

OUR NEXT SPEAKER IS BRAD WHEELER. BRAD IS THE VICE PRESIDENT, MARITIME OPERATIONS FOR THE INTERNATIONAL REGISTRIES, INC., AND A DEPUTY COMMISSIONER FOR MARITIME AFFAIRS FOR THE REPUBLIC OF THE MARSHALL ISLANDS. CAPT. WHEELER HAS TAUGHT AT THE MASSACHUSETTS MARITIME ACADEMY, THE FEDERAL MARITIME ACADEMY'S "GLOBAL MARITIME AND TRANSPORTATION SCHOOL", AND HE HAS LECTURED AT THE U.S. COAST GUARD ACADEMY. CAPT. WHEELER NOT ONLY HOLDS AN ACTIVE UNLIMITED MASTERS LICENSE; HE IS ALSO A COMMANDER IN THE UNITED STATES NAVY RESERVE.

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GOOD MORNING. I HAVE BEEN FORTUNATE TO HAVE SAILED FOR 29 YEARS ON A VARIETY OF VESSELS THAT HAVE INCLUDED PASSENGER LINERS, PRODUCT TANKERS, LIQUEFIED NATURAL GAS CARRIERS, USNS LOGISTIC SUPPORT VESSELS AND A FFG. I HAVE BEEN A MEMBER OF THE GLOBAL MARITIME DISTRESS AND SAFETY TASK FORCE FOR OVER 5 YEARS AND HAVE BEEN A PRIVATE SECTOR ADVISOR TO THE US DELEGATION AT THE INTERNATIONAL MARITIME ORGANIZATION'S SEARCH AND RESCUE COMMITTEE. I CURRENTLY REPRESENT THE MARSHALL ISLANDS AS A DELEGATE TO COMSAR AND I AM A MEMBER OF THE E-NAVIGATION CORRESPONDENCE GROUP.

THE MARSHALL ISLANDS SHIP REGISTRY PROGRAM WAS INITIATED BY THE MARSHALL ISLANDS GOVERNMENT IN 1988. THE REGISTRY MAINTAINS OFFICES IN NEW YORK AND RESTON VIRGINIA. CORRESPONDENT AND INSPECTOR OFFICES ARE LOCATED IN LONDON, ZURICH, PIRAEUS AND HONG KONG. MORE RECENTLY OFFICES HAVE BEEN ESTABLISHED IN FT. LAUDERDALE IN 2000, SINGAPORE IN 2003, SHANGHAI IN 2004, TOKYO IN 2005 AND DALLIAN JUST THIS YEAR.

THE MARSHALL ISLANDS SHIP REGISTRY IS NOW THE FIFTH LARGEST OPEN REGISTRY IN THE WORLD SURPASSING THE 34 MILLION GROSS TON MARK BEFORE THE END OF THE THIRD QUARTER OF 2006. VESSEL TYPES INCLUDE OIL TANKERS, BULK CARRIERS, MOBILE OFFSHORE DRILLING UNITS, CONTAINER SHIPS AND YACHTS.

THE MARSHALL ISLANDS IS A SPONSOR, TOGETHER WITH THE UK, JAPAN, SINGAPORE, AND THE UNITED STATES, OF THE E-NAVIGATION PROJECT RECENTLY ADOPTED BY THE IMO. WE SUPPORT THIS COMPREHENSIVE REVIEW OF THE SOMETIMES FRAGMENTED GROWTH OF A WHOLE RANGE OF NEW, SATELLITE-BASED NAVIGATION SYSTEMS WHICH HAVE BEEN WIDELY AND UNIVERSALLY, ADOPTED BY THE WORLD'S OCEAN GOING FLEETS.

ONE FEATURE OF THE PROJECT DESERVES ATTENTION. IN THE BODY OF THE PROJECT IS A STATEMENT THAT THERE IS A NEED FOR REDUNDANT RADIO NAVIGATION SOURCES: A NUMBER OF SOURCES ARE LISTED. HOWEVER, A CLOSE READING OF THE LIST REVEALS THAT ALL OF THE RADIO NAVIGATION SOURCES, SAVE ONE, ARE SATELLITE BASED. THE ONLY NON-SATELLITE SOURCE LISTED IS LORAN.

