More than a UNIVAC Customer!

Donald Lyle Ream

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Prologue

Donald Ream passed away April 8, 2014. Several retired US Navy officers and a couple of retired UNIVAC/Sperry executives resolved to honor Mr. Ream and his place in computer systems' history with an initiative to get a United States ship named for him. This Information Technology (IT) Legacy paper primarily consists of the nomination letter and a supporting nomination paper, which were jointly prepared then sent to the Secretary of the Navy via a US Senator's office. The SECNAV office reply is copied at the end of the epilogue.

Nomination Letter

Xx October 2014

To: Secretary of the Navy Ray Mabus
1000 Navy Pentagon
Washington, D.C. 20350-1000

Subject: Name a US Navy ship "Donald L. Ream"

Via: The Honorable John S. McCain

In 1956 at the behest of the then Chief of Naval Operations, Admiral Arleigh Burke, the Bureau of Ships began development of the Naval Tactical Data System (NTDS)[1] as a formal project. With completion of the Service Test of the system in three Navy ships in 1962, the project delivered the first successful shipboard, computer-automated system to the U.S. Navy. While many people and U.S. companies contributed to the project's success, Mr. Donald L. Ream was the chief engineer and the guiding light in digital computer technology for the Navy. Don Ream retired from the Naval Sea Systems Command in 1982, and died on April 8, 2014 in Tempe, Arizona. The enclosed nomination paper summarizes his career and its influence. What follows in this cover letter is a discussion of some of the groundbreaking changes in performance and tactics that were enabled by the successful application of digital computer systems to naval warfare.

[1] *When Computers Went to Sea - The Digitization of the United States Navy* – compiled by Capt. David L. Boslaugh, USN ret.

The NTDS brought about a revolution in the conduct of anti-air warfare. Very early in the Vietnam War it was realized that the NTDS equipped ships were the only ships with the capability to carry out the demanding task of managing the Positive Identification Radar Advisory Zone (PIRAZ). Stationed in the center of the Gulf of Tonkin, midway between the carriers and the port of Haiphong, the PIRAZ ship monitored and controlled ingress and egress of all air sorties from the gulf over North Vietnam.

NTDS ships were the only ships equipped with the NTDS digital communications LINK 11 that provided them with the ship-to-ship coordinating capability to reliably engage and make missile kills of North Vietnamese aircraft. Over the course of the war, four NTDS equipped ships brought down 11 aircraft. The NTDS air-intercept control module was used to conduct thousands of fighter intercepts of which almost 10% were combat intercepts. The outstanding performance of Chief Operations Specialist Larry Nowell, serving aboard both the missile frigate Mahan and the missile cruiser Chicago on PIRAZ station, facilitated by the NTDS computer system which helped him control more than 1,500 NTDS supported intercepts by Navy and Air Force fighters. More than 100 of these were live combat intercepts resulting in 13 North Vietnamese aircraft kills. He was also credited with saving four USAF F-4 Phantom fighters, almost out of fuel, using NTDS to expeditiously direct tanker airplanes to them. Chief Nowell's outstanding achievement was one of many that were made possible and his performance became the new norm in NTDS equipped ships.

Two decades later, Rear Admiral Thomas F. Marfiak, who was the Anti-Air Warfare Coordinator for the Arabian Gulf Battle Force during Operation Desert Shield and Operation Desert Storm while commanding the guided missile cruiser Bunker Hill wrote: "In many ways, Link 11 and NTDS reached their summit during these two operations. They performed admirably throughout, providing real time information to a far-flung battle force during a time of great importance to our nation. In that regard, generations of technicians and engineers, who worked tirelessly to provide us the tools, can take great pride".

