
Enhanced Loran (eLoran)

History & Need

*Presentation to
PNT Advisory Committee Meeting
14 May 2009*

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eLoran Independent Assessment Team (IAT)
Executive Director**

IAT Charter (August 2006)

- **Conduct independent assessment of Loran**
 - *Assemble team of experts* to review & assess continuing **national need** for the current US Loran infrastructure*
 - *Report findings & recommendations directly to Under Secretary of Transportation for Policy and to Deputy Under Secretary of Homeland Security for Preparedness*
- **Assess information from recent studies & working groups' reports***
 - *Use, for example, LORAPP & LORIPP working group reports; studies by Volpe Center, FAA, USCG, HSI, others*
 - *Supplement with information from key stakeholders and others* as appropriate*

*Note: IAT membership, materials reviewed, & others consulted listed on backup charts

Conclusions & Recommendation (Dec 2006)

- **Conclusions**

- *Reasonable assurance of national PNT availability is prudent & responsible policy*
 - For critical safety of life & economic security applications
 - And for all other “quality of life” applications
- *eLoran is cost effective backup – to protect & extend GPS – for identified critical (other GPS-based) applications*
 - Interoperable & independent
 - Different physical limitations & failure modes
 - Seamless operations & **GPS threat deterrent**
- *Given US Government support, anticipate users will equip with eLoran as the backup of choice*
 - International community also looking for US leadership

- **Recommendation**

- *Complete eLoran upgrade & commit to operate for 20 years*
 - Affordable within recent funding history

Why eLoran

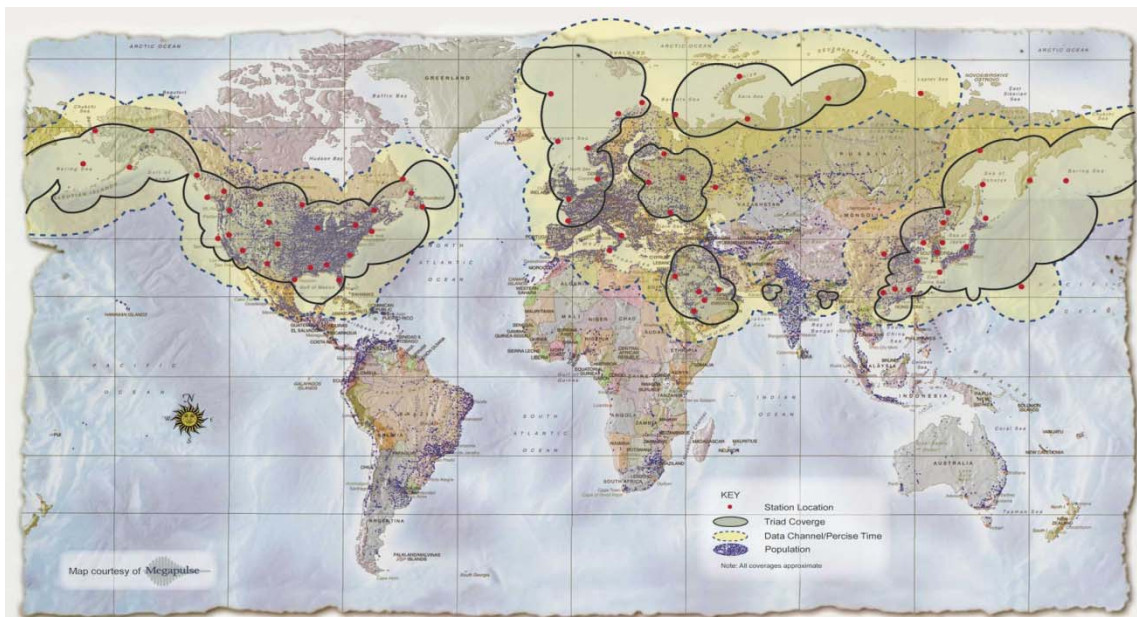
- eLoran meets needs of all identified critical applications – and others
 - 10-20 meter navigation accuracy for harbor entrance
 - 0.3 mile required navigation performance (RNP 0.3) & aviation integrity
 - Stratum 1 for precise frequency users & 50 ns time accuracy
- eLoran is a *modern* system, NOT 1958 Loran-C
 - New infrastructure – solid state transmitters, state-of-the-art time & frequency equipment, uninterruptible power supplies – **essentially complete**
 - New operating concepts – time of transmission, all-in-view signals, message channel with differential corrections, integrity, etc. – **fully tested**
 - New user equipment - digital, process eLoran & GPS interchangeably, compact H-field antennas eliminate “p-static” – **nascent industry ready**
- eLoran is affordable – IAT “deep dive” into costs (*over-bounded*)*
 - Did NOT critique costs, categories, or needs – largest set of max values
 - \$159M invested to date – \$5-25M/yr FY 1997-2006
 - Less than \$143M to fully complete eLoran ... **most likely considerably less**
 - Avoid \$146M costs of decommissioning existing Loran-C infrastructure
 - Ops & maintenance currently \$37M/yr
 - Reduce with eLoran-enabled automation – **start today**

