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Leaders in what's now. Innovators of what's next.



eLoran

Are we at a tipping point?

Charles Schue, President & CEO

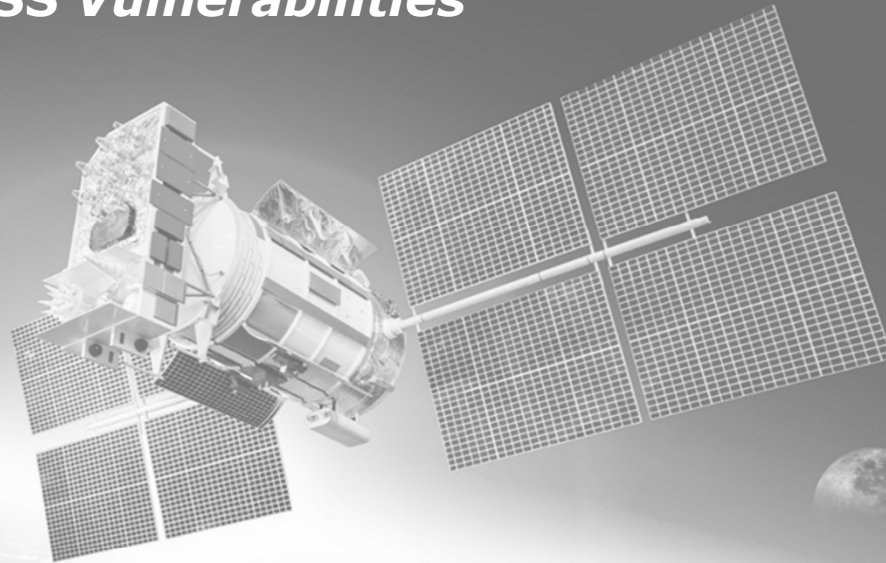


September 22nd, 2016

Concern: GNSS Vulnerabilities

GPS / GNSS Vulnerabilities

- ✓ **Antenna needs clear view of the sky**
- ✓ **Performance Degradation**
 - ✓ **Natural**
 - ✓ **Human**
- ✓ **Spectrum Competition**
- ✓ **Radio Frequency Interference**
- ✓ **System Anomalies & Failures**
- ✓ **Jamming**
- ✓ **Spoofing & Counterfeit Signals**
- ✓ ***Proliferation of Satellite Systems***
- ✓ ***Satellite Launch Problems***
- ✓ ***Ground Segment Problems***
- ✓ ***Program Delays***
- ✓ ***Funding Issues***



Sole source?

Overly reliant?

Growing Awareness of Vulnerability



HOME TOP VIDEOS DECISION 2016

ONGOING: ALEPPO'S CHILDREN ZIKA VIRUS OUTBREAK

U.S. WORLD LOCAL POLITICS HEALTH TECH SCIENCE POP CULTURE BUSINESS INVESTIGATIONS SPORTS MORE

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NEWS U.S. NEWS

WORLD INVESTIGATIONS CRIME & COURTS ASIAN AMERIC

NEWS

AUG 8 2016, 3:36 AM ET

GPS Under Attack as Crooks, Rogue Workers Wage Electronic War

by MIKE BRUNKER

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Once the province of hostile nations, electronic warfare has arrived with little fanfare on U.S. highways and byways.

Criminals, rogue employees and even otherwise law-abiding citizens are using illegal "jamming" devices to overpower GPS, cellphone and other electronic signals over localized areas. The devices are small and mobile — a common variety plugs into a vehicle's cigarette lighter — making it difficult for law enforcement to identify the culprits.

And experts say the threat to the Global Positioning System (GPS) — the critical space-based navigational, positional and timing network — is escalating as "spoofing" devices become readily available.

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Growing Awareness of Vulnerability

