Bushipe Role in Navy Communications in the Space Age

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The U. S. Navy has always been and will continue to be, in the forefront of communications developments.

The science of radio communication owes an everlasting debt to the U. S. Navy. Not only have Navy service and civilian personnel contributed to the technical development of radio; the Navy has also encouraged private inventors and industrial corporations to persevere in advancing the field since the earliest beginnings of wireless. The "Father of The Vacuum Tube" Dr. Lee De Forest, in the dedication of his autobiography, expresses his gratitude "to the United States Navy, which was always prompt to use my new wireless and radio devices and whose Admirals never failed to give me welcome encouragement when it was most sorely needed."

The Navy has always recognized in radio an answer to the need for quick, reliable communication to and between ships dispersed and deployed at great distances. Thus Lieutenant Bradley Fiske, USN, was experimenting with pre-Marconi ship-to-ship wireless communication, using inductive coupling between huge loops wound around the vessels, as early as 1888.

The first official Navy wireless message was sent in 1899 via wireless telegraph with Marconi as operator. The message was sent from the Steamship *Conce* to the Highland station on the Jersey coast. The transmission was accomplished during a naval parade in honor of Adm. George Dewey, returning victoriously from Manila.

Marconi, who had patented numerous wireless inventions, was invited that same year to the United States to experiment under naval supervision.

Marconi and the Navy

When Marconi came to America in 1899 seeking a market for his newly invented wireless telegraphy, forward-looking Navy officials arranged to have him install his apparatus on the *New York* and the *Massachusetts.* Marconi himself operated the equipment on the *New York* as Rear Admiral Farquher sent the first official wireless message to Navesink, 20 miles away, for relaying to Rear Admiral Phelps at New York Navy Yard. Using a spar lashed to the topmast as an antenna, the two ships were able to exchange messages over 36 miles of water.

The Navy gave enormous impetus to the development of American wireless (as distinguished from British, Italian, French, or German) when the Bureau of Equipment installed U. S. apparatus on the *West Virginia* in 1905. The successful performance of this equipment during the cruise of President Roosevelt from New Orleans to Washington received wide-spread publicity and generated great interest in American wireless circles. Moreover, this effective demonstration led American maritime companies to appreciate the utility of wireless. Steamship lines, coasters, tankers, and towing firms raced to equip their fleets with the simple detectors and headphone receivers that characterized U. S. equipment; the bulkier, less efficient coherer and ink tape-printer became restricted to foreign vessels.

A dramatic "first" in radio occurred when the North Atlantic Fleet was equipped with wireless telephony (voice radio) in preparation for its round-the-world cruise under Rear Admiral "Fighting Bob" Evans in 1908. The first installations*, on the *Connecticut* and the *Virginia,* were tested in the fall of 1907; speech was transmitted and received at ranges as great as twenty miles. Said Admiral Evans, "If there is one thing more than another, in the fleet, of which I am proud, it is the wireless telephone..... The sailing of the fleet and the flotilla (sixteen battleships, six destroyers, and two auxiliary vessels made the globe-girdling trip) will mark a new era in

** The Commanding Officer is said to have reported "I can not continue the evaluation until the gear is placed in working condition." Sound familiar?*

maritime communications and is just ground for pride to every American that the United States Navy is the first to adopt and demonstrate this new method, and on such a comprehensive scale."

Radio In World War I

With the outbreak of war in Europe in 1914, a Naval Communications Board was appointed to reorganize the naval radio services. On recommendation of the board, the Naval Communication Service was organized in 1915, with Captain William Bullard as its first Director. The Communication Service acquired vast facilities after U. S. entry into the war, when President Wilson directed the Navy to take over all radio stations in the U. S. and its possessions except those already under Army control. Among the stations thus acquired was the Marconi Wireless Telegraph Company facility at New Brunswick, N. J. Outfitted with a 200 kw. Alexanderson alternator transmitter, this station, assigned call letters NFF, was the most powerful in the world. Ships all over the globe could hear NFF, and so could troops on the battlefronts with field receivers. Messages from President Wilson to the German people were broadcast from NFF to the radio center POZ at Nauen, outside Berlin.

