. Truman and another on the USS Memphis. Selected results from the Truman test are shown in Figures 3 and 4. Figure 3 depicts data throughput as a function of range and number of clients.

It is noted that throughput decreases as the distance from the client to the access point increases, and it also decreases as more clients transmit or receive data from the same access point. This suggests that it is not sufficient to cover the area of interest with the minimum number of access points. Consideration should also be made with respect to the number of potential users in a particular area. It is also noted that the highest throughput reached 1.4 Mbps, compared to 90

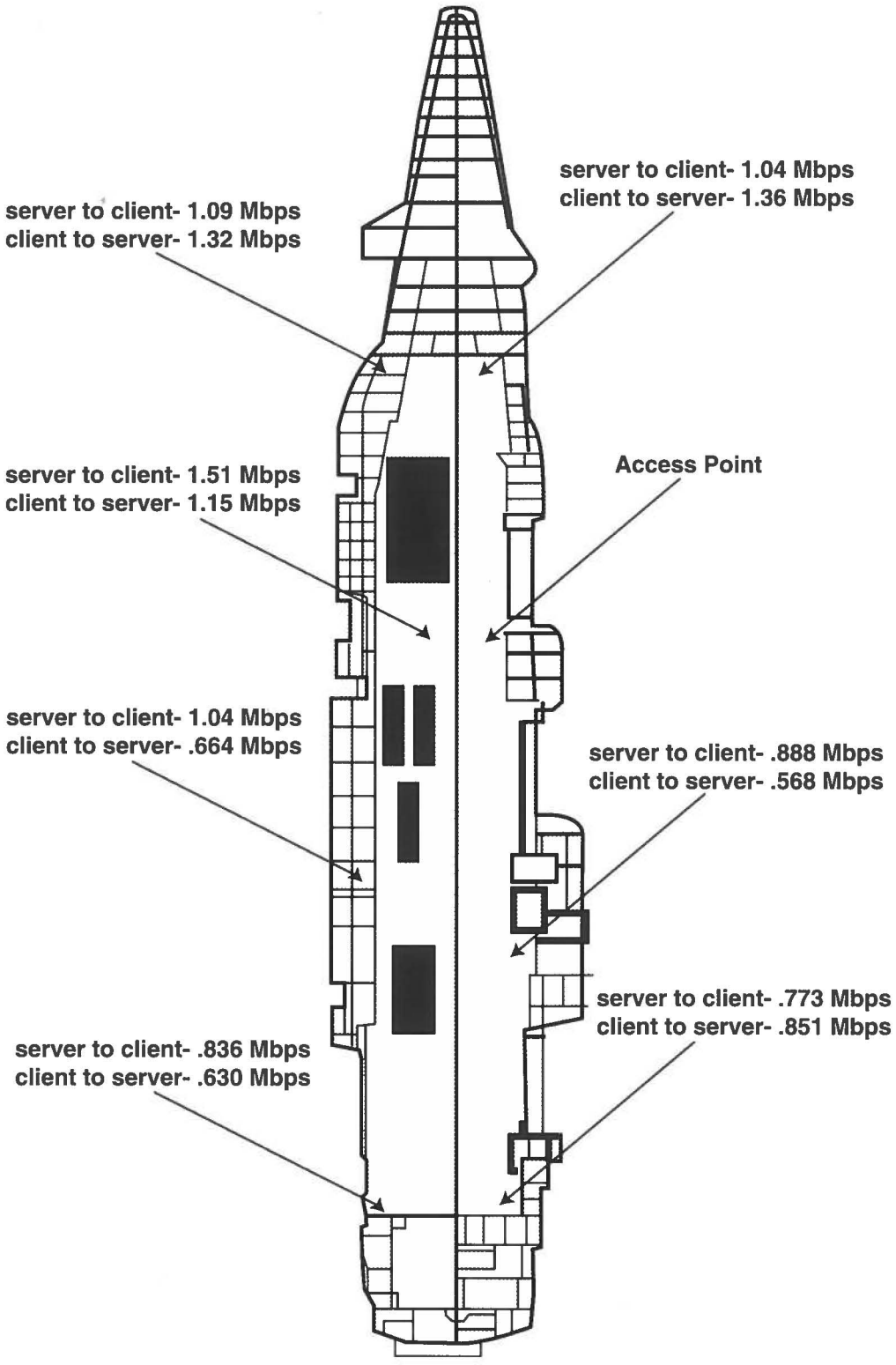


Figure 4. Throughput at various locations in the Hanger Bay of USS Harry S. Truman

The ballistic missile submarine USS Maine (SSBN 741), one of the U.S. Navy's newest Ohio-class submarines shown here and on page 9, conducts surface navigational operations approximately 50 miles south of Naval Station Roosevelt Roads, Puerto Rico. (U.S. Navy photos.)

Kbps achieved in the Ohio test. Figure 4 illustrates date rates at various locations of the hangar bay. The access point was placed on the starboard side just aft of the hangar bay window at Frame 120. It should be mentioned that one access point covers the entire hangar bay. But as noted earlier, data rates will drop as more users enter the same area. As a result, more than one access point may be needed to prevent data rates from dropping below a certain level.

The first objective of the Memphis test was to determine the number and optimal locations of access points required to cover the Los Angeles Class submarines, and throughput between clients and access points. It was determined that ten access points are needed: four in the engine room and six in the forward compartment. These access points provided signal-to-noise ratios (SNR) from as high as 50 dB to 20 dB in virtually every corner of the submarine. A summary of data rate measurements is listed in Table 1. It is noted that the signal strength had no significant impact on data rate.

