

EGNOS in Maritime: Navigating with Integrity

EGNOS SP Workshop Day 2

Athens

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Research and Radionavigation (R&RNAV)

- General Lighthouse Authorities (GLA) of the United Kingdom and Ireland



General Lighthouse Authorities (GLA)



Irish Lights



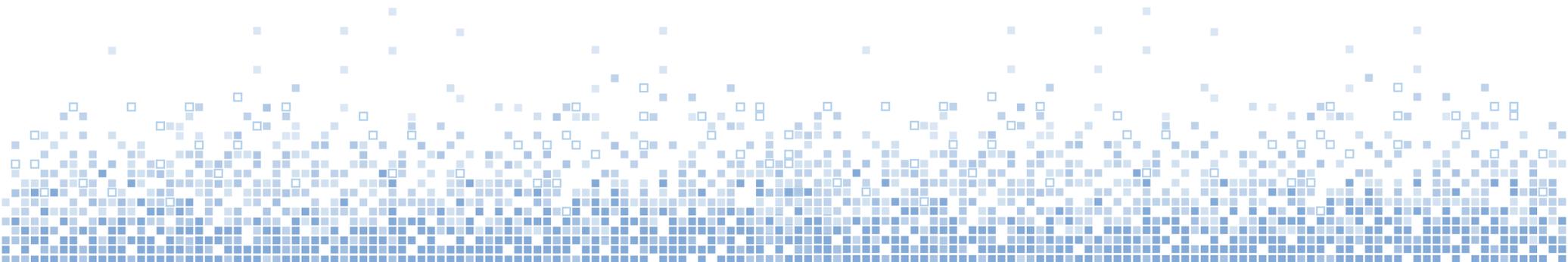
Northern
Lighthouse
Board



Trinity House

GLA are responsible to UK and RoI governments for the provision of statutory Aids-to-Navigation services for all mariners throughout the British Isles

The challenging maritime environment



Maritime navigation is challenging

- Complex sea spaces
- Competing marine uses
- Larger ships
- More ships?
 - 30% increase by 2030?
- Greater management of sea traffic

‘Marco Polo’

16,000 TEU (20ft unit), 396m long



Increasingly integrated logistics

>95% of world goods go by sea; maritime is vital to EU trade

High integrity, smart maritime & multimodal systems...improving safety, reducing congestion, increasing efficiency, protecting environment, reducing emissions



Human factors increasingly important



Human error contributes to most accidents

- experience of mariners reducing
- pressure on crewing levels
- training burden
- type specific operation of equipment

Digital information is compelling

- precise GPS position on ECDIS
- no inherent integrity of GPS
- possible inconsistency with
 - scale of display
 - survey quality of charts



Autonomous vessels

‘Maritime Unmanned Navigation through Intelligence in Networks’ (MUNIN) EU FP7 project (2013-2016)

- Concept of autonomous ship, guided by automated on-board decision systems, controlled by remote operator (shore station)



Picture credit: courtesy YARA, Norway

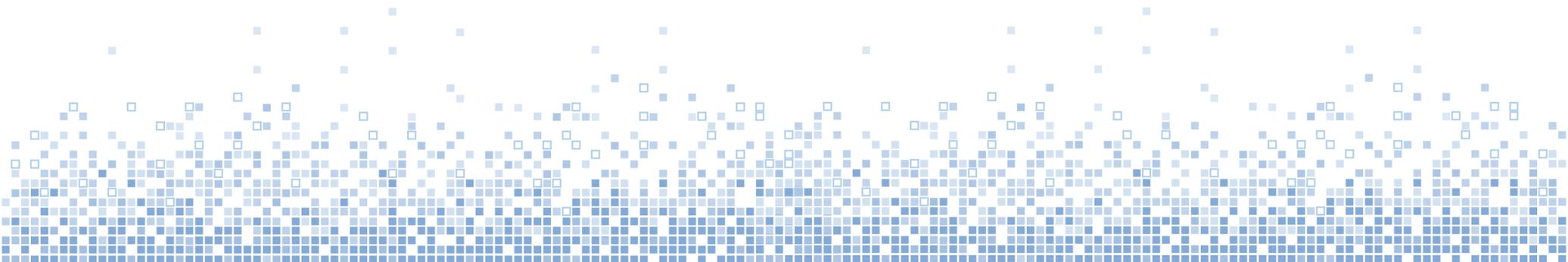
From concept to reality in 2018:

- YARA Birkeland
- electric container feeder, zero emissions
- should eliminate 40,000 truck journeys per year