To achieve adequate radio communication from France to the U. S. was more difficult. The most powerful stations in France, at Paris and at Lyon, were equipped with only 40 kw. transmitters. Lyon gave better reception in the U. S. because of the direction of its aerial, but interference was too great for reliable communication even after the Navy established a receiving site at Bar Harbor, Maine, to get close to Europe and far from the tropical sources of radio noise. To ensure reliable communication from the armies of the American Expeditionary Force, the U.S. government decided to erect a powerful transmitting station in France. The task of building the station was assigned to the Navy, in accordance with the Roosevelt directive; so the Navy, in collaboration with the French Signal Corps, built the famous Lafayette radio station near Bordeaux. Two 500-kw. arc transmitters fed an inverted L antenna supported by eight 835-foot towers, giving a strong signal all the way across the North American continent. Begun in 1918, Lafayette went on the air in 1920 and proved of great value for communication with the postwar occupation forces.

After the war the Navy, reluctant to see America's radio communication facilities returned to foreign-controlled interests, suggested that a domestic communication company be organized. With the help of the General Electric Company, the Radio Corporation of America was organized to purchase the assets and business of the Marconi Wireless Telegraph Company. At the suggestion of Navy Captain Hooper, RCA and entered into a cross-licensing agreement to eliminate patent conflicts that stood in the way of creation of an effective national communication system.

Now, in the Space Age, the Navy bas again demonstrated its leadership; this time in Space Communica

Satellite Communications

Satellite communications are receiving a great deal of attention in the national space effort. This particular area of space technology holds much promise for both commercial and military users. At least a dozen communication satellite projects are in various stages of development at present – all making use of different potential advantages which this new field offers. All three military departments, the Defense Communications Agency (DCA), the National Aeronautics and Space Administration (NASA), and private industry are busily engaged in developing satellite technology under a broad national coordinated effort.

Communication by satellites is appealing, of course, because it offers improvements in present capabilities, such as greater coverage density and freedom from some ionospheric disturbances. However, the real attractiveness of satellites for communications lies in their potential to do things possible in no other way. These accomplishments may include worldwide direct dialing, intercontinent

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television, and high-speed real-time digital data links for computers on a global basis.

The Bureau of Ships, as the lead Bureau for communications, manages the Navy's satellite communications program. The Communications By Space Relay Program of the Bureau is composed of four parallel efforts to take full advantage of work carried out by NASA and the other military departments and to exploit all modes of space communications that satisfy Navy requirements. These efforts are:

(1) Participating in Projects SYNCOM and the DOD SATCOM project for high-capacity long-range communications.

(2) Experimenting with active satellites operating in the very low frequency (VLF) band to explore the possibilities of worldwide Fleet communications.

(3) Exploring use of passive satellites for high reliability.

(4) Developing shipboard instrumentation for eventual Fleet operational satellite communications.

Satellite Communications Ship

The Department of Defense research and development effort in active communications satellites is to demonstrate the feasibility of establishing a system of active satellites for long distance, reliable military communications.

The Bureau of Ships has developed a shipboard terminal installation that complements the Army stations at Fort Dix and Camp Roberts. USNS *Kingsport* (AG-164), an MSTS cargo ship, is fitted with communications equipment providing two-way, wide-band, high-data rate, microwave communications with either or both of the shore stations In addition to her communication capability, the ship will have a tracking telemetry and command control (TT&C) capability. She can track the satellite using either beacon tracking, a computer-programmed mode, or a console-controlled mode. She will receive and record telemetry and doppler measurements of the satellite and will originate and transmit commands to the satellite.

SYNCOM is a NASA communications satellite project with the objective of injecting a satellite into a circular orbit of 24-hours period, which will be inclined 33°. The daily subsatellite trace will appear as a narrow figure eight lying between 33° N and 33° S latitude. The satellite communications ship will support the SYNCOM program during its initial phase. It will be able to communicate via the SYNCOM satellite and later via the DOD satellites, and will also have the corresponding TT&C capability.

The shipboard terminal will greatly increase the flexibility of the research and development programs. The ship will not only supplement the fixed communications and tracking stations as one more surface station, but its mobility will also aid in making observations which could not be made by fixed stations. These observations include defining fringe coverage areas and comparing overwater with overland propagation characteristics.

