NAVWAT - Future High Precision Navigation System for Inland Waterways

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NAVWAT

- **Concept Study** investigating new applications for future GNSS systems
- Funded by the Federal Ministry for Transport, Innovation and Technology through the

  Austrian Space Application Programme, 6th Call

- Partners: via donau (lead), TeleConsult Austria
- Project Duration: April 2009 – March 2010

Project Goal

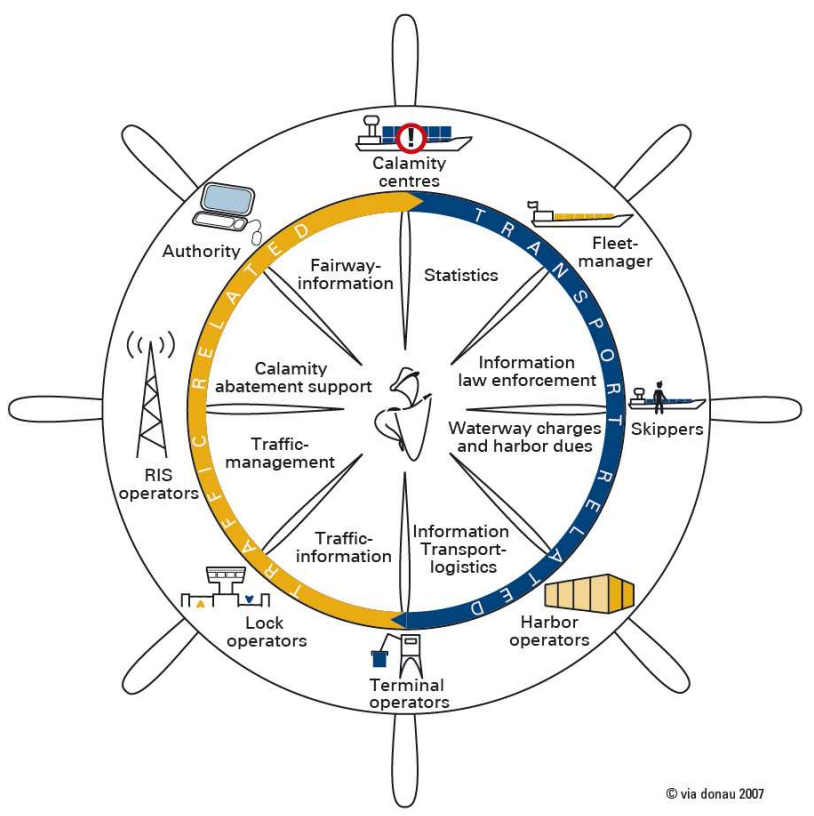
- Identify inland waterways applications that
  - benefit from high accurate positioning services
  - provide an operational benefit (safety and/or efficiency) to ship users
- Propose a technical solution
- Derive requirements for future GNSS systems

River Information Services

- Directive 2005/44/EC on harmonised River Information Services (RIS):

  … **optimising the use** of the infrastructure and

  … improving **safety** on European waterways.



