

Signals of Opportunity:



Loran in the World's "Areas of Interest"

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for the

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Background



- **Backup/alternative PNT “opportunities”**
 - Man-made conditions
 - e.g. Areas of military action
 - Natural conditions
 - e.g. Disaster recovery
- US Army program: “Signals of Opportunity”
 - (We call it “Loran”...)

Areas “of interest”



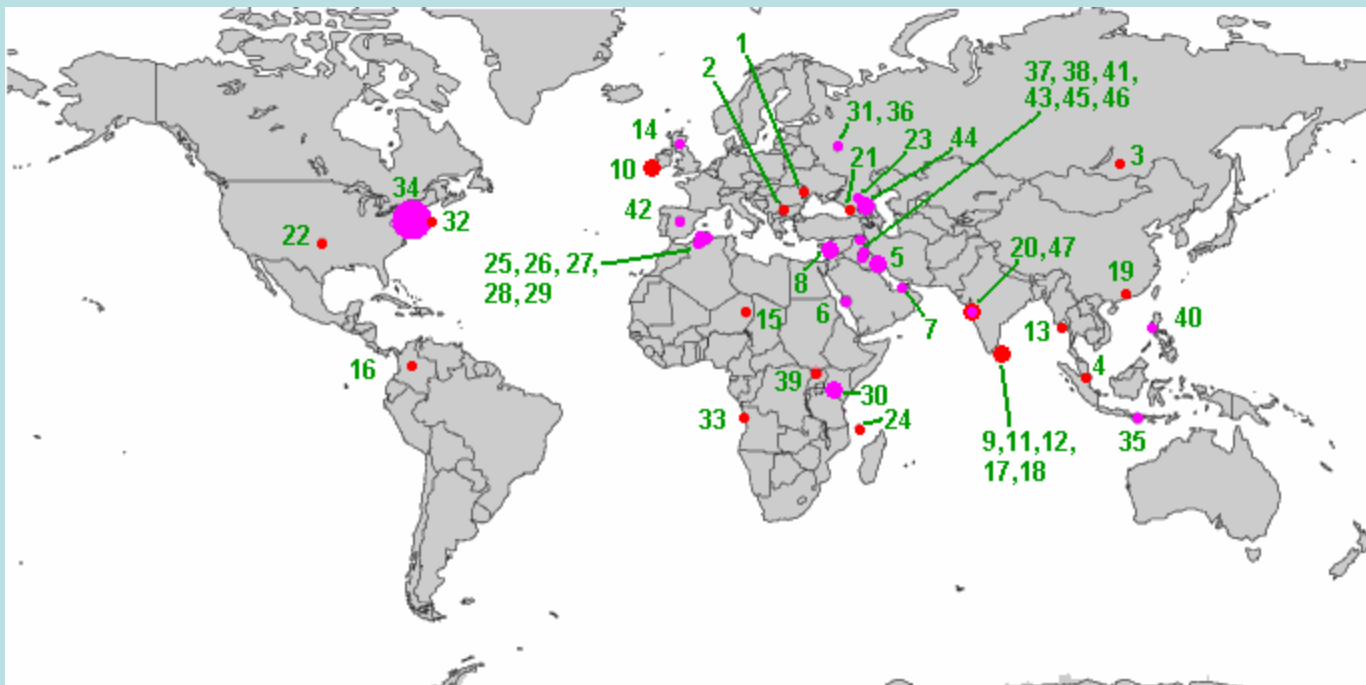
- Think about this while I talk -- more later.
 - Do fighting and Loran mix?



Areas “of interest”



- Another map – one of many
 - Terrorism




DoD and backup



“DOT understands the importance of GPS as part of the national infrastructure and recognizes the need for backups. Similarly so should the Department of Defense.”

-- DoD brief, 2004



Available Backups to GPS

- **Externally Referenced**
 - Positioning/Navigation Systems/Sensors which are based on sources external to the platform.
 - Examples include Loran and other types of RF Ranging.
 - System errors are generally consistent over time and distance traveled.
 - Limitations are the availability of observations from the source.
- **Self-Contained**
 - Positioning/Navigation Systems/Sensors whose functions are solely based on observations experienced by the platform.
 - Examples include Inertial Navigation Systems and other types of Dead Reckoning systems.
 - System errors generally degrade with respect to time and/or distance traveled.

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Options



- Signals of Opportunity –
 - Discover
 - Feed and forage approach, but with pre-intelligence
 - Establish
 - Bring-along, or augment local signals
 - Preserve
 - Reap benefits of planning; use predictable signals.

Discover



- Use only with great care
 - Prior intelligence over time is essential
 - Assess availability, continuity, accuracy, integrity
 - In-theater analysis may be difficult
 - Can assurance be obtained through diplomacy or money?
 - Must a treaty or a deal be struck?

Discover



- Legacy systems:
 - Some signal elements stable, attractive for re-use
 - Commercial television, FM, AM
 - Often single-purpose, short range, line-of-sight
 - Military and Civilian communications transmitters
 - VOR / DME / TACAN / ILS – short-range by design
- Mods / Augmentation
 - Stabilize carrier? Digital time-tick or position broadcast?
 - Increase power when needed, for coverage, penetration?
 - Networks of existing stations?