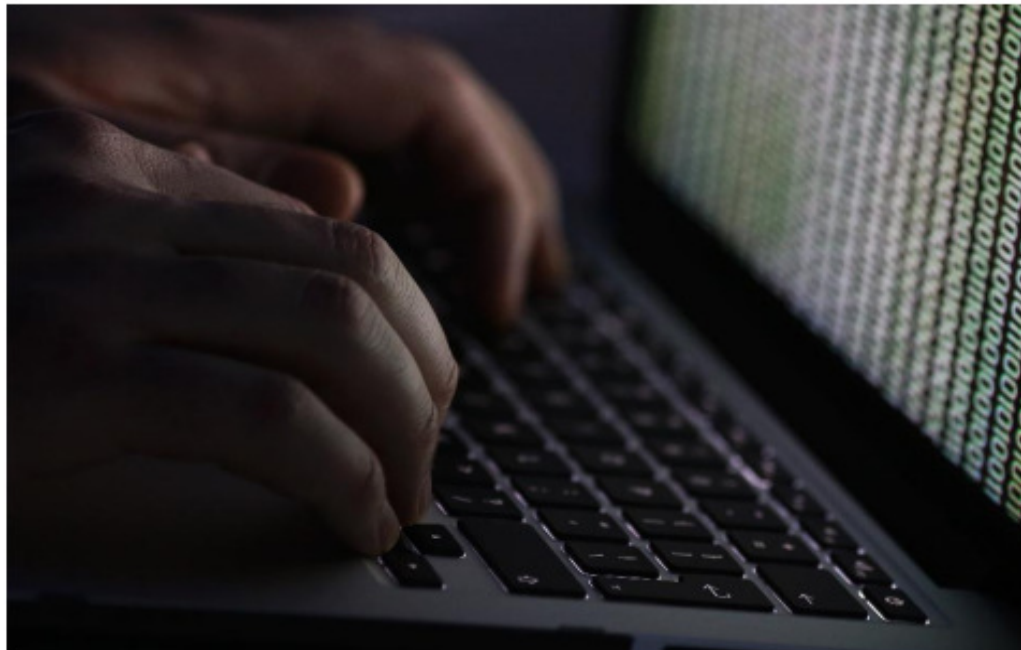
How Cyberwar From Hacking To GPS Jamming Is Changing The Face Of Society



Kalev Leetaru, CONTRIBUTOR

I write about the broad intersection of data and society. [FULL BIO](#)

Opinions expressed by Forbes Contributors are their own.



A user on a laptop. (Chris Ratcliffe/Bloomberg)

This past March Bloomberg offered a [compelling](#) look inside the world of election hacking in which campaigns and their supporters hack into their opponents and steal or destroy data, saturate the online space with fake messaging and otherwise attempt to skew the election in their favor. Given the subsequent unveiling of the successful hack of the DNC here in the United States and the previous hacks of both campaigns in 2008, the article appears all the more prescient.

Indeed, this past April the head of the US Cyber Command [testified](#) before Congress that there was growing concern

Want to retire comfortably?

If you have a \$500,000 portfolio, download the guide by Forbes columnist and money manager Ken Fisher's firm. It's called *The Definitive Guide to Retirement Income*. Even if you have something else in place right now, it still makes sense to request your guide!

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FINER INVESTMENTS*

Forbes

Aug 6, 2016



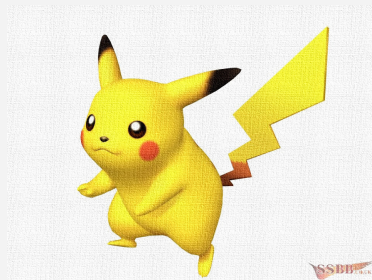
America's Top Equipment Finance Lender



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See Blog and News Feed at RNTFnd.org



