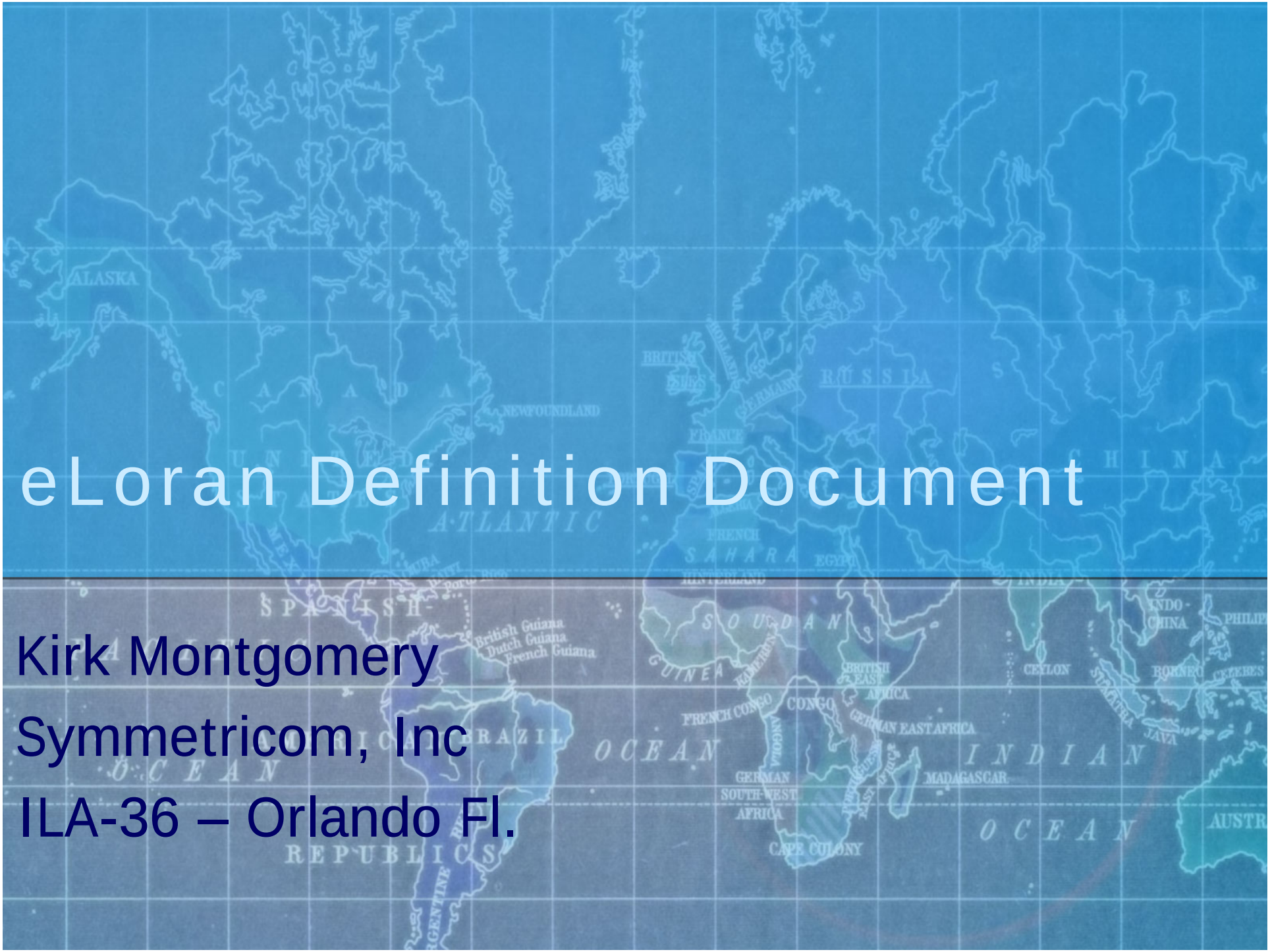

eLoran Definition Document

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Schedule

- 3 day workgroup meetings @ NAVCEN between 29 Nov & 1 Dec 2006
  - Elevator Speech
  - Outline
  - Draft Document
- First rough draft completed during the Christmas Holidays
- Delivered to ILA-BOD on 12 Jan 2007
- Final Draft delivered to the team 16 Jan 2007
- Comments sought until 1 Apr 2007
- Other drivers
  - FRN
  - NAVCEN Website

