Driver assistance functions for safety inland vessel navigation

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DLR

LÆSSI

Knowledge for Tomorrow

Motivation

Inland shipping:

- Important pillar of the European transport system
- Ecological way to transport goods
- Safety related especially when transporting dangerous goods

Challenging: due to increasing ship size, dense traffic, reduced visibility

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Foto: Thomas Butler / pixelio.de

Foto: Manfred Adam , Schiffsbilder.de

Motivation

Accidents by collision of ships with bridge superstructure

It is necessary to enhance security and efficiency of inland vessels

This is addressed by new driving assistance systems to support the navigator

Project LAESSI

LAESSI: (Guiding and assistance systems to improve safety of inland navigation)

Duration: 10/2015 till 03/2018 (final demonstration March, 2018)

Objectives: Development of driver assistance systems to support the skipper

Founding:

German federal ministry for economics affairs and energy

Project LAESSI - Assistance Functions

- **Mooring assistant**
  - distances to map contours and direct measurement of distances

- **Bridge approach warning**
  - Monitoring the height of the ship

- **Conning-Display**
  - Display of the movement of the ship

- **Track control system**
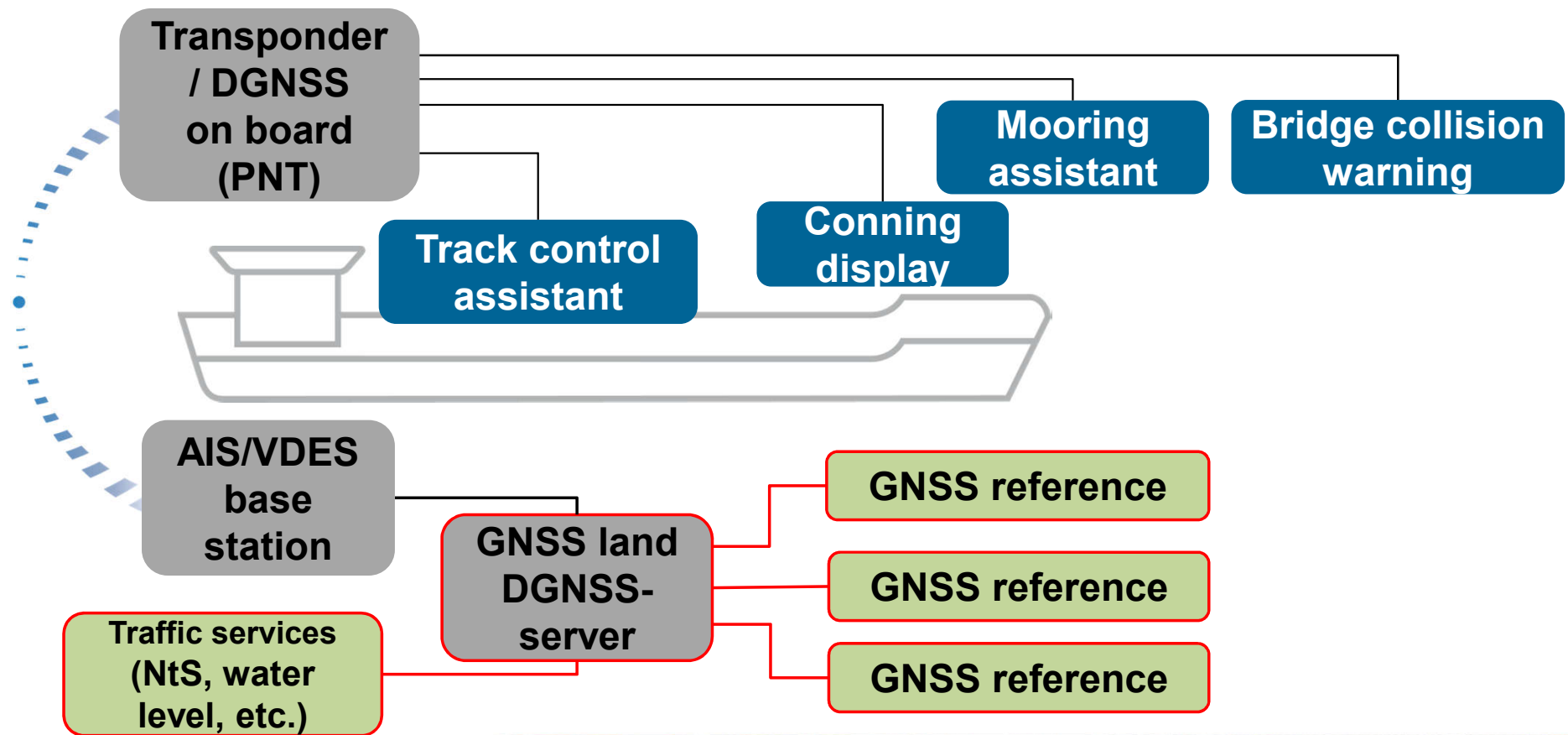 - Automatic guidance of the ship along a given track
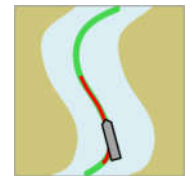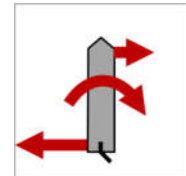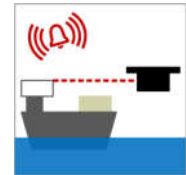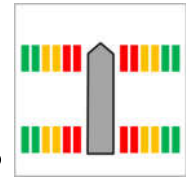
High accuracy requirements: Transition from code to phase-based GNSS methods (RTK)!
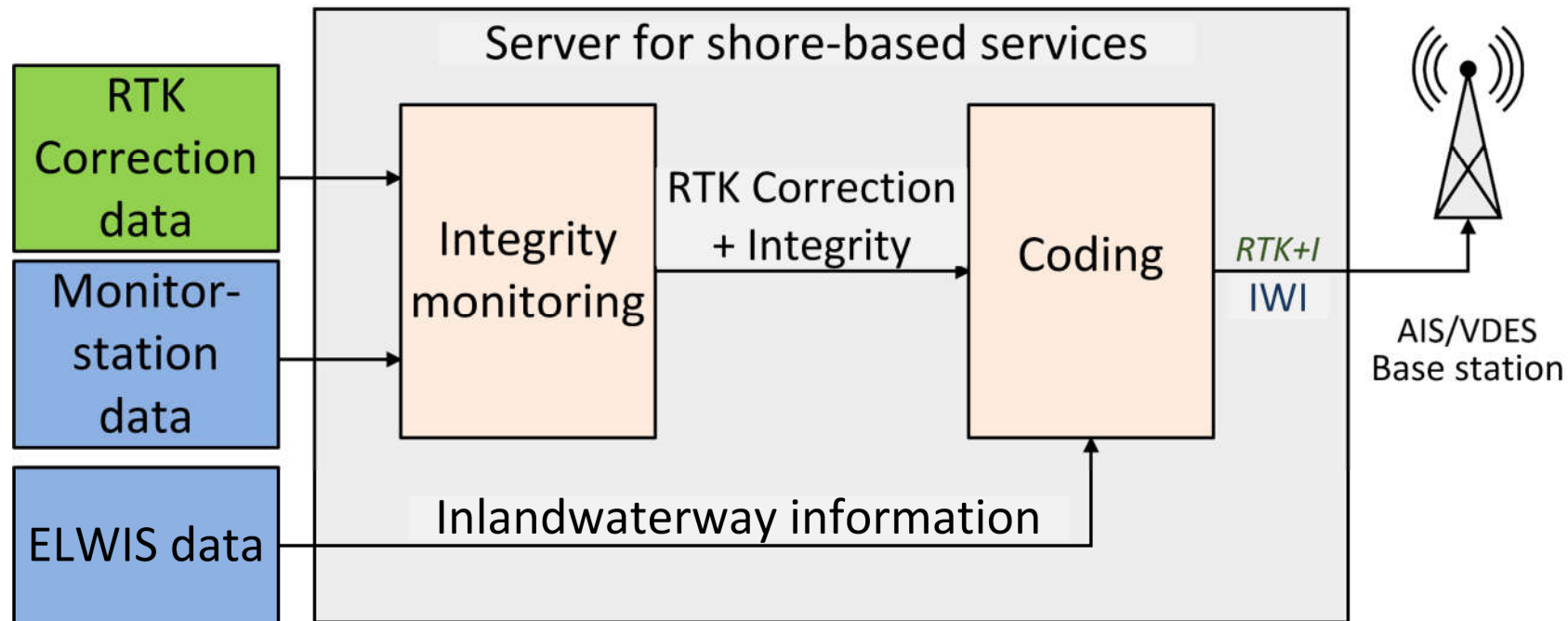
System Setup - Overview
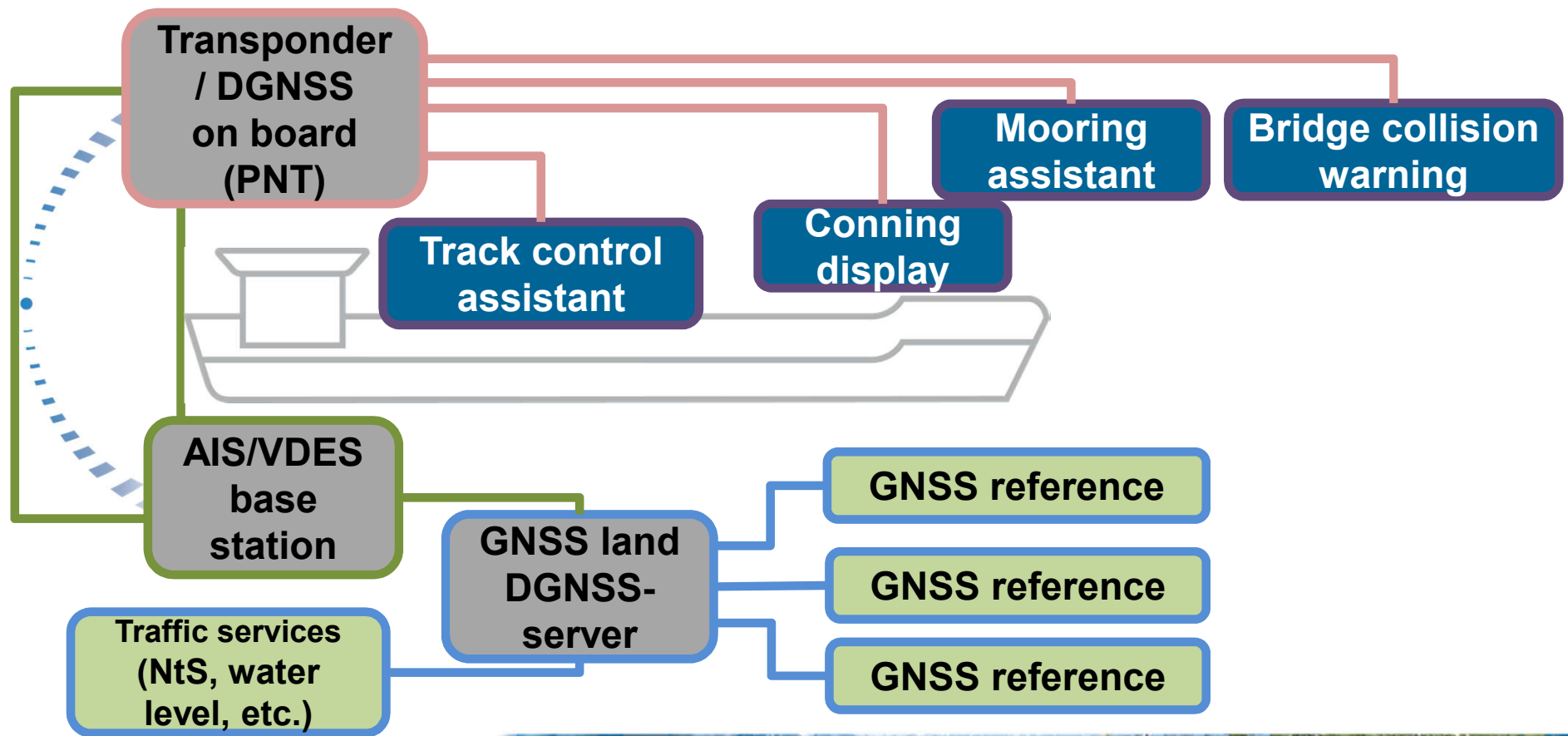
System Setup – Shore side
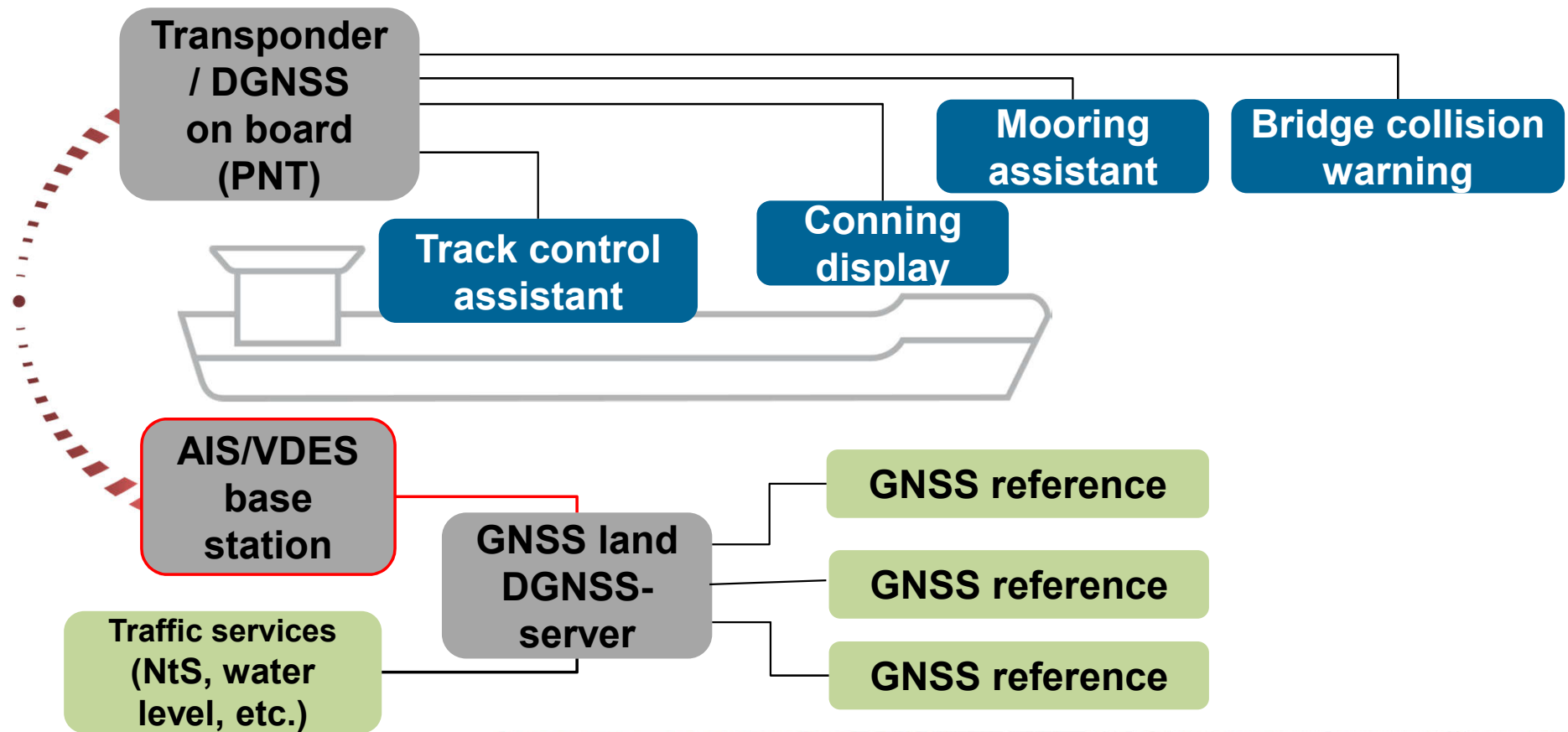
System Setup – Shore side