RIS on the Danube

Current problems

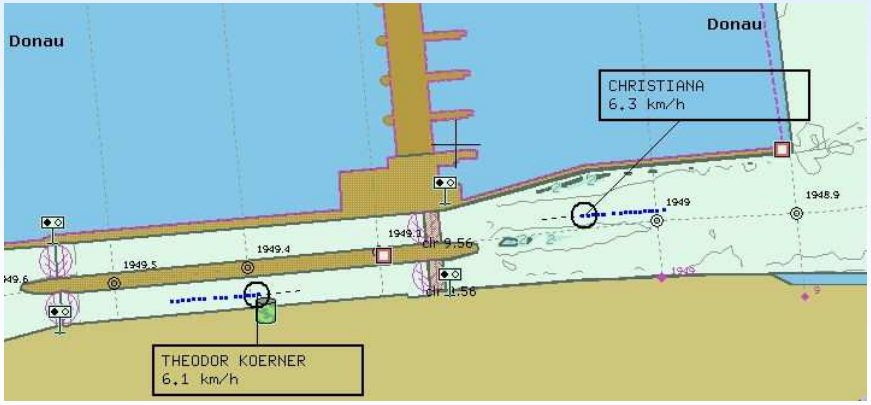
- Collisions with infrastructure

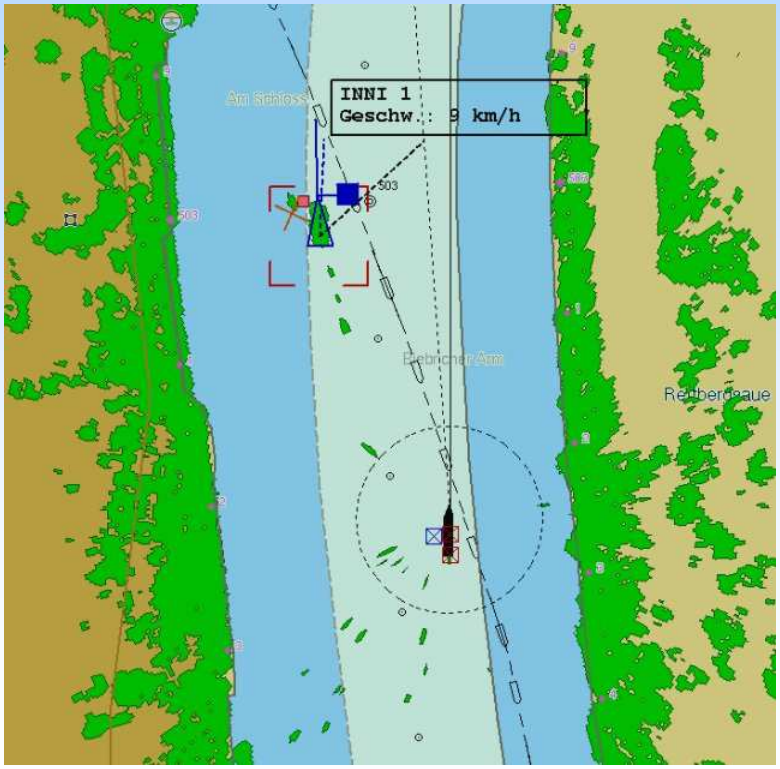
Current problems

- Collisions with infrastructure have often severe secondary effects (example: railway bridge)

Current challenges

- Need to improve tracking & tracing technologies:
  - Shape of vessels not displayed accurately (especially for barge convoys)
  - Position information lacks accuracy & integrity