Document

- Outline
  - Executive Summary
  - Introduction
  - eLoran System Description
  - Applications
  - Service Provisions
  - Conclusion
- The Four Horsemen
  - Accuracy
  - Availability
  - Integrity
  - continuity

Introduction

- Overview
  - Policy makers
  - Service Providers
  - Users
  - 30 Second Elevator Speech
- Background
  - Describe LORAN-C
  - Motivations
  - Describe eLORAN
- Content
  - What is in the document

The eLoran Signal

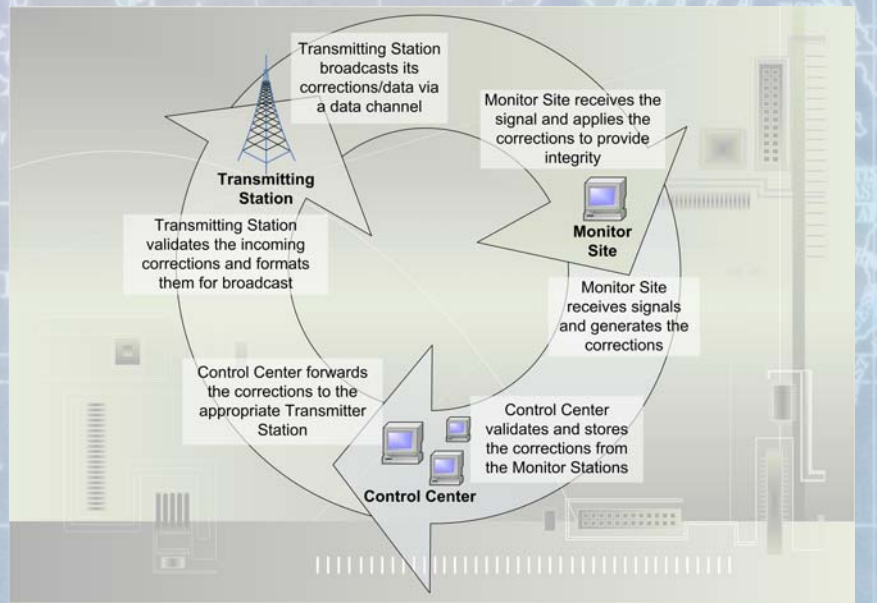
- The data channel conveys:
  - Corrections
  - Warnings
  - signal integrity
- The data transmitted will include at a minimum:
  - The identity of the station, almanac data, differential monitor IDs
  - Absolute time with leap-second information
  - Warnings of anomalous radio propagation conditions:
    - Early skywaves
    - Warnings of signal failures
  - Authentication the *eLoran* transmissions
  - Official-use only messages
  - Differential Loran corrections
    - Maximize accuracy for maritime and timing users
    - Differential GNSS corrections.
- Changes maximize the accuracy & integrity of the system

System Components

- Transmitting Stations:
  - UPS - Power failures will not affect the transmitted signal.
  - Phase corrections are done in a continuous manner
  - The time reference system uses multiple cesium clocks, or an alternative technology of at least equal quality.
  - *eLoran* transmissions are synchronized, traceable, & GNSS Independent
- Control Stations:
  - *eLoran* transmitting stations run unattended
  - Personnel are on call to respond rapidly
  - Scheduled maintenance work is planned carefully to minimize the impact on users of stations being off the air
    - Users are given adequate notice of interruptions via well-publicized channels of communication.
  - Security of these sites and of any critical communications systems is of a high level, reflecting the importance of the applications for which the transmitted signal is being used.
- Monitor Sites:
  - Provide integrity for the user community
  - Real-time information to the control centers regarding signals in space.
  - Users are notified immediately if any abnormalities are detected.
  - Reference Stations
    - Timing
    - HEA
    - Aviation

User Equipment

- All-in-view mode
  - Accurate and reliable position and timing measurements.
  - Cycle Integrity
- Loran Data Channel
  - Receive and decode the messages
  - Apply this information based on the user specific application
  - This information, coupled with the published Signal Propagation Corrections, provides the user with a highly accurate PNT solution.