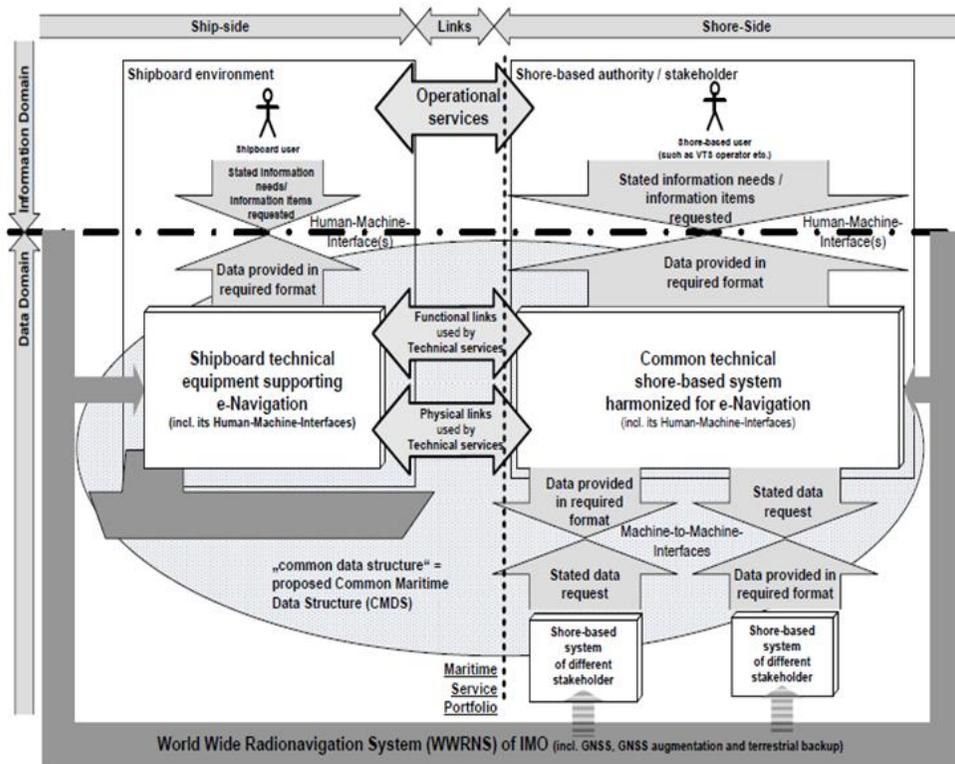
Picture credit: courtesy MUNIN project

e-Navigation...
in a future of improved decision support &
increased levels of automation and autonomy



e-Navigation

- “... harmonized collection, integration, exchange, presentation and analysis of maritime information on-board and ashore by *electronic means* to enhance berth-to-berth navigation”
- Resilient Positioning, Navigation & Timing (PNT) – with integrity – is fundamental



Note: There are operational and technical interactions between different shipboard environments. These are not shown for simplicity's sake in this figure.