- Providing correction data with integrity messages

System Setup – Data transmission

Transponder / DGNSS on board (PNT)

Mooring assistant

Bridge collision warning

Track control assistant

Conning display

AIS/VDES base station

GNSS land DGNSS-server

GNSS reference

GNSS reference

GNSS reference

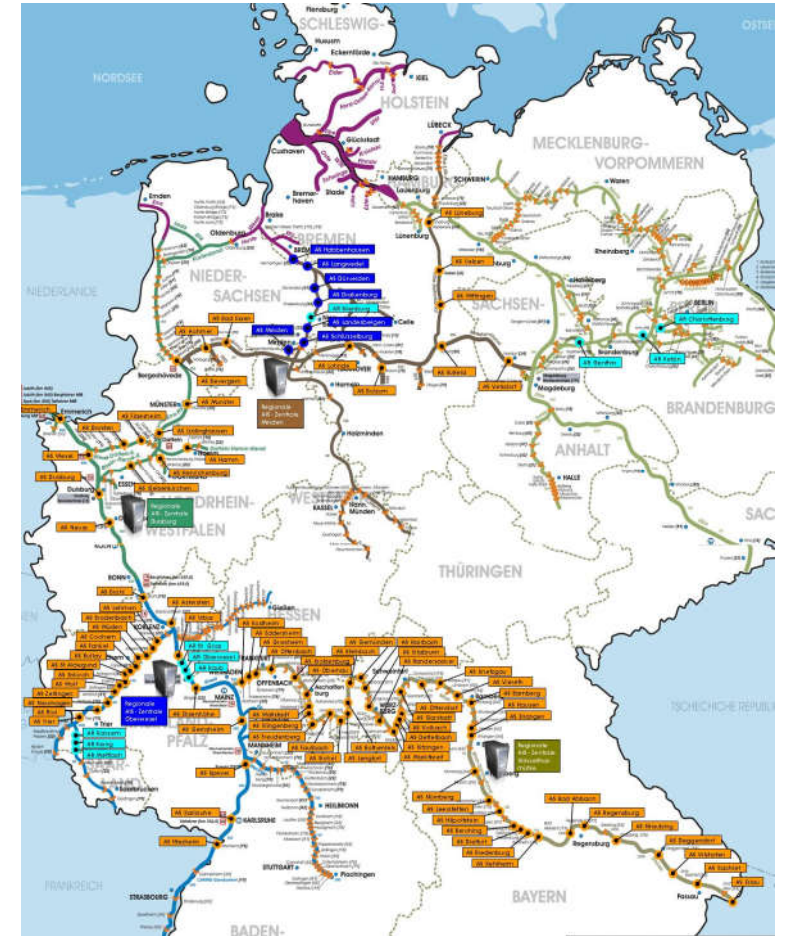**Traffic services (NtS, water level, etc.)**

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System Setup – Data transmission

Inland AIS
(Automatic Identification System)

- Standardized by the IMO since 2002

- Data exchange between ships and shore

- Mandatory for vessels

- Land infrastructure available
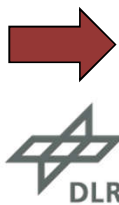
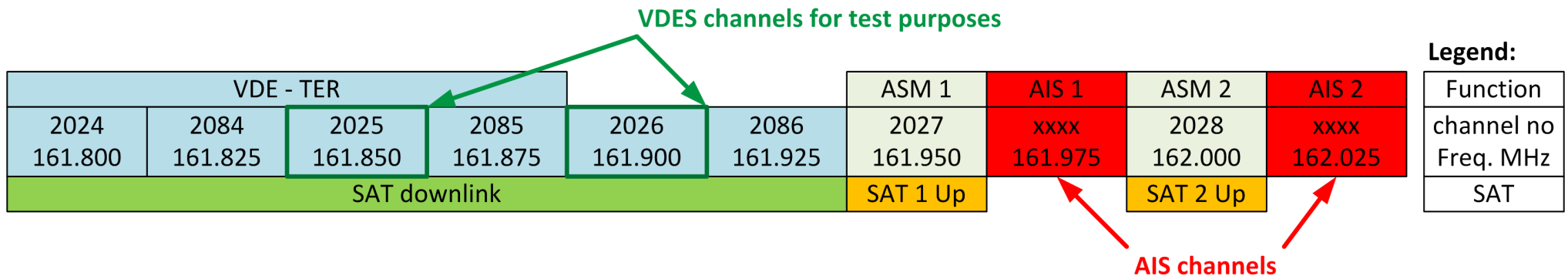→ Can be used for data transmission, but data capacity is limited.