Niche

MITRE

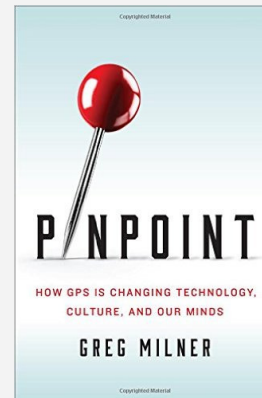


InsideGNSS
GPS | GALILEO | GLONASS | COMPASS



The MARITIME
EXECUTIVE
INTELLECTUAL CAPITAL FOR EXECUTIVES

MOTHERBOARD



GIZMODO

The Statesman

Mainstream



Forbes



THE
NEW YORKER



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The Atlantic

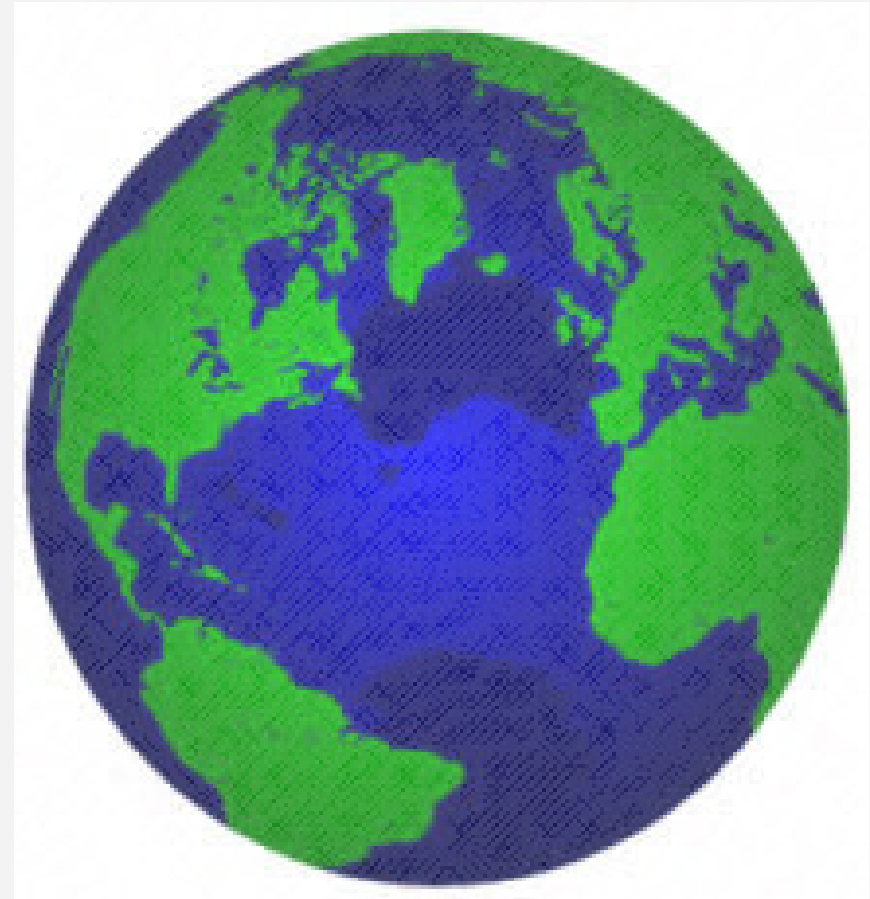
UPI



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The Global (e)Loran Position

- Russia, China, Iran
- Poland, Egypt, Vietnam, Australia, Canada, Two Others
- Republic of Korea
- Kingdom of Saudi Arabia
- UK and NW Europe
- United States



Iran Developing Homegrown Alternative to GPS

News ID: 1090226 Service: Defense

© June, 01, 2016 - 13:55



TEHRAN (Tasnim) – Iran's defense minister on Wednesday unveiled three of the latest technological achievements made by local experts, including the transmitter of an indigenous positioning and navigation system that could be a substitute for the Global Positioning System (GPS).

Existing (Nearby) Loran-C Infrastructure

- Denmark (1)
- France (2)
- Germany (1)
- Norway (4)
- UK (1)

For stationary **Timing** alone, users must be able to see a single station.

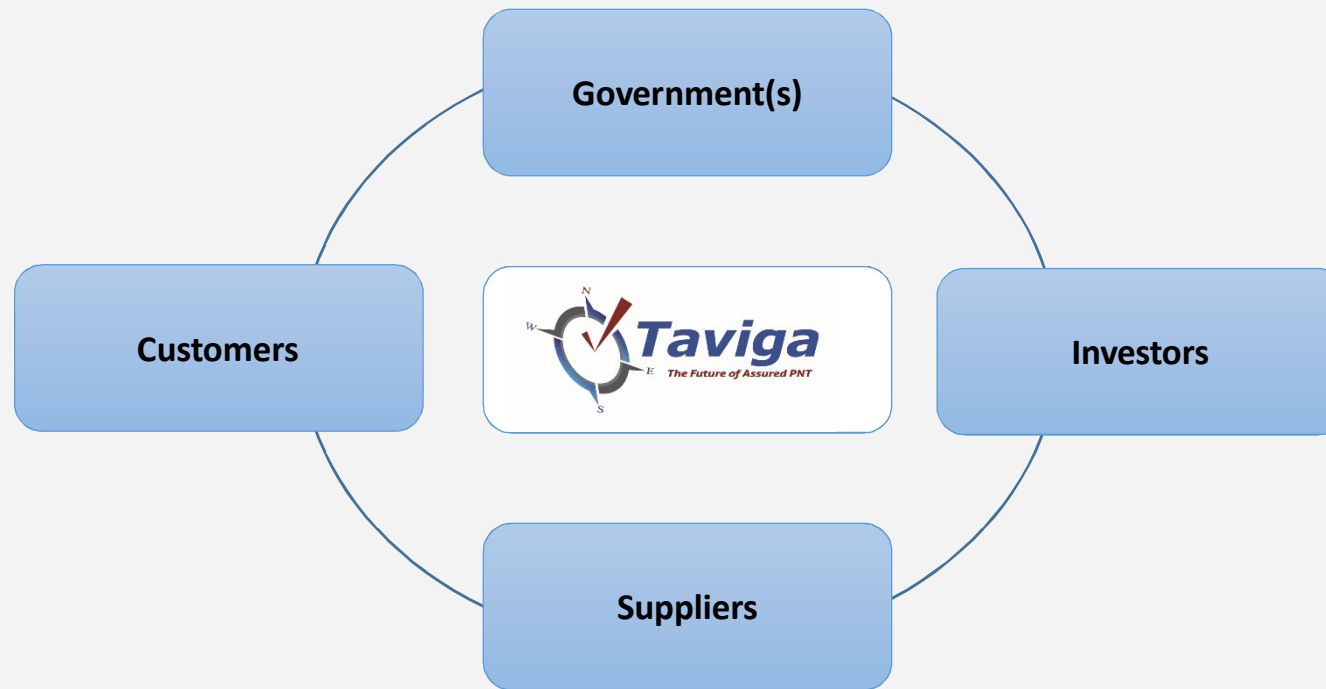
For resiliency, **Timing** users must be able to see two stations.

