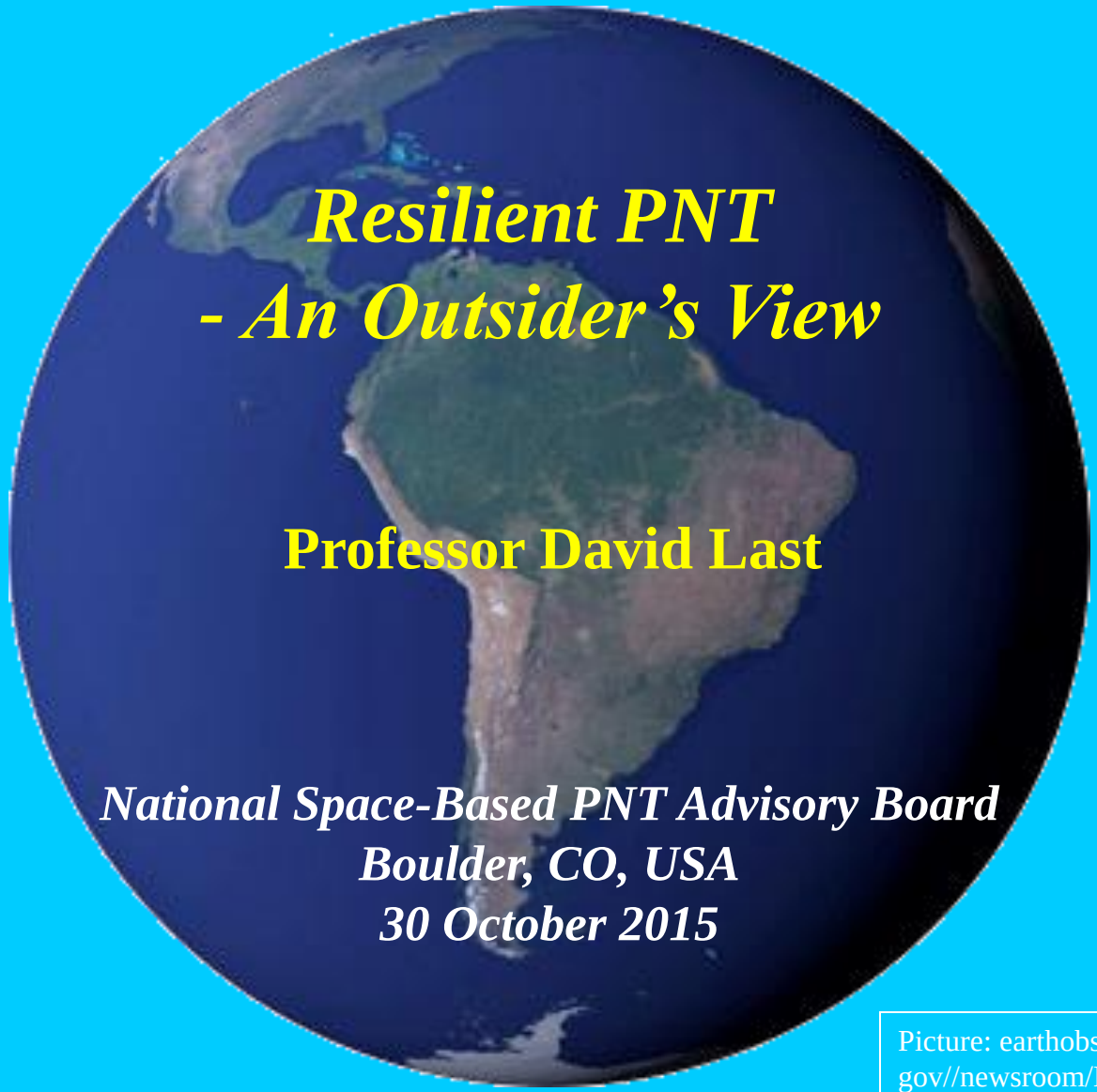
Resilient PNT
- An Outsider's View



Professor David Last

National Space-Based PNT Advisory Board
Boulder, CO, USA
30 October 2015

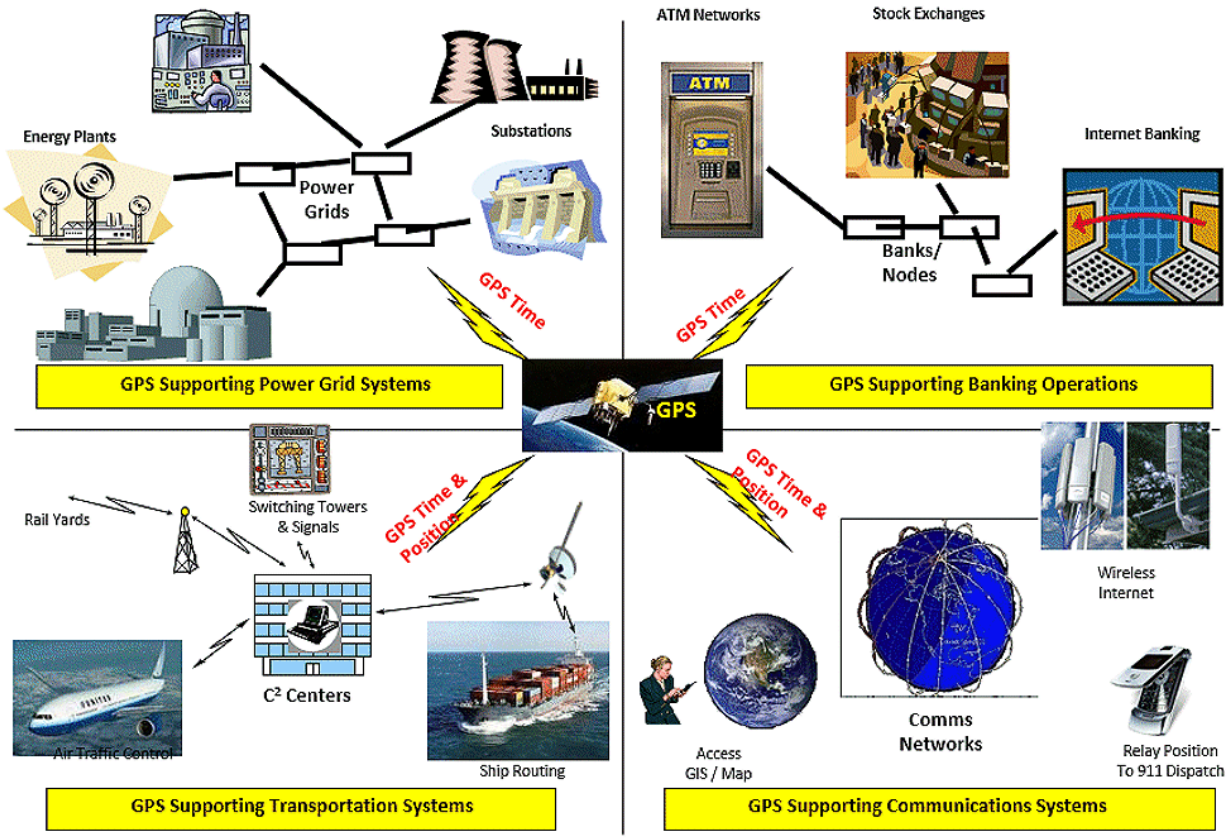
Picture: earthobservatory.nasa.gov//newsroom/BlueMarble/

A Proper Navigator

Photo: Dreamstime.com

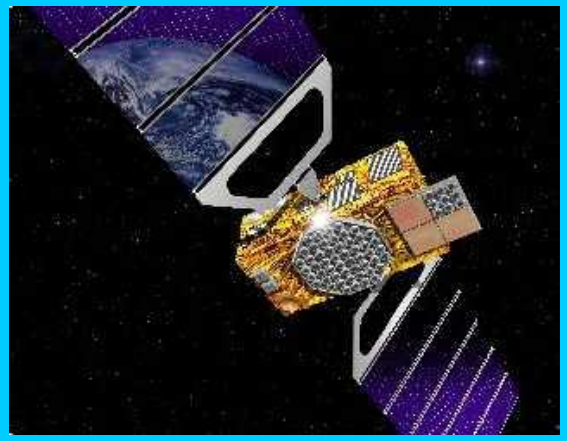
Photo: Ashtech Inc., Optron Pty.