NTDS was also applied to anti-submarine warfare beginning with the experimental Anti-Submarine Warfare Ship Command and Control System (ASWSCCS) that was installed in three test ships in early 1967. At sea testing in 1968 proved the efficacy of NTDS in this role. Before NTDS, the two-ship ASW attack was the only way to achieve high probability of a submarine kill; with NTDS the successful single-ship attack became commonplace. As a result, ASWSCCS formed the basis of the combat direction systems in the 31 ships of the Spruance Class destroyers, the 55 ships of the Oliver Hazard Perry Class of guided missile frigates, as well as in later ship classes. NTDS revolutionized the conduct of anti-submarine warfare (ASW).

The Naval Tactical Data System provided many positive contributions to the U.S. Navy. NTDS equipment and computer programming standards were used in hundreds of later weapon system projects ranging from the Automated Carrier Landing System to the AEGIS Combat System. For example, AEGIS, the most evolved shipboard weapon system to date, began its development in the late 60s with NTDS computers, displays, the NTDS/NATO data link 11, and operating system software (an NTDS cruiser computer

program). AEGIS improved the overall ship's combat system by tightly coupling the ship's radars and weapons systems to the command system.

Other contributions include the Marine Tactical Data System that used modified NTDS computers, and the P-3C Maritime Patrol Airplane that used modified NTDS computers in the first automated airborne anti-submarine warfare system.

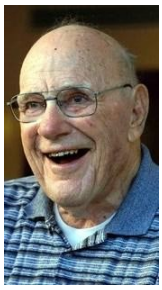
None of this would have been possible without the early innovations and technical/managerial leadership of Donald L. Ream who championed the digital computer throughout the 50s and 60s in the face of stiff opposition. Many people in government and industry at that time saw no use for computers, envisioning them mainly for use in research labs and universities, but Mr. Ream persisted, successfully!

It is strongly recommended that a U.S. Navy ship be named "Donald L. Ream" in honor of his engineering guiding light that brought the US Navy into the digital age.

/s/
(Arizona Constituent)
Enclosure: Nomination of "Donald L. Ream" as a name for a US Navy ship

Nomination Paper

NOMINATION OF "DONALD L REAM" AS A NAME FOR A U.S. NAVY SHIP



This is a request to name a U .S. Navy ship in honor of Donald L. Ream. Donald Lyle Ream was the driving force that brought US Navy tactical and strategic weapon systems into the information age decades before the US industry in general. (Photo from an on-line obit at Dignity Green Acres Mortuary, Scottsdale, AZ – April 2014.)

In 1954 the highest levels of leadership in the U.S. Navy were concerned about the future viability of the Navy's surface fleet. Fleet exercises with massed Soviet style practice air attacks against U.S. task forces had revealed that World War II style manual plotting teams could not support fighter, gun and missile direction at a pace fast enough to adequately defend forces afloat. The high speeds of new jet propelled attack aircraft allowed too many attackers to break through to fleet center; thus, in war game exercises task forces were theoretically annihilated.

In April 1956, the Chief of Naval Operations tasked the Bureau of Ships (BUSHIPS) to develop an automated system to correct this problem with fleet anti-air battle management. It would be called the Naval Tactical Data System (NTDS) and the new BUSHIPS NTDS project office was expected to do in five years, what normally took 15 years of development time. The heart of this radical new command and control system were what would become the Navy's first shipboard digital computers, and a young Bureau of Ships engineer, Donald L. Ream, was assigned the job of developing the new computers. His task was to transistorize the Navy's super secret, room-filling, vacuum tube based digital, code

breaking, computers to make them small enough to fit into a shipboard compartment, and to survive in an at-sea environment.[2] Mr. Ream prevailed against seemingly impossible technical odds. The resulting Naval Tactical Data System was later adjudged one of the most successful projects ever undertaken by the U.S. Navy to that time, as verified by a number of reviews including a 1964 case study of the project by the National Academy of Sciences. This study singled out Don Ream as one of the principal contributors to project success.

Ream was no stranger to the Navy. In 1944, Ensign Ream was posted to the nine-month long radar school at Harvard University/MIT. While there he conversed from time to time with a young WAVE officer, Ensign Grace Hopper, who showed him the huge Harvard/IBM Mark I electromechanical computer she was learning to program. Fascinated, he decided he would someday learn more about these computing machines. After radar school, Ream became electronics officer of Motor Torpedo Boat (PT) Squadron at Mindoro in the Philippines. Later, he was assigned as electronics officer of the minesweeper tender USS Chimo until his Navy discharge in June 1946.

