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EGNOS WORKSHOP 2021

EGNOS in Maritime

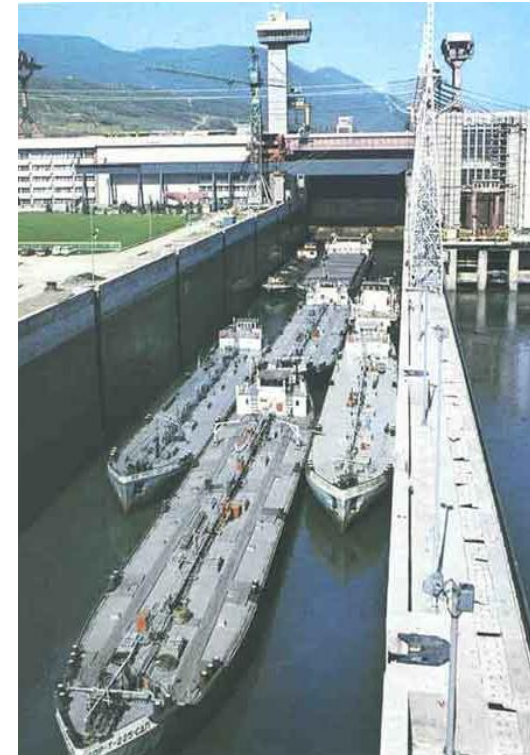
02/11/2021

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Demanding Maritime applications





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Lazy days in Aviation...

- One type of operation (take off/landing)
- Lands on airfields only
- Relaxed accuracy requirements
- Well defined antenna location and installation
- Certified equipment
- No (or little) multipath
- Low risk of interference / spoofing
- Little GNSS signal obstruction
- No other aircrafts coming too close
- Can go away if weather is too bad



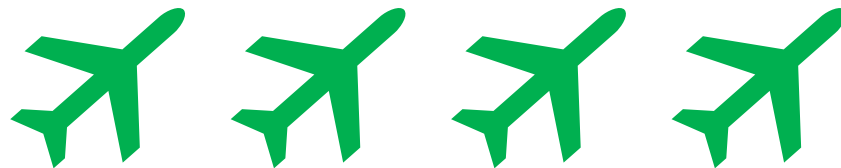
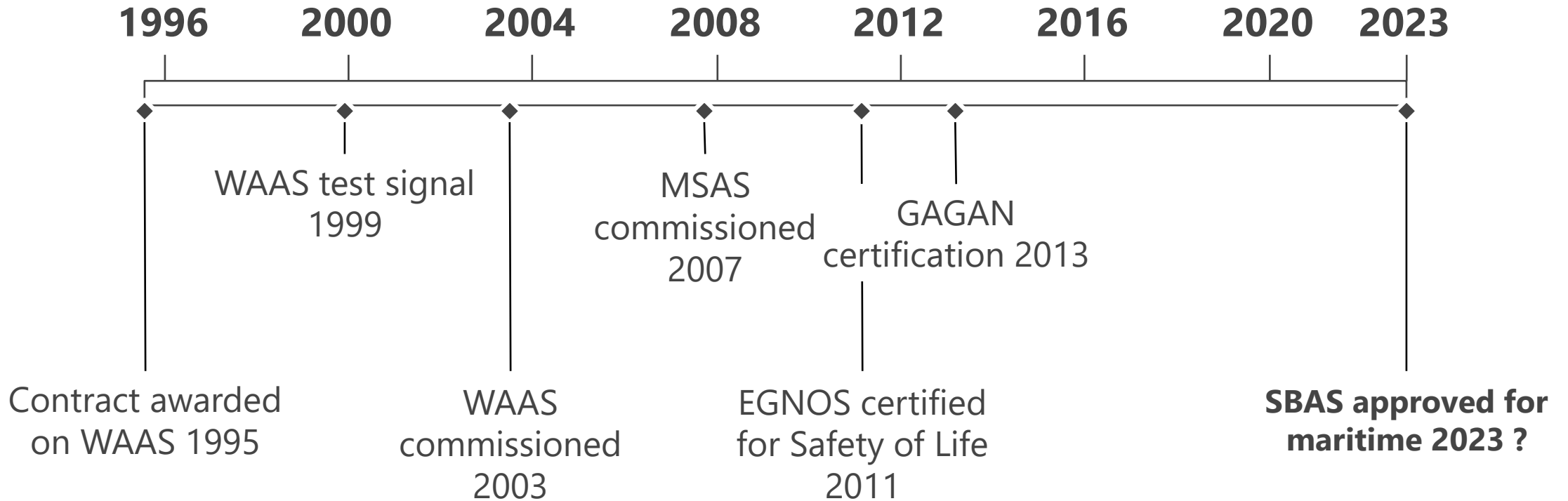
<http://www.nrk.no/nyheter/okonomi/1.7375207>