SNR		>50dB	50-40 dB	40-30 dB
Forward Compartment	server to client	1.44	1.44	1.44
	client to server	1.25	1.26	1.23
Engine Room	server to client	1.42	1.40	1.40
	client to server	1.22	1.22	1.22
Total	server to client	1.43	1.42	1.42
	client to server	1.24	1.23	1.23

Table 1. Average data rates (in Mbps) from testing conducted onboard USS Memphis.

Average data rates of 1.2 to 1.4 Mbps are achieved throughout the submarine with relatively small variations from one location to another [3].

The second objective was to evaluate the effectiveness of various wearable computers and handheld computers. It turned out that wearable computers (Xybernaut and ViA II) in their present form are not suitable for use in submarines. Hard disks carried on the waist belt may easily collide with the deck while climbing ladders or yielding to oncoming crew members in narrow passageways, causing them to crash. The third objective was to obtain crew feedback on the prototype software applications. Surveys conducted onboard indicated that the damage control and maintenance manager applications were desirable, the graphical interface was well understood at all levels of user experience, the boot cycle time required by Windows 95/98 devices was too long, and the instant on/off feature of Window CE devices was preferred.

References

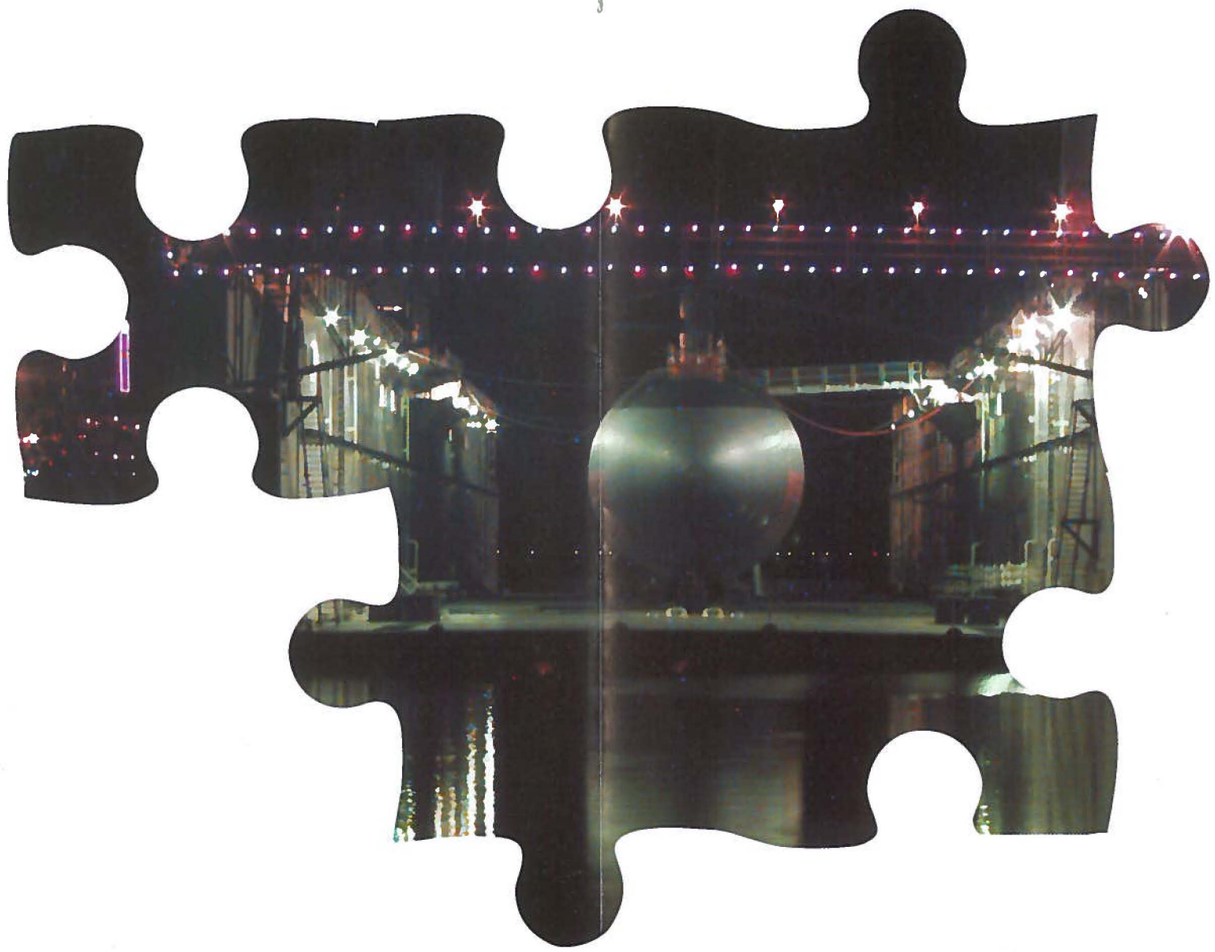
[1] Kurt J. Rothenhaus, "Distributed Software Applications in Java for Small Portable Processors Operating on a Wireless LAN," MS Thesis in Computer Science, Naval Postgraduate School, Monterey, CA, September 1999.