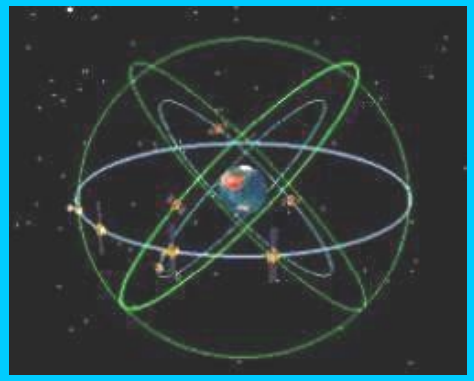
National Critical Infrastructure – Dependence on GPS



GPS Critical Infrastructure Timing Study: Usage/Loss Impacts/Backups/Mitigation James Caverly, NPPD (DHS) 2007

GPS plus …

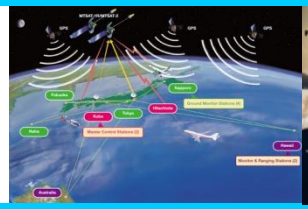




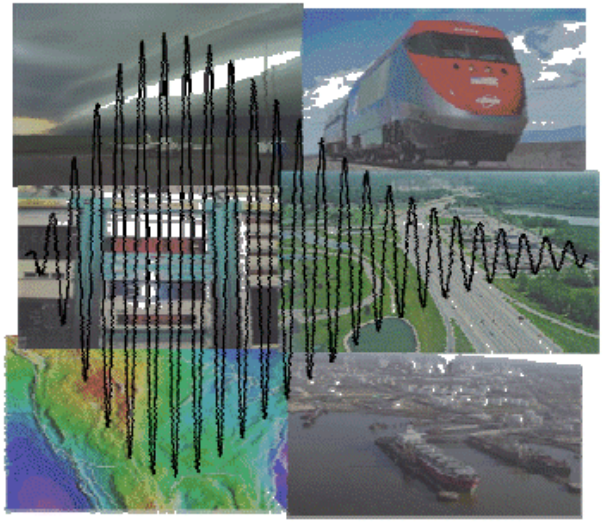
GLONASS (Russia) **Compass-Beidou (China)**

QZSS (Japan) **GALILEO (Europe)** **IRNSS (India)**

… and all the augmentations:



Loran's Capability to Mitigate the Impact of a GPS Outage on GPS Position, Navigation, and Time Applications