System Setup – Data transmission

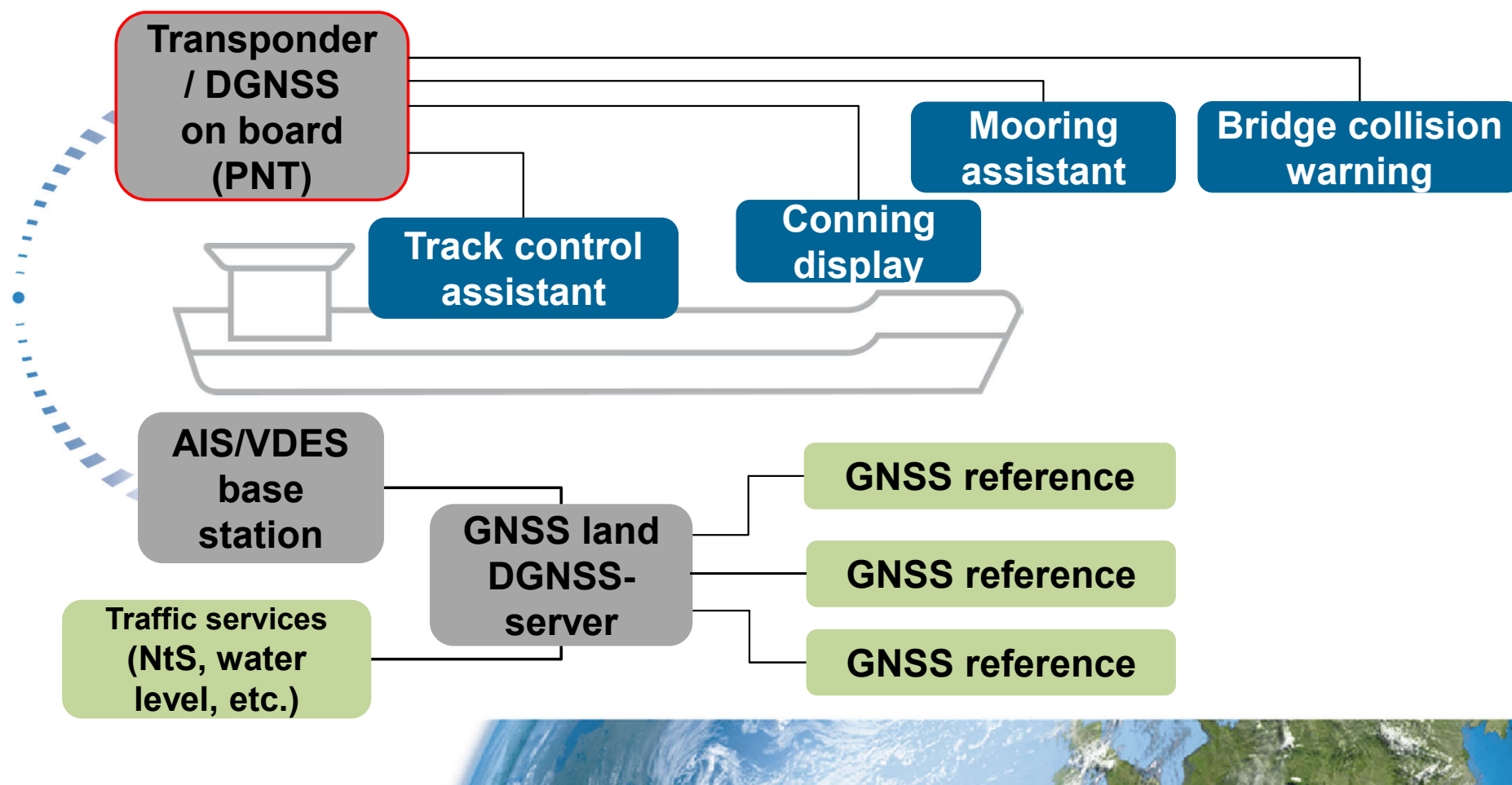Communication by **VDES** (**V**HF **D**ata **E**xchange **S**ystem):

Enhancement of AIS standard
• Additional transmission capacity, additional channel

Standardization phase

VDES channels for test purposes

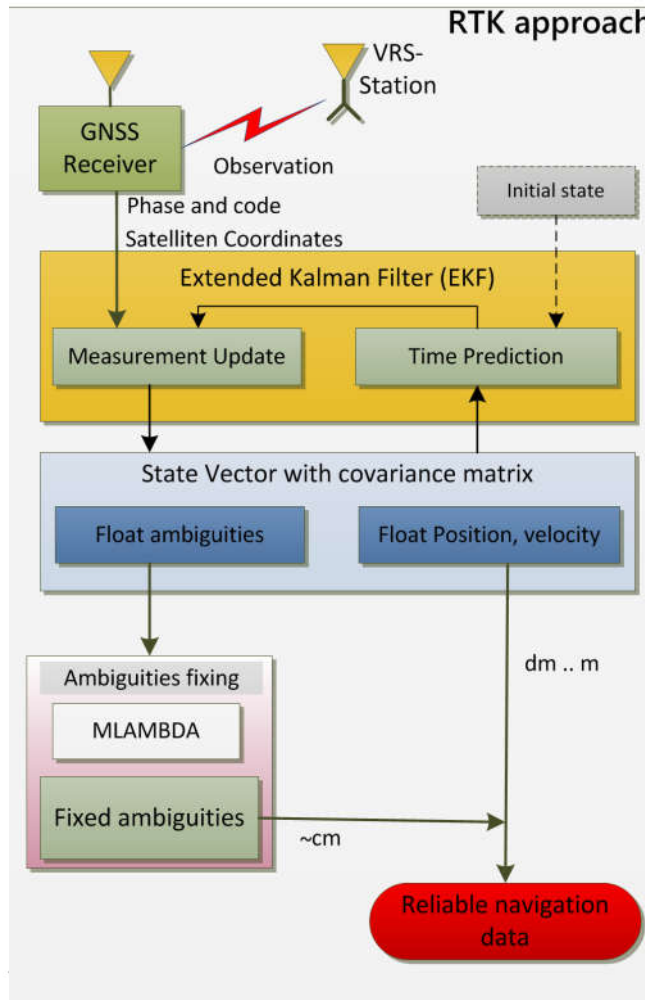|						ASM 1	AIS 1	ASM 2	AIS 2	Legend:
VDE - TER										Function
2024 161.800	2084 161.825	2025 161.850	2085 161.875	2026 161.900	2086 161.925	2027 161.950	xxxx 161.975	2028 162.000	xxxx 162.025	channel no Freq. MHz
SAT downlink						SAT 1 Up		SAT 2 Up		SAT