[2] Steven M. Debus, "Feasibility Analysis for a Submarine Wireless Computer Network Using Commercial-off-the-Shelf Components," MS Thesis in Electrical Engineering, Naval Postgraduate School, Monterey, CA, September 1998.

[3] Mark W. Roemhildt, "Analysis and Vulnerabilities of Spread Spectrum Wireless Local Area Networks on Surface and Sub-Surface Combatants," MS in Systems Engineering, Naval Postgraduate School, September 1999.

Pieces of the Puzzle

Student research in wireless networking



Research at the Naval Postgraduate School exists, first and foremost, to support the graduate education of its students. Research projects are designed to address current and future needs of the Fleet and Joint Forces, while at the same time, provide several thesis topics for student investigation. Large scale research initiatives at NPS are completed only because students tackle a focused, small scale issue within the overall project. Student theses are the pieces to the completed puzzle.

Analysis of Radio Frequency Components for Shipboard Wireless Networks
LT Mark M. Matthews, USN ('99)

Computers and computer networks are generally viewed as tools that allow personnel to increase productivity. However, due to the limitations of traditional local area networks (LANs), the Navy has not been able to efficiently leverage commercial computer technology for general shipboard applications. Recent advances in wireless LANs (WLANs) now permit mobile users to employ network applications to manage and share information. Mobile computers can be used by the crew to supplement damage control reports and reduce the strain on the over-taxed voice circuits. Watchstanders can make log entries into a central database that utilizes automated data trend analysis algorithms to detect deteriorating components and schedule maintenance to correct the problem prior to component failure. The advantages to using WLANs onboard Naval vessels are nearly endless.

This thesis evaluates commercially available wireless networking components for use onboard Naval vessels. Installing such equipment would enable mobile watchstanders to access services provided on LANs. The theories and principles governing the operation of WLANs are discussed. Then, current commercially available components are evaluated in a laboratory setting. Finally the promising component evaluated is tested in the hangar bay of an aircraft carrier and throughout the inhabitable compartments of a Los Angeles class submarine.

Distributed Software Applications in Java for Portable Processors Operations on a Wireless LAN
LT Kurt J. Rothenhaus, USN ('99)

As the wave of future information technology makes its way into the construction and design of new ships and submarines, it is imperative to examine methods to thoroughly economically backfit older platforms with similar technology. Affordable, commercial-off-the-shelf (COTS) industrial products have provided us with a means to reduce miscommunication and exponentially increase the availability of information via small pen-based computers operating on a wireless LAN. To take full advantage of the communications capabilities of these units and to fill the unique needs of the afloat Navy, the development of software applications is required. These software applications must be effective, tailored, and inexpensive if they are to be made available to older platforms. A distributed JAVA-based Intranet is the solution. The simplicity and economy of web-based software coupled with the power and functionality of pen-based computers creates a dynamic and effectual architecture.

Damage Control and Log Taking Java Applications for Shipboard Wireless LANs
1st LT Hanceri Sayat, Turkish Army ('99)

Damage control communications and watchstander log taking practices onboard submarines and ships need to be improved. Currently, damage control relies on a slow, error prone process involving sound powered telephone talkers and a grease pencil annotated white board. Log taking practice also suffers from similar problems. Logs are taken on paper forms, collected daily, and filed into cabinets. Wireless networks and mobile computing devices can be a solution to improve the efficiency of these practices.