To derive **Timing** while mobile requires that users be able to see three stations.

Positioning users must be able to see at least three stations.



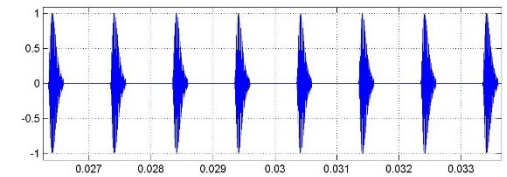
Simplified Commercial Model



- **Taviga:** Venture Leader; Marketing & Management; Service-Level Agreement(s)
- **Investor:** Capital and/or Operational Expenditures (CapEx and OpEx)
- **Supplier:** Technology; Expertise; Existing Customer Relationships
- **Government:** Idle Loran-C Assets and Spectrum; Long-Term Commitment
- **Customer:** Revenue Streams

Go-To-Market Plan

Access spectrum & sites.
Until so, "do no harm".

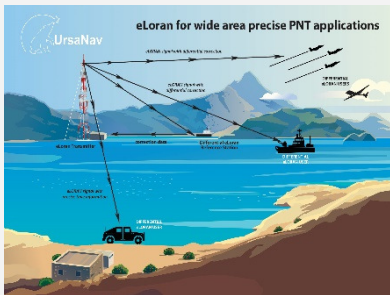


Convert sites to eLoran.
Legacy system transformation.

Sell subscriptions | solutions.

Grow market beyond timing.

Fully recapitalize system.



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Underlying Magic: Enhanced Loran (eLoran)

- **NOT** Loran-C!
- Exceptionally hard to disrupt
- Very wide area coverage
- Penetrates indoors
- Protected spectrum
- Fully independent and redundant
- Diverse failure modes from GNSS
- Idle Loran-C assets & spectrum



Proven Technology – Available Today

eLoran-21

User Receivers



Transmitting Site



Remote Time Scale
GNSS
TWSTT
TWLFTT
Microwave
Dedicated Fiber
"Hot Clock"

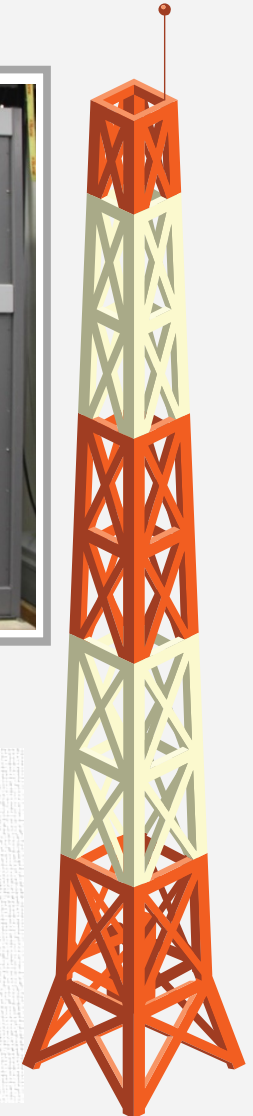
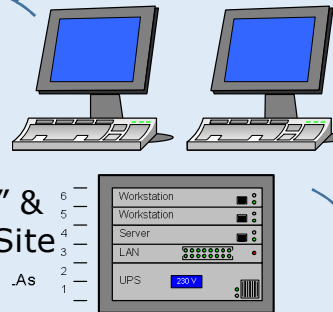
Local Time Scale
5071A Cesium PRS
5071A Cesium PRS
5071A Cesium PRS

Differential Reference Site



Can operate 70-90 days without a remote reference.