Prepared for the
FEDERAL AVIATION ADMINISTRATION
VICE PRESIDENT FOR TECHNICAL OPERATIONS
NAVIGATION SERVICES DIRECTORATE

March 2004

Press Office
U.S. Department of Homeland Security

Homeland Security

February 7, 2008
Contact: (202) 282-8010

STATEMENT FROM DHS PRESS SECRETARY LAURA KEEHHNER ON THE ADOPTION OF NATIONAL BACKUP SYSTEM TO GPS

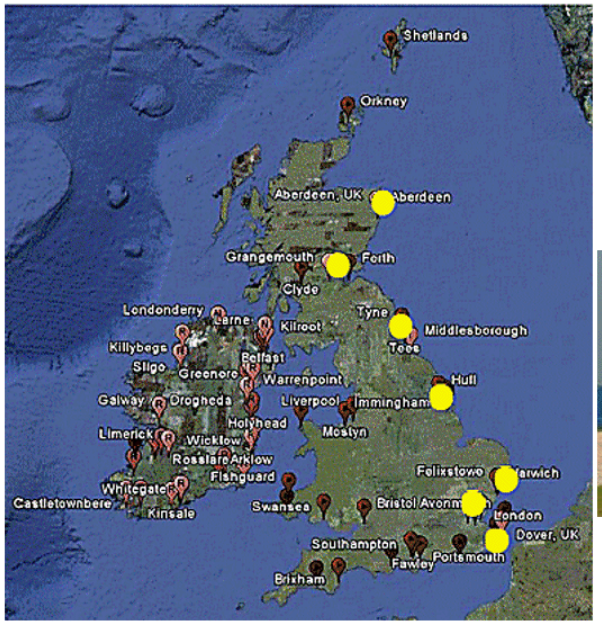
Today the U.S. Department of Homeland Security will begin implementing an independent national positioning, navigation and timing system that complements the Global Positioning System (GPS) in the event of an outage or disruption in service.

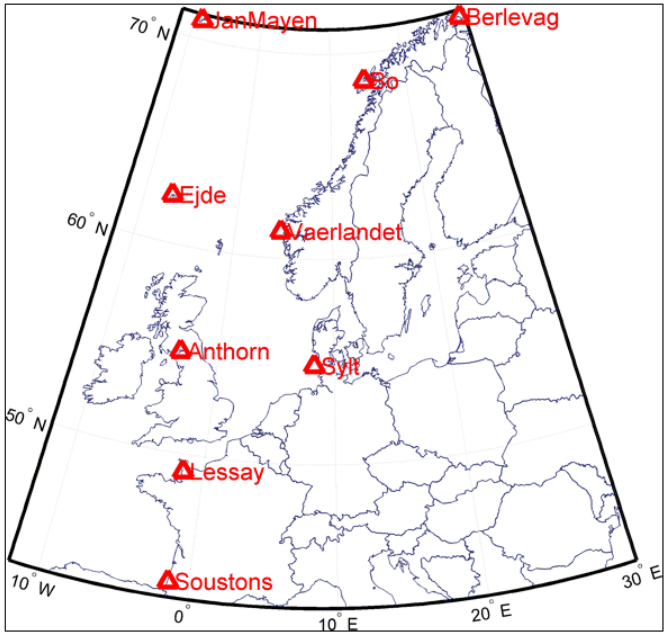
The enhanced Loran, or eLoran, system will be a land-based, independent system and will mitigate any safety, security, or economic effects of a GPS outage or disruption.

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.

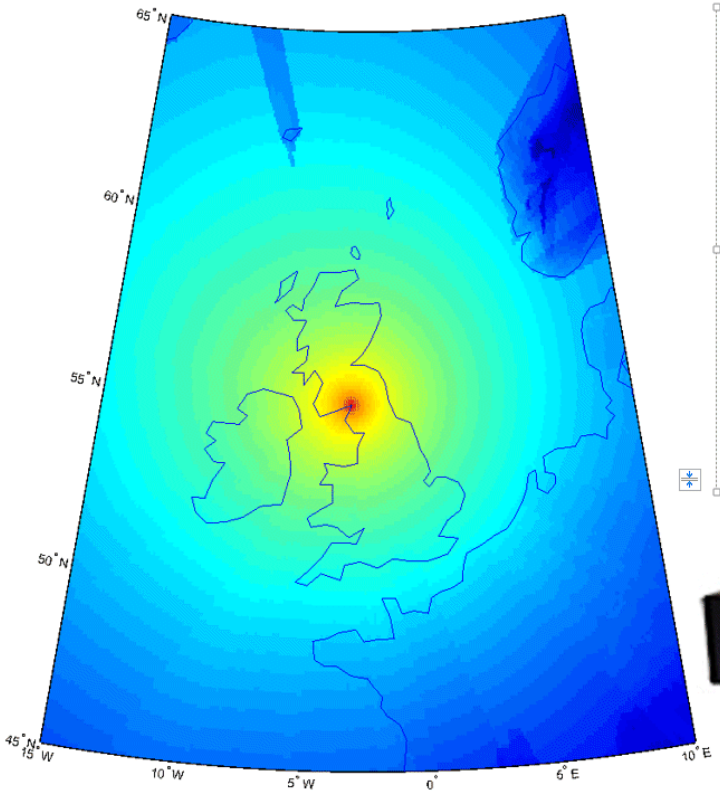
Prototype eLoran using the stations of the North-West European Loran System: UK Initial Operational Capability was declared on 31 October 2014





