A Perspective on the Future of eLoran

Presentation to the

Royal Institute of Navigation NAV 08

&

International Loran Association ILA 37

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What This Is Not & What It Is

- **Not … once again (sigh …)**
  - *The Independent Assessment Team (IAT) report*
- **Is**
  - *The author's perspectives on the future of eLoran*
  - *Supplemented with information from recent US Government announcements and briefings*
  - *Fundamentally the author's comments*

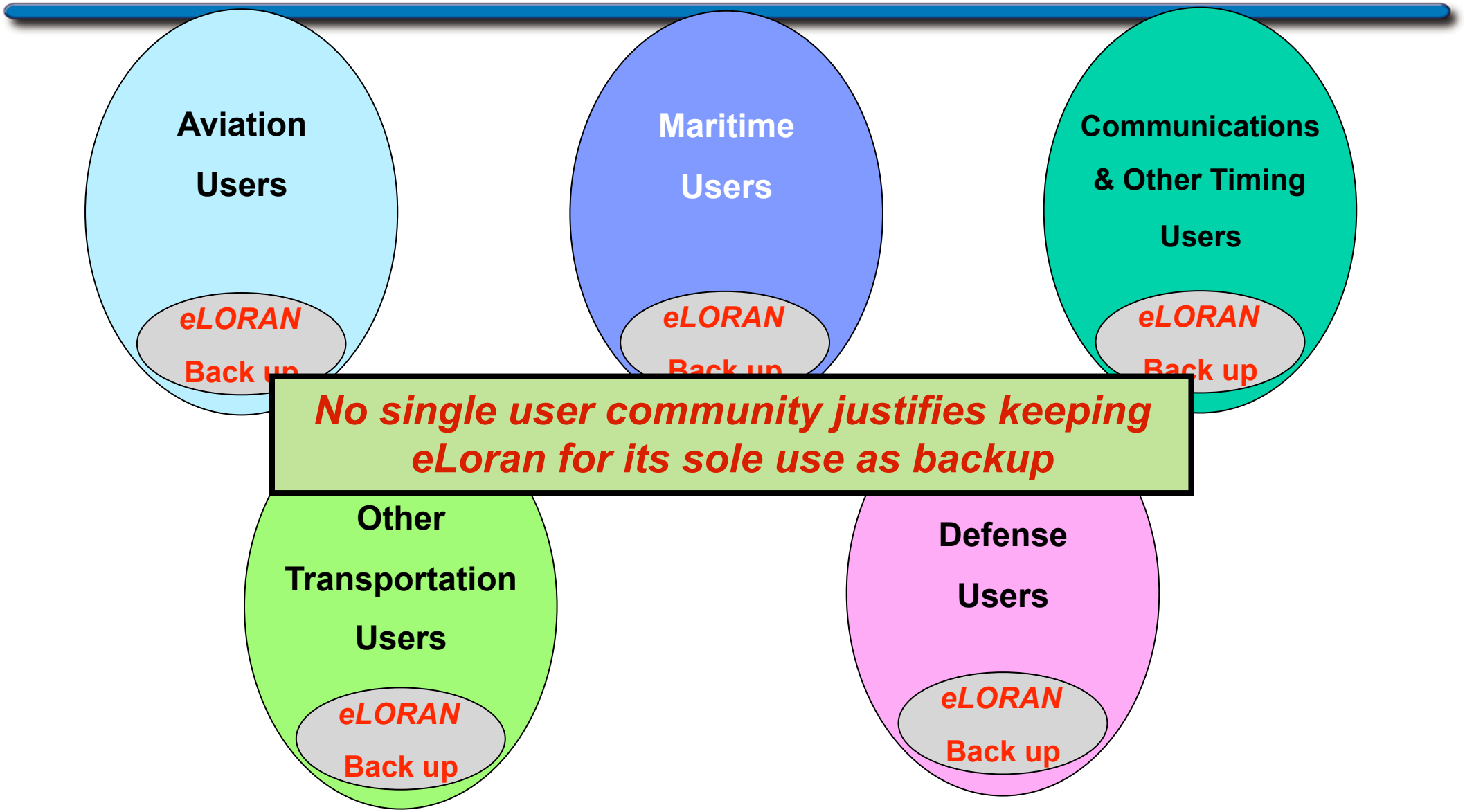
Background

- **Navigator – found Bermuda in 44' sailboat**
  - *Sun lines (occasional) & star sights (almost never)*
  - *Dominantly DR with magnetic compass & speed log*
  - *Checked water temperature (Gulf Stream) … all available means*
- **Electronics engineer in USCG**
  - *If not for the Loran program …*
- **Loran-C – the beginning**
  - *East coast US chain, several other chains worldwide – ¼ mile*
  - *40 people per transmitter*
- **Exclusive Economic Zone**
  - *Some automation, limited remote control – 11 people*
  - *Full remote control, solid state transmitters – 4.5 people*
- **Long break … then NAVCEN 1996-1999**
  - *Loran Consolidated Control System*
  - *Congressional modernization funding*
  - *Experiment with de-staffing transmitters*

