



TRAFICOM

Finnish Transport and Communications Agency

The role of radio systems and wireless communication in digitalisation and automation of maritime systems

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5G in Finnish Ports

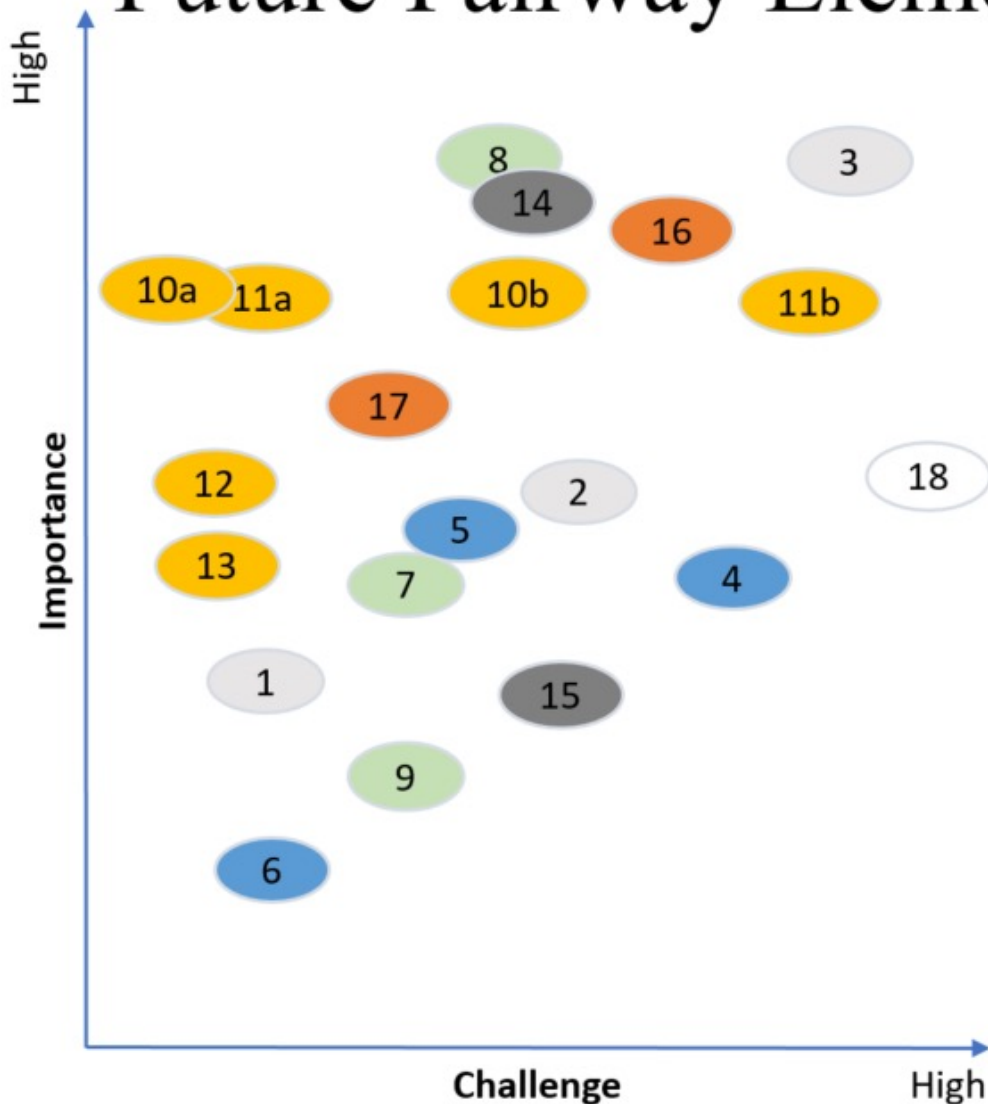
5G Momentum ecosystem by Traficom

<https://www.youtube.com/watch?v=zJNADVHqWL8>

Radio communications in port operations

- ▶ **Wireless broadband, surveillance, situational awareness, remote operations, IoT**
 - ▶ Commercial 4G/5G services provided by Mobile Network Operator (MNO)
 - ▶ Private 4G/5G network provided by port or port operator with own spectrum license or on spectrum leased from MNO
 - ▶ WLAN (WiFi) provided by port or port operator
- ▶ **IoT**: Separate network for low bit rate sensor data provided by port, port operator or third party communications service provider
- ▶ **Maritime safety service**: Maritime VHF, AIS, emergency transmitters, radars
- ▶ **Navigation**: GNSS, GNSS repeaters, radars, sensors