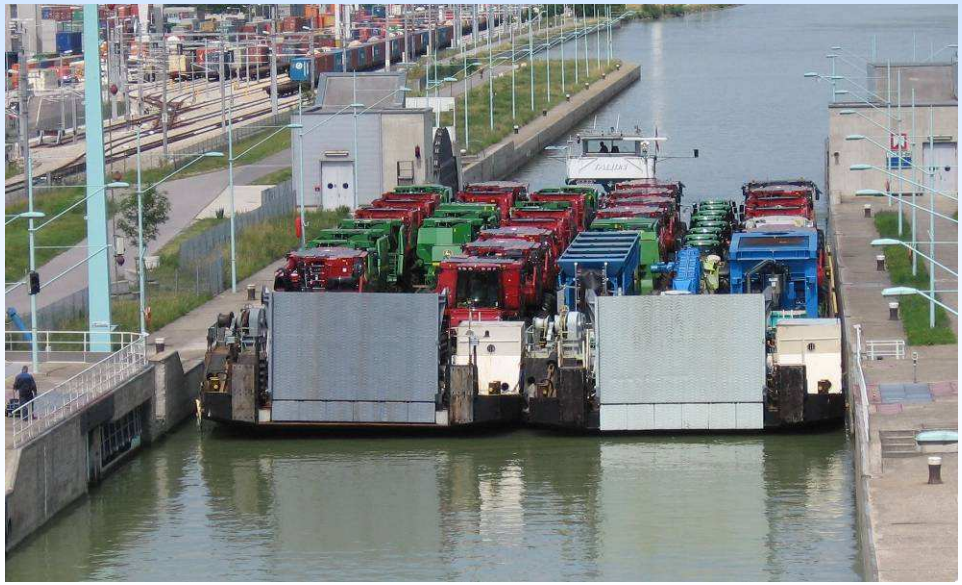
Application Scenarios

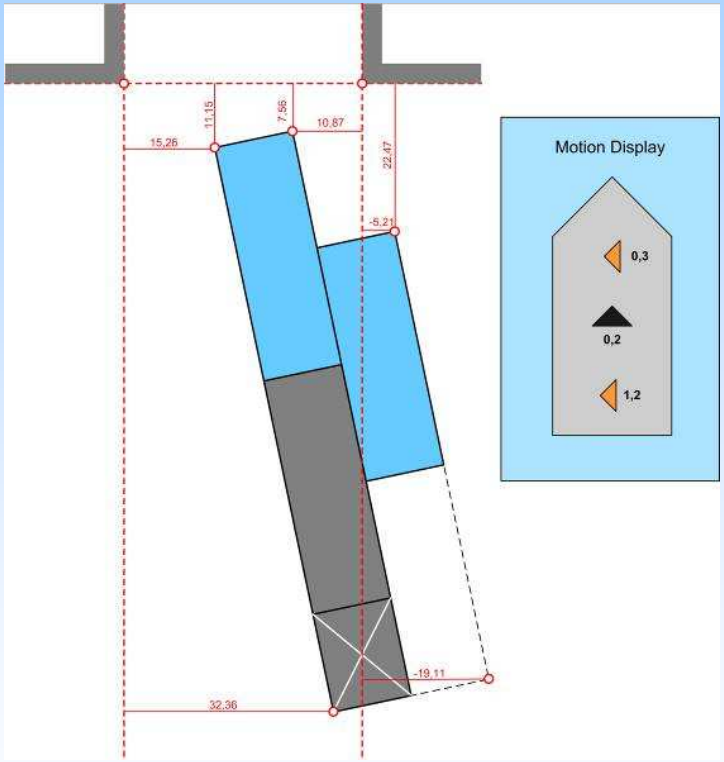
- Three scenarios that require high accurate GNSS position information
- They represent the situations with high risk of collisions with infrastructure
  - Approach to river lock
  - Passing a bridge
  - Approach to riverside berths and ports

Scenario 1

Approach to Lock

- Difficult maneuver with only limited space available
- Effects of currents and wind