IN GMDSS, THE REQUIREMENT IS TO MAINTAIN TWO SEPARATE AND INDEPENDENT MEANS OF SENDING DISTRESS COMMUNICATIONS. I FEEL THAT HAVING SEPARATE AND INDEPENDENT MEANS OF ELECTRONIC POSITIONING SHOULD BE TAKEN INTO ACCOUNT AS WELL. GOOD SEAMANSHIP AND COMMON SENSE DICTATE THAT ONE SHOULD NEVER RELY ON JUST ONE SYSTEM.

A CASE IN POINT IS THE GROUNDING OF THE ROYAL MAJESTY ON CAPE COD. WE KNOW NOW THAT THIS INCIDENT OCCURRED BECAUSE THE WATCH OFFICERS WERE RELYING SOLELY ON GPS POSITIONS.

I WAS ALWAYS TAUGHT TO NEVER RELY ON JUST ONE MEANS OF NAVIGATION. IN THE 1980'S AS MATE ON TANKERS RUNNING A MILE OFF THE COAST OF FLORIDA TO CATCH THE COUNTER CURRENT TO THE GULF STREAM, WE ALWAYS TOOK VISUAL BEARINGS CROSS CHECKING OUR POSITION WITH LORAN-C. IF THE WEATHER CLOSED IN WE WOULD COMPARE RADAR RANGE AND BEARINGS WITH LORAN-C. WE CONTINUE TO TEACH OUR TRAINEES TO CHECK THE VESSEL'S POSITION NOT ONLY WITH THE GPS BUT TO CONFIRM IT WITH A SECOND INDEPENDENT MEANS.

THE MARINE COMMUNITY, AS WELL AS ALL POSITIONING, NAVIGATION, AND TIMING (P-N-T) USERS, ARE NOW AWARE THAT SATELLITE SIGNAL-GPS, GALILEO, AND GLONASS PLUS VARIOUS AUGMENTATIONS SUCH AS THE WIDE AREA AUGMENTATION SYSTEM (WAAS), EGNOS, GPS AIDED GEO AUGMENTED NAVIGATION (GAGAN) AND DIFFERENTIAL GPS-ARE VULNERABLE TO ERRORS CAUSED BY:

- IONOSPHERIC AND ATMOSPHERIC DELAYS
- SMALL DEVIATIONS WITH THE ATOMIC CLOCKS
- MATH ERRORS WITH RECEIVING UNITS
- SATELLITE SIGNALS TAKING A CIRCUITOUS PATH TO THE RECEIVERS
- GEOMETRY BETWEEN THE RECEIVER AND SATELLITES.

ONE OF THE GPS SATELLITES THAT COVERED THE EAST COAST OF THE UNITED STATES FAILED ABOUT TWO YEARS AGO. THE GPS RECEIVERS CONTINUED TO DISPLAY VESSEL POSITIONS BASED ON SIGNALS RECEIVED FROM OTHER GPS SATELLITES STILL WITHIN THEIR FOOTPRINT. THERE WAS AN INCREASED ERROR IN THESE VESSELS' POSITIONS. THIS CONTINUED TO HAPPEN UNTIL A REPLACEMENT SATELLITE WAS PLACED IN THE SAME ORBIT. MARINERS WERE INFORMED OF THE ERROR THROUGH NBDP AND ENHANCED GROUP CALLING. AS LONG AS THEY HAVE CHECKED THESE WARNINGS IN A TIMELY MANOR, THEY WOULD BE AWARE OF THESE ERRORS. IF NOT, THEY COULD HAVE GOTTEN INTO TROUBLE.

THE POSSIBILITY OF HAVING OWN SHIP DISPLAYED ON AN ECDIS WITH INPUT NOT ONLY FROM THE GPS BUT WITH THE ADDITIONAL OVERLAY OF OWN SHIP BY LORAN WOULD GIVE THE NAVIGATOR AN IMMEDIATE INDICATION OF A FAULT IN ONE OF THE SYSTEMS...SHOULD THEIR OWN SHIP TARGETS DIVERGE.