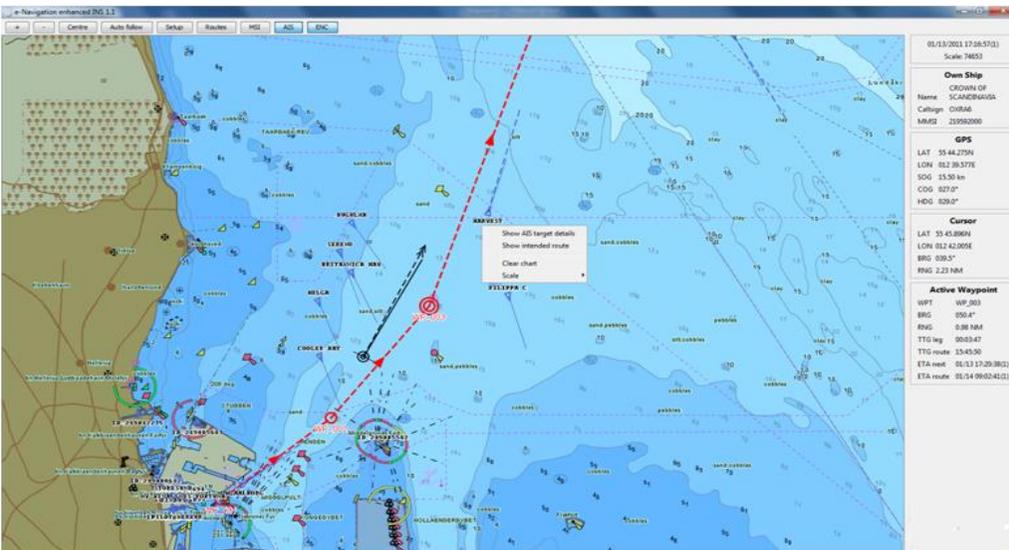
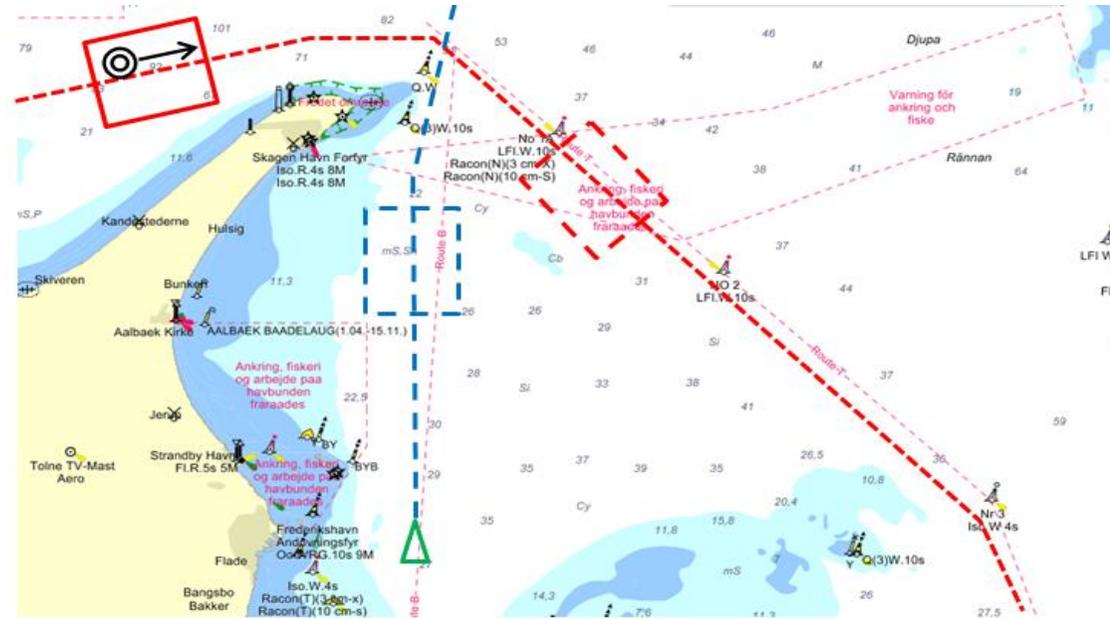
GNSS-based PNT used throughout Integrated Bridge Systems and Shore Control Stations e.g. AIS



e-Navigation services

Examples

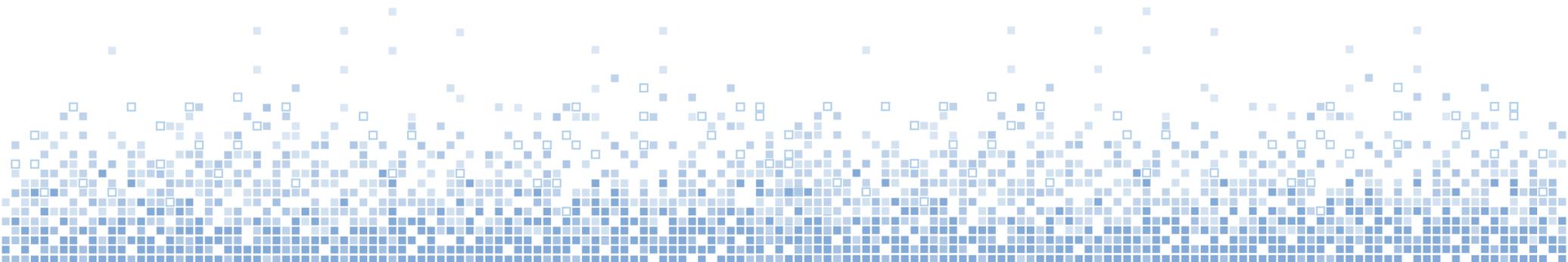
- Volumetric navigation & portrayal of error 'ellipses'
- Intended route
- Suggested route
- Route exchange



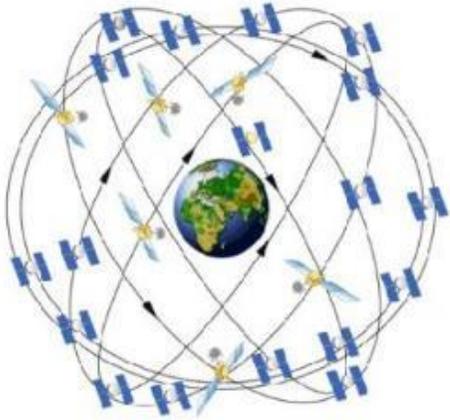
Route optimisation:

- safety
- efficiency
- environmental impact
- less fuel
- lower emissions

Mariners need SBAS for Integrity of navigation



GNSS is principal means of navigation



- GNSS has no inherent integrity
- DGPS radio beacons - limited coverage
- SBAS seen as important for wide area maritime integrity
- Fall back for resilience is traditional Aids-to-Navigation



Need for integrity at system level – is a maritime service feasible for EGNOS V2?