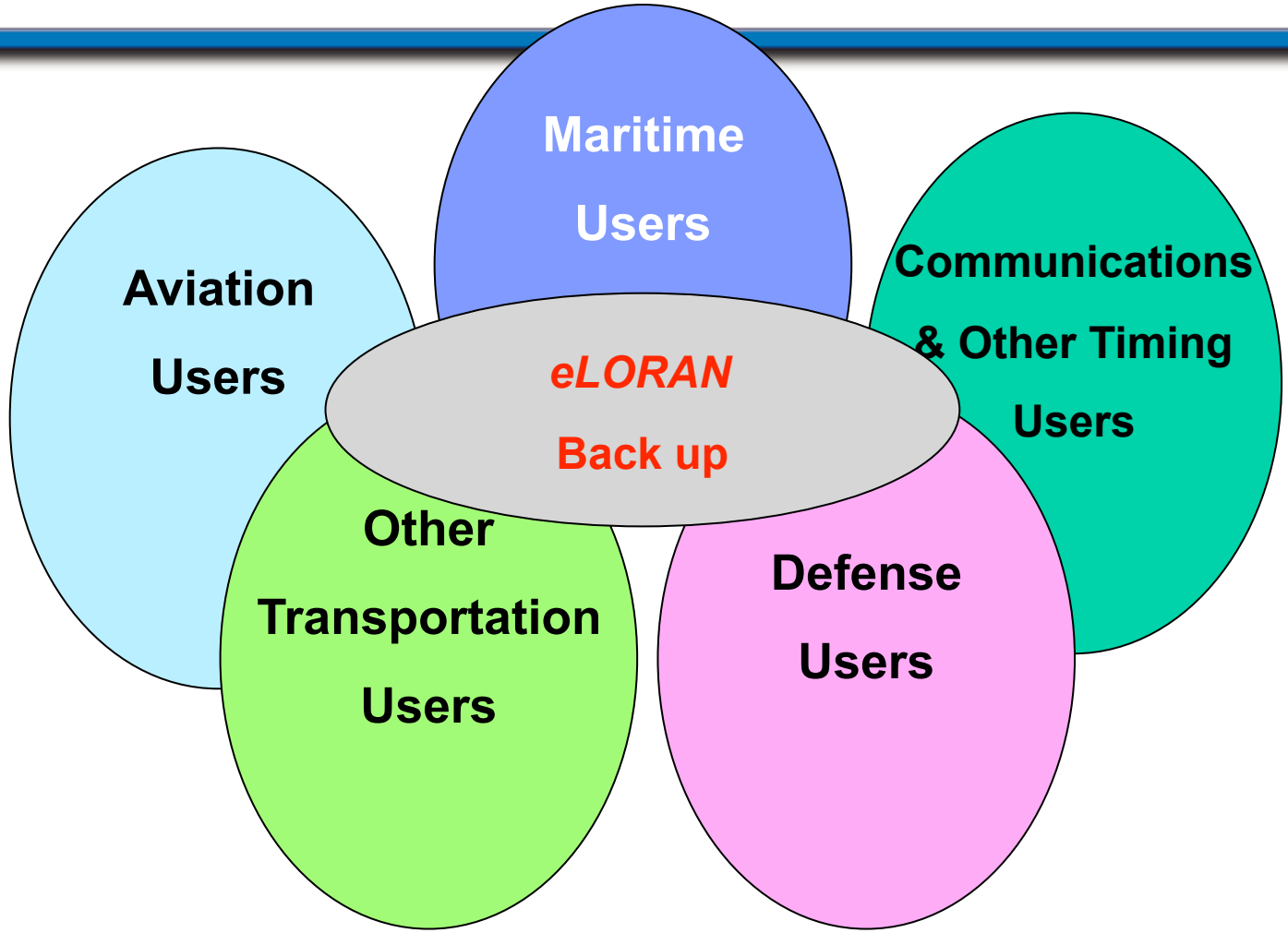
Current Needs Are Quite Different

- **1970s – professional navigator user groups**
  - *Military, aviation, maritime radionavigation systems*
  - *Service providers – DoD, FAA, USCG*
- **2000s – everyone is a user**
  - *Position, navigation, timing, & frequency utility*
  - *Ubiquitous in critical safety-of-life, national & economic security, and quality-of-life applications*
  - *Designated executive agent, generally historically based – internal agency funds competition*
    - **Eg, USAF for GPS**
- **Tragedy of the Commons**