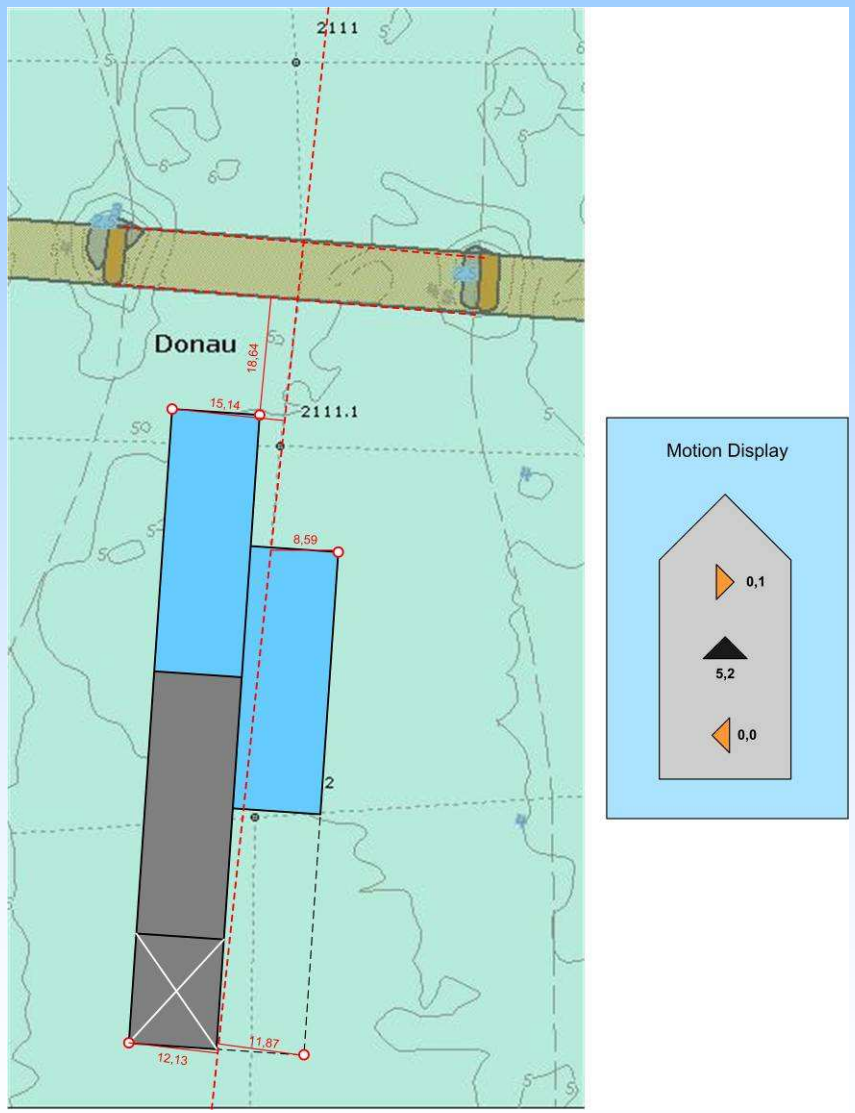




Scenario 2

Passing a bridge

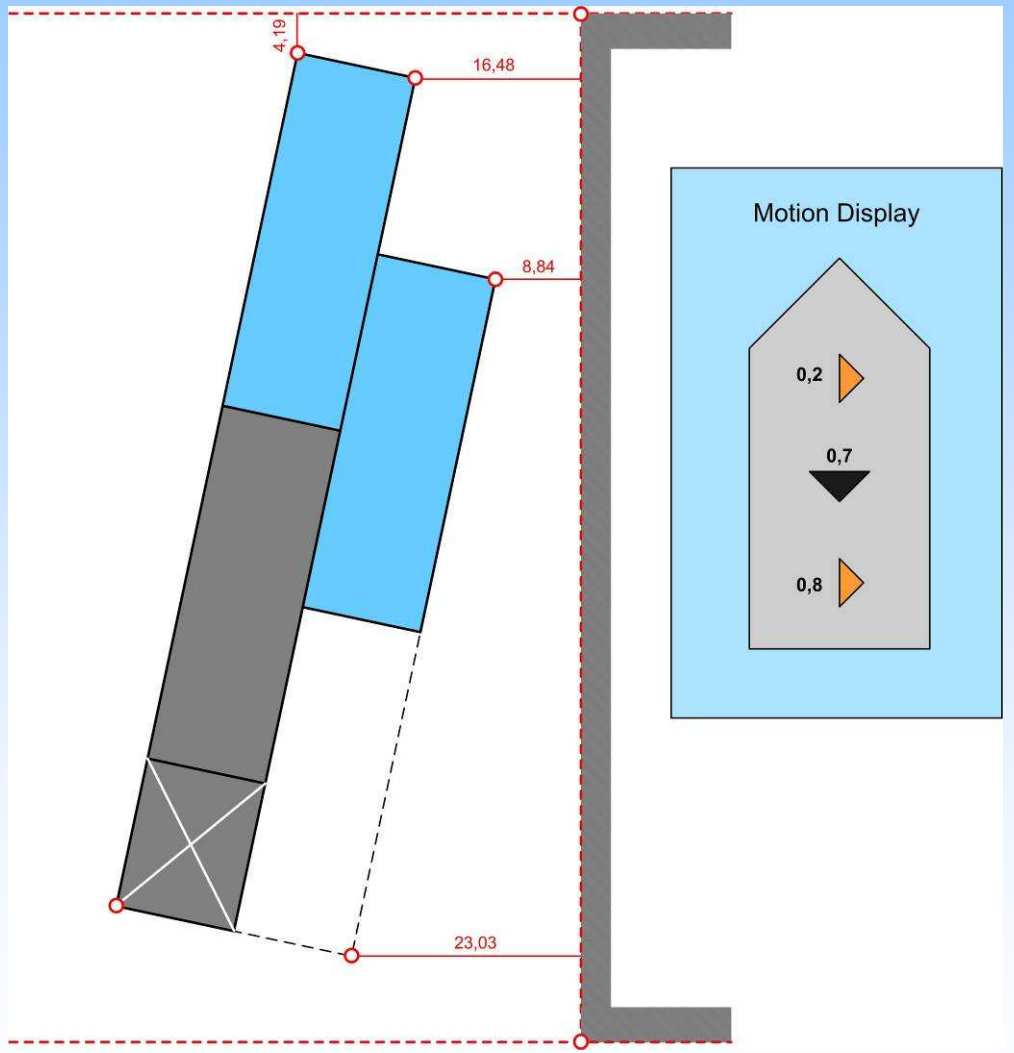
- Narrow corridor to pass at full speed
- Vessel needs to be aligned well in advance



