



LC DELTA: Low Cost Digitally Enhanced Loran for Tactical Applications











OUTLINE

- INTRODUCTION / SOAPBOX
- WHAT IS LC DELTA, AKA TACTICAL LORAN?
- REQUIREMENTS FOR TACTICAL LORAN
- HISTORICAL PERSPECTIVE
- SCENARIOS FOR USING LC DELTA
- ALTERNATIVE DEPLOYMENT METHODS
- KEY COMPONENTS
- CONCLUSIONS
- QUESTIONS
- POSSIBLY SOME ANSWERS

WHAT IS LC DELTA?

- SIMILAR TO "FIXED" LORAN (SITE), BUT -DEPLOYABLE, EXPEDITIONARY, MOBILE, PORTABLE, RELOCATABLE, TRANSPORTABLE -ALL POINT TO TACTICAL CAPABILITY -ADDITIONALLY, WORKS ON MOVING VESSELS • NOT ENTIRELY A NEW IDEA; HOWEVER -USES LATEST ELORAN TECHNOLOGY -BUILDS UPON LORAN RECAP EFFORT -PREFERS, BUT DOESN'T REQUIRE TOT CONTROL -HAS LOWER COST THAN A FIXED SYSTEM • FIXED, EN ROUTE, AND TERMINAL PNT
- DATA CHANNEL CAPABILITY

REQUIREMENTS?

- SMALL <u>SIZE</u>, <u>WEIGHT</u>, & <u>POWER</u> (SWAP)
- EASILY TRANSPORTABLE CONFIGURATION
- "RAPID" INSTALLATION & DE-INSTALLATION
- SIGNIFICANTLY LOWER COST
- EASY TO USE
- TECHNOLOGY EQUIVALENT TO STRATEGIC SITES
 - -SIGNAL SPECIFICATION
 - -ENHANCED DATA CHANNEL FORMATS
 - -HARDWARE/SOFTWARE
- EQUIVALENT RELIABILITY & ROBUSTNESS

PREVIOUS TACTICAL SYSTEMS

LORAN-D (SPERRY GYRO)
-1960s - 1970s
-15 "CYCLE GENERATORS"
-30 kw @ 533 PPS
-400-FOOT QUICK ERECTING TOWER



AIR TRANSPORTABLE LORAN SYSTEM

 -1960s - 1987
 -AN/FPN-44 TUBE-TYPE TRANSMITTER
 -400+ KW
 -625-FOOT TLM

PREVIOUS TACTICAL SYSTEMS

- ST MARY'S RIVER MINI-CHAIN (MEGAPULSE) -1970s
 - LOW POWER SOLID-STATE TRANSMITTERS
 - -LOW POWER
 - -150-foot rohn guyed antenna
- PULSE/8 (RACAL)
 - -1970s 1980s
 - LOW POWER SOLID-STATE TRANSMITTER
 - -1 KW
 - 300-foot antenna
- NONE DEPLOYED ON MOVING VESSELS

SCENARIOS FOR TACTICAL LORAN

- AUGMENTATION TO IMPROVE POOR COVERAGE
 - -PORTABLE LOCALLY POSITIONED STATIONS
 - -SINGLE STATION
 - -NETWORK OF STATIONS
- AUGMENTATION TO TEST STATION RELOCATION
 - -PORT CLARENCE TO NOME
- ADDITIONAL STATIONS
- LOCALIZED STRATUM-1 SOURCE
- COMPONENT SOLUTION(S)

-SYSTEM LESS ANTENNA

-USED DURING STATION RECAP

WHY MIGHT WE NEED LC DELTA?

WAS NATURE MAD AT THE EAST COAST?



CHARLEY – THE WARNING SHOT



FRANCES – JUPITER & MALONE I



IVAN — THIS DOG WILL HUNT!



JEANNE – JUPITER & MALONE II



OR WERE THERE POLITICAL FACTORS!



Accessed from the WWW.