Tragedy of the Commons – All Use, None Pays



But There Is a Combined Community Need



An ensemble of users needing backup could support continuing eLoran

Initial Solution

- **DOT as executive agent**
  - *Already the civil user advocate for use of GPS*
  - *USCG for Loran operations & maintenance (O&M)*
    - Historical precedent – since WWII
    - $35M/year – reduce with automation
  - *FAA for eLoran upgrade*
    - Mid-continent gap closure precedent (1980s)
    - ~$20M/year (5-8 years) – worst case but front load
- **Post-9/11 impact**
  - *Formation of DHS in 2003, moved USCG from DOT*
  - *2004 National Space-Based PNT Policy*
    - DOT remains civil user advocate
    - DHS responsible for backup systems

Enter Independent Assessment Team (IAT)

- **Why use outside group to study tough problems?**
  - *Technical knowledge & experience*
  - *Contacts & access to critical stakeholder & other data*
  - *Independence & detachment*
- **Ground rules for IAT**
  - *Panel of experts*
  - *Sponsor sets context & asks questions*
  - *IAT collects data, probes outside experts & stakeholders, conducts assessments, and examines external impacts within context*
  - *IAT provides the response – based on data & context assessments*

US Congress Assessment of IAT

- **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

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."*

Continuing Congressional Interest

- **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****."*

What Does This All Mean?

- **Policy – eLoran as backup – announced February 2008**
  - ***Policy supported by Congressional language***
  - ***But initial implementation (transfer from USCG to DHS) not***
- **Bellwether indication**
  - ***The current policy is that eLoran is the national backup***
  - ***And unless or until there is a new implementation plan acceptable to Congress, USCG is executive agent***
- **At least this is what makes sense to me**

What Now, Coach?

- **Automate – *immediately***
  - ***18 LORSTAs in CONUS & 2 in Alaska ready to go***
  - ***Equipment available for 2 more in Alaska***
  - ***Reduce station staffing by about 100 people, 25 more soon***
- **Seriously investigate contract operation options**
- **Continue & expand current eLoran ops**
  - ***TOT & LDC most critical – add to all signals ASAP***
  - ***Common view time transfer okay until TWSTT can be implemented***
  - ***Dummy data until differential monitors operating***
- **Fully support standards efforts at IALA, RTCM, etc.**

Automation

- **Recognize that eLoran is a backup capability**
  - *Not an excuse to be careless in operations*
  - *But allows reasonable savings – don't need 24x7 30-minute response; 2-hour to 1-day okay*
- **Pseudorange processing, all-in-view receivers**
  - *One signal no longer as critical as in TD ops*
  - *Identify those that may be critical – e.g., Jupiter (which is very close to nearest maintenance facility)*
- **Best transmitter equipment ever – use it**
  - *SSX – soft fail & no maintenance for a year okay*
  - *Ensemble time scale – 3 CS – 1 month accuracy*
  - *UPS & auto-start generators*
  - *Redundant communications*

Remaining Work

- **Focus first to implement differential eLoran**
  - *Monitors for temporal variations in ports & waterways*
  - *Harbor surveys to address spatial variations*
  - *Add time service locations*
- **Next—Two-Way Satellite Time Transfer (TWSTT)**
  - *Current GPS all-in-view daily average is pretty good operationally AND reasonably independent of GPS*
  - *But TWSTT or common view to non-GPS satellite needed for full, long term independence*

Finish Alaska

- **Shore power to Shoal Cove**
- **Update or relocate Attu & Port Clarence**
- **Test new transmitter technology**

Expand the eLoran Backup Capability

- **Add 4 new transmitters in CONUS**
  - *Coverage for southern Florida, Key West, Caribbean; southern Texas; southern California*
  - *Additional continuity assurance mid-continent*
- **What about that North Slope in Alaska?**
  - *Global Warming – navigable water where there wasn't before*
  - *Northwest Passage & "edge of slope" EEZ claims*
  - *National defense, national security, marine safety, resource & environmental issues, tourism & SAR*
- **Hawaii ??**