"Control" & Monitor Site



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Making the Market

✓ **Demonstrate “value-add” for customers**

- Reduced Costs
- Increased Revenue
- Spectrum & Operations Efficiencies
- Business Continuity (resilience beyond simple “holdover”)
- Technology Enabler
- Regulatory Compliance

✓ **Market GNSS (“space-only”) Risks**

- Government Studies; Best Practices; Legislation

✓ **Partner with timing, GNSS companies**

- “eLoran Inside™” their products

✓ **Encryption**

- Improves security; Enables protected revenue model

✓ **Position eLoran as pivotal to solutions**

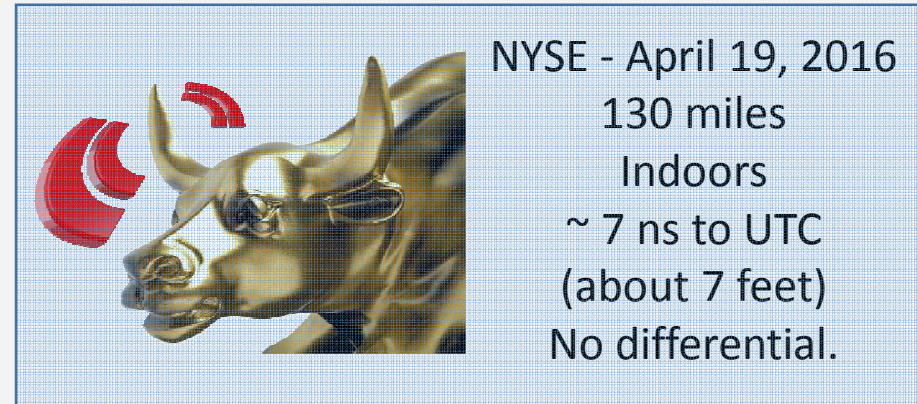


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Market Drivers -> Business Case

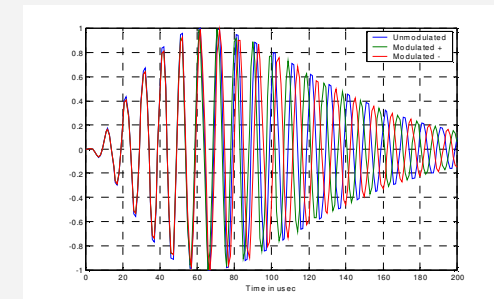
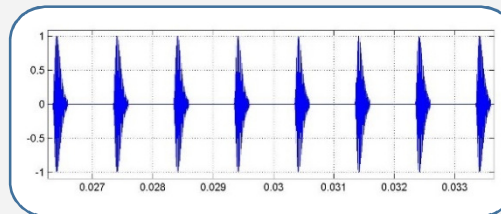
✓ **Timing**

- Telecommunications
- Banking / Finance (MIFD II)
- Digital Broadcast
- Electrical Grid



✓ **Data**

- First Responders
- Defense
- Intelligence
- Assisted GNSS



✓ **Positioning**

- UAV/UAS/Drones (Geo-Fencing)
- e-Navigation
- Autonomous Shipping
- Maritime Trade Warfare (Ship-to-Ship jamming)

✓ **Encryption (Data and/or P-T Service) & Transportability**

Market Obstacles

✓ **GPS (GNSS) is really good, and FREE**

- Exceptionally good, but not perfect
 - GLONASS, Galileo, and GPS have all had failures
- Well, not really free
 - GPS: > \$30B to date
 - Galileo: > €4B to date

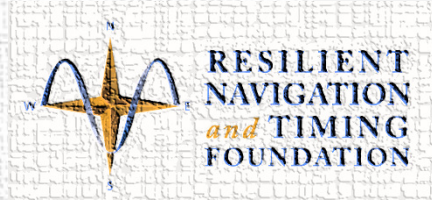
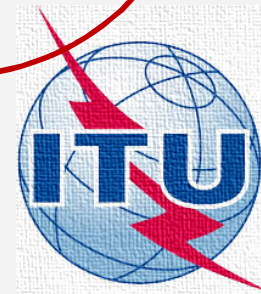
✓ **Multiple GNSS are better than one**