Enhanced Differential Loran Maritime Trials in The Netherlands Declared Successful

Picture: www.insidegnss.com



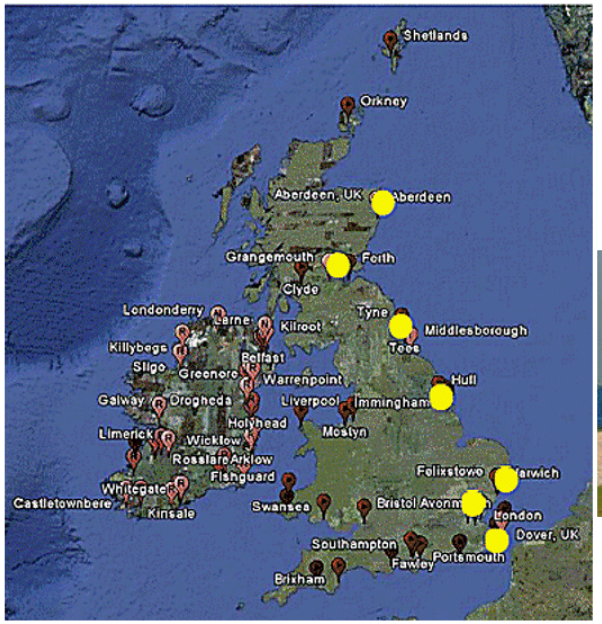
The Timing Bonus

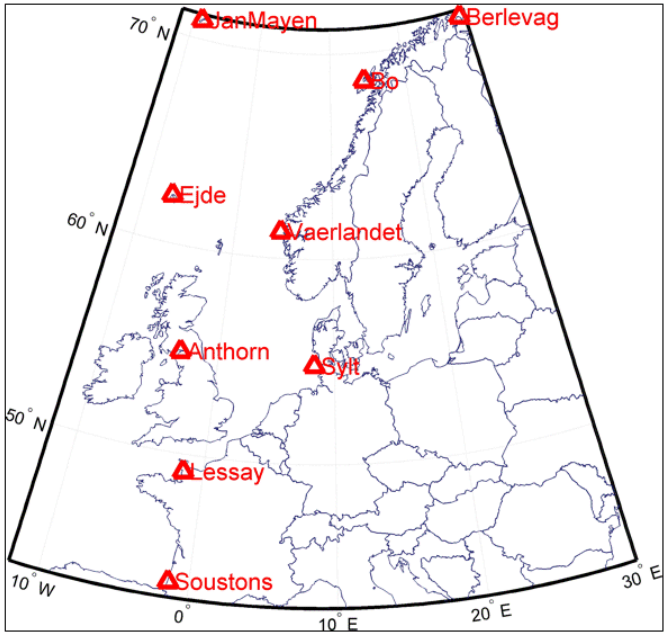
The GLAs' prototype eLoran system already delivers precise timing to telecoms operators and broadcasters across the UK and Ireland

Commercial GPS-eLoran Timing Receiver

Picture: Chronos Technology Ltd

Prototype eLoran using the stations of the North-West European Loran System: UK Initial Operational Capability was declared on 31 October 2014