*More cost detail in backup

Finish eLoran = “no cost solution”

The Way Ahead (Unanimous by IAT)

- **Implement IAT recommendations**
 - *Decide to retain eLoran for 20 years as primary backup to protect & extend critical (& other) GPS applications*
 - *Fund completion of eLoran*
 - *Reduce eLoran staffing (O&M costs) – start now*
 - *Stimulate eLoran receiver development & equipage*



Closing thoughts

- *Established capability*
 - *Well proven*
 - *High cost to re-establish*
- vs.**
- *Low cost to retain*

2009: all 18 CONUS & 2 (of 6) Alaska sites upgraded to eLoran

Post-IAT: San Diego Incident (Jan 2007)

- **Inadvertent interference**
 - *Single location, no attempted deception*
 - *Self-discovered & corrected in less than 4 hours*
- **Impacted many users, these & more:**
 - *First responder paging & dispatch routing*
 - *Harbor safety & security, including USCG AIS & DGPS*
 - *Aviation navigation & communications*
 - *Cellular telephones & other networks*
- **Best detection technology today & projected**
 - *36 hours to localize within a mile*
 - *Then door-to-door search*
- ***With eLoran would have operated through***
 - *All applications above & unidentified others*
 - *Instantly & seamlessly*

This is not the only incident, but the best studied

Post IAT: Federal Register Notice (Jan 2007)

- **Released 8 January 2007**
 - *Jointly release by DOT & DHS*
 - *USCG action office & docket # USCG 2006-24685*
- **Regarding possible actions on future of US Loran**
 - *Develop & deploy eLoran*
 - *Maintain current Loran-C*
 - *Decommission Loran infrastructure*
- **Response**
 - *Approximately 1000 responses*
 - *Overwhelmingly supportive of need for Loran continuation (& upgrade to eLoran)*

Formal IAT Report Briefings (Jan-Oct 2007)

- **US Government officials**

- *Dep Sec DOT & DHS, Under & Asst Sec DoD, Asst Admin FAA & NGA, Asst COMDT USCG, Deputy CIO DNI, others*
- *OMB & NSC; Natl PNT Coordination Office; Natl PNT Architecture (NSSO), Joint Program Dev Office (JPDO)*
- *DoD PNT SWarF, DOT Extended POS/NAV Executive Committee, DHS Geospatial/PNT Executive Committee*
 - **Key to decision at March 2007 National PNT Executive Committee meeting – assigned to DOT & DHS to implement**

- **Outside US Government**

- *Natl Security Telecommunications Advisory Committee*
- *UK Ministry for Transport's "Cross Government" meeting*

eLoran Standards – work in progress

- **Radio Technical Commission for Maritime Services (RTCM)**
 - *eLoran signal in space & user equipment*
 - *RTCM special committee 127 (SC-127) established 2007*
- **International Association of Lighthouse Authorities (IALA)**
 - *e-Navigation standards for maritime operations*
 - **Electronic Charting & Display (ECDIS)**
 - **Electronic Nautical Charts (ENC)**
 - **Radionavigation systems (positioning inputs) – two needed: GPS/DGPS & eLoran**
 - *Consultative group established summer 2007*

