Roadmap for Connectivity of Remotely Controlled and Autonomous Ships

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Use case examples (specified in 3GPP)

- Video streaming, DL & UL
- Positioning inside a vessel
- Wireless LAN services
- Machine type communication, inside vessel, between vessels, between UEs at sea
- Vessel shore reporting
- Search and rescue operations

- Handling of warnings and alarms
- IMO's VTS, TOS, LPS, and others
- Pilotage services
- Tugs services
- Interworking and harmonization of all maritime communication systems

Design principles for autonomous and remotely operated systems connectivity

Sensors are essential
- Health of a system
- Situational awareness (environment)
- Hybrid positioning (GNSS+5G)

Redundancy needed
- No single point of failure
- Multiple radio technologies, back ups

Common technologies and domain specific solutions
- Long range for maritime
- Low delays for remote machinery
- Satellites and HAPs for aerial and ships

http://www.newsweek.com/2015/04/17/flying-cars-are-coming-do-you-really-want-one-319639.html
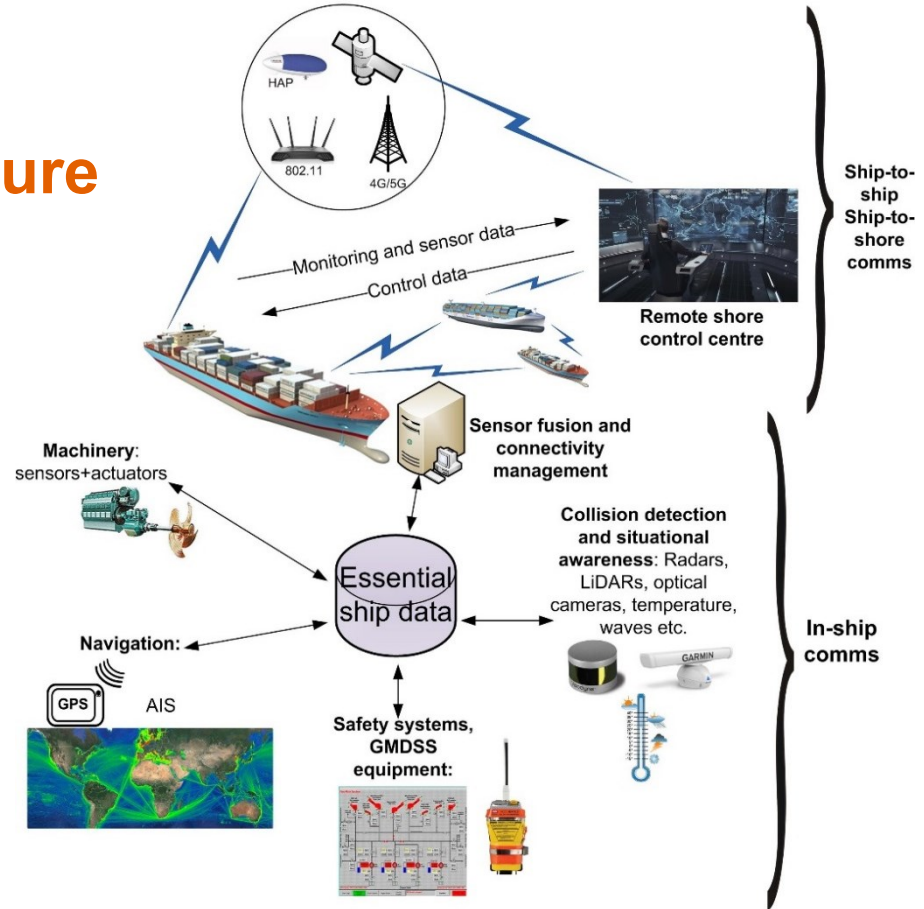
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Possible connectivity routes in maritime domain