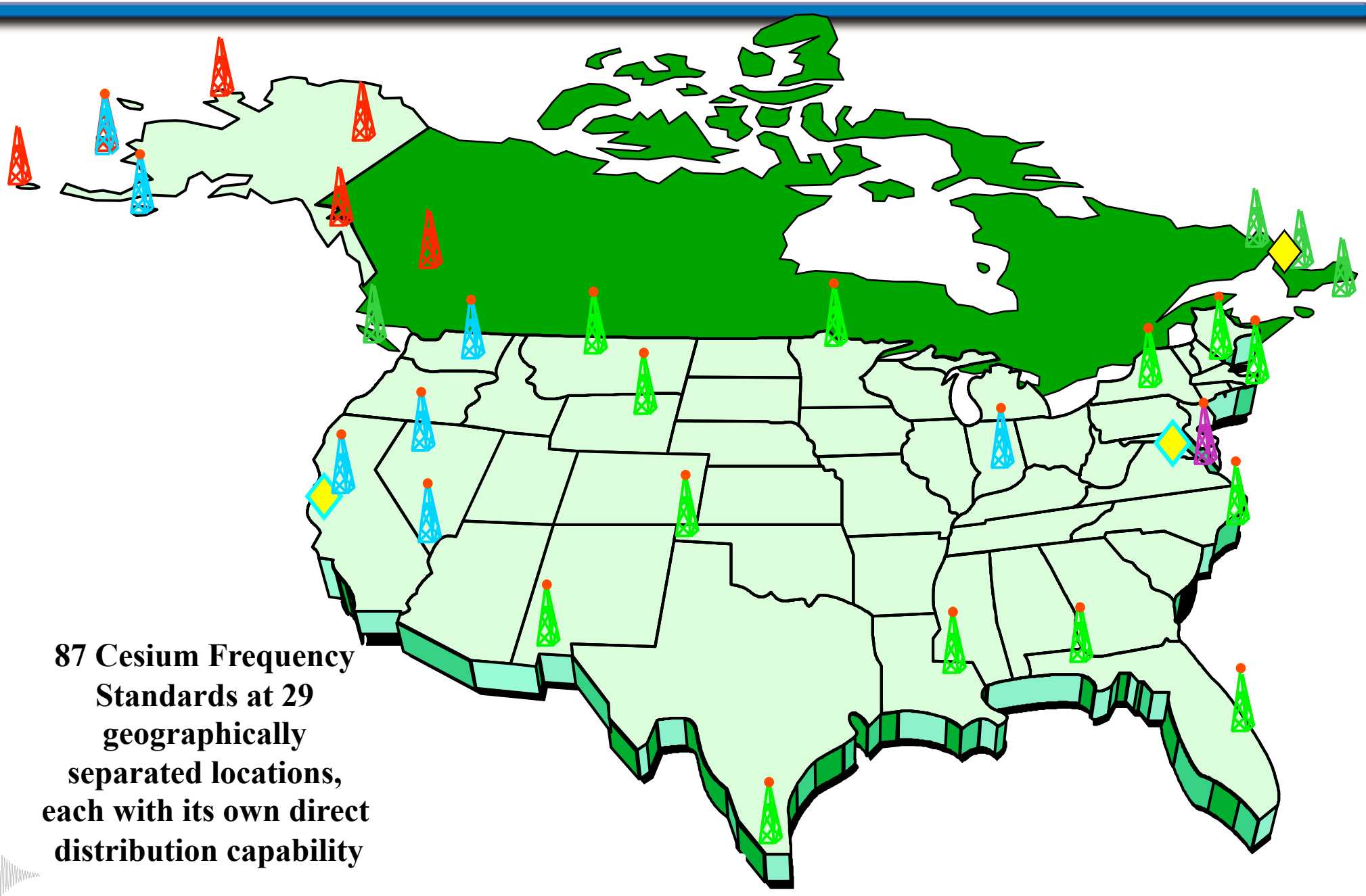
Standards

- **IALA for maritime e-Navigation**
  - *GPS/DGPS, eLoran, & electronic charts*
- **RTCM for maritime eLoran**
  - *SC-127 – process similar to SC-104 for maritime DGPS 1980s-1990s*
  - *Continue to work hard on all details of LDC*
  - *IMO standard & IEC performance standard needed*
- **Engage with RTCA for aviation eLoran**
  - *Critical issue is understanding impact of various LDC implementations on integrity*
  - *Will lead to ICAO standards*
- **Engage with time & frequency community**
  - *Not easy but needed*