GPS ANTENNAS HAVE BEEN SUSCEPTIBLE TO FAILURE DUE TO THE RADIATION FROM HIGH INTENSITY RADARS OF OTHER VESSELS THAT HAVE BEEN CLOSE ABOARD. IT HAS CAUSED THE SOLDER TO MELT IN SOME OF THESE RECEIVERS.

GNSS CAN BE IMPACTED NOT ONLY BY NATURAL CAUSES BUT ALSO BY INTENTIONAL SOURCES SUCH AS THAT EMANATING FROM TERRORISTS AND MILITARY INTERVENTION. THESE INCLUDE WESTERN AND NON-WESTERN MILITARIES. THE TECHNIQUES OF INTENTIONAL INTERFERENCE INCLUDE ATTACKS ON SATELLITES IN ORBIT, ATTACKS ON GROUND CONTROL STATIONS, NOISE JAMMING AND MORE EFFECTIVE SPOOFING JAMMING. THE DEFENSE AGENCIES OF VIRTUALLY ALL TECHNICALLY ADVANCED NATIONS ARE WORKING ON JAMMING AND ANTI JAMMING SYSTEMS.

ALMOST ALL OF THIS TECHNOLOGY IS UNDERSTANDABLY SECRET AND IS NOT AVAILABLE TO CIVILIAN USERS SUCH AS THE WORLD'S COMMERCIAL MARITIME VESSELS. ALL USERS OF GNSS SIGNALS, INCLUDING MARINE USERS, ARE THEREFORE AT RISK OF LOSS OF NAVIGATION, COMMUNICATIONS, AND SURVEILLANCE (AIS AND LRIT) SYSTEMS, ALL OF WHICH ARE GNSS DEPENDANT.

THIS IS WHY THE E-NAVIGATION PROJECT CITES THE NEED FOR A REDUNDANT RADIO NAVIGATION SYSTEM. LORAN IS THE ONLY REDUNDANT RADIO NAVIGATION SYSTEM AVAILABLE TO THE MARINER. THE E-NAVIGATION PROJECT BEFORE THE IMO IS IN ITS INFANCY, AND IT WILL TAKE TIME BEFORE ITS ELEMENTS ARE ADOPTED AS STANDARDS. WE ARE CONFIDENT, HOWEVER, THAT THE LORAN WILL BE UTILIZED AS AN INDEPENDENT REDUNDANT SYSTEM FOR GNSS.

THERE IS SOME RECENT HISTORY HERE. NOT LONG AGO, WITH THE EMERGENCE AND ADOPTION OF THE GPS SYSTEM, IT WAS THOUGHT THAT LORAN WAS OLD TECHNOLOGY AND COULD BE DISCARDED. MANY OF THE STATIONS WERE SCHEDULED FOR DECOMMISSIONING, AND SOME WERE TURNED OFF. RECENTLY, HOWEVER, THE MARITIME WORLD HAS BECOME AWARE OF THE VULNERABILITY OF GPS, AND IS NOW VOICING ITS CONCERN. LORAN IS REGARDED AS A VALUABLE, LOW COST BACK UP TO GNSS. MANY COUNTRIES ARE MODERNIZING OLD STATIONS, BUILDING NEW STATIONS, AND ADDING LORAN TO THEIR NATIONAL PLANS. EUROPEAN COMMUNITY IS IN THE PROCESS OF ADOPTING ITS FIRST EUROPEAN RADIO-NAVIGATION PLAN (ERNP), AND LORAN IS LISTED AS A CORE TECHNOLOGY. THIS IS ALL GOOD NEWS TO MARINERS.

THE SITUATION IN THE UNITED STATES, HOWEVER, IS LESS OPTIMISTIC. THE COAST GUARD, ONCE A WORLD LEADER IN RADIO-NAVIGATION, HAS PROPOSED TO TURN OFF ITS 24 LORAN STATIONS. THIS IS HARD TO UNDERSTAND BECAUSE THE UNITED STATES JOINED THE MARSHALL ISLANDS IN SPONSORING THE IMO E-NAVIGATION PROJECT IN DECEMBER OF 2005.