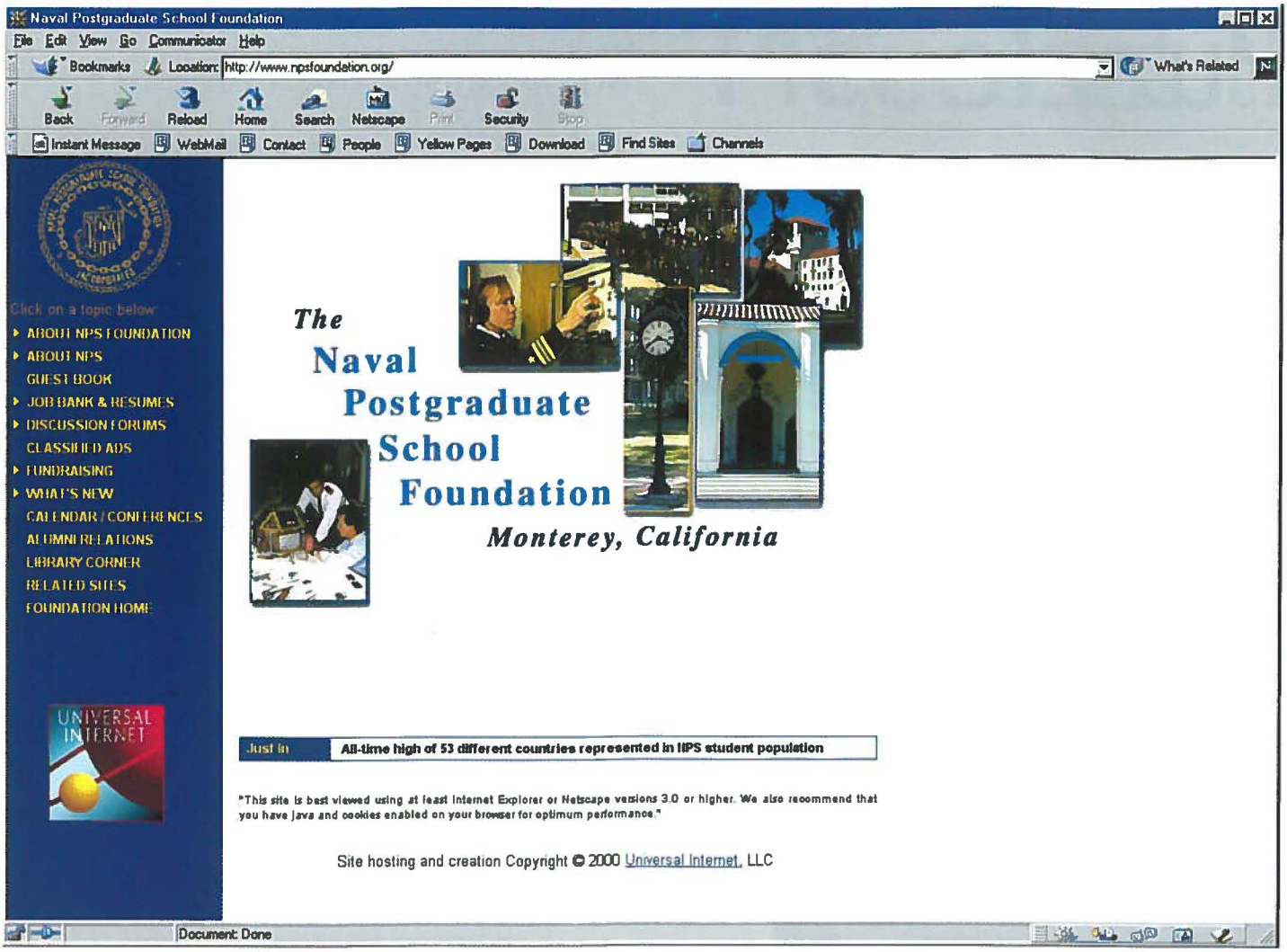
In this thesis, a distributed Java prototype software is developed to utilize the benefit of an onboard Intranet consisting of wireless LANs and pen-based handheld computers. For both practice areas, data could be entered into a handheld computer and then wirelessly transmitted to a database server. This data can be processed by powerful main platforms and different supervisors can review it at any time in parallel. An applet and a servlet program module are created to provide small, user friendly, platform independent electronic forms. Since handheld computers have some limitations like screen dimensions, computing power, and Java Virtual Machine, features of these software approaches are tested on a few different handheld computers to find the best software approach and computer product.

Analysis and Vulnerabilities of Spread Spectrum Wireless Local Area Networks On Surface and Sub-Surface Combatants
LT Mark W. Roemhildt, USN ('99)

This research effort discusses data transfer over Local Area Networks (LAN) that utilize a wireless transmission medium. The Wireless Local Area Network standard, IEEE 802.11, utilizes two major spreading schemes in the form of Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS) techniques. This thesis addresses and compares these two spreading schemes.

Naval vessels pose unique transmission difficulties due to the inherent multi-path environment within the skin of the ship as well as the security risks corresponding with the potentially hazardous area in which they must operate. Research was conducted in order to determine how effective and vulnerable an IEEE 802.11 compliant Wireless LAN (WLAN) network would be on a surface and sub-surface combatant.

WLANs also pose several vulnerability issues that may jeopardize the information being transmitted. This thesis addresses vulnerability and exploitability issues as well as security and encryption methodologies.



Alumni career services greatly enhanced with launch of the NPS Foundation's new web site