Future Fairway Elements



CORE INFRASTRUCTURE

- 1 Aids to Navigation
- 2 Electronic position finding aids
- 3 Communication systems

FAIRWAY INFORMATION

- 4 Digital twin of the physical infra (static)
- 5 Navigational charts and nautical publications
- 6 Dynamic navigational warnings

WEATHER AND SEA STATE

- 7 Realtime weather and sea state info for the area
- 8 .. for a certain location and the planned route
- 9 Climate change information

NAVIGATION & SEAFARING SERVICES

- 10 a) VTS services, b) enhanced VTS
- 11 a) Pilotage, b) remote pilotage
- 12 Ice breaking
- 13 Tug services

PORT ARRIVAL & DEPARTURE RELATED SERVICES

- 14 Port just-in-time
- 15 Administrative services: customs & boarder guard

OTHER

- 16 Support for the emergency services, SAR,
- 17 Sustainability information & services
- 18 Situational picture

Credit: Marikka Heikkilä, University of Turku

By Sea4Value Fairway

ELEMENT 2: Communication – dedicated maritime radio systems

<p>Partners</p> <p>Distress network (incl. VHF base stations on shore) operated by MRCC.</p> <p>Safety network (incl. VHF base stations on shore) operated by FinTraffic/VTS.</p> <p>Traficom grants radio licenses and radio operator certificates. FTIA together with Fintraffic VTS could provide the maritime specific free of charge communication infrastructure (either inhouse and via service contracts with commercial companies)</p> <p>(In case of VDES SAT, providers may be commercial operators, but not likely to be used in the Finnish Fairways)</p>	<p>Content/service</p> <ul style="list-style-type: none"> MF, HF and VHF maritime radios <ul style="list-style-type: none"> Speech DSC (Digital Selective Calling) AIS (automatic identification system, can also be satellite-based) NAVDAT for general data HF for general data LF for eLoran MF for DGNSS Emergency beacons, satellite-based <ul style="list-style-type: none"> EPIRB (Emergency position-indicating radio beacon) PLB (Personal Locator Beacon), not recommended for professional use Future: <ul style="list-style-type: none"> VDES (VHF data exchange system) e.g. for eNavigation (AIS, ASM, VDE TER/SAT) for general data Autonomous Maritime Radio Device (AMRD) on VHF 	<p>Delivery channels</p> <p>This is the dedicated delivery channel for maritime speech and data.</p> <p>Enables the provision of other elements (exchange of digital information services and reports between providers and consumers).</p>	<p>Customers / user groups</p> <p>Obligatory communications channels for commercial / professional maritime operations.</p> <p>Optional for recreational boating.</p> <p>Vessels, VTS, generally the providers and consumers of data and information elements.</p> <p>MRCC</p>
<p>Requirements from the other elements</p> <p>Infrastructure element – carrier to other services</p> <p>Enables provision of other elements.</p>	<p>Financing</p> <p>State financed. Publicly funded</p> <p>Fairway Service fees</p> <p>Readiness level</p> <p>In operation. Development of GMDSS, eNavigation and VDES ongoing on international forums.</p> <p>Old systems are not supporting cyber security, e.g. AIS. Authentication is not supported.</p>		

<p>Partners</p> <p>Satellite and mobile network operators</p>	<p>Content/service</p> <p>Today:</p> <ul style="list-style-type: none"> • Inmarsat with VSAT (user eq) satellite service for speech and data • 2G-4G commercial mobile networks for speech and data • VIRVE (TETRA technology) <p>Future:</p> <ul style="list-style-type: none"> • Iridium approved for GMDSS • 4G/5G networks built today on market basis <ul style="list-style-type: none"> • Also satellite component in the future? • Models for dedicated capacity/QoS for transport and public-private partnership? • VIRVE2 (4G/5G technology) for defined user groups • What will be the role of future non-GSO satellite systems (e.g. SpaceX, OneWeb megaconstellations)? • (5G, VIRVE2 and sat com not maritime specific but shared by other user domains) 	<p>Delivery channels</p> <p>-</p>	<p>Customers / user groups</p> <p>All fairway users</p> <p>Vessels, passengers, VTS, generally the providers and consumers of data and information elements.</p> <p>Leisure yachts</p>
<p>Requirements from the other elements</p> <p>Mainly stand-alone elements</p>			
<p>Financing</p> <p>Service financed by user fees (vessels pay to get connectivity)</p> <p>We need to find new models to complement the commercial services to enable co-operation between the MNO and other actors to complement the communication network, where it is not profitable to build the required service level and availability on commercial basis.</p>		<p>Readiness level</p> <p>Iridium approved, 5G is being built on commercial basis, VIRVE2 is being built, non-GSO satellites are being launched but service level in Finland uncertain. IMT systems for maritime use under development by 3GPP (tested widely in Korea) and currently discussed in IALA and IMO.</p> <p>Old implementations are not supporting current cyber security requirements. Cyber security built in to many systems but when implemented in maritime, cyber security need to be considered.</p>	