Applications

- Aviation
- Maritime
- Land Mobile
- Location Based
- Time & Frequency
- Each Section
  - Performance Requirements
    - Traceable
  - Table of Benefits
    - Safety
    - Security
    - Economic

Aviation

- Support aircraft operations gate-to-gate
  - Departure
  - En-route
  - Approach
  - Landing
- Non-precision approaches by providing sufficient horizontal guidance.
  - Horizontal Accuracy 0.3 Nautical Mile (556 meters) - 307 meters, 95%
  - Availability 0.999 – 0.9999
  - Integrity 1 x 10-7 per hour
  - Continuity 0.999 – 0.999
- Signal Propagation Corrections are published for each airport and applied by the user receiver in real-time during each phase of operation.
- Most *eLoran* aviation receivers employ so-called *H-field* (or, magnetic loop) antennas. Extensive tests have shown that these antennas are almost immune to the effects of the Precipitation Static (P-Static) experienced in rain and snow, which has been a major problem for users of traditional Loran-C airborne receivers.

Maritime

- e-Navigation will improve:
  - Safety
  - Security
  - Protection of the marine environment
  - Potentially reducing costs
- GNSS is the principal Source:
  - Cannot be guaranteed to meet the required availability and reliability
  - Combination of GNSS and *eLoran* will
- HEA
  - Accuracy 10 meters (95%)
  - Signal Availability 0.998 over 2 years
  - Time to Alarm 10 seconds
  - Service Reliability 0.9997 over 3 hours
- The signal propagation errors along the channels and throughout the harbors must be measured
  - Corrections are published, and stored in each receiver
  - Real-time differential Loran corrections are applied to remove the small fluctuations in the signals due to weather or transmitter timing variations
  - By using these real-time corrections, ships achieve the exceptional accuracy required for safe navigation in confined waterways.
- *eLoran compass*.

Land Mobile

- *e-Loran* compass
- Authenticate its own and GNSS data
- Immune to jamming
- Signal penetration
  - Indoors
  - Urban Canyons
  - Shipping Containers
  - Warehouses
- Tracking items
  - High-value
  - Safe and timely delivery must be guaranteed.
  - Hazardous Cargo
- Performance Standards:
  - Unlike aviation and maritime systems, those designed for land tracking applications are generally not required to meet published performance standards. Rather, their performance is normally assessed and optimized for user specific applications.

Location Based Services

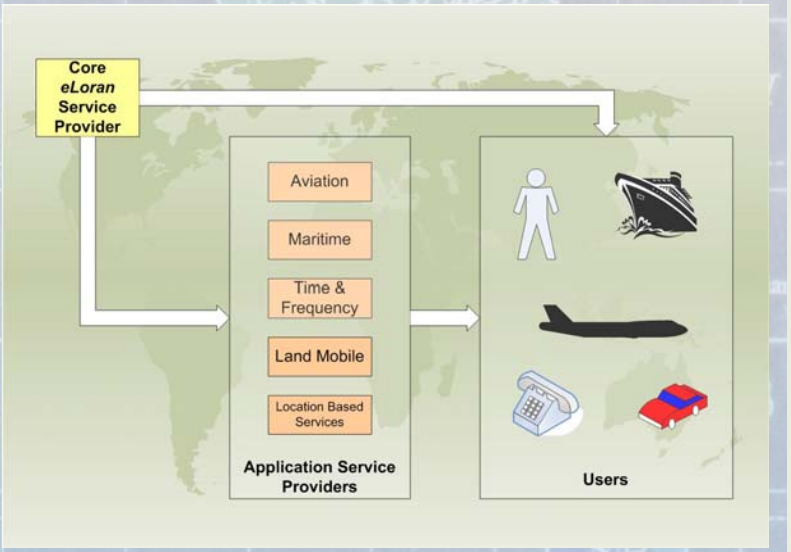
- Signal penetration
  - E-911(US) or E-112 (Europe) response systems
  - Location-based encryption systems
  - Geo-fencing
  - Weather balloon tracking
  - Offender tracking
  - Location-based billing.
- Performance Standards:
  - These applications, as with those for any land mobile applications, need to be assessed and optimized for user specific applications.