In Maritime operations you are not always this lucky



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SBAS L1 GPS implementation





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Current situation

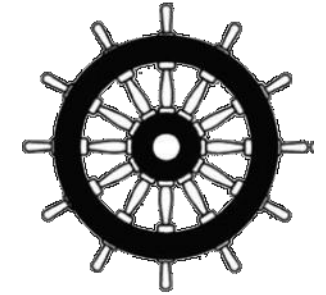
- SBAS can provide added value for maritime navigation under IMO SOLAS regulations
 - SBAS is already used in many maritime applications
 - It has been demonstrated that EGNOS could meet the IMO 1046 requirements for Ocean waters, Harbour entrances, Harbour approaches and Coastal waters
 - SBAS still not approved for such use
 - SBAS service provider agreements with national authorities not in place
- => **Currently, use of SBAS for maritime navigation is at mariner's own risk!**

SBAS – Space Based Augmentation System.
Examples: EGNOS and WAAS
SOLAS - International Convention for the Safety of Life at Sea
IMO – International Maritime Organization



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Process towards the wheel mark





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Different SBAS versions and ways of using

SBAS usage	SBAS service	
	Legacy: GPS L1	Emerging: L1/L5, multiple constellations
Direct from GEO	DO229, future maritime	Future
SBAS as source for IALA DGPS service	Used in some DGPS services today	Future?



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Guidelines for use of SBAS in Maritime

- Apply differential corrections from SBAS in same way as in aviation

- Use of integrity information :
 - Mandatory: Consider UDREI, GIVEI and MTO for don't use conditions
 - Optional: Use sigmas (error estimates) from SBAS
 - Optional: Use local error models for SBAS

- Output of protection level is optional

=> **Some SBAS MTs are optional**



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Maritime integrity

- In aviation: Receiver calculates protection level which is then compared to alarm limit
- In maritime: For GPS and DGPS, integrity is represented by:

Safe Caution Unsafe

- This status is an output from the RAIM algorithm and is relative to selected accuracy level (100 m, 10 m and other)
- In maritime RAIM is mandatory and output of protection level is made optional

Fjord of Trondheim - Test site for Autonomy



- Test field for autonomous vessels and test site used in several EGNOS projects like MAREC, SEGRA, EGNOS Next



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Summary and next steps

- Current and future SBAS SIS can be used in maritime applications
- Redistribution of EGNOS through maritime radiobeacons is implemented
- Maritime integrity concept is different from aviation:
 - protection level is optional
 - quality estimates is mandatory, for example position error ellipses and 95% accuracy
 - RAIM will be required also when applying SBAS corrections
 - it will be the responsibility of the equipment manufacturer to find suitable algorithms
- Further work on the legacy SBAS (GPS L1) is the finalization of the equipment standard in IEC TC80
- Set up service level agreements with service providers must continue
- In parallel with this work on SBAS for GPS L1, the maritime standardization work for the new DFMC SBAS service has been started
- Ideally a DFMC SBAS test standard for maritime equipment should be available well in advance of the service becoming operational

=> **A maritime DFMC SBAS service may be a game changer**

**DFMC - Dual
Frequency
Multiple
Constellation**



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Thank you

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