Mr. Ream returned to the College of William and Mary where he had earned a degree in chemistry, had been elected to Phi Beta Kappa and had played first-string football in 1941-42. This time he was awarded a degree in mathematics, which led to Don being recruited to join the Navy's central code breaking group at the Communications Supplementary Activity Washington (CSAW) on Nebraska Avenue in Washington, D.C. At CSAW he was assigned the challenging task of keeping a number of specialized electronic code breaking devices in running order. Then, in 1950 when the Navy was experimenting with using the very new technology of general-purpose digital computers for code breaking, Ream was assigned to the project that was building the Navy's first code breaking computers, the Navy Atlas series of top secret devices were designed and built with thousands of vacuum tubes. In 1952 he was sent to England for six months to work with the British counterpart to the newly formed National Security Agency (NSA). There he worked with a number of British digital computing mathematicians and engineers including code breaking and computing pioneer, Alan Turing.

In 1955, Ream was recruited to the Computer Design Section of the Bureau of Ships, also based at the Nebraska Avenue site, and put in charge of the Atlas code breaking computer project. There he was subsequently given the task to not only develop the new transistorized shipboard NTDS computers, but to also provide transistorized computers for the shore based Navy Operational Control Center Project. Don spent the next several years involved in detailed conceptual and technical design of these computers and in guiding the primary contractors building these machines: Remington Rand Univac and Control Data Corporation (CDC). Subsequently, he managed system design and installation of the CDC computers as the first digital systems in the Hawaii and Norfolk, Va. Fleet Command Centers. At that time, they were the largest multicomputer systems in existence.

[2] IEEE Press, 1999: *When Computers Went to Sea - The Digitization of the United States Navy* – Capt. David Boslaugh, USN (ret)

By 1963 Ream was in charge of both the BUSHIPS Computer Design Section and the Bureau's Strategic Command and Control Systems Management Office, which was the strategic counterpart of the NTDS project office. In the latter position he was responsible for systems engineering of the National Emergency Command Post Afloat and the Fleet Flag Data System. Don later took over the BUSHIPS Combat Systems Management Office, which included the NTDS project as well as strategic system projects.

During these many years of managing the Bureau's digital tactical and strategic systems projects Don Ream was in charge of developing four generations of Navy tactical computers. Specifically, he wrote the specifications and managed the engineering and development of the following:

- The AN/USQ-17 transistorized prototype NTDS computer used in the shore based NTDS tests.
- The CP-642A[3] and B computers were the first fully militarized shipboard computers. The Naval Tactical Data System, Marine Corps, foreign navies, and NASA used many hundreds of these.
- The Control Data Corporation 1604 computer, that was first installed at the Naval Postgraduate School, Monterey, CA, for use by students and the Fleet Numerical Weather Center.
- The Ramo-Wooldrige AN/UYK-1 computer; the first successful, small word length, general purpose, fully militarized computer.
- The CP-667 shipboard computer, the first large scale militarized computer using integrated solid-state circuits. In 1967 it was the most powerful computer in Navy inventory.
- The AN/UYK-7 computer, an integrated circuit, militarized, next generation Navy standard computer, was used in all shipboard combat systems designed after 1975.
- Four generations of militarized shipboard peripheral data processing equipment including magnetic tape drives, control stations, data input keysets, high speed printers, digital data converters, display systems, and disk memories.

In 1969 Don Ream and his NTDS office accepted the responsibility to develop the application of general-purpose digital computers into the new Los Angeles class of fast attack submarines using the AN/UYK-7 computer. By the 1980s this system was being back-fitted into every USN fast attack submarine, which became the model for the command and control system designed for the Ohio Class ballistic missile submarine.