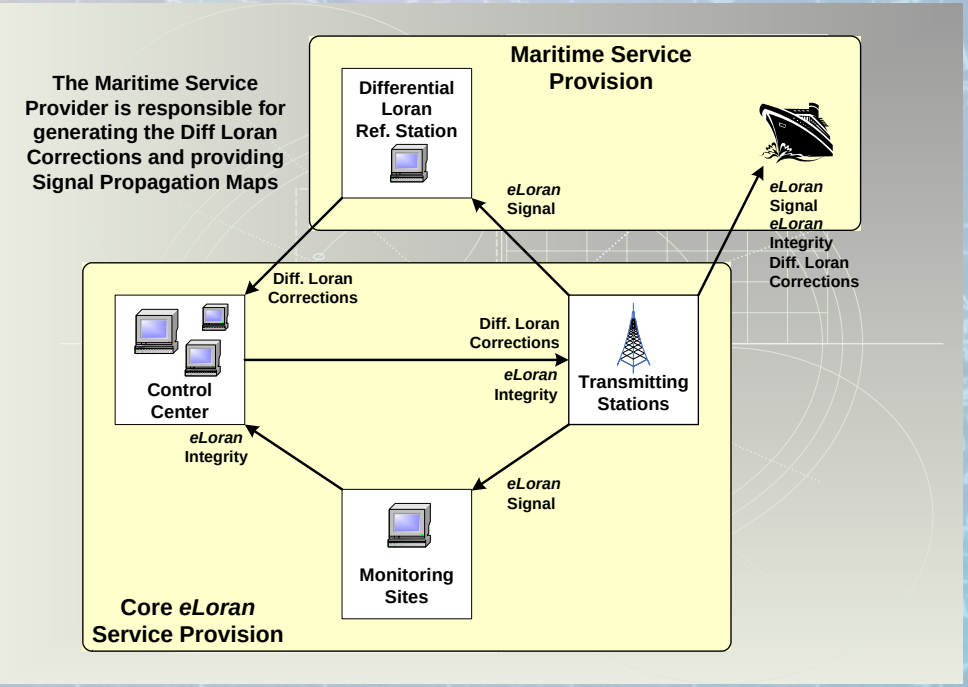
Time & Frequency

- *eLoran* is a viable alternative source of time
  - Transmissions are precisely synchronized to UTC.
  - LDC – Station ID and Time of day
  - LDC – Corrections
  - Recover time to ~50nSec RMS (UTC)
- Signals are available indoors
  - Avoid installing an outside antenna with a clear view of the sky
  - Downtown/Urban Canyons
  - Expensive
- Meets Stratum 1 even without the LDC Corrections
- Possible Uses:
  - Telecommunications networks
  - E-911 or E-112
  - Power grid phase synchronization, flow control and fault isolation

Service Provision

- eLoran may be considered as comprising:
- Core *eLoran* Service Provider
- Application Service Providers





Next Steps

- To fully define an eLoran service:
  - **Plan** - Addresses policy, considers operational issues, presents a service description and identifies future developments. It may include a summary of user requirements that are met.
  - **Performance Specification** - Defines the level of performance including coverage that the service provider is committed to providing. It may take the form of a service level agreement.
  - **Interface Control Document** - Defines the signal so that it can be accessed by user equipment
- The plan and performance specification will be owned by the service provider.
- The eLoran interface control document shall be standardized globally to ensure interoperability
- Each Core eLoran Service Provider and each Application Service Provider will need to develop its own service definition documents based on international standards and local service provision requirements.

Conclusion

- An **internationally** standardized (PNT) service
- Available for a wide range of applications
- Independent, dissimilar, complement to (GNSS)
- PNT users will be capable of retaining the safety, security, and economic benefits of GNSS, even when their satellite services are disrupted or when using eLoran in areas where GNSS in not available.
- eLoran is capable of providing this level of service by meeting the accuracy, availability, integrity, and continuity performance requirements for
  - aviation non-precision instrument approaches
  - maritime harbor entrance and approach maneuvers
  - land-mobile vehicle navigation
  - location-based services
  - precise time and frequency users

Executive Summary

- **Last section completed**
- **2 pages**
  - **Overview**
    - **30 Second Elevator Speech**
  - **eLoran System**
  - **Service Provision**
  - **The Way Ahead**

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