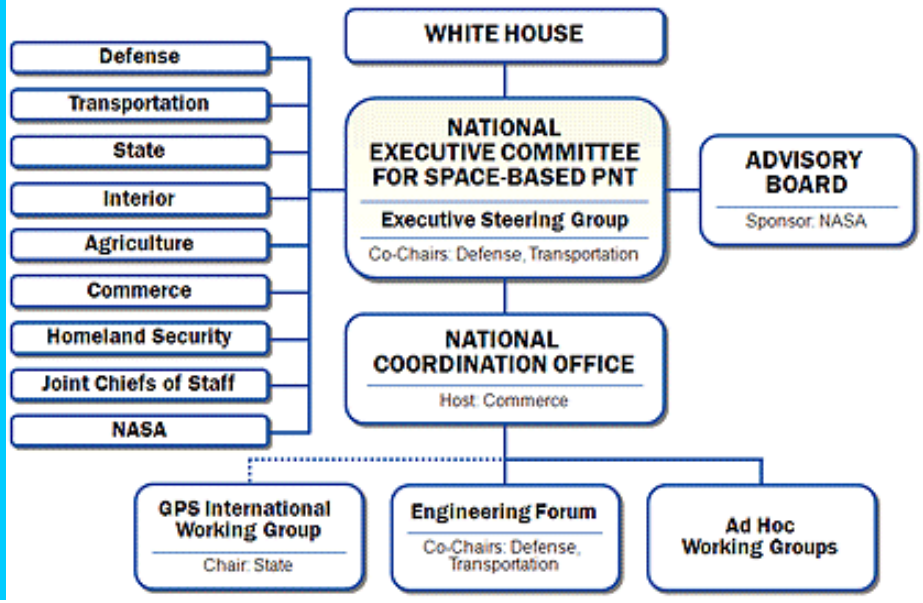




SPACE-BASED POSITIONING NAVIGATION & TIMING

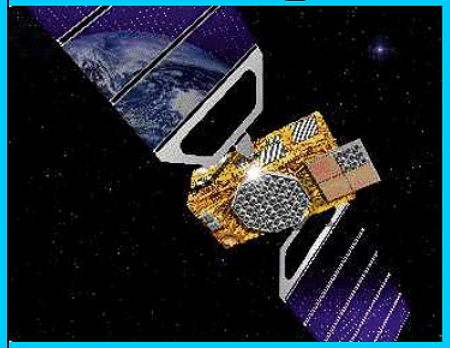
NATIONAL EXECUTIVE COMMITTEE

Organizational Structure

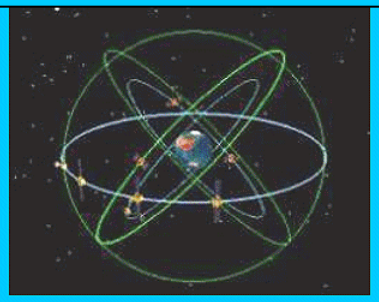


Systems - or simply GNSS?

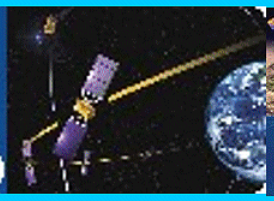
GPS plus …

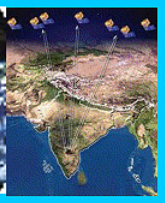


GLONASS (Russia)



Compass-Beidou (China)





QZSS (Japan) GALILEO (Europe) IRNSS (India)