Scenario 3

Approach to berth

- Accurate guidance required
- Effects of currents and wind



User Community interviews

- Early involvement of user community is important
- Have been considered in system design
- User feedback
  - Position information should be reliable
  - Modeling of convoy shape shall require minimum interaction
  - Try to avoid fixed installations on barges (reasons of theft)
  - Integration with existing Hardware/Software onboard
  - Different requirements for convoys and motorised cargo vessels

Identified Challenges

- Modeling of convoy shape
- System architectures that meet the specific needs
- User Terminal Design

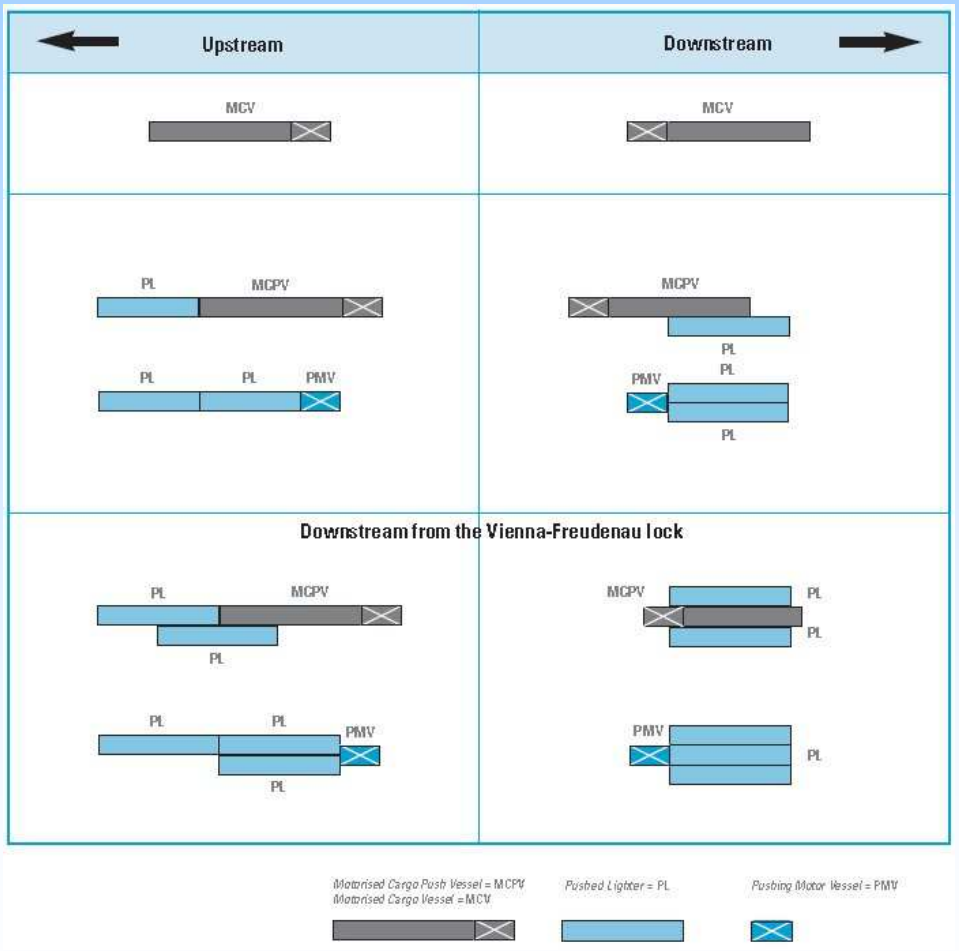
System Design Highlights

- Three System Architectures
  - SA 1: Large convoys
  - SA 2: Small-medium convoys
  - SA 3: Individual vessels
- Innovative concept for convoy shape determination
- Integration of Inland ENCs containing information on river infrastructure
- Integration into RIS Concept through
  - Provision of accurate position and heading information (improved Tactical Traffic Information)
  - Automatic update of convoy size in Inland AIS transponder