THE COAST GUARD DOES RECOGNIZE THE POSSIBLE LOSS OF GPS NAVIGATION. THE COAST GUARD'S POSITION IS THAT VESSELS CAN REVERT TO OLDER, TRADITIONAL FORMS OF NAVIGATING AND CAN CONTINUE TO OPERATE SAFELY AND EFFICIENTLY. WE DO NOT THINK THAT THIS VIEW TAKES INTO ACCOUNT THE CHANGE IN SPEED OF MODERN DAY VESSELS.

THIRTY YEARS AGO MOST OF VESSELS WERE MAKING BETWEEN 12 AND 15 KNOTS. NOW, WITH THE ADVENT OF MORE EFFICIENT HULL DESIGNS LIKE SWATH, FAST FERRIES, AND CONTAINER VESSELS, THE AVERAGE SPEED HAS INCREASED TO 19 KNOTS AND FAR BETTER. THE DISTANCE TRAVELED BETWEEN ROUTINE FIXES IS NOW GREATER THAN IT HAS BEEN IN THE PAST. THERE IS LESS AVAILABLE FOR THE NAVIGATOR TO MAKE DECISIONS.

ARTICULATED TUG AND BARGE (ATB) UNITS ARE NOW 180,000 BBLs IN SIZE WITH ONLY A CREW OF 7. THEY TAKE THE PLACE OF A T-2 TANKER THAT USED TO CARRY A CREW OF 35 OR MORE. THE TUG DOES NOT HAVE REPEATERS ON THE BRIDGE WINGS TO TAKE CROSS BEARINGS OR CELESTIAL SIGHTS, BECAUSE THEY DON'T HAVE BRIDGE WINGS. THE WATCH OFFICER IS THE LOOKOUT, NAVIGATOR, HELMS MAN AND RADIO OFFICER. WHAT ALTERNATIVES DOES THE WATCH OFFICER HAVE WHEN HIS ECDSS CHART NO LONGER DISPLAYS OWN SHIP INPUT FROM THE GPS, IF NOT FOR LORAN. HE CAN'T AFFORD THE TIME TO DO SIGHT REDUCTIONS OR CROSS BEARINGS.

GMDSS REQUIRE THE WATCH OFFICER TO INPUT MANUALLY HIS POSITION INTO THE VHF DSC, MF/HF DSC RADIOS, INM-C AT LEAST EVERY 4 HOURS. LONG RANGE IDENTIFICATION AND TRACKING (LRIT) WILL REQUIRE UPDATES OF POSITION EVERY 6 HOURS. IF GNSS IS NOT AVAILABLE WHAT OTHER ELECTRONIC NAVIGATION MEANS DO WE HAVE AS A BACK UP OTHER THAN MANUALLY INPUT THIS INFORMATION INTO THE EQUIPMENT?

ANOTHER CRITICAL DIMENSION OF GPS DEPENDENCY IN THE MARINE WORLD IS TIMING. GPS PROVIDES A HIGHLY ACCURATE, PRECISE, STRATUM, 1 TIMING SIGNAL. MODERN TELECOM NETS NOW RELY ON GPS TO REGULATE THEIR SYSTEMS. VIRTUALLY ALL TELECOM SYSTEMS RELY ON GPS. THE LOSS OF THE GNSS SIGNAL WILL CAUSE MANY OF THESE SYSTEMS, INCLUDING MARINE SYSTEMS, TO FAIL. BOTH AUTOMATIC IDENTIFICATION SYSTEMS (AIS) AND LRIT SYSTEMS USED FOR NATIONAL SECURITY AS WELL AS SAFE NAVIGATION ARE AT RISK. IN FACT ANY SYSTEM THAT PASSES THROUGH A COMMERCIAL TELECOM NET IS AT RISK, INCLUDING OUR CELL PHONES.

WE RECOGNIZE THAT MANY OF THESE TELECOM SYSTEMS EMPLOY FREE STANDING BACK UP DEVICES SUCH AS QUARTZ OSCILLATORS OR CESIUM CLOCKS TO BRIDGE TIMING GAPS. BUT THE REAL WORLD PERFORMANCE OF THESE GAP FILLERS IS SUSPECT: MILITARY GPS JAMMING EXERCISES HAVE COLLAPSED NEARBY TELECOM SYSTEMS ALL OVER THE WORLD. TERRORISTS ARE WELL AWARE OF THIS LESS WELL KNOWN VULNERABILITY.