Establish / Augment



- Bring-Along systems have their place
 - Natural disaster – no infrastructure
 - Military – remote theater of operations
 - Allies encouraged to deploy and maintain precisely-timed systems for peacetime benefit and use as SoOP when necessary
- Example is Tri-Nav, ORNL
- DARPA
 - Robust Surface Navigation
 - Sub-surface Navigation

Preserve



- Likely the least trouble and expense
- Bilateral/multilateral agreements in place
 - Vehicles for negotiated costs of systems, not necessarily paid in cash.
- Civil use in peacetime
 - eLoran may be ideal for SoOP
 - Retain it for both civil and military purposes

OK, no more suspense



- A world-wide **eLoran** alternative:
 - Reduces target value of GPS, Galileo, GLONASS
 - Reduces concern abroad over US ownership of GPS
 - Embraces GNSS and Loran similarities/dissimilarities
 - Provides “peacetime dividend” – PNT services
 - System is widely available now, could be expanded
 - Proven for positioning, navigation timing.
 - Meets RNP 0.3 / HEA / Stratum 1.
 - All are benefits to an ally for equipping and maintaining

Preserve/Expand Loran

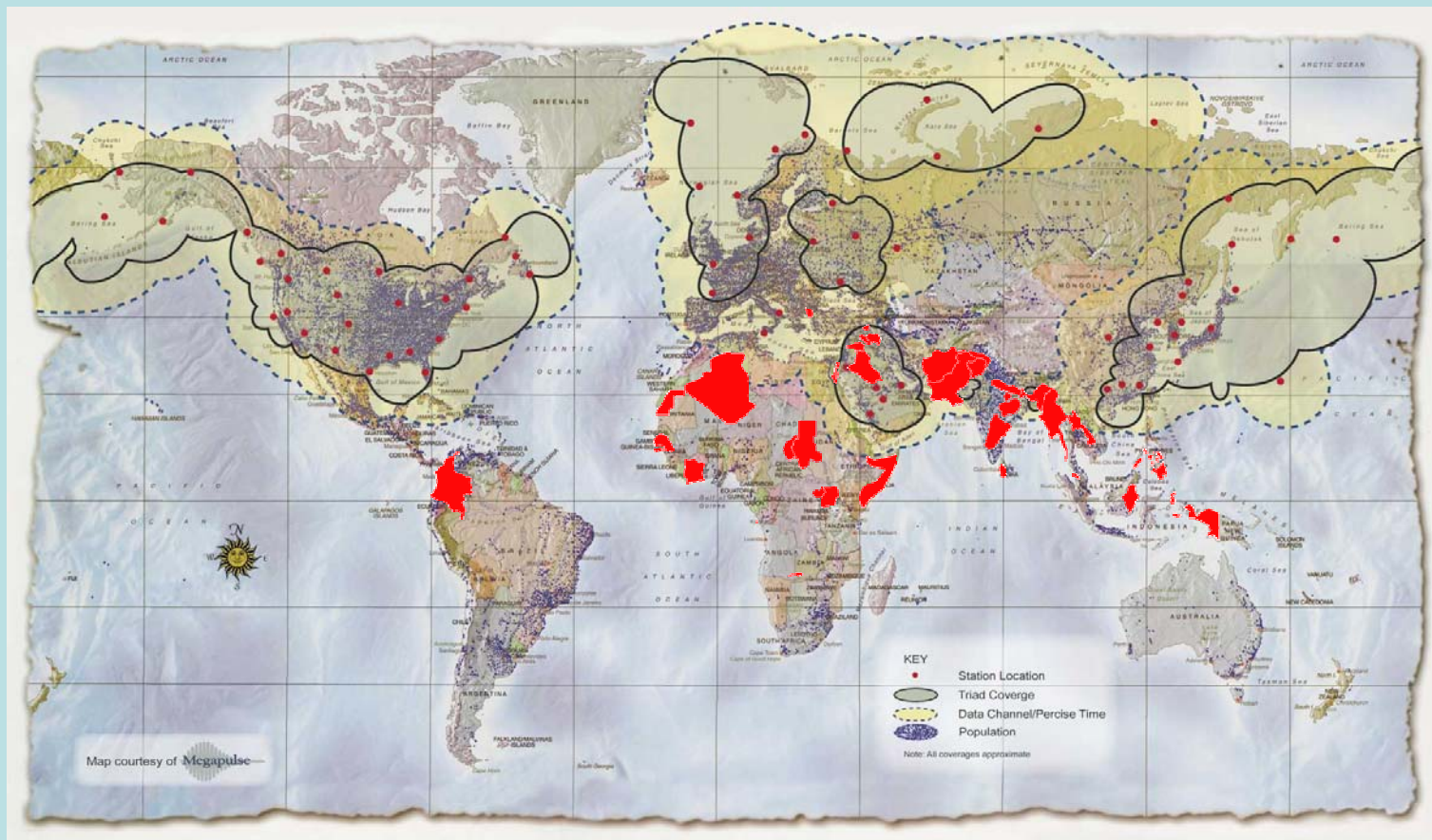


- eLoran signal is robust, difficult to jam.
- Few transmitters, large coverage
 - eLoran reduces coverage effect of a single outage
- Need protection for the spectrum world-wide
 - Remove concerns for safety-of-life applications

Preservation - 1



- Coverage: it's a start



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SoOP in Areas of Interest

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Next Steps



- **Recommended Action Items**
 - Produce updated worldwide Loran coverage map
 - P, N, T , and data channel coverage
 - “Best models”
 - Measured data where available
 - Obtain international protection for Loran spectrum
 - “Aviation Radio-Navigation Service” or ARNS status
 - Continue to encourage expansion of coverage
 - The entire world is potentially “of interest”
 - Non-coverage areas are markets of opportunity