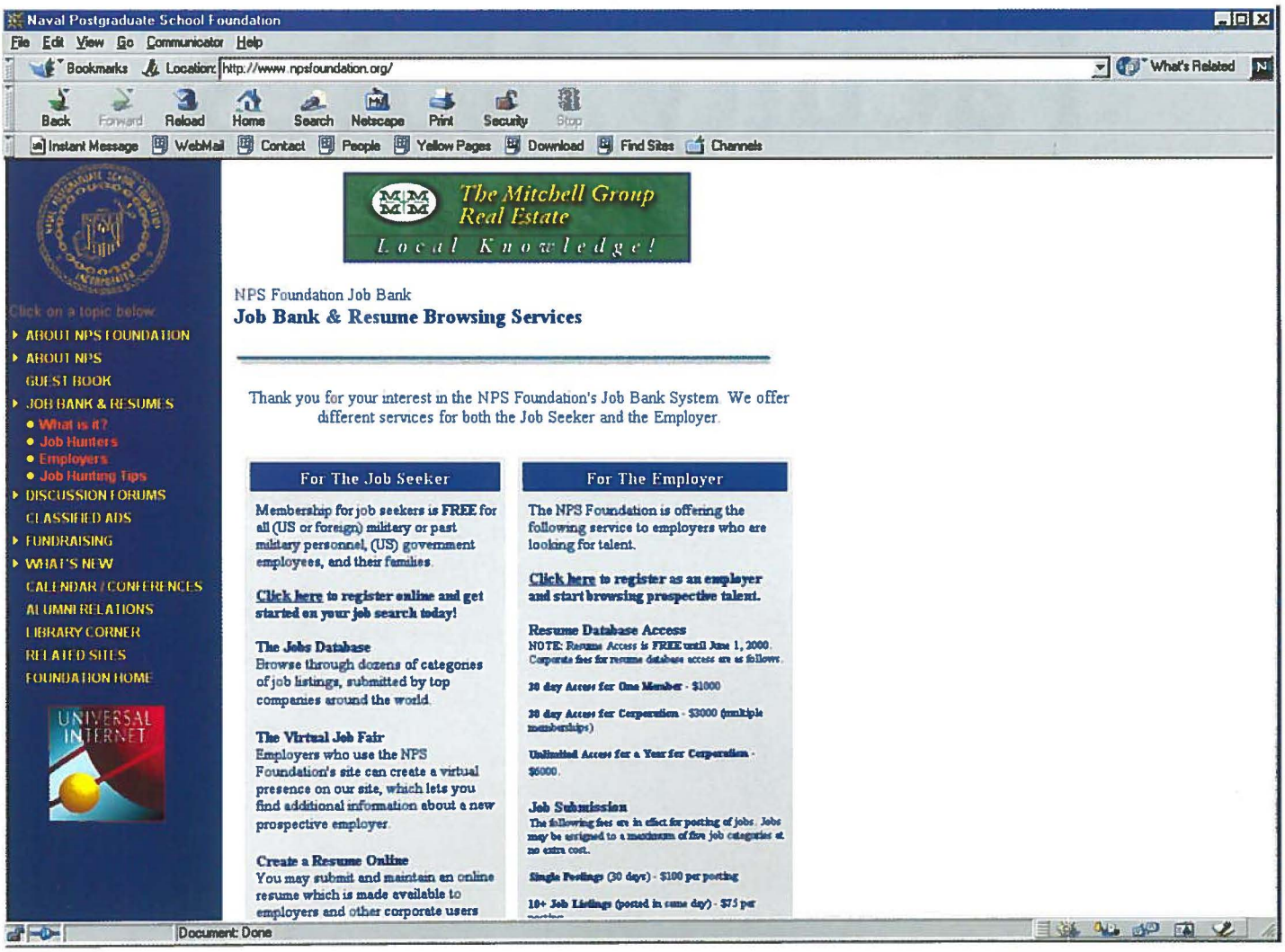
As of February 1, 2000, the Naval Postgraduate School Foundation's web site is up and running. This web site is the product of cooperation between the school, the foundation and Universal Internet. UI is headed by Brian Steckler (NPS '94, MS, Information Technology Management).

The web site address is www.npsfoundation.org. It offers great potential to provide valuable services to the school, alumni, and the corporations that elect to use the site. Happenings at the school will be posted on a regular basis. We expect that summaries of key thesis work and research projects will be posted in the future. There is a "Threaded Discussion Forum" to promote professional growth and interaction. There will be an extensive resume listing service for alumni, spouses, enlisted people, and veterans. Companies can list employment opportunities in a "job bank." They can also participate in sponsorship through ad banners or other advertising.

In sponsoring this web site, the NPS Foundation (a 501 C (3) non-profit corporation) hopes to help raise both the visibility of the school and funds to support the school in a variety of ways.

While operational now, the web site will become more sophisticated as time goes by. We encourage comments and suggestions to make the site even more useful to a wider audience. We would really like participation by as many alumni as possible.

Henry H. Mauz, Jr.
Admiral USN (ret.)
President, NPS Foundation



National Security Affairs' Professors Focus on Naval Strategy

Douglas Porch

James Wirtz

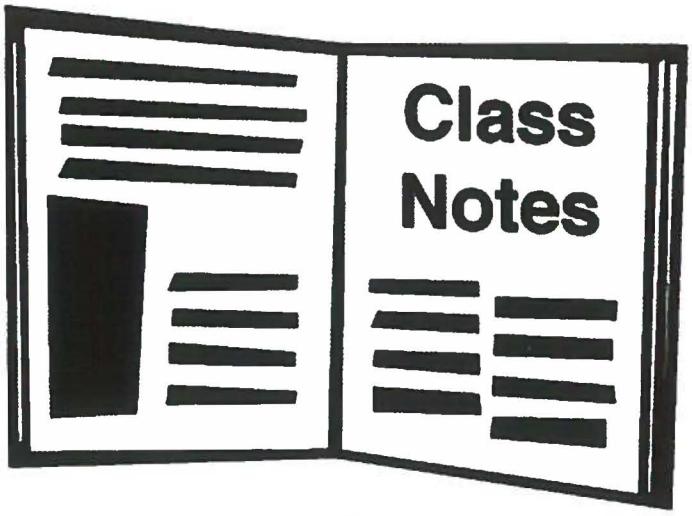
As part of an ongoing effort to help define strategic concepts for the Navy, Professor **Douglas Porch** and Associate Professor **James Wirtz** of the Department of National Security Affairs recently published articles dealing with two issues of interest to U.S. Navy strategists and planners. Sponsored by the Office of the Chief of Naval Operations (N3/5), their work focused on the future of carrier battle groups in an era of improving missile technology and on the impact of the Revolution in Military Affairs (RMA). In "The Taiwan Strait Crisis of 1996: Strategic Implications for the United States Navy," published in the Summer 1999 issue of the Naval War College Review, Professor Porch explores how the movement of U.S. Naval units influenced the behavior of the Chinese government. Porch takes exception with those who exaggerate the impact U.S. intervention had on the course of the crisis and warns that improving Chinese area denial capabilities could further reduce the political influence of the deployment of U.S. Naval forces in the region in times of crisis. In "QDR 2001: The Navy and the RMA," Professor Wirtz evaluates evidence for the existence of a so-called Revolution in Military Affairs and assesses the way technological change might alter Navy strategy and maritime threat environments in the years ahead. Published in the Autumn 1999 issue of the National Security Studies Quarterly, the article assesses the way the potential impact of the RMA has been considered in recent Navy war games. Wirtz also offers suggestions about how Navy leaders might portray the Navy's response to the RMA in the upcoming Quadrennial Defense Review and develops a framework for thinking about Naval strategy that highlights the importance of placing technological change in a political and strategic context.