Mr. Ream was also advisor to the Polaris Missile System Project for development of their submarine-based fleet Digital Geoballistic Computer (DGBC) which provided targeting input to the nuclear missiles. He also served as project engineer for a BUSHIPS contract in support of the National Security Agency's 'Project Lightning,' a multi-contractor R&D effort to raise the basic clock rate of computers from one megacycle to 1000 megacycles. In addition, he trained and educated generations of naval engineering duty officers and civilian engineers not only in the technology of digital systems engineering, but also in the ever changing details of effective system design and systems acquisition management.

[3] Seymour Cray did some of the circuit and logic design for the AN/USQ-17 and CP-642A before becoming renown in his own right at Control Data Corporation and Cray Engineering, Inc.

In 1974 Mr. Ream was awarded the American Society of Naval Engineers Gold Medal for his significant contribution to naval engineering. The citation read in part: "Although many people have been involved in and contributed much to the development of the NTDS, the soundness of the overall system design and the enviable record of reliability and maintainability which has been achieved under combat conditions can be largely attributed to his technical leadership through the development and Fleet introduction of the system. Of great importance to the future Navy, Mr. Ream solely spearheaded the successful development of the AN/UYK-7, the next generation shipboard multi-processor computer and the micro-miniaturized computer, the AN/UYK-20. He personally developed the specification for, and the rationale behind the design of the modular, advanced computer which made possible for the first time the design of a fully integrated combat system for our complex multi-mission warships and its inclusion in new ship designs and other military projects for the future. Mr. Ream is recognized as the outstanding authority in this country, and perhaps the world, on military computers and their applications to real-time data systems." Don Ream was advanced to the Federal Executive Program (GS-16) in 1979 and retired from the Naval Sea Systems Command in 1982. He died on April 8, 2014 in Tempe, Arizona.

In March of 1981[4] the Navy did a Fleet wide assessment of Univac's tactical computer reliability with the following MTBF results: CP642B @ 4,128 hours, AN/UYK-7 @ 2,528 hours and AN/UYK-20 @ 12,096 hours.

Following Mr. Ream's death, one of the corporate executive officers who had worked with Ream as a young engineer during the development of Navy tactical computers in the late 1950s, wrote the following: "I am just one of many people from Sperry Univac who worked as a contractor for the Navy who came to know and have great respect for Don. We had the privilege of working with him over a period of nearly two decades. He was a tough manager of his contractors but treated them (us) with kindness and the greatest respect. We knew he always had the best interest of the Navy at heart. He will remain in my memory as one of the very best of persons whom I have been associated with over my working career."

Don Ream was more instrumental than any other person in bringing the U.S. Navy into the information age decades ahead of the other industries! Don's guidance led the Navy to making maximum use of the new digital technology that gave the USN a great advantage during the "Cold War" years. What Rear Admiral Grace Hopper was to Navy business, administrative, and financial computing systems, Don Ream was to tactical and strategic digital weapon systems. However, because his work had to be done in far greater secrecy, his contributions were well known only to those who had a need to know. We, who served with him in the Naval Tactical Data System, Operational Control Centers and subsequent projects, recommend strongly that a U.S. Navy ship be named "Donald L. Ream" in his honor.

[4] *When Computers went to Sea*, page 372 - Also cited in *Semiconductors at UNIVAC,* page 27- by B. N. 'Mike' Svendsen; a history paper created at the request of Dr. Tom Misa, Director of the Charles Babbage Institute at the University of Minnesota, July 2013; http://vipclubmn.org/Articles/UnivacSemiconductorPaper.pdf.

Epilogue

The Nomination participants are:

- Principal author – Captain Donald Leichtweis [USN, retired]
- Legacy paper editor – Lowell A. Benson, BEE 1966 U of MN, UNIVAC 1960 => UNISYS '94.
- Retired UNIVAC executives – James Rapinac and David Kolling
- Retired US Navy officers – Capt. David Boslaugh, Capt. Carl Drenkard, and Cmd. Charles Alcon.

