
Enhanced Loran (eLoran)
An Independent Perspective

Presentation to the
Civil GPS Service Interface Committee

James T. Doherty
Institute for Defense Analyses
22 April 2008

What This Is Not & What It Is

- **Not**
 - *The Independent Assessment Team (IAT) report*
 - *Which had been used to inform the US decision on eLoran*
- **Is**
 - *The author's perspectives on eLoran*
 - *Request for feedback and data as we move forward*
- **Similar brief given**
 - *May 2007 Annual Assembly Meeting & Conference of the Radio Technical Commission for Maritime Services (RTCM)*
 - **RTCM SC-127 on eLoran subsequently initiated**
 - *September 2007 International Association of Lighthouse Authorities (IALA) Ad Hoc Meeting on Loran/Chayka*
 - *October 2007 Royal Institute of Navigation NAV07 meeting*

Why an IAT?

- **Panel of experts – Independent Assessment Team**
 - *From government, industry, academia, etc.*
 - *With relevant experience in senior decision-making positions*
- **View issues from the national perspective**
 - *Not agency or user group specific*
- **Report directly to senior sponsor(s)**
 - *Under Secretary & Deputy Under Secretary*
- **Not a new study but a review of prior studies**
 - *Vulnerability assessments*
 - *Cost/benefit analyses*
 - *Technical studies and data collection*
 - *Stakeholder perspectives*

How Did It Work?

- **Initial assessment: August thru December 2006**
- **Document review**
 - *About 40 reports, comprising 1500-2000 pages*
- **Three 2-day meetings – monthly intervals**
 - *Stakeholders (agencies & user communities)*
 - *Investigators, study teams, & data collectors*
 - *Industry – signal provider & user equipment*
 - *Service providers – US & international*
- **Extensive “deep dive” into cost data**
 - *Reconciliation of differences & “over bound”*
- **Consensus conclusions & recommendations**
 - *Report to sponsors & follow up with others*

eLoran Defined

- **eLoran – 21st Century low-frequency (100 KHz) position, navigation, time (PNT) service**
 - *Latest evolution of LOnG RANge Navigation (LORAN) concept*
 - *Internationally standardized*
- **eLoran meets PNT performance requirements, including**
 - *Accuracy, availability, integrity, and continuity***for applications of**
 - *Aviation users, including non-precision approach*
 - *Maritime users, including harbor entrance and approach*
 - *Land mobile users, and*
 - *Precise time and frequency users*
- **eLoran is an independent dissimilar complement to GNSS**
 - *Enables diverse user communities to continue operations when GNSS services are disrupted*
 - *Retains safety, security, environmental, and economic benefits of critical applications*

eLoran Is NOT Loran-C (but backwards compatible)

- **Upgraded infrastructure**
 - *Solid state transmitters*
 - *Modern “ensembled” time & frequency systems*
 - *Uninterruptible power supplies*
 - *Differential monitor network*
- **Modernized operations concepts**
 - *Data messaging channel – differential signals, etc.*
 - *Time of transmission control – independent of GPS/GNSS*
 - *“All-in-view” signal tracking*
- **New user equipment – eLoran & GPS/GNSS**
 - *Digital signal processing – interoperable with GPS/GNSS*
 - *Incorporates differential signals & survey data*
 - *H-field antennas – eliminates “P-static”*

eLoran as Backup (& Extension) of GPS

- **GPS-based PNT is ubiquitous, economical, & dependency is growing in applications providing**
 - *Safety of life, economic security, quality of life*
- **GPS (& in future GNSS) is vulnerable to disruption**
 - *Interference, atmospheric, noise floor, obstruction (urban canyons, foliage, et al), etc.*
- **eLoran as backup (& extension) system**
 - *Critical PNT performance requirements*
 - *Interoperable with & independent of GPS/GNSS*
 - *Different failure modes – system & propagation*
 - *Seamless operation for backup & also extends to GPS-challenged areas*

eLoran Pacing Requirements

Studies & data demonstrated eLoran meets

- **Harbor entrance & approach maritime navigation**
 - *10-20 meter accuracy*
 - *Differential monitor sites & stored survey data*
- **Aviation non-precision approach**
 - *Required navigation performance 0.3 nautical mile (RNP 0.3) accuracy with*
 - *Aviation quality integrity signal*
- **Stratum 1 frequency stability**
 - *Also met by Loran-C*
- **50 ns time accuracy**
 - *Traceable to Universal Coordinated Time (UTC)*
 - *Differential time monitor sites*

eLoran User Equipment

- **Nascent UE industry**
- **Prototypes exist**
 - *Integrated eLoran-GPS receiver designs*
 - No one envisions standalone eLoran design
 - *Common user interface*
 - *Compact H-field antenna, generally integrated with GPS*
 - *Limited production reasonably available*
 - Potential for significant cost reduction
- **Market surveys**
 - *Classic & new applications*
 - *“Reliable” GPS*
 - *Next equipment upgrade cycle*

Way Ahead & Your Feedback

- **Need for standards?**
 - *Must stop the engineering “what ifs”*
 - *Need a “Version 1.0” standard for eLoran*
 - **Signals in space**
 - **UE performance & testing**
 - *What is deferred until later Versions?*
- **What is the upgrade path? For example,**
 - *For how long should eLoran be backwards compatible for legacy Loran-C users?*
 - *Should the operating concepts be upgraded (e.g., single-rate all transmitters); when?*
- **What else is needed for the users to equip?**
 - *Are regulations or incentives needed?*
 - *For all or just some user groups?*