AIS channels

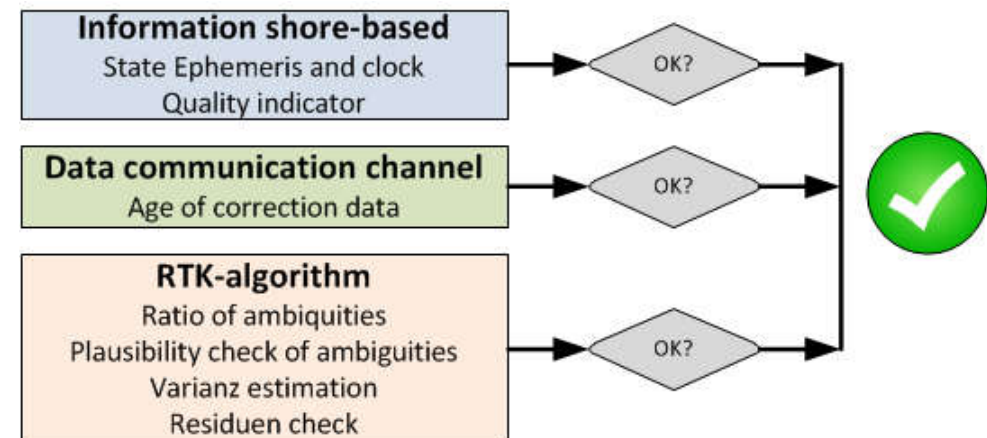# System Setup – Ship side

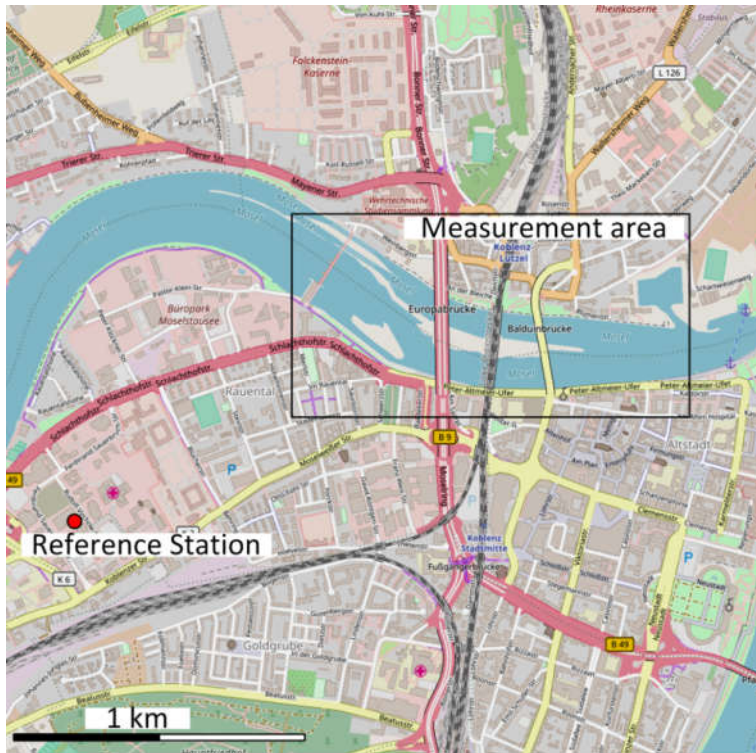# System Setup – Ship side

- Estimation of position, velocity and ambiguities

- Ambiguities fixing

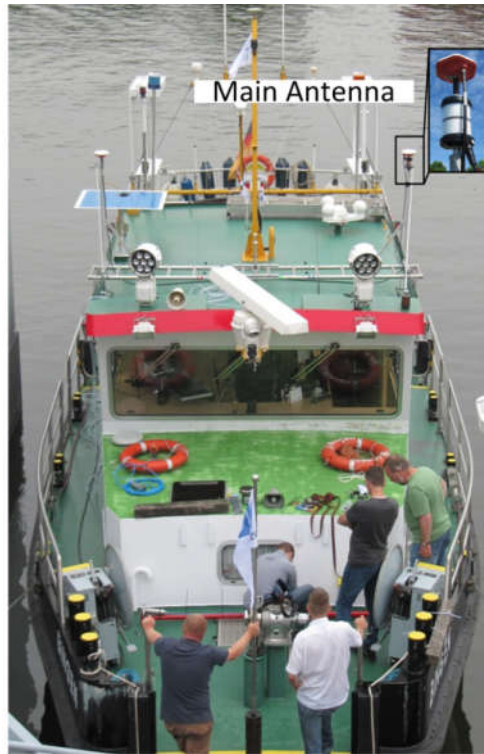- Correction of position and velocity

Integrity check to prove the solution

Measurement campaign - Koblenz
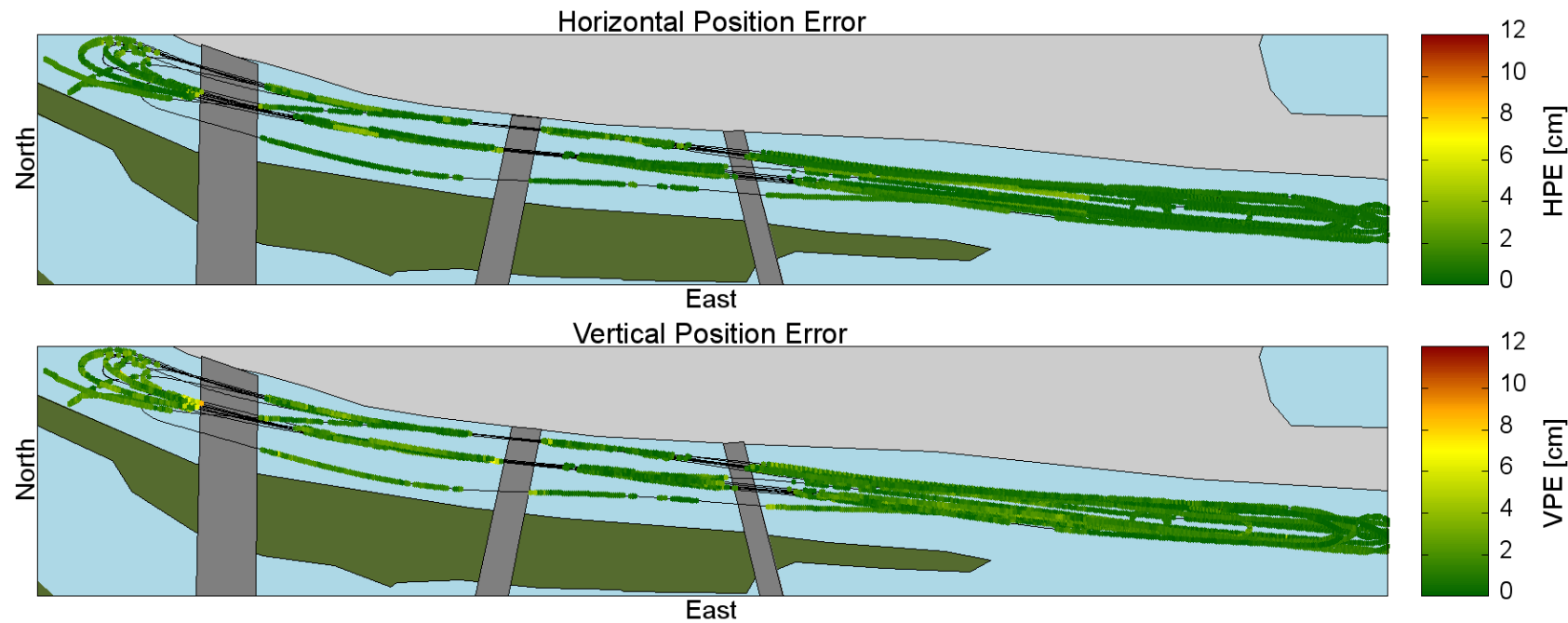

Challenging area

MS Bingen

- Geodetic GNSS receiver

- PNT-Unit

- Reference station: Koblenz (~3 km)