Status of eLoran (May 2009)

- **Critical PNT applications remain vulnerable**
 - *Maritime, aviation, land mobile, and time & frequency*
- **eLoran ready to be US (& global) PNT backup**
 - *For assured, robust PNT for “big four” user groups (above)*
- **US decision: *eLoran is national backup***
 - *Policy decision at March 2007 National PNT ExCom*
 - Congressional support FY2008 appropriations
 - *Announced by DHS February 2008*
 - Continued Congressional support FY2009 appropriations
 - Affirmed in Federal Radionavigation Plan, January 2009
- ***Apparent reversal* in FY2010 budget, January 2009**
 - *Terminate Loran-C (with no “new start” for eLoran)*

Loran-C may be obsolete (as some say) & can go, but ***eLoran is essential***

Questions

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Backup

IAT Members

- Dr. Bradford Parkinson – Stanford University – Chair**
- James Doherty – IDA, former USCG NAVCEN – Exec Director**
- John Darrah – IDA, former Chief Scientist AF Space Command**
- Arnold Donahue – NAPA, former OMB**
- Dr. Leon Hirsch – IDA Research Staff Member**
- Donald Jewell – IDA, former AF Space Command**
- Dr. William Klepczynski – IDA, former US Naval Observatory**
- Dr. Judah Levine – NIST Time Services**
- L. Kirk Lewis – IDA, Executive Director GPS IRT**
- Dr. Edwin Stear – IDA, former VP Boeing & AF Chief Scientist**
- Philip Ward – IDA, former Texas Instruments (GPS receivers)**
- Pamela Rambow – IDA Research Assistant**

Who We Met with

Government Agencies

- *Department of Transportation (DOT)*
- *Federal Aviation Administration (FAA)*
- *Volpe National Transportation Systems Center (VNTSC)*
- *Department of Homeland Security (DHS)*
- *US Coast Guard (USCG)*
- *Homeland Security Institute (HSI)*
- *US Naval Observatory (USNO)*
- *National Security Space Office (NSSO)*
- *National Institute of Standards & Technology (NIST)*
- *National PNT Coordination Office (NPCO)*

User Groups & Organizations

- *International Loran Association (ILA)*
- *Aircraft Owners & Pilots Association (AOPA)*
- *National Boating Federation (NBF)*
- *American Pilots Association (APA)*

User Equipment Industry

- *Cross Rate Technology*
- *Megapulse*
- *Peterson Integrated Geopositioning*
- *Rockwell Collins*
- *Symmetricom*
- *Timing Solutions Corporation*

Studies Reviewed (Principle Investigators)

- *GPS Vulnerability (VNTSC)*
- *Timing (HSI, NIST, USNO)*
- *PNT Architecture (NSSO)*
- *eLoran Costs & Benefits (USCG, FAA, VNTSC, Megapulse, Trinity House)*
- *Loran Integrity Performance Panel research & findings (LORIPP)*
- *Loran Accuracy Performance Panel research & findings (LORAPP)*
- *eLoran Characteristics (FAA, USCG, Stanford University, Peterson Integrated Geopositioning)*
- *Aviation Backup Requirements (FAA, Aviation Mgmt Associates)*
- *Aviation Certification Issues (FAA)*
- *Aviation eLoran Performance (FAA)*
- *Maritime Backup Requirements (former TASC/Litton/Northrop Grumman)*
- *Maritime eNavigation (Trinity House & University of Wales)*
- *Interference Detection & Mitigation (IDM) Plan (DHS, USCG)*
- *eLoran Performance Data (Ohio University, Stanford University, Peterson Integrated Geopositioning)*
- *Location-Based Security (Logan Scott Associates, Stanford University)*
- *eLoran as Time & Frequency System (Timing Solutions Corporation)*

eLoran Costs

- **Nonrecurring eLoran funds to date (provided to FAA)**
 - *FY 1997-2006: \$159M (FY 2001-2006: \$17M - \$25M per year)*
 - *Completed existing transmitters, building modifications, etc. in CONUS & began in Alaska (first of six transmitters completed)*
- **Decommissioning costs of current infrastructure**
 - *USCG estimate \$146M (~\$97M of this in Alaska)*
- **Operations & maintenance (recurring funds – currently in USCG base)**
 - *Currently \$37M per year*
 - *eLoran estimate ~\$15M per year*
- **Personnel impact of eLoran**
 - *Currently 283 USCG personnel*
 - *Reduce to less than 41 government plus 55 contractor*