<p>Partners</p> <p>FTIA Fintraffic VTS Service providers</p>	<p>Content/service</p> <p>Platform to enable digital authentication and services discoverability for facilitating the provision of Maritime Services. (Such as Maritime Connectivity Platform, MCP)</p> <ul style="list-style-type: none"> • The Maritime Identity Registry (MIR): Facilitating authentication of entities exchanging information • The Maritime Service Registry (MSR): Facilitating service discoverability <p><i>Enables safe information exchange and service provision, authentication of users.</i></p> <p>Cyber security: certificates and control mechanisms are important</p>	<p>Delivery channels</p> <p>IP-connections</p>	<p>Customers / user groups</p> <p>Service providers End-users</p>
<p>Requirements from the other elements</p>			
<p>Financing</p>	<p>Readiness level</p> <p>Development and testing ongoing</p> <p>Unclear, who would be in charge of this nationally</p> <p>Are the certificate and security policies defined? – Partly</p>		

ELEMENT 3: Electronic Position finding aids

Partners

GNSS: GPS operated by US, Glonass by Russia, Galileo by EU (the only civil system!?), (Beidou by China)

Supporting GNSS:

- SBAS by EGNOS service provider
- IALA Beacon DGPS service by Fintraffic VTS
- DGNSS, RTK and PPP services by many commercial service providers

Future possibilities:

- HAS (high-accuracy service) by Galileo service provider
- Local RTK/PPP over VDES by Fintraffic VTS
- **VDES R-Mode and MF R-Mode by Fintraffic VTS**
- eRacon service by FTIA inhouse or via service contract

Content/service

- **Maritime radar**
 - Professional use (9 GHz band)
 - Recreational use (3 GHz band)
- **GNSS** (Global Navigation Satellite System)
 - GPS
 - Glonass
 - Future: Galileo and its PRS (publicly regulated service) and OSNMA (Open Service Navigation Message Authentication)
 - (Often combinations of the above)

GNSS service and in the future MF/VDES R-mode and eRacon service provide vessels with absolute position information which can be displayed in electronic nautical charts.

SBAS service, commercial DGNSS/RTK/PPP services, IALA Beacon DGPS service and in the future Galileo HAS and local RTK/PPP over VDES provide augmentation (integrity and better accuracy) to GNSS services.

Delivery channels

- GNSS satellites
- DGNSS terrestrial components via MF, VHF, SAT, internet (via 4G/5G to cloud)
- eRacon via radar frequencies
- VHF radio for AIS to report position to other fairway users or VTS center (also virtual AIS and AIS AtoN)

Customers / user groups

Obligatory communications channels for commercial /professional maritime operations.

Optional for recreational boating.

Vessels

Requirements from the other elements

VHF communication channel used for AIS

Communication channel for providing signals/data must exist

Financing

Galileo is being built by EU
Public funding for public services
User fees for commercial services

Readiness level

In operation. Galileo is being built. **Services for Interference Detection and Mitigation available and under development** (e.g. Orolia M-SecureSync available for military use -> for commercial).

GNSS, IALA Beacon DGNSS - standardized and widely used by vessels (room for improvement related to MCMF).

SBAS, VDES R-Mode and MF R-Mode – standardisation for maritime use ongoing.

Others pending for standardisation.

Future work: Transport automation needs for communication services

- ▶ Traficom has identified steps to understand the future needs of transport for communication services.
 1. Understand the need of **one user**. The first planned use cases are defined and the performance requirements set by the **planned use cases** for the communication network service are understood.
 2. Understand the needs on the **communication network**, i.e. scalability with all simultaneous users. The service level requirements set for the communication network for the first services are defined with the first estimated number of users.
 3. Are the KPIs and measurement methods accurate or do we need to develop new ones? Existing measurement methods and available measured data on the performance of communication networks are analysed. **New measurement methods** are developed for future analyses.
 4. How could the **networks be developed cost-effectively**? The possibilities of implementing the service level requirements in future communication networks should be explored. Dedicated channels for transport? Public-private-partnerships? New regulations?

ADMO

5G-Advanced *for* Digitalization of Maritime Operations

1

Establish comprehensive understanding on maritime connectivity and possibilities from 5G-Advanced

2

Provide opportunities to digitalize ship operations with 5G/5GA

3

Support companies developing digital services and products for ship building and shipping

Thank you!

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