- Reference: Tachymeter

- GPS/GLONASS, 2Hz

- GSM Communication channel

Measurement campaign - Koblenz

Horizontal Position Error

Vertical Position Error

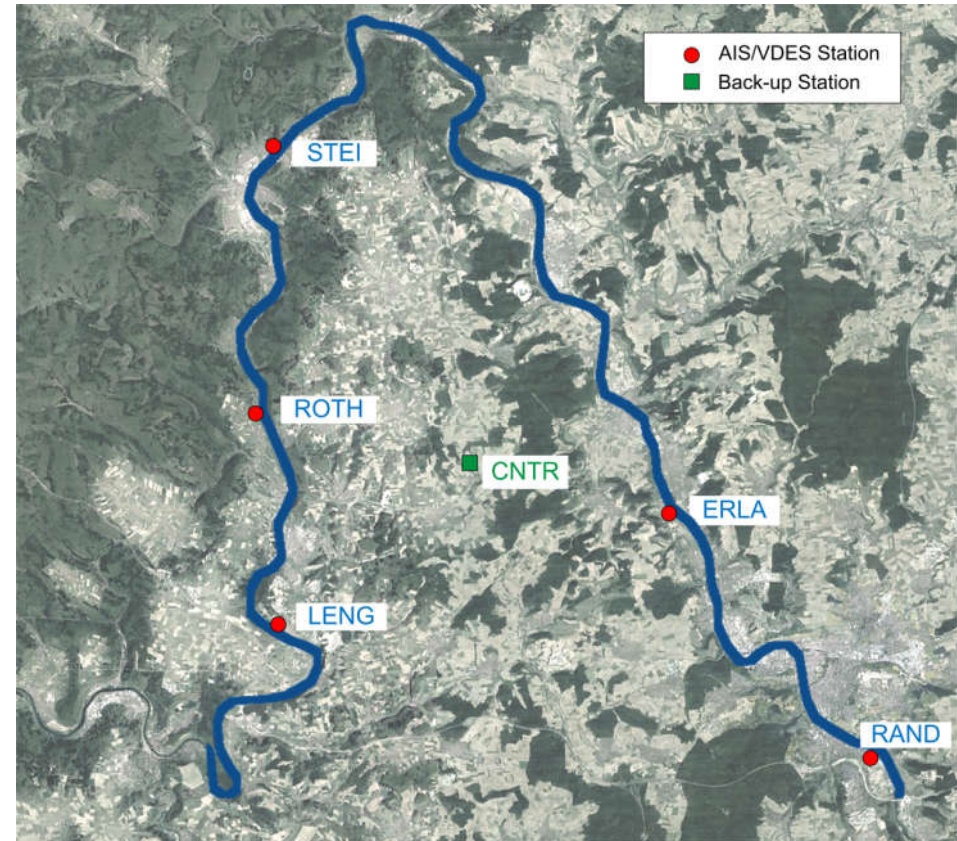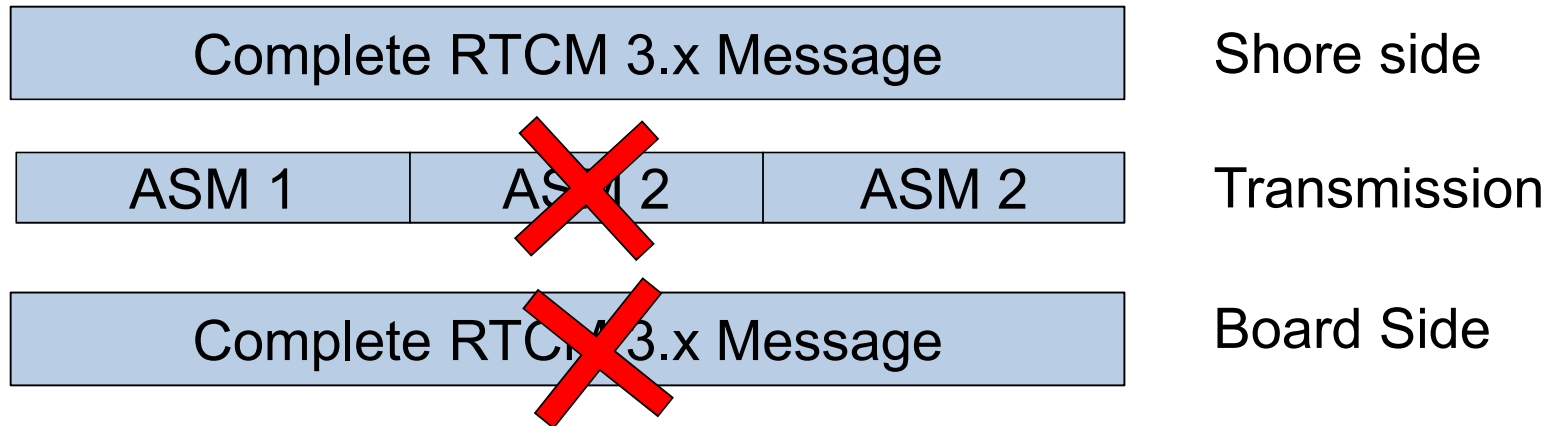|	Reliable solution	RMS [cm]	99 % [cm]	Max. [cm]
horizontal	82%	1.1	4.0	7.3
vertical		1.3	5.0	8.2

Measurement campaign - Main

- 2 days campaign

- AIS/VDES and GSM (backup)
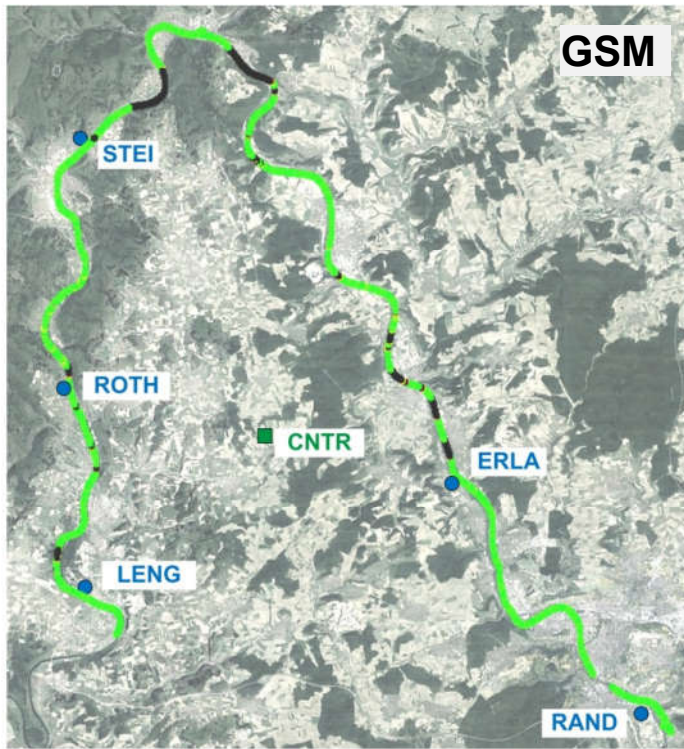
- 2Hz, GPS+GLONASS