FINALLY LET ME ADDRESS VULNERABILITY. GPS IS TRANSMITTED FROM A SATELLITE AT LEAST 6,000 NAUTICAL MILES AWAY AT A POWER OF 20 WATTS. ITS SIGNAL ON EARTH HAS A STRENGTH OF ONE WATT TO THE MINUS 16 POWER- ONE TEN QUADRILLIONTH OF A WATT. THIS ULTRA WEAK SIGNAL

WORKS FINE TO A RECEIVER WHEN IT'S WORKING, BUT IT CAN BE EASILY JAMMED. THIS IS NOT A WEAKNESS OR A FAILURE, IT'S JUST A LIMITATION. FOR "SAFETY OF LIFE" APPLICATIONS, SUCH AS MARINE SERVICE, OR WHERE ECONOMIC DEPENDENCY IS HIGH, THE SIGNAL SIMPLY CANNOT BE PERMITTED TO FAIL.

LORAN, IN CONTRAST, IS TRANSMITTED FROM TALL, GROUND BASED STATIONS WITH A POWER FROM 500,000 TO OVER A MILLION WATTS. BECAUSE OF ITS WAVE LENGTH OF SEVERAL KILOMETERS, A JAMMER WOULD NEED A TALL TOWER AND IMMENSE POWER. AS A PRACTICAL MATTER, LORAN IS NEARLY IMPOSSIBLE FOR A TERRORIST TO JAM, AS A RECENT MITRE CORPORATION STUDY HAS CONFIRMED.

LORAN IS A PERFECT, COMPLETE COMPLEMENT TO GPS FOR SAFETY AND SECURITY IN THE MARITIME INDUSTRY. IT SHOULD BE CONTINUED IN THE UNITED STATES, AS IT WILL BE CONTINUED AND EXPANDED IN THE REST OF THE WORLD.

#### CHAPTER 12 OF BOWDITCH STATES:

"LORAN-C BOASTS THE HIGHEST NUMBER OF USERS OF ANY PRECISE RADIO NAVIGATION SYSTEM IN USE. IT HAS BEEN DESIGNATED THE PRIMARY FEDERALLY PROVIDED MARINE NAVIGATION SYSTEM FOR THE U.S. COASTAL CONFLUENCE ZONE, SOUTHERN ALASKA, AND THE GREAT LAKES. THE MARINE COMMUNITY COMPRISES THE VAST MAJORITY OF LORAN C USERS (87%), FOLLOWED BY CIVIL AVIATION USERS (14%). THE NUMBER OF LORAN USERS IS PROJECTED TO GROW UNTIL WELL INTO THE 21ST CENTURY.



NOTWITHSTANDING THE POPULARITY OF THE SYSTEM, THE U.S. DEPARTMENT OF DEFENSE IS PHASING OUT USE OF LORAN C IN FAVOR OF THE HIGHLY ACCURATE, SPACE-BASED GLOBAL POSITIONING SYSTEM (GPS). THIS PHASE OUT HAS RESULTED IN THE CLOSING OF THE HAWAII-BASED CENTRAL PACIFIC LORAN C CHAIN AND THE TRANSFER OF SEVERAL OVERSEAS LORAN C STATIONS TO HOST GOVERNMENTS".

WE, AT THE MARSHALL ISLANDS, RELY ON GPS. WE HAVE ONE OF THE 5 MONITOR STATIONS LOCATED ON KWAJALEIN, BUT WE WOULD ALSO LIKE TO SEE THE LORAN SYSTEM COVERAGE NOT ONLY MAINTAINED BUT EXPANDED. RELYING ON REDUNDANT GNSSs SUCH AS GPS AND THE FUTURE GALILEO IS LIKE HAVING BOTH A SEXTANT AND A BUBBLE SEXTANT ON A CLOUDY DAY. IT'S NOT ONLY COMFORTING, BUT IT JUST MAKES GOOD SENSE TO HAVE ANOTHER INDEPENDENT SYSTEM LIKE LORAN TO FALL BACK ON IN THE EVENT THAT GNSS ENCOUNTER PROBLEMS.

THANK YOU