

THE FACTS...

“Reliance on satellite navigation and timing systems has become a single point of failure for much of America and is our largest, unaddressed critical infrastructure problem.”

Dr. Brad Parkinson, “The father of GPS”

▶ THE PROBLEM

BROAD DEPENDENCE — Broad dependence upon satellite signals for navigation & timing places U.S. critical infrastructure and economic activity at risk... DHS determined that the GPS timing signal alone is essential to 11 of 16 national critical infrastructure sectors... transportation, energy, telecom, IT, financial sectors especially dependent... everyone in U.S. uses satellite navigation & timing services.

JAMMING — Jammers illegal, but cheap, easy to get... no detection network, scarce enforcement resources, max penalties may not be sufficient... domestic incidents are increasing due privacy concerns... international jamming - North Korea, others.

SPOOFING — Iran capture of UAV... University of Texas demos w/ civilian UAV, large yacht... time manipulation threat to financial sector.

▶ THE WAY FORWARD

ENFORCE & DETER — Stricter anti-jamming laws, regulations... interference detection network... appropriate enforcement resources.

PARTNERSHIP FOR RESILIENCE — A cooperative agreement between the US Govt & a non-profit or commercial entity to build eLoran

- High power - very difficult to disrupt
- Precise signal with 8-10 m navigation accuracy, <50ns time accuracy
- Penetrates underwater, underground, indoors
- Good Business Case
 - Low cost to build, \$16-20M/yr to operate and maintain in contiguous 48 states
 - High demand for services
 - Numerous possible revenue streams
- Cost is less than ½ of disposing of infrastructure

▶ ACTION TO DATE

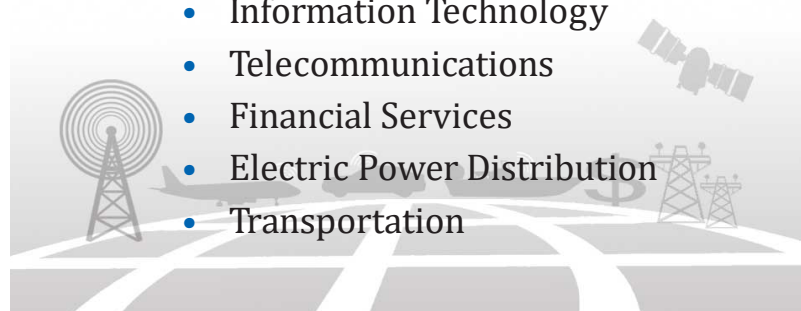
INDUSTRY — Local area GPS augmentation systems... improved receivers, antenna... some users have atomic clocks for continuity during short term outages... all important efforts... none serve entire nation... none sufficient during extended outage... many, perhaps most, users have no continuity plan for GPS outage.

U.S. GOVT — 2004 NSPD 39 directs acquisition of GPS backup capability... 2008 PNTExCom agreed & DHS announced upgrade of antiquated terrestrial Loran-C to new, difficult to disrupt eLoran... DHS efforts stalled in 2009... 2010 + DHS tore down much of infrastructure needed for eLoran... Dec 2014 President signs bill directing halt to destruction of infrastructure & authorizing cooperative agreement to build eLoran, Dec 2015 Dep Sec Transportation, Dep Sec DOD tell Congress they will build eLoran system. March 2016 no lead federal action agency yet assigned.

INTERNATIONAL — UK using eLoran for timing & infrastructure... South Korea & India contracting for eLoran system... Russia working to upgrade Chayka (Russian Loran) to eChayka for Arctic nav... Saudi Arabia installing eLoran... China retaining legacy Loran & rumored to be upgrading... Even Iran has announced a system... April 1, 2014 - Russian GLONASS down for 11 hours... Jan 2016 US receives fault reports from around world after minor GPS timing glitch causes some types of receivers to fail.

▶ MOST IMPACTED

- Information Technology
- Telecommunications
- Financial Services
- Electric Power Distribution
- Transportation



Protect, Toughen, Augment

*Policy Recommendations for Global Navigation Satellite Systems**

Protect GPS/GNSS

- Recognize PNT as critical infrastructure
- Designate and empower a lead federal official
- Protect the adjacent bands to GNSS as “quiet” neighborhoods
- Make ownership of jammers a misdemeanor
- Make use of jammers a felony
- Make anti-jamming and anti-spoofing laws enforceable at all levels of government
- Establish a national system to detect & rapidly locate jamming
- Ensure sufficient enforcement personnel to detect, prevent, respond to and prosecute jamming

Toughen Receivers & Users

- Develop standards for jam-resistant receivers to include ARAIM and RAIM
- Establish as an industry best practice having more than one source of precise Position, Navigation and Timing (PNT) for critical infrastructure
- For critical infrastructure that uses space-based PNT, establish as an industry best practice being able to continue normal operations in the event of an extended GNSS service disruption.

Augment GPS/GNSS Services

- Provide a wide-area, difficult to disrupt, diverse non-space PNT service (GPS-Earth/eLoran)
Develop standards for seamless use with space-based PNT
- Encourage development of numerous, complementary terrestrial PNT services to increase resilience (integrated radar, local positioning systems, inertial, etc.)

*Adapted from presentations and positions advocated by Dr. Brad Parkinson and discussed at the US government’s Position, Navigation and Timing Advisory Board. The Resilient Navigation and Timing Foundation heartily supports these policies and initiatives.