Mr. Ream's teams had a philosophy of standardization and normalization so that if a technician or programmer could work with one instruction set architecture, he/she could readily transition to an ensuing computer model. The text below this computer model set describes ISA re-use emanating from the 'Navy Standards Program.'

Don Ream epoch Navy computer models at the Lawshe Museum in S. St. Paul, MN.

Nomenclature	1st Delivery	Qty	Notes – models left to right.
AN/USQ-17	Mar. 1958	6	30-bit word length, 8 microsecond 16k word memory
CP-642A*	Sept. 1961	143	30-bits, 8 *u*sec 32k word memory, germanium circuits
CP-642B	Feb. 1963	239	30-bits, 4 *u*sec 32k word memory, silicon transistors
CP-667	Feb. 1964	3	36/30 bit, 2 *u*sec 131k memory, integrated circuits (IC)
CP-789**	Apr. 1963	326	18-bit, 4 *u*sec 16k memory, used 642B PC cards
CP-808	Sept. 1964	19	**MTDS version of CP642B**; 30-bits, 4 *u*sec 32k memory.
CP-848***	May 1965	367	18-bit, 2 *u*sec 32k memory
CP-855****	July 1965	120	30-bits, 2 *u*sec 32k memory, hardware floating point
CP-890*****	June 1967	164	30-bits, 1.8 *u*sec 64k memory, IC logic
AN/UYK-7#	April 1969	3,000+	32-bits, 1.5 *u*sec 48k memory, IC, multi-processor units

*The 30-bit Instruction Set Architecture (ISA) became the ISA for the UNIVAC/Sperry 490 computer series, the Navy's CP-901 airborne ASW computer aboard the P-3C, the German Navy 1830B coastal patrol boat processor, the Marine Corps' AN/UYK-8, and the FAA's IOP major airport Air Traffic Control computer.

**Identification Friend or Foe (IFF) pre-processor, subsequently used by FAA for their first Automated Radar Terminal System and by JPL for space age telemetry processing – UNIVAC type 1218. Also, the ISA for the UNIVAC/Sperry 418 computer series and the AF AN/UYK-11 Minuteman launch/control processors.

***Used for Tarter, Terrier, and Talos shipboard missile launch and control – UNIVAC type 1219.

****Used by NASA and the AF for early mission control and satellite tracking – UNIVAC type 1230.

*****Used for Trident submarine navigation.

#The 32 bit ISA was also used in the AN/AYK-10 aboard the Navy's S-3A carrier based ASW aircraft, for the Canadian AN/AYK-502 Aurora CP-140 ASW aircraft, and the US Navy's AN/UYK-43 computer.

The AN/UYK-20 was not modeled - it had a 16-bit micro-programmed logic of the AN/UYK-15 ISA. This 16-bit ISA extended into the Navy's airborne AN/AYK-14; the ASA, AF, and NASA AN/UYK-23; the Sperry type 3760 communications processor; the Navy's UYK-44 & USQ-69; and the Canadian UYK-502 & UYK 505. *LABenson*

DEPARTMENT OF THE NAVY
OFFICE OF THE SECRETARY
1000 NAVY PENTAGON
WASHINGTON DC 20350-1000

October 23, 2014

Mr. Jeffrey A. Leas
55806 N. 330th Avenue
Wickenburg, AZ 85390

Dear Mr. Leas,

Thank you for your recent letter requesting a new ship be named for Mr. Donald L. Ream, a chief engineer and leader in digital computer technology for the Navy. I am responding on behalf of the Secretary of the Navy.

The Secretary appreciates the interest of all who participate in the ship naming process and gives careful consideration to all suggestions. Mr. Ream, selected the Outstanding Naval Engineer for 1974, has certainly left his mark on naval warfare and is a worthy candidate. Your recommendation will receive every consideration when names are chosen for future ships.

If I can be of further assistance, please do not hesitate to contact me.

Sincerely,

Sarah Self-Kyler
Commander, U.S. Navy
Special Assistant for
Public Affairs to the
Secretary of the Navy