Faculty Notes

Mechanical Engineering Professor Flies Backseat

NPS faculty sometimes have to get very involved with their research projects on a personal basis in order to obtain the necessary data to complete the project. Professor Morris Driels, Department of Mechanical Engineering, does research with the Joint Munitions Effectiveness Manuals in connection with target acquisition using visual and FLIR sensors. In order to be able to experience the use of optical aids and FLIR sensors first hand, he undertook water survival and aviation physiology training to enable him to fly "back seat" in U.S. Navy aircraft. So far he has flown with VS-35 at NASNI-San Diego, but flights with F18s are anticipated.

Morris Driels (left)



Class of 1964

Retired US Marine Corps **LtCol Thomas J. Smyth** is now employed as a senior manager with the Hawaii Department of Business.

Class of 1972

Retired **CDR Terrance E. Anderson** retired from his second career after 20 years with Boeing. Anderson says his job now is having fun with his grandchildren, a little free enterprise, and spending time with his wife of 34 years.

Retired **CDR Norman T. Camp** went on to receive his Ph.D. in Oceanography in 1976, retiring in 1983 after 20 years active duty. He has since worked on Navy research and development projects, and was Vice President of several R&D firms. He is now fully retired.

Retired **CAPT Richard A. Payton** is currently employed as a healthcare executive for the University of Florida, Jacksonville.

Class of 1973

Retired US Army **LTC Richard A. Corradini** is presently employed with a base operations support contractor as the Facilities Engineering Department Manager providing public works / maintenance support for military installations.

Class of 1974

Retired **CDR Kent H. Killam** is now a professor of computer science and information technology at Hawaii Community College in Hilo, HI.

Class of 1976

Retired **LCDR Paul F. Van Tassel** is currently employed as the Manager of Test and Planning, Lockheed Martin Government Electronic Systems.

Class of 1977

US Marine Corps reserves **Col Kenneth D. Watts** is now a business development manager for Raytheon Systems Company in Huntsville, AL. For the reserves, he is an adjunct faculty member at the Marine Corps Command and Staff College in Quantico, VA.

Class of 1979

US Coast Guard **CAPT Ronald D. Reck** is currently the Deputy Commander, Coast Guard Maintenance and Logistics Command in Alameda, CA.

Retired **CDR Onedia Hayes Sylvest** is now the Associate Director of Computing and Information Services for Texas A & M University.

CAPT David W. Willmann is now serving as the Senior Navy Representative at the Army War College. He also performs faculty duties for the college.

Class of 1981

Retired **LCDR Christopher K. Fair** works as a support contractor to several NAVSEA program offices, primarily with PEO Mine Warfare and the CVNX program.

Retired **CDR William A. Weronko** is now the plant manager for Aurora Pump in Illinois, a division of Pentair.

Class of 1982

Retired **CDR Dennis R. Ferrell** is now employed as a pilot with Federal Express.

Class of 1983

After 29 years active

Getting Involved

The Naval Postgraduate School now has well established chapters in Washington, D.C. and Canada, and is proud to announce new chapters in both Chicago and San Diego. If you are interested in joining these chapters, contact the alumni representative listed below. If you are interested in helping start a new chapter in your area, send us an e-mail at alumni@nps.navy.mil

Washington, D.C. -
CAPT Robert R. Osterhoudt, USN (ret.)
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LCDR Sean Midwood
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'98 grad wins AIAA/NPS award

The 1999 recipient of the Admiral William Adger Moffett Award is CDR **Christopher W. Rice, USN**. The award is presented annually to an officer student in the Aeronautical Engineering program on the basis of academic excellence, including thesis and career potential. The American Institute of Aeronautics and Astronautics and the Naval Postgraduate School jointly sponsor the award.

CDR Rice enlisted in the U.S. Navy in 1976 and received his commission from the U.S. Naval Academy in 1983 with a B.S. in Aerospace Engineering. After designation as a Naval Aviator in May 1985, he reported to Fighter Squadron One Hundred One for fleet replacement training in the F14A. He graduated from the U.S. Air Force Test Pilot School at Edwards Air Force Base in June 1990. He completed his master of science degree in aeronautical engineering in March 1998 and his aeronautical engineer degree in September 1998 at the Naval Postgraduate School. He is currently serving as the Executive Assistant to the Commander, Naval Air Warfare Center-Weapons Division at China Lake, California.

CDR Chris Rice accepts the award along with his family and NPS Superintendent RADM Robert C. Caplin.

duty, retired **CAPT Steven G. Slaton** is now a senior operations analyst at Concurrent Technologies Corporation in Bremerton, WA.

Class of 1984

Retired **CDR Paul R. Dauphinais** is now the President of York County Technical College in Wells, ME.

Retired **CAPT William L. Sheppard** is now a business development manager working with international customers at Raytheon Naval and Maritime Systems in Rhode Island.