Measurement campaign - Main

Communication aspects with AIS/VDES:

| Complete RTCM 3.x Message | Shore side |

| ASM 1 | ASM 2 | ASM 2 | Transmission |

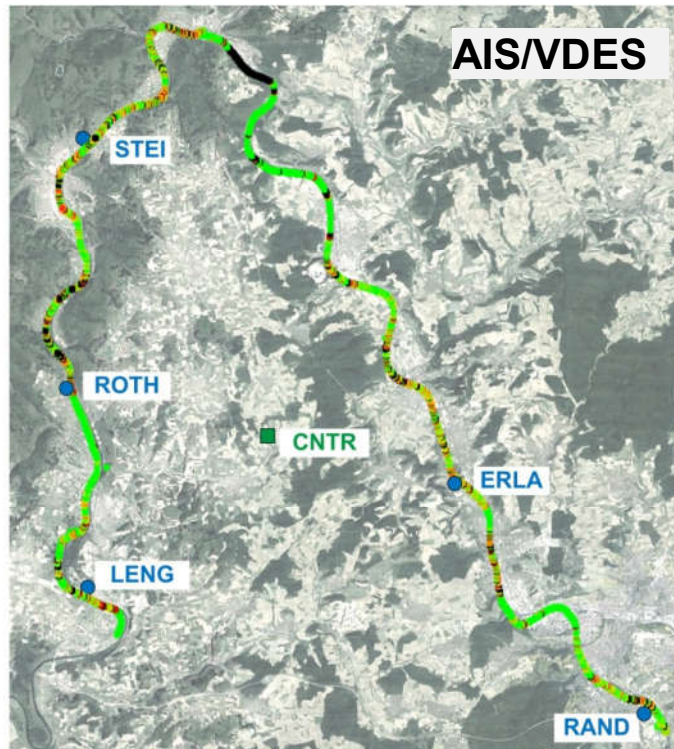| Complete RTCM 3.x Message | Board Side |

Age of Correction: Number of epochs/second from the last received correction data set
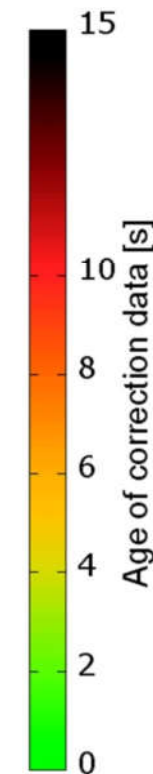
Measurement campaign - Main
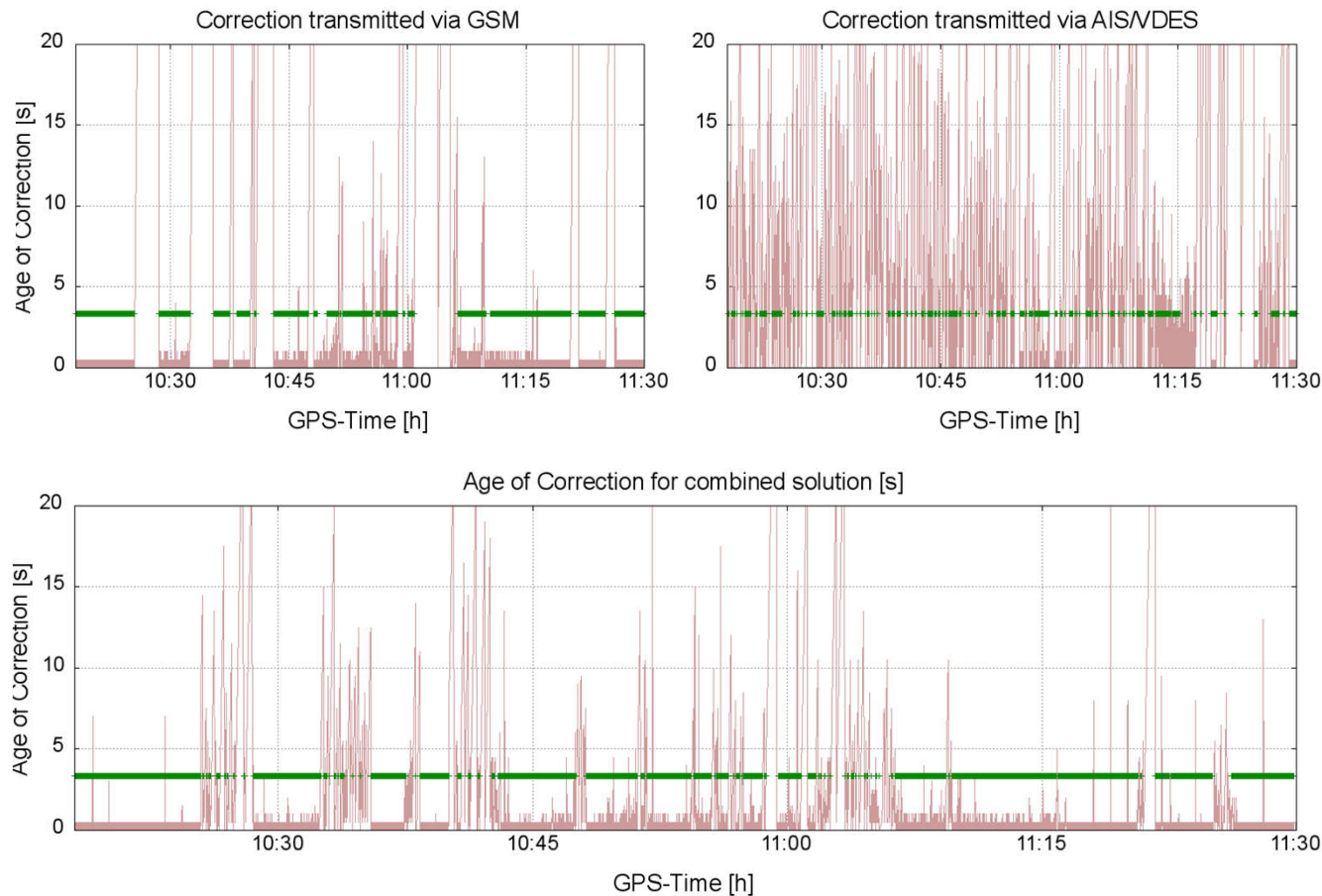