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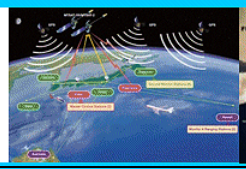
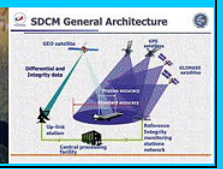
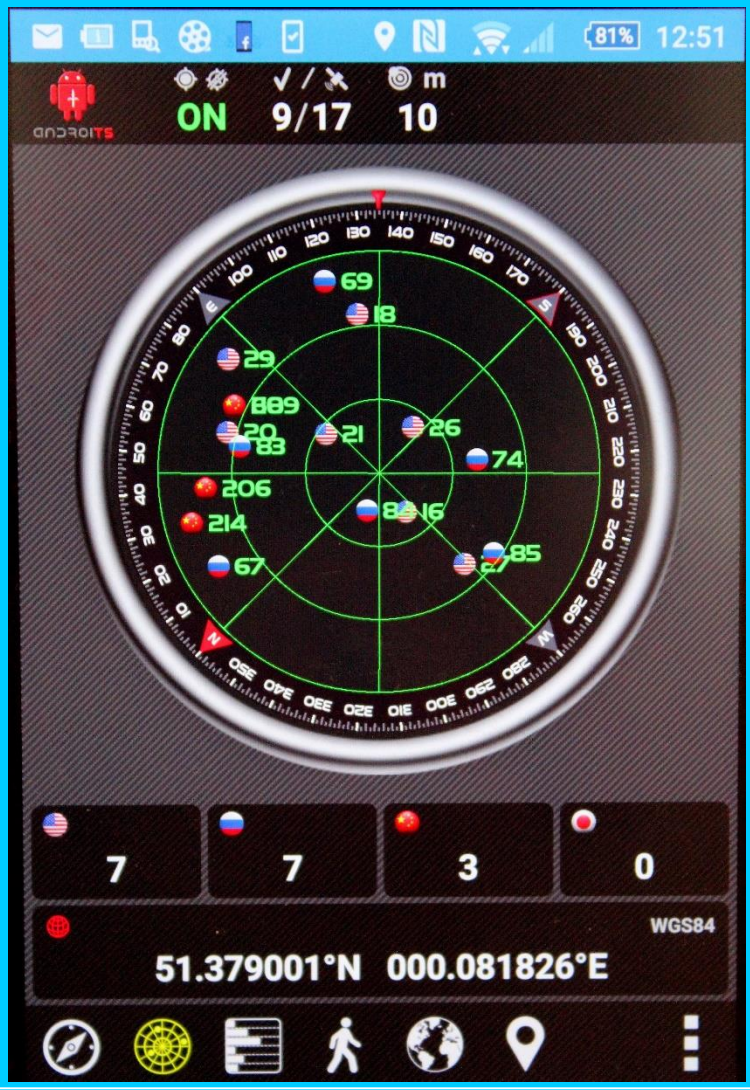
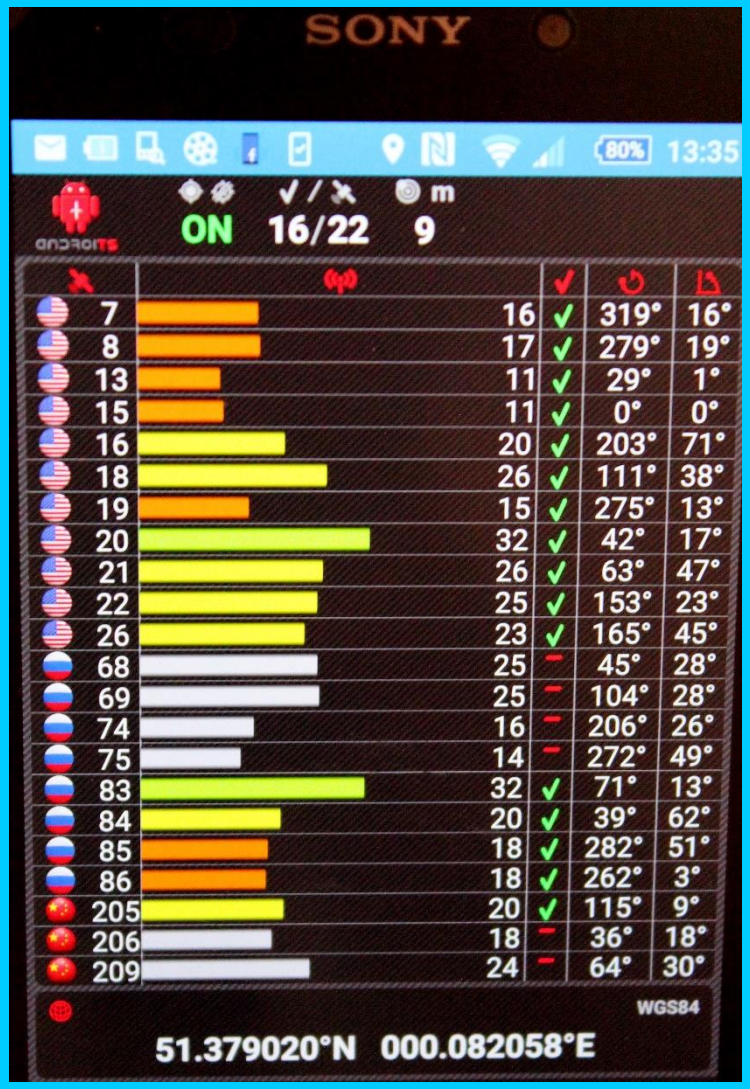
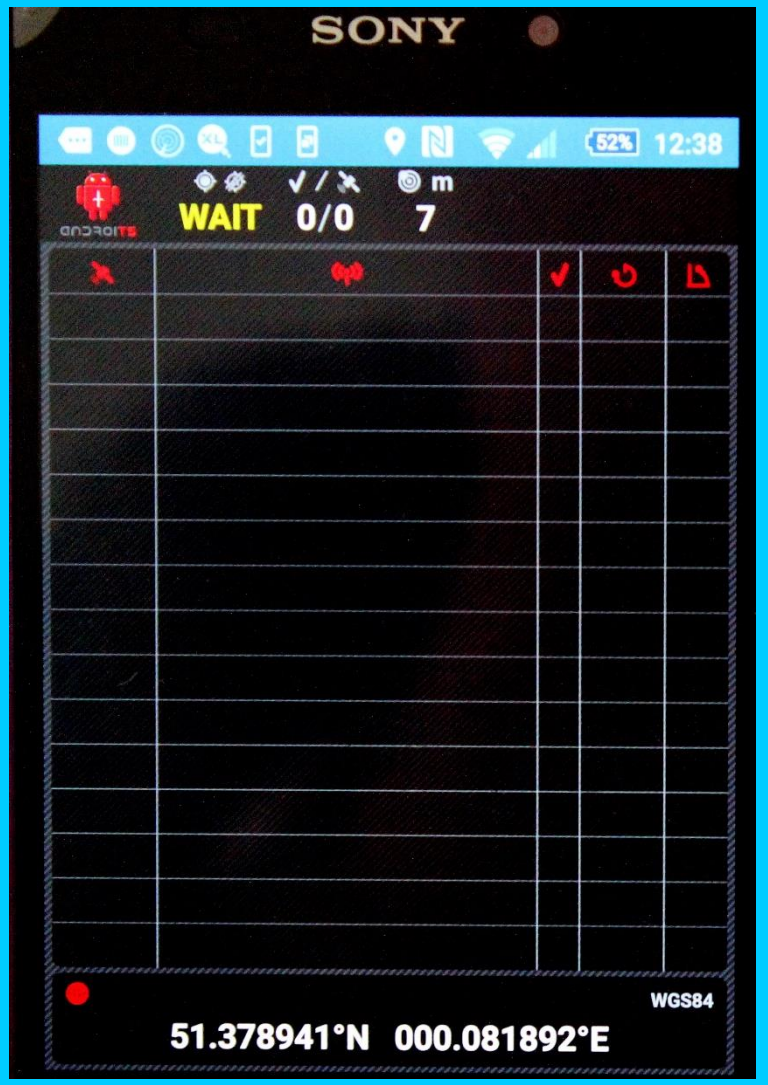






Pictures: Bob Cockshott – UK KTN, wwwbidhaabora.com





Pictures: Bob Cockshott – UK KTN

- **Does the US see a role for eLoran as a complement to GPS in delivering resilient PNT?**

- **Does the US recognise and encourage the move to GNSS receivers that take advantage of multiple constellations?**