IAT Assessment of Costs

- **Based on USCG & FAA reported costs – *overbound of costs***
- **For eLoran in CONUS**
 - *eLoran upgrades remaining* \$ 51M
 - *eLoran expansion (4 xmtrs @ \$15M)* \$ 60M (likely less ~ \$40M)
 - *Major maintenance (backlog & deferred)* \$ 44M (\$2M/yr for 20 yrs)
- **Alaska**
 - *eLoran upgrades remaining* \$ 32M
 - *Major maintenance (backlog & deferred)* \$245M (\$12M/yr for 20 yrs)
- **Initial assessment**
 - *Provide additional nonrecurring funds – \$143M (over 5-8 years, or **offset by avoiding decommissioning costs of \$146M**)*
 - \$111M to complete eLoran in CONUS
 - \$32M to complete eLoran in Alaska
 - *Reduce current O&M (\$37M/yr) thru eLoran economies*
 - Begin with available economies in CONUS today – remove crews
 - Apply savings to major maintenance

US Congress Assessment of IAT (July 2007)

- **DHS Appropriations language FY2008 – House**
 - *The Committee also understands that in late 2006, DOT convened an Independent Assessment Team, in cooperation with DHS, to complete yet another evaluation of Loran C. The Team concluded that Loran C should be retained and modernized to serve as a long term back up for GPS.*
- **DHS Appropriations language FY2008 – Senate**
 - *The Committee understands that a group composed of officials from the Departments of Homeland Security and Transportation, and other Federal agencies met earlier this year and unanimously agreed that the United States should maintain the Loran system.*

US eLoran Decision (February 2008)

DHS press release February 7, 2008

- *“Today the U.S. Department of Homeland Security will begin implementing an independent national positioning, navigation and timing system that complements the Global Positioning System (GPS) in the event of an outage or disruption in service.*
- *“The enhanced Loran, or eLoran, system will be a land-based, independent system and will mitigate any safety, security, or economic effects of a GPS outage or disruption. GPS is a satellite-based system widely used for positioning, navigation, and timing. The eLoran system will be an enhanced and modernized version of Loran-C, long used by mariners and aviators and originally developed for civil marine use in coastal areas.*
- *“In addition to providing backup coverage, the signal strength and penetration capability of eLoran will provide support to first responders and other operators in environments that GPS cannot support, such as under heavy foliage, in some underground areas, and in dense high-rise structures. The system will use modernized transmitting stations and an upgraded network.”*

Continued Congressional Interest (July 2008)

- **DHS Appropriations language FY2009 – Senate**

- *"The Committee denies the request to transfer \$34,500,000 to the National Protection and Programs Directorate (NPPD) for the operations and maintenance of Long Range Aids to Navigation [loran] stations. There are no merits in transferring operations and maintenance costs from the Coast Guard to NPPD and then transfer funding back administratively to the Coast Guard to continue operation of loran-C. The Committee has no prejudice with NPPD assuming a dominant role in the development of the Enhanced Long Range Aids to Navigation system. NPPD should determine how much it will need to develop this system and request resources accordingly."*

- **DHS Appropriations language FY2009 – House**

- *"The Department proposed moving the Long Range Aids to Navigation (LORAN-C) program from Coast Guard to the National Protection and Programs Directorate (NPPD). Since Coast Guard will remain responsible for operating LORAN-C until a replacement system is developed, there is no logical reason to transfer these funds at this time to NPPD, an agency that has neither the preparation nor the experience to operate the LORAN-C system. Therefore, the Committee recommendation includes \$34,500,000 for Coast Guard to continue to operate this critical system."*