Modeling of convoy shape

Operational constraints

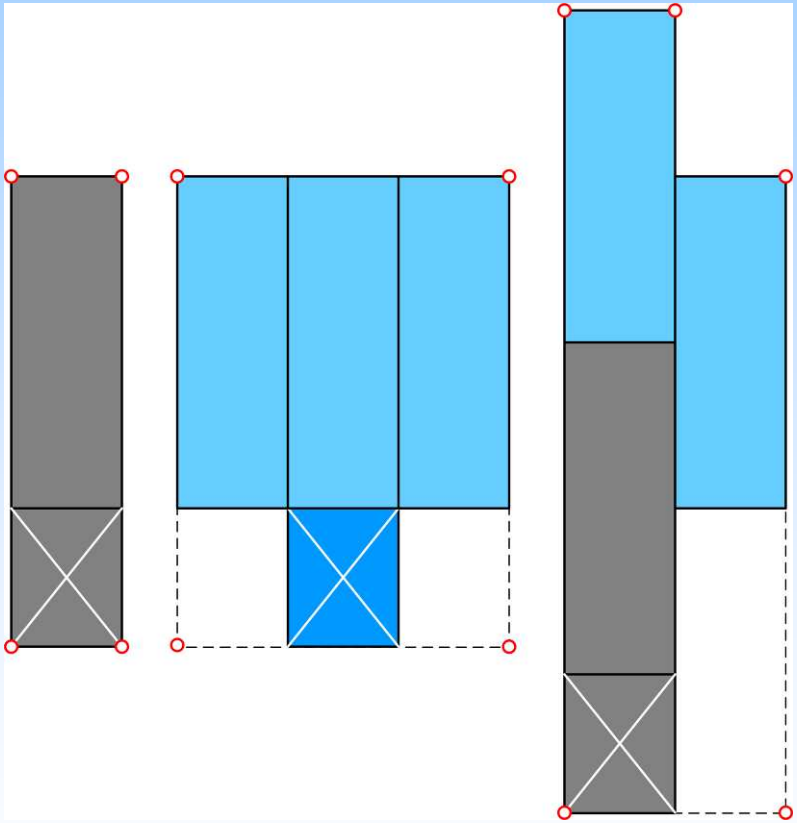
- Cargo transport is often done by barge convoys
- Modeling of convoy shape is complex
- Users comment: Automated approach required