LORSTA JUPITER TLM DAMAGE

LAST WEEK IN PORT CLARENCE

LAST WEEK IN PORT CLARENCE

- HIGH OPERATIONAL INTEREST
 - -ILLEGAL IMMIGRATION
 - -DRUG TRAFFIC
- LARGE AREAS OF SHALLOW WATER AT LONG RANGES FROM LAND
- THE LACK OF LORAN COVERAGE
- COULD AN ADVERSARY DENY GPS AND EXPLOIT THE ADVANTAGE?
- WHAT COULD WE DO IN RESPONSE? —TACTICAL LORAN SITE
 - -LAND BASED OR VESSEL BASED

ALTERNATE DEPLOYMENT VESSELS

- AEROSTATS (TETHERED)
- AIRSHIPS (UNTETHERED)
- FIXED-WING AIRCRAFT
- LARGE NAVIGATIONAL BUOYS
- OFFSHORE PLATFORMS

MOORED AEROSTAT

AEROSTAT ALOFT

SEA BASED AEROSTAT

LC DELTA AIRSHIP ALOFT OVER CITY

TACAMO VLF/LF CAPABLE AIRCRAFT

LARGE NAVIGATIONAL BUOY

OFFSHORE PLATFORMS

KEY COMPONENTS: ANTENNA

- TLM, SLT, TIP (COMPONENT SCENARIO)
- LOOP NOT PRACTICAL
- QUICK ERECTING
- 150- 400-FEET
- TRAILING WIRE
- SMALLER POWER = SHORTER ANTENNA

KEY COMPONENTS: POWER

- PRIME POWER
- GENERATOR SET
- WHOLE / PARTIAL UPS

KEY COMPONENTS: RECEIVER MODS

- PRESUME 9^{TH} pulse data channel
- TWO MESSAGES CURRENTLY DEFINED —UTC TIME & STATION IDENTIFICATION —DIFFERENTIAL & LORAN CORRECTIONS
- 3RD NOT DEFINED EARLY SKYWAVE WARNING
- FOUR NEW PROPOSED MESSAGES
- AVIATION MOUNTED TRANSMITTERS

 - -ONE MESSAGE FOR NORTH DATA
 - -ONE MESSAGE FOR EAST DATA
 - -AN OCCASIONAL MESSAGE FOR EMISSION DELAY
 - -MAXIMUM SPEEDS UP TO 256 M/S (498 KNOTS)
 - -MAXIMUM ACCELERATION OF 3.1 M/s

KEY COMPONENTS: RECEIVER MODS

- FIXED TRANSMITTERS
 - -SAME TWO MESSAGES AS AVIATION TRANSMITTERS
 - -SET NORTH ACCELERATION WORD TO NON-VALID NUMBER
 - --MOST OF COMMS BANDWIDTH AVAILABLE TO SUPPORT DIFFERENTIAL LORAN

KEY COMPONENTS: RECEIVER MODS

- SHIP-BORNE TRANSMITTERS
 - --REFERENCE MESSAGE AND EMISSION DELAY MESSAGE SENT OFTEN ENOUGH TO LIMIT TIME TO FIRST FIX
 - -OTHERWISE, POSITION AND VELOCITY CAN FIT IN ONE MESSAGE
 - -SATURATION OF VELOCITY WORD OCCURS AT EIGHT M/S (15.6 KNOTS)
 - --NO ACCELERATION DATA (PRESUME MODEST SHIP MANEUVERS!)

KEY COMPONENTS: TIME RECOVERY & SIGNAL GENERATION

KEY COMPONENTS: TRANSMITTER

400 kW NSSX

10/15 kW DIGITAL AM

1 MW DX-LW DIGITAL LONG WAVE

CONCLUSIONS

- THE TECHNOLOGY EXISTS TODAY
 - -ANOTHER USE OF LORAN RECAP TECHNOLOGY
 - -ANOTHER USE FOR LORAN DATA CHANNEL
- THE COST IS AN ORDER OF MAGNITUDE LESS THAN A FULL-SCALE FIXED SITE
- ALTERNATIVE DEPLOYMENT POSSIBILITIES
- PROOF-OF-CONCEPT COULD BE DONE
- PHYSICALLY & FISCALLY POSSIBLE TODAY!
- QUESTIONS? / COMMENTS?

GOT LORAN?