In addition to the direct R&D contribution to both programs, the value of the ship is enhanced by its application to military communications. Strategic and tactical communications dictate mobility. The ship terminal, as a truly mobile communications and TT&C center, will assist in the development of design criteria and system parameters necessary for an effective military satellite communications system.

VLF Satellites

The Navy's continuing need for reliable communications to ships at sea has led to a program to explore the possibilities of developing a VLF communications satellite The Navy has long pioneered in VLF work and has a great fund of technical knowledge and a pool of scientific talent experienced in VLF techniques. A VLF satellite transmitting down through the ionosphere promises to be very attractive as a communication link.

One of the major problems in developing an operation system has been the almost total lack of knowledge concerning the mode of propagation of low frequencies through the ionsphere. (LOFTI I results were reported in the October 1961 issue of the *Bureau of Ships Journal.*)

Navy Microwave Space Relay Program

The Communications MOON Relay System (CMR) was developed by the Bureau of Ships, to which NRL provided scientific direction.

CMR is the Nation's "*first* operational space communications system."* It can transmit radioteletype, CW, voice, and facsimile messages. Using transmitting stations at Opana, Hawaii, and Annap-

* *Testimony by Hon. John H. Rubel, Assistant Secretary of Defense (Deputy Director, Defense Research and Engineering) 10 April, 1963.*

olis, Maryland with receiving stations at Wahiawa, Hawaii, and Cheltenham, Maryland, a two-way link was established during 1959 between the mid-Pacific and the U. S. East Coast. These stations can be manned by Navy personnel from five to ten hours daily (from moonrise in Hawaii to moonset in Maryland). The system is capable of handling traffic during periods of severe ionospheric disturbance when HF trunks to Hawaii are unusable.

CMR is not only important as a reliable communications link; it is also valuable in a scientific capacity. As a forerunner amongst satellite communications projects, CMR has generated a vast amount of basic scientific data on the nature of propagation of radio energy through space and the ionosphere and has provided an ideal tool for studies on modulation techniques, antenna characteristics, and terminal instrumentation. Information generated from studies at CMR has been used as the basis for formulating design criteria for follow-on communications satellite projects, both passive and active. Because no launching cost is involved in this natural satellite and because the moon is so reliable, CMR has served as a relatively inexpensive source of space communications data and as a laboratory for equipment development.

The experience with CMR will now be generalized in the Navy's Microwave Space Relay program. Experiments with new terminal equipments and techniques will provide even more information in the newly important microwave frequency region and on more sophisticated modulation techniques. These improvements will allow the Navy to communicate via tropospheric scatter and both passive and active satellites (including WESTFORD types) developed by other agencies. Through this effort, the applications to shipboard installations can be studied and operational shipboard space communications systems developed.

● U.S. Naval Submarine Base, Pearl Harbor, winner of the 1963 Ney Memorial Award for Outstanding Food Service. Subase Pearl General Mess was adjudged the best in the ashore category.

● U.S. Naval Repair Facility, San Diego, awarded the National Safety Council Plaque (Shipbuilding and Repair Division, Group A) as the safest Government yard in which to work in 1962.

● U.S. Naval Ship Repair Facility, Yokosuka, highly praised by the Commanding Officer, USS *Constellation* (CVA-64), for accomplishing major repairs during a limited availability.

● New York Naval Shipyard, praised by the Commanding Officer, USS *Vancouver* (LPD-2), for the outstanding job done in constructing and fitting out the ship.

Quality Assurance With MIL-Q-9858

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Under the terms of specification MIL-Q-9858, contractors are required to establish and maintain a quality control system as an integral part of their contracts. Part one of this article, which appeared in the August issue of *The Journal*, provided definitions of terms used in quality assurance and quality control, explained the purpose of quality control, and established the requirements for quality control in contracts. In this second part of the article the objectives of quality assurance planning will be itemized.

The objectives of quality assurance planning are herein grouped into nine major areas. These objectives relate what MIL-Q-9858 should mean to a manufacturer. The objectives are:

Design and Quality Standards

● *Development* and review from design concept to product delivery. To ensure the incorporation of