Class of 1985

Retired **CDR Wendy L. Bradfield-Smith** now works part-time as a financial planning assistant, and as a consultant on meteorological and oceanographic equipment.

CAPT Brian G. Brannman is currrently serving as Commanding Officer, Naval Hospital Okinawa.

CAPT Kevin Carnan is now the serving as Commander, Defense Finance and Accounting Service, San Diego.

Retired **LCDR Thomas P. Dolan** recently joined the faculty of Georgia State University in Atlanta as part of the political science department.

Retired **CDR Lawrence E. Hess** is currently working as a department manager, Tactical Systems Division in support of PMS 461 (Advanced Combat Direction System / Ship Self-Defense Systems Program Management Office.)

Class of 1986

Reserves **CDR Andrew T. Crepea** works as an operations research analyst with the Naval Air Systems Command in Patuxent River, MD.

US Army **LTC Steven R. Mirr** recently completed command of a mechanized infantry battalion. He is now assigned to the Land and Littoral Warfare Assessment Division of the Joint Staff.

Royal Thai Air Force Reserves **CAPT Surasek Mungsing** is now a lecturer in the department of Computer Engineering at Sripaturn University in Bangkok.

Class of 1987

Retired **CDR Brooks P. Merritt** is now working

as a contracts and finance manager for Rolands and Associates Corporation in Monterey.

Retired **CDR Shawn T. O'Rourke** is now the Vice President for Integrated Computer Engineering Inc. in Campbell, CA. His primary focal areas are program management and process improvement in both federal and commercial software intensive system acquisitions.

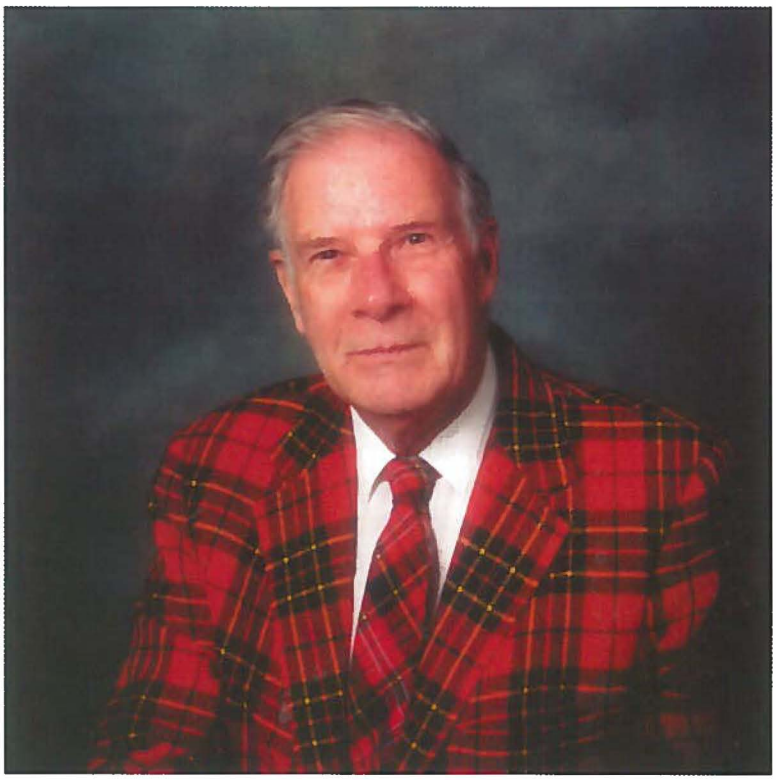
CAPT Mark G. Wahlstrom is currently serving as the ACOS for training and exercises for the Commander, Second Fleet / Striking Fleet Atlantic and was recently screened for Major Command Afloat Cruiser-Destroyer List. Mark is responsible for training carrier battle groups and amphibious ready groups deploying from the east coast. He anticipates being detailed to command an AEGIS cruiser later this year.

Class of 1988

CDR Marvin Heinze is currently completing a federal executive fellowship with the National Defense Research Institute at RAND in Santa Monica, CA. His primary research is supporting an assessment of domestic preparedness for dealing with weapons of mass

Award created in honor of Dr. Richard Hamming

Through the generosity of Mrs. Wanda Hamming and other significant contributors, the Naval Postgraduate School Foundation has been able to establish two meaningful awards for the NPS faculty. One award, the Hamming Award for Interdisciplinary Achievement, will recognize each year one faculty member who has made important contributions involving more than one academic discipline. That initial level of the award will be $2,500.00. The other award will be the Hamming Award for Excellence in Teaching, which will compliment the existing Rear Admiral John Jay Schieffelin prize for teaching excellence. Each of these newly established Hamming awards represent an effort by the Foundation to recognize the outstanding faculty at NPS.



The late Professor Richard Wesley Hamming was a renowned scientist and engineer whose accomplishments led directly to major breakthroughs of great benefit to the United States. He did important work at the Manhattan Project at Los Alamos. At Bell Telephone Labs after the war, he made discoveries in information coding that are now used in every computer, CD-ROM and computer network. He developed the Hamming method of integration and the Hamming filters that are central to a variety of signal processing techniques. After retiring from Bell Labs in 1976, Dr. Hamming accepted a faculty position at the Naval Postgraduate School in the Computer Science Department. He also taught in the departments of Electrical Engineering, Computer Engineering and Mathematics. He remained at NPS until his death in 1998. His teaching embodied the same creativity and spirit of innovation that marked his life. It is fitting that the Hamming Awards be established as a lasting tribute to this great American.

destruction.