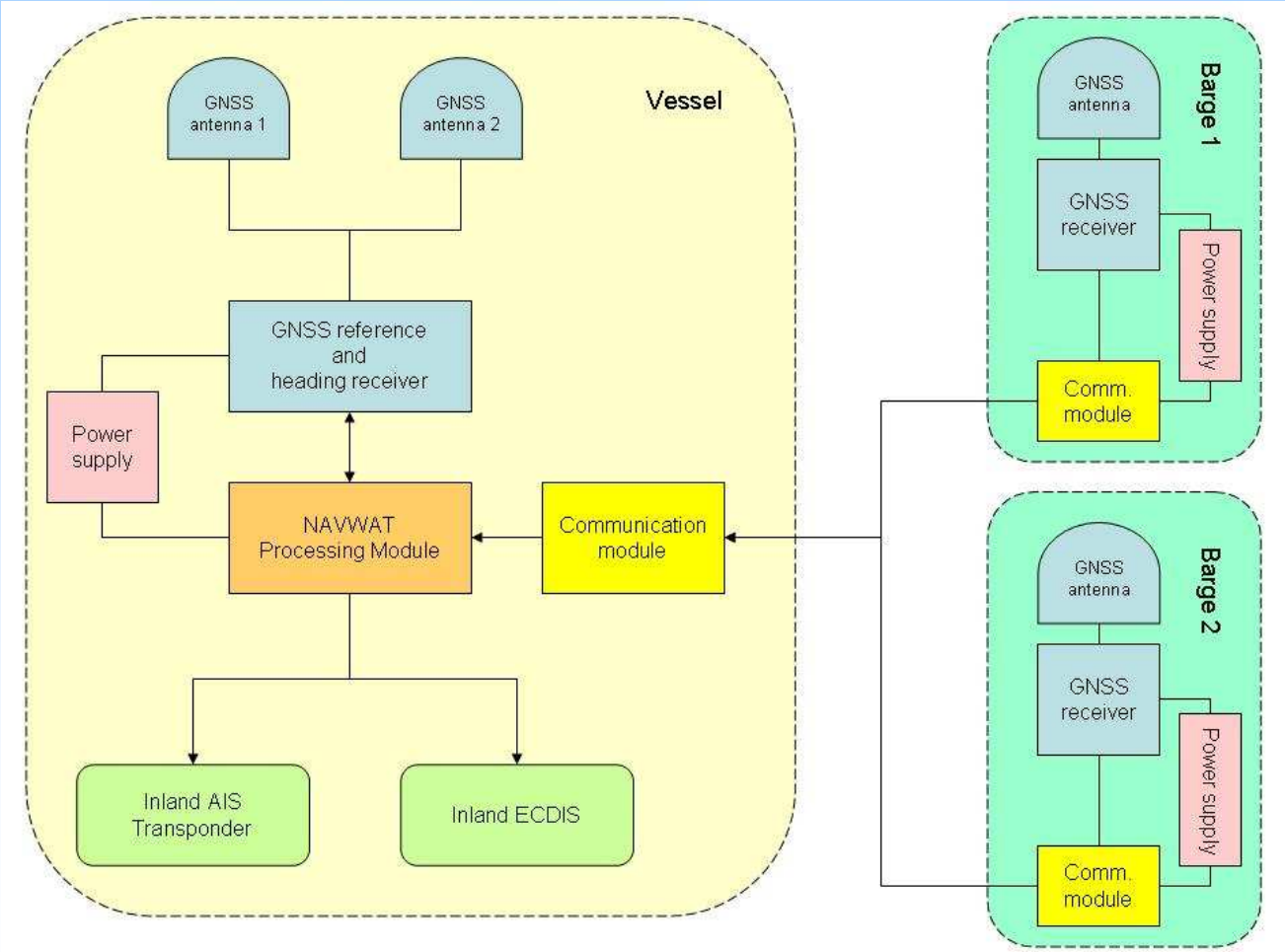
Modeling of convoy shape

Modeling of convoy shape

- Definition of reference points at characteristic corners
- Semi-automated definition of a mathematical shape represented by the reference points



User Terminal Design



Barge units:

- Removable
- Robust
- Waterproof
- Battery backup

Specific challenges for GNSS in the inland waterway environment

- Signal shading by topography and infrastructures
- Frequent signal blocking when passing under bridges
- Limited reception of augmentation signals from GEO satellites
- High multipath effects in the vicinity of infrastructures

Requirements for future GNSS

GNSS Systems analyzed

- GPS including the GPS modernization process
- GLONASS including the GLONASS modernization process
- Galileo including not only L-band but also potential C- and S-band signal extensions
- Other GNSS systems like the future Chinese COMPASS
- SBAS systems including future evolutions like WARTK
- Conventional DGNSS systems including RTK
- Virtual Reference Station DGNSS
- Precise Point Positioning technologies

Requirements for future GNSS

Candidate Systems

- GNSS
  - GNSS system of systems (GPS, Galileo, etc.)
- Augmentation
  - Future SBAS with WARTK
  - Virtual Reference Station Network solution

Feasibility of pilot implementation using current GNSS infrastructure

- Implementation feasible using conventional RTK system
- Key innovative parts can be demonstrated
  - Convoy shape modeling
  - Protection level computation (Integrity information)
  - Integration into RIS architecture (Inland AIS, Inland ECDIS)
- Demonstration to users would enhance the desired user acceptance – accelerated product roll-out when the necessary GNSS infrastructure is available
- Product introduction could immediately start when new GNSS services are available

NAVWAT 2 is …

- **Pilot implementation** of the NAVWAT Concept.
- Funded by the Federal Ministry for Transport, Innovation and Technology through the

  Austrian Space Application Programme, 7th Call

- Partners: TeleConsult Austria (lead), via donau
- Project Duration: Jan. 2011 – June 2012

NAVWAT 2

Status:

- System design and development ongoing
- Pilot system to be tested in a real-life environment on Austrian Danube in spring 2012