... plus integrity at user level (with HPL) – is this possible with future EGNOS?

Realising the role of SBAS in maritime navigation



Maritime horizons for Integrity

SBAS approach to maritime is different from aviation

- 2D positioning (height can be important, but uses other sensors)
- 10m accuracy, coast and harbour approach (1m in ports)
- 25m HPL (2.5m in ports), 10^{-5} integrity risk over 3 hours
- demanding multipath and interference environment
- complementary to DGPS radio beacons?

... with a global international approach to maritime SBAS services



International framework

IMO Safety of Life at Sea (SOLAS) convention regulates ships on international voyage (all passenger ships and non-passenger ships >500 GT)

Non-SOLAS vessels (leisure, small fishing vessels etc.) can use SBAS today

IMO Performance Standards encompass SBAS/EGNOS use by SOLAS vessels

- GPS, GLONASS & GALILEO all recognised by IMO as components of World Wide Radionavigation System (WWRNS)
- IMO Resolutions A.1046 and A.915 define GNSS-based integrity requirements
- IMO Performance Standard MSC.401(95): Multi-System Receiver
 - not a mandatory carriage requirement

Steps in progress for Type Approved receiver with SBAS (including EGNOS)

- RTCM SC131 maritime receiver guidance being developed
- IEC to develop test specifications
- Type Approved receivers with SBAS expected from ~2020

Maritime 'recognition' of SBAS

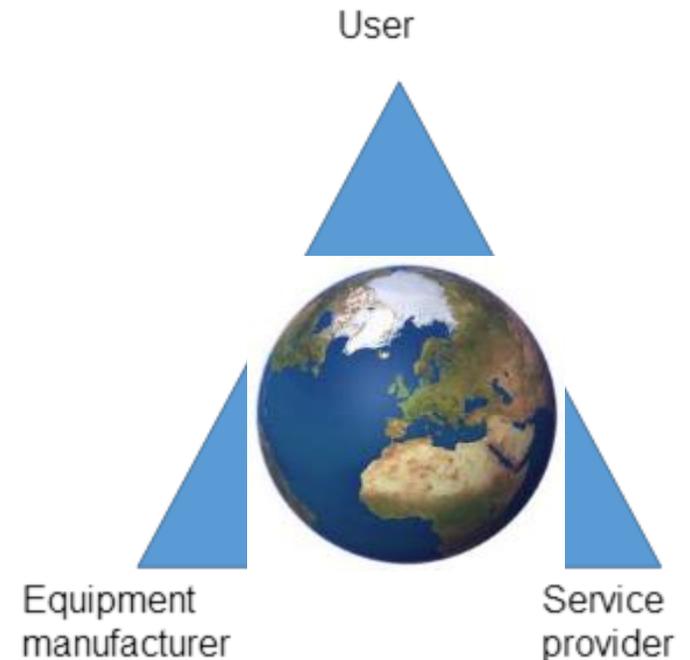
IMO has decided that augmentation systems do not require recognition as components of WWRNS

Maritime users will need assurance of maritime SBAS service provision

- system definition & service performance
- Maritime Safety Information, Notices to Mariners (e.g. notification of outages)
- roles, responsibilities and liabilities
- assurance of service longevity

New alternative international 'recognition' must be explored for SBAS

- with International Association of marine aids to navigation and Lighthouse Authorities (IALA/AISM)
- such that IALA represents and gives guidance to service providers



Conclusion:

**SBAS should safeguard the mariner and world trade –
but benefits must be better understood**



SBAS Integrity and human factors

Maritime SBAS services have the potential to safeguard the mariner, vessels, passengers, cargo, the environment and trade
Concept, use and benefits of SBAS Integrity not well understood by all maritime stakeholders

- with human factors (manned & autonomous vessels)
- portrayal, decision support, use in e-Navigation & IBS
- enhances capability to trap human errors & reduce accidents

There remains a need to educate & raise awareness

- if SBAS benefits are not understood, market uptake will be limited



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Thank You