- True, but still vulnerable

✓ **eLoran seen as a **threat** to GNSS investment instead of **insurance****

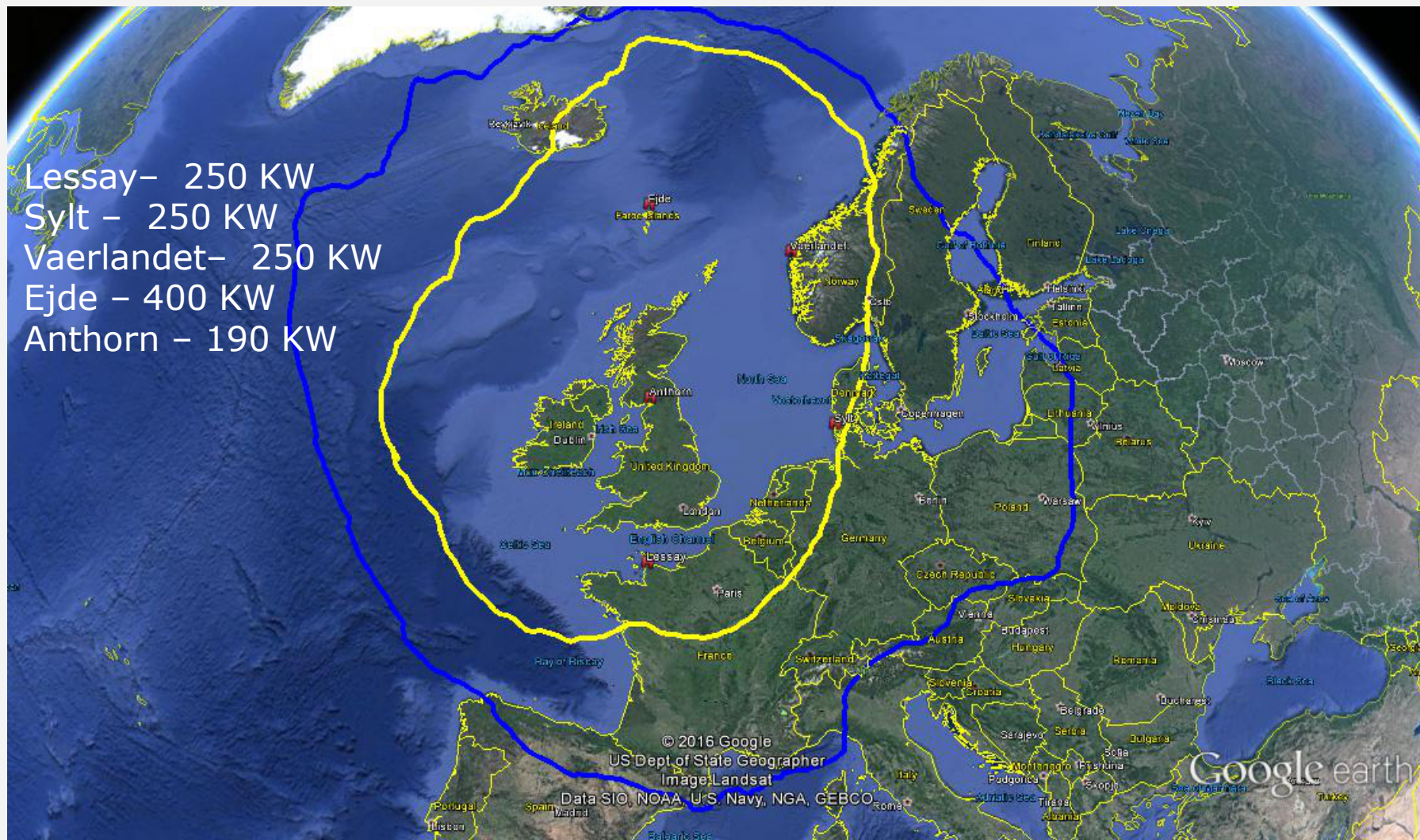
- eLoran is NOT a competitor
- eLoran is a proven backup
- eLoran is the best alternative when GNSS is not available (indoors)
- eLoran provides a Value-Add to GNSS market
- Inexpensive to providers and users

Standards Bodies & Organizational Support



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Opportunity: Resilient PNT for the NW European Market