US Marine Corps **LtCol Michael J. Roderick** is now on the Navy Warfare Development Command Staff at the Naval War College.

Class of 1989

CDR James V. Jarvis is currently a student at the Senior Air War College at Maxwell AFB in Alabama.

CDR Robert P. Murphy is currently serving as the Comptroller for the Commander, Submarine Force, US Pacific Fleet (COMSUBPAC) in Pearl Harbor, HI.

Class of 1990

US Marine Corps **Maj Peter C. Reddy** is currently serving in the command, control and communications department for the Marine Aviation Weapons and Tactics Squadron One.

Class of 1991

After completing his XO tour aboard on AEGIS equipped destroyer, **CDR Randall M. Hendrickson** is now the requirements officer for the Navy Theater Wide Tactical Ballistic Missile Defense program.

CDR Evan Jones is currently serving as the National Reconnaissance Office liaison officer to the US Pacific Command.

Class of 1992

Retired US Marine Corps **Maj Robert Gregory** recently retired and is now a communications engineer for Adroit Systems, Inc. in Alexandria, VA.

Reserves **LCDR Scott A. Morgan** now lives in the UK working for BP Amoco Shipping as the procurement manager.

South Korean Army **MAJ Hyun K. Park** is currently studying for his Ph.D. in computer science at the Korea Advanced Institute of Science and Technology.

Thor Simensen is currently employed with Lockheed Martin Corporation in northern Virginia.

Canadian Air Force **CAPT Ron Stockermans** is now a project manager at Hermes Electronics, designing and building low frequency active sonobuoys.

Taiwain, R.O.C. Navy **LCDR Chun-Wei Wang** was awarded his Ph.D. in mechanical engineering from Rensselaer Polytechnic Institute in 1998, and is now an Associate Professor at Chung-Cheng Institute of Technology.

Retired **CDR Michael W. Zabarouskas** now works for Digital Systems International Corporation performing simulation modeling.

Class of 1993

LCDR Rena Loesch is now the communications officer for Commander Carrier Group Eight.

LCDR Stan Pendergrass currently serves as the logistics officer at Commander, US Naval Forces Southern Command at Roosevelt Roads, Puerto Rico.

Retired US Marine Corps **LtCol Ken Sweltz** is now a senior project engineer for Concurrent Technologies Corporation in Johnstown, PA. He is working on networking, software engineering and information security issues.

Keem B. Thiem is now the project manager for the Infrared Sensor Stimulator Project (IRSS), a joint Air Force / Navy program.

Class of 1994

Retired **LCDR Larry E. Arkley** is currently the controller for Evergreen Air Center in Tucson, AZ.

LCDR Lance Hernandez is assigned as the IPT lead for S-3B acquisition projects at the Naval Air Warfare Center in Patuxent River, MD.

Class of 1995

Michael Downs is now an implementation manager for Intel Online Services.

David R. McDermitt is currently employed as a senior software engineer at Science Applications International Corporation (SAIC).

US Marine Corps **LtCol Paul J. Warhola** is now a military analyst and Marine Corps Representative to the Office of the Secretary of Defense, Program Analysis and Evaluation, Joint Warfare Systems Program Office.

Class of 1996

William F. Beaver is now the program team leader for the CH-60S AMCM demonstration program at Sikorsky Aircraft in Connecticut.

LCDR Timothy P. Callaham is now the Chief Engineer onboard USS Cape St. George (CG-71).

US Air Force **Maj Brian Hobbs** is now teaching Chinese and Japanese at the Air Force Academy in Colorado.

US Army **MAJ Kenneth Rodgers** is now serving at the Space and Missile Defense Command in Hunstville, AL.

US Army **MAJ Robert K. Armstrong** is now the Modeling and Simulation Officer for the Marine Corps Air Ground Combat Center in Twentynine Palms, CA.

Class of 1998

Brazilian Navy **CDR Ataide R. Braga** is now the import and export director for the entire Brazilian Navy.

LT Scott Swords is now serving as the electronic warfare officer / command control warfare officer for Commander, Carrier Group Two, part of the USS Harry S. Truman battle group.

Class of 1999

LT John W. Bailey is currently assigned to the Naval Force Aircraft Test Squadron as a Test NFO.

US Army **MAJ Robert M. Cornejo** now attends the Singapore Armed Forces Command and Staff College.

US Marine Corps **Maj Fritz V. Doran** is now the engineering branch head for the ground systems division at the Marine Corps Tactical Systems Support Activity in Camp Pendleton, CA.

US Army **CPT Mark M. Herrin** is currently assigned to the Defense Supply Center in Columbus, OH.

LCDR Thomas G. Williams recently reported as the department head in charge of intelligence applications at the Navy and Marine Corps Intelligence Training Command.

What's Inside

Researchers at NPS are examining the possibility of installing Wireless Local Area Networks onboard submarines and surface ships, increasing the dissemination of information to every crewmember on the boat. Learn more in our feature story, Wireless (page 2).

Alumni career services have been greatly expanded with the launch of the NPS Foundation web site. On the site, alumni can post their resumes, search through a database of open positions in the defense industry, and participate in discussion forums (page 12).

See what your fellow alumni are saying, and doing. Check out the Class Notes section (page 16).

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