1. 4G/5G connection
2. Satellite connection
3. Long range HF/VHF connections
4. High Altitude Platforms
5. Routing mesh networks using drones
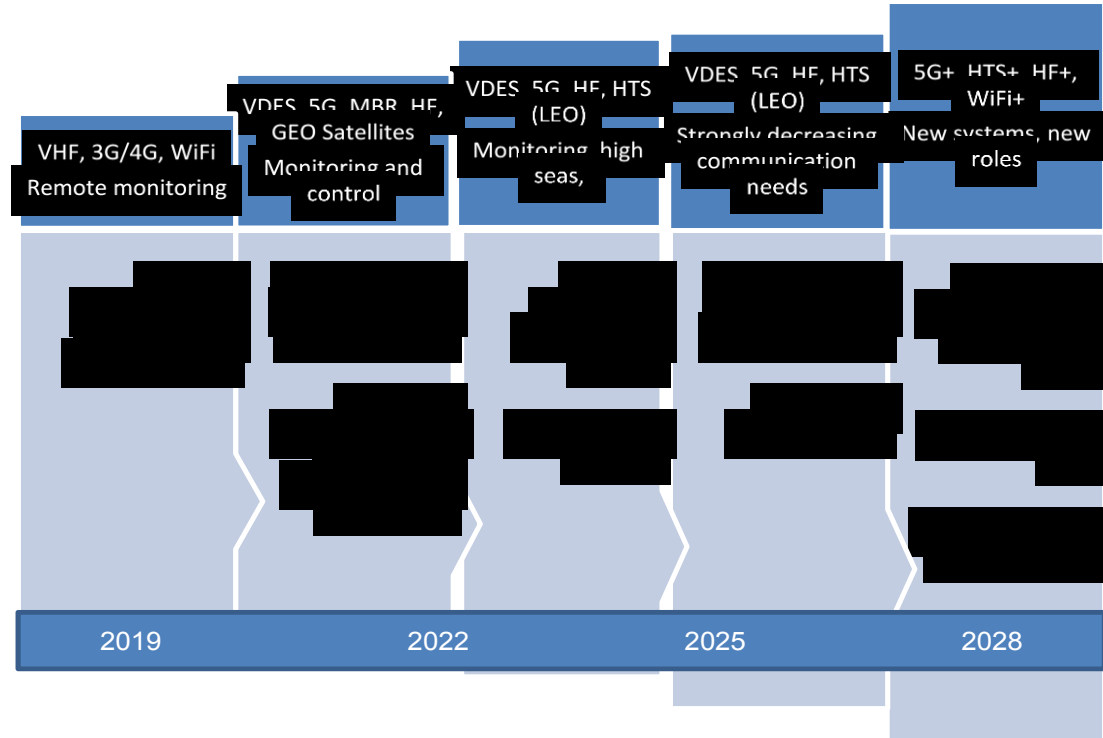6. WiFi connections
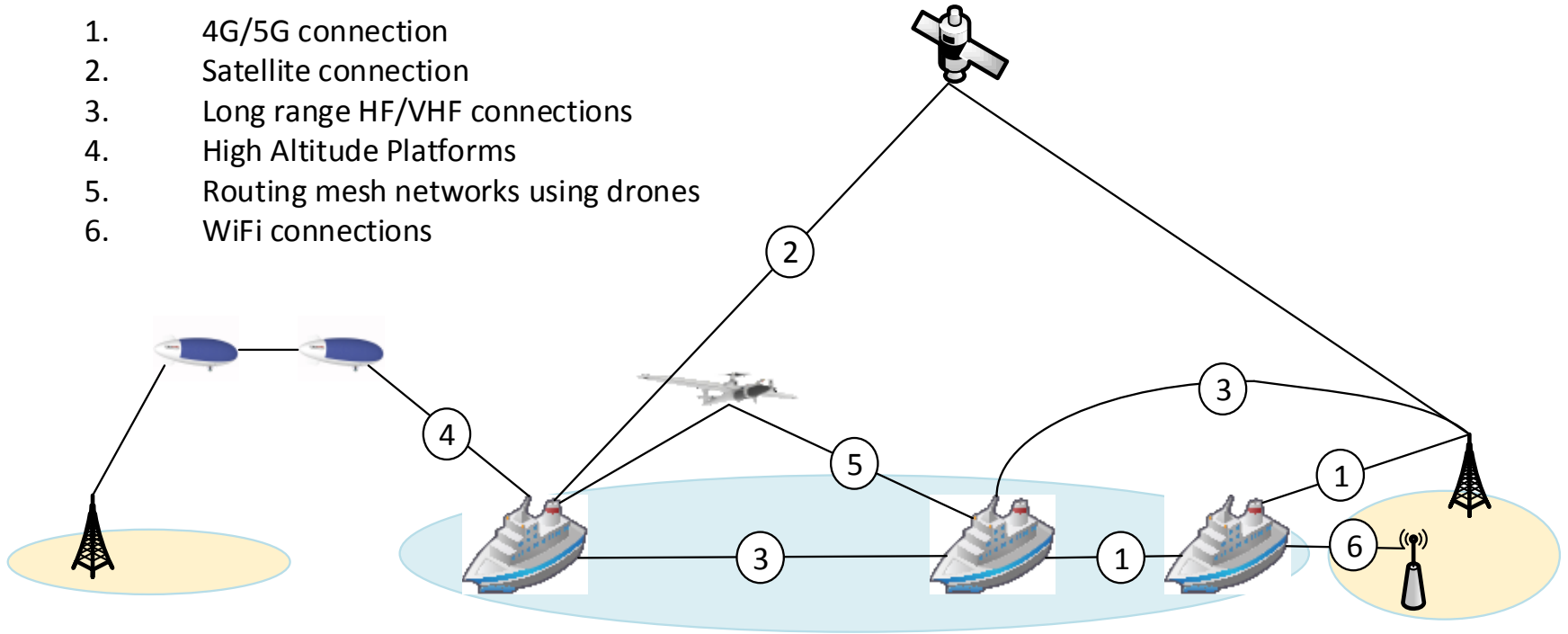
Communications architecture

- Redundant systems, multiple air interfaces

- *Transmission requirements are asymmetrical => higher load in uplink*

Connectivity timeline

VHF, 3G/4G, WiFi
Remote monitoring

VDES, 5G, MBB, HF, GEO Satellites
Monitoring and control

VDES, 5G, HF, HTS (LEO)
Monitoring, high seas,

VDES, 5G, HF, HTS (LEO)
Strongly decreasing communication needs

5G+, HTS+, HF+, WiFi+
New systems, new roles

| 2019 | 2022 | 2025 | 2028 |

Thank You!

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