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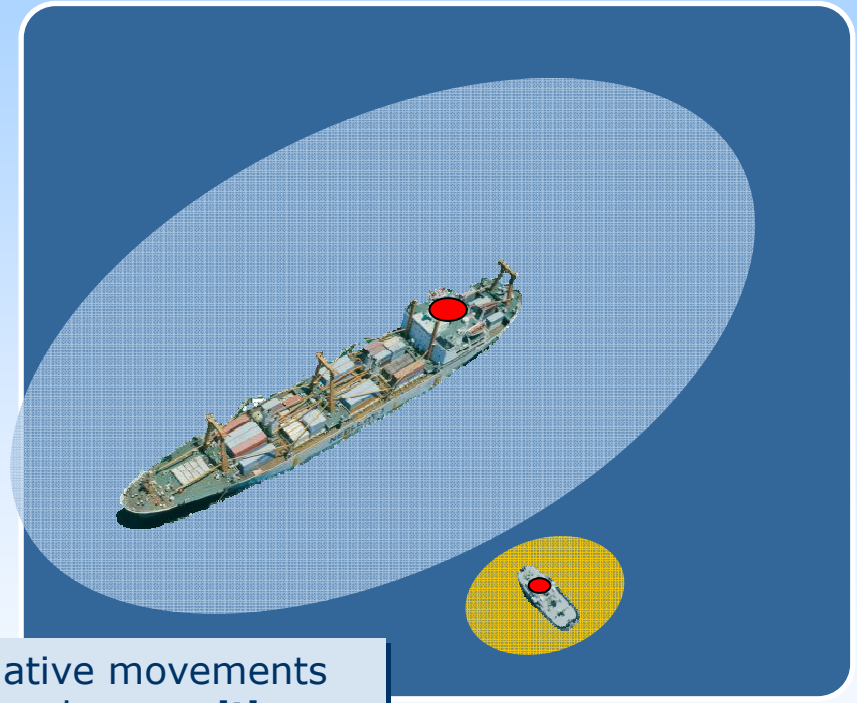
Related Activities

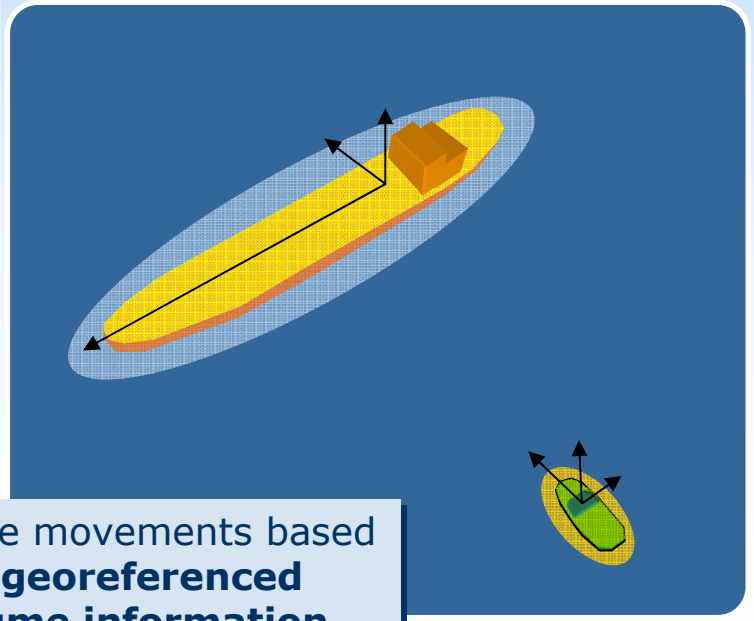
- **ARIADNA** - Maritime Assisted Volumetric Navigation System
  - Development of **innovative navigation solutions** for management of vessel traffic to avoid human error in navigation and to **improve efficiency and safety**.
  - Focus:
    - Collision avoidance vessel-to-vessel and vessel-to-infrastructure
    - Representation of vessel shape and risk area (ship volume)
  - Programme: FP7, THEME 7: Transport (including Aeronautics)
  - Project duration: Nov. 2009 – Oct. 2012
  - http://www.ariadna-fp7.eu/

Related Activities



Relative movements based on **position information**

Improvement of safety and efficiency due to better risk modeling



Relative movements based on **georeferenced volume information**

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Conclusion

- Collision avoidance is a topic still to be exploited
- NAVWAT identified three applications scenarios
- Highly accurate positioning information is a prerequisite
- Operational constraints & needs have been accounted for
  - Modeling of convoy shape
  - Mounting restrictions on barges
  - Integration into RIS architecture is a must
- Future GNSS and augmentation system requirements have been identified
- Pilot implementation with current GNSS infrastructure will be realized in the follow-up project NAVWAT 2

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