One More Consideration - Clocks

- **201 Cesium Frequency Standards**
  - *3 each at 67 widely geographically separated locations*
  - *Independent source of time & frequency*
- **Tremendous national (continental) asset**

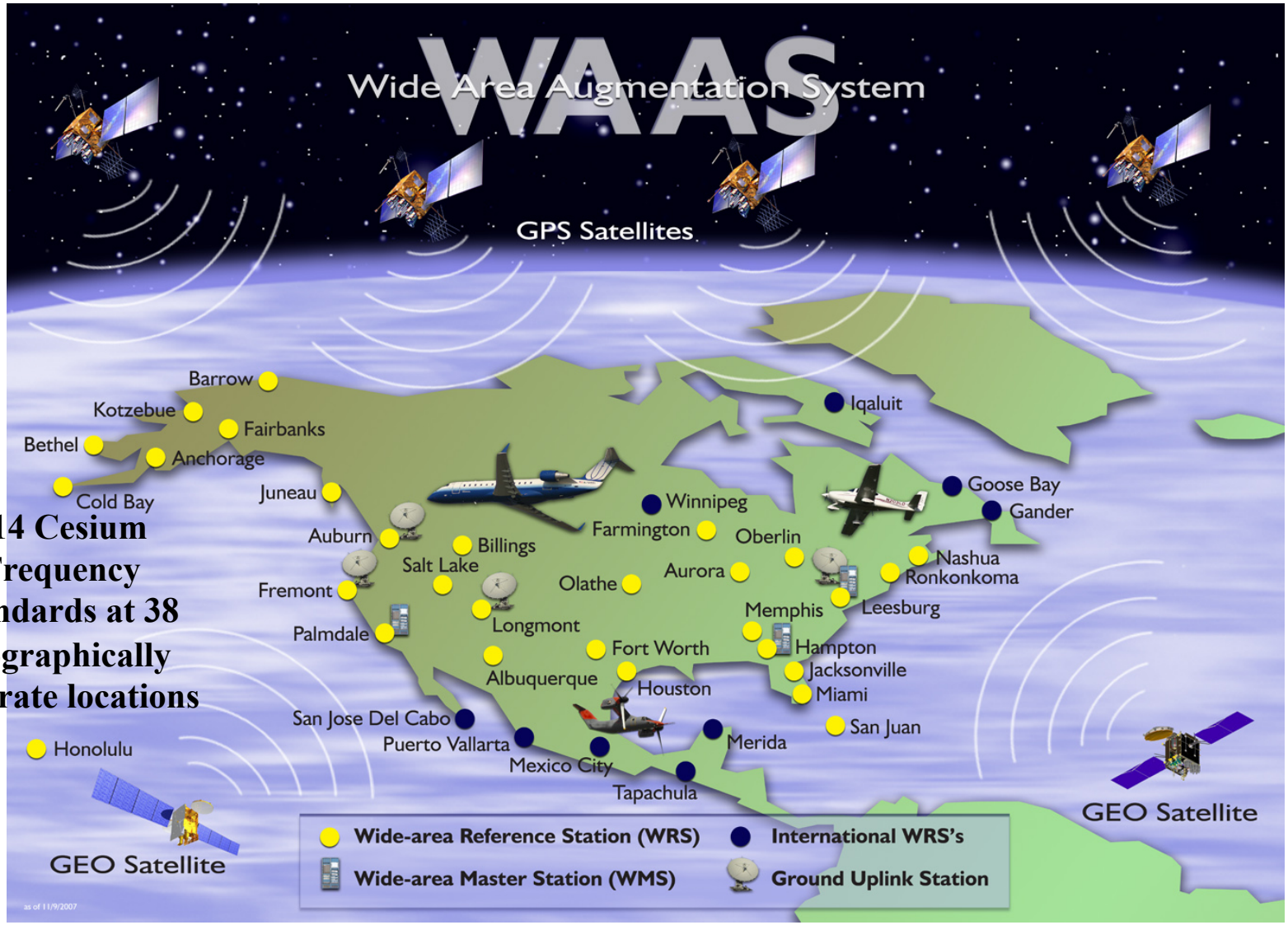
Loran Clocks



87 Cesium Frequency Standards at 29 geographically separated locations, each with its own direct distribution capability

WAAS Clocks

114 Cesium Frequency Standards at 38 geographically separate locations



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