Less but larger outages

More but shorter outages

Correction Age for the two communication channels

Time to alarm 4s

Measurement campaign - Main

Results based on 2 days measurement campaign

	Reliable solution [%]
AIS/VDES	52.0
GSM	78.2
AIS/VDES+GSM	84.1

Driver function: Mooring Assistance

Installation of the sensor
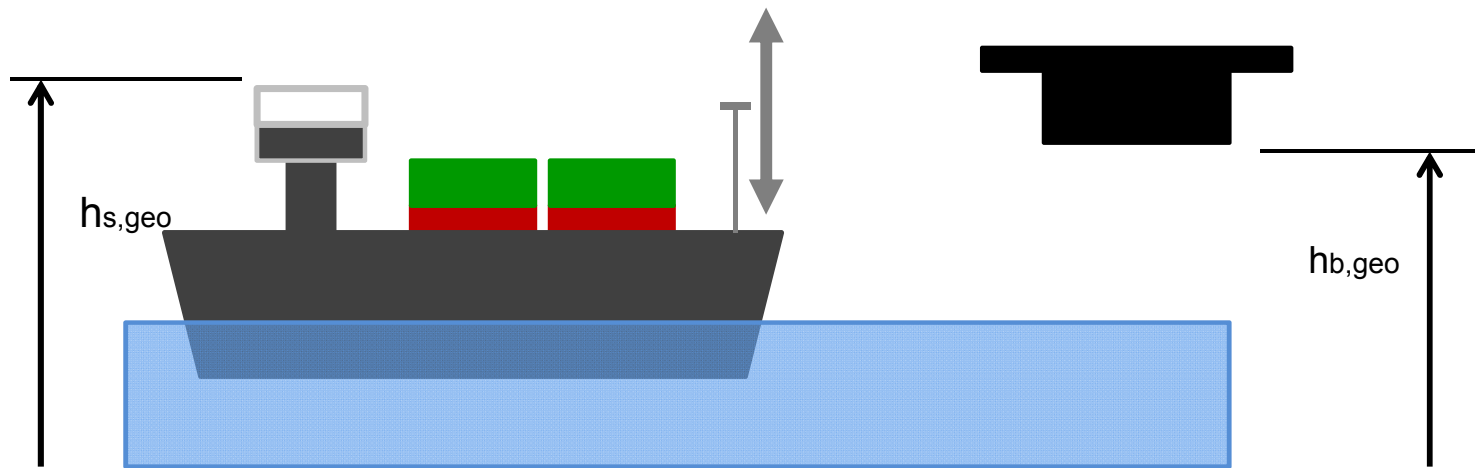at the bow of the ship

Near quay wall   Passing other vessel
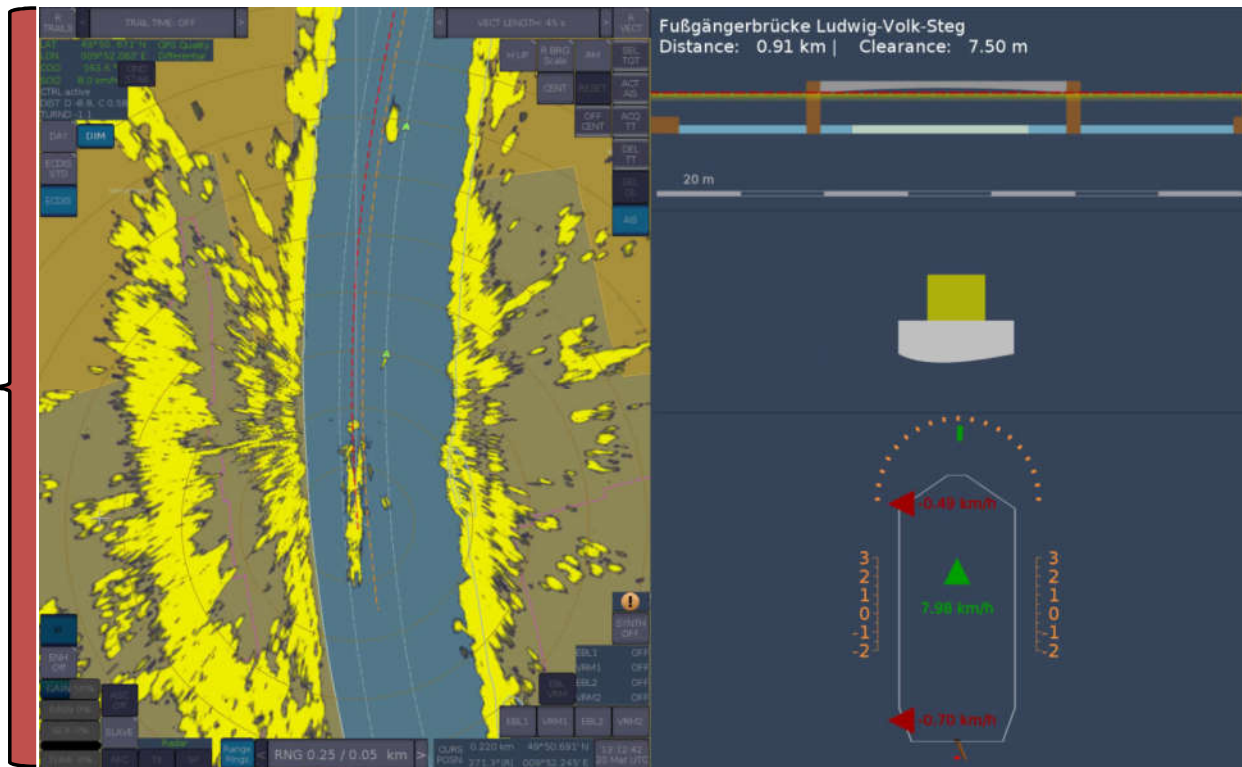
Driver function: Bridge Warning System

GNSS based approach:

- Inspection of the geodetic height of the ship against the height of the bridge
- for different components of the ship
- Two time horizons of alerts: warning, alarm

Driver function: Display Concept

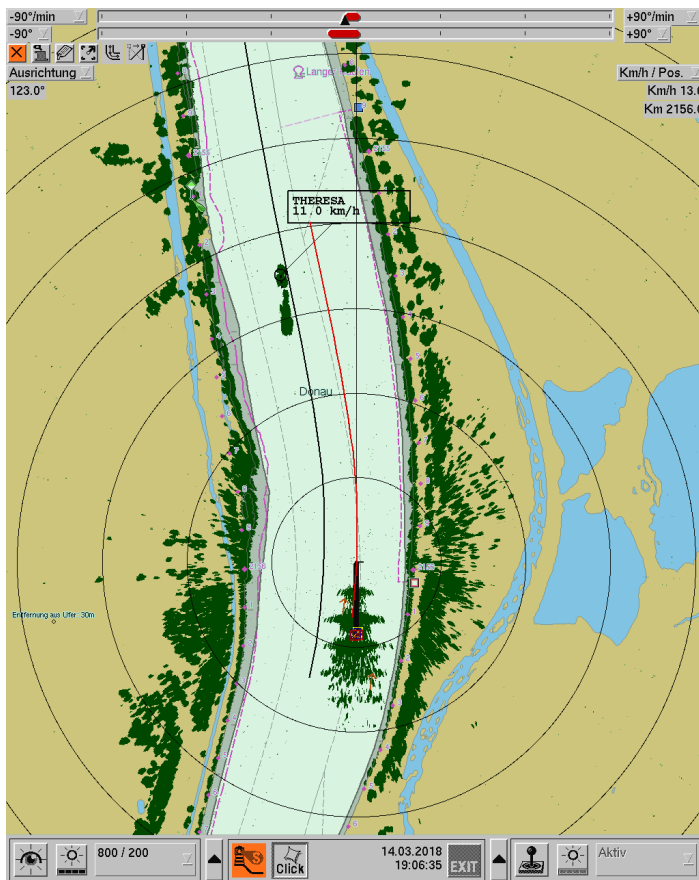Inland ECDIS navigation with track control

Bridge approach warning, Docking assistant (Laser Scanner)

Conning–Display and Docking assistant Distances to map contours

Driver function: Track Control System

- Basic track: Guiding line stored in navigation system (black line)

- Easy Adaption of track while cruising: Lateral displacement of commanded track (red line)

- Traffic situation has to be monitored by skipper

Conclusion

- Results of LAESSI will help to make inland shipping easier and safer

- LAESSI provides examples for usage of AIS-VDES in inland navigation

- Next project in preparation: automatic guidance into a waterway lock

- Future: autonomous inland vessels ?

Thank you for your attention

Questions?

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