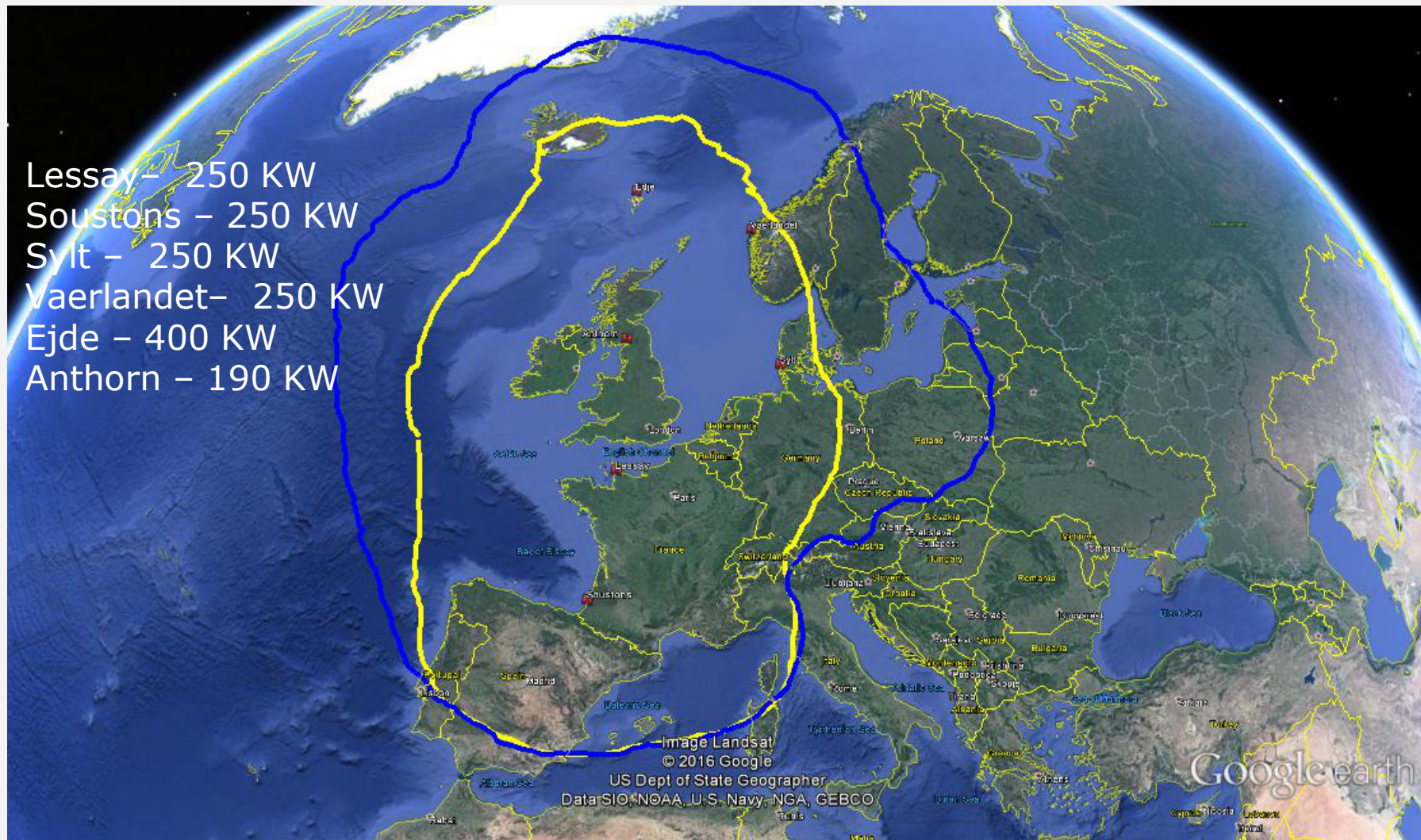


Representative Single-Site and Redundant **Timing** Coverage.



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Opportunity: Resilient PNT for the NW European Market



Representative Single-Site and Redundant **Timing** Coverage.

U.S. Congressional Action

Dec 2013: 'When space assets are not available, what's the plan?' – PL 113-66 Nat. Defense Auth Act

Dec 2014: 'Stop tearing down infrastructure until there is a GPS backup' & 'DHS may partner with private sector on eLoran' – PL 113-281 USCG Auth Act

Apr 2014: Hearing on Navigation – House

May 2015: 'DOD must build backup for GPS' – HR 1678, pending

Jul 2015: Hearing on Federal Radionavigation Plan – House

Jun 2016: 'USCG must build backup for GPS' – HR 5531, pending

Sep 2016: House Transportation and Infrastructure Committee Bill

Sep 2016: Matching Senate Bill?



U.S. Congressional Action

CHAPTER 807—POSITION, NAVIGATION, AND TIMING. Sec. '80701. Land-based complementary and backup system.

IN GENERAL.—Subject to the availability of appropriations, the Commandant of the Coast Guard, in consultation with the Secretary of Transportation, shall provide for the establishment, sustainment, and operation of a reliable land-based enhanced LORAN, or eLORAN, positioning, navigation, and timing system to provide a complement to and backup for the Global Positioning System (in this section referred to as 'GPS') to ensure the availability of uncorrupted and nondegraded positioning, navigation, and timing signals for military and civilian users in the event that GPS signals are corrupted, degraded, unreliable, or otherwise unavailable.



U.S. Congressional Action

REQUIREMENTS.—The system established shall—

- (1) be **wireless**;
- (2) be **terrestrial**;
- (3) provide wide-area coverage;
- (4) deliver a precise, high-power **100 kilohertz** signal;
- (5) be **synchronized with coordinated universal time**;
- (6) be resilient and extremely difficult to disrupt or degrade;
- (7) be able to penetrate underground and inside buildings;
- (8) be capable of ready deployment to remote locations;
- (9) **take full advantage of the infrastructure of the existing, unused Government long-range navigation system (commonly known as 'LORAN')**;
- (10) incorporate the expertise of the private sector with respect to development, building, and operation;
- (11) work in concert with and complement any other similar positioning, navigation, and timing systems;
- (12) be available for use by Federal and non-Federal government agencies for public purposes at no cost; and
- (13) incorporate such other requirements determined necessary by the Commandant.



U.S. Congressional Action

REQUEST FOR PROPOSALS.—

(1) IN GENERAL.—Not later than three months after the date of enactment of this section, the Commandant, in consultation with the Secretary of Transportation, shall publish a request for proposals to solicit options for—

(A) eLORAN system architecture; and

(B) business models for the design, installation, operation, and maintenance of an eLORAN system in accordance with this section for a period of **no less than 20 years**.

(2) CONTRACTING OPTIONS.—The request for proposals shall request options that—

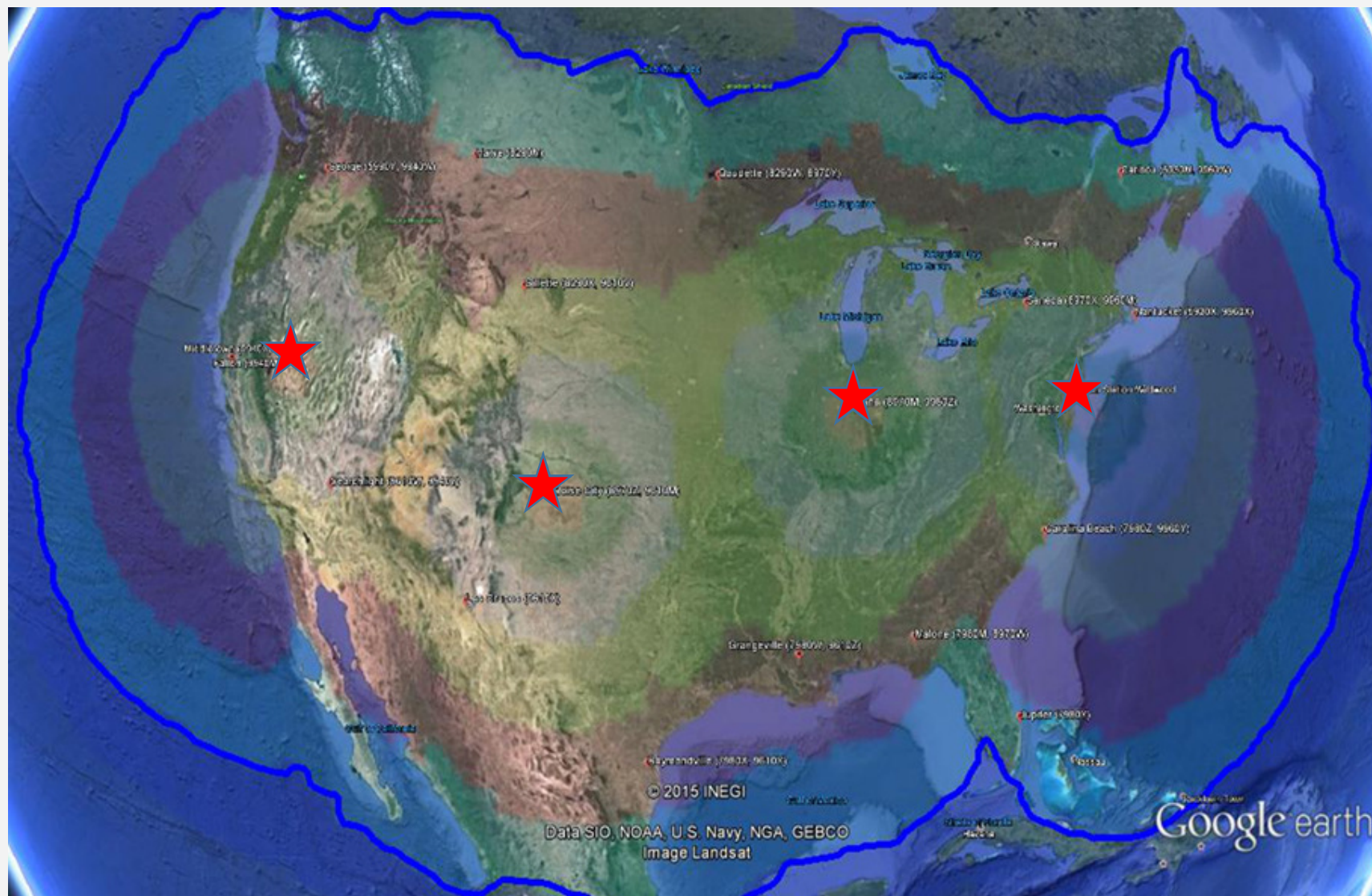
(A) incorporate the expertise of the private sector; and

(B) allow for the expeditious installation, daily operation, and routine maintenance of an eLORAN system architecture.

IMPLEMENTATION DATE.—Not later than 180 days after the date of enactment of this section, the Commandant of the Coast Guard, in consultation with the Secretary of Transportation, shall provide to the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a plan to ensure that the system required under this section is fully operational not later than 3 years after such date of enactment.



Initial Four Transmitting Sites: Timing and Data





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September 22nd, 2016



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