R(anging)-Mode Baltic Project

A step forward towards reliable maritime PNT data

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17th Meeting of the int'l Steering Committee for the Policy Area Safe of EUSBSR

9 November 2017, Gdynia

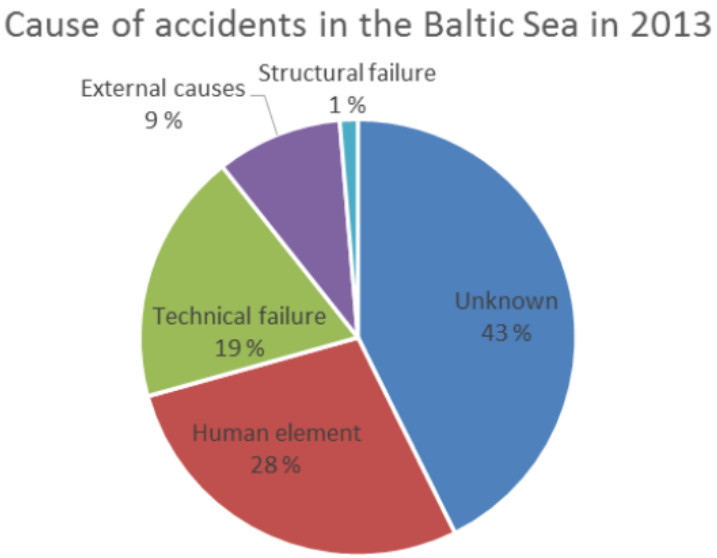
Content

- R-Mode – Backup system for resilient maritime positioning
- R-Mode Baltic – Implementation of an R-Mode testbed
- Project contribution to EU Strategy of Baltic Sea Region
- Summary

Resilient Position, Navigation and Time

- Accidents at Baltic Sea serious problem for sensitive eco-system
- HELCOM annual report for Baltic Sea
  - 2013: 57 collisions and 44 groundings
  - Most of the failures (technical or human driven) result from ambiguous outputs of technical devices (e.g. nautical sensors) and misinterpretations or wrong decisions by the nautical staff.

Maritime user community asks for resilient positioning, navigation and time (PNT) information.



Source: HELCOM annual report 2013

GNSS in maritime domain

Safe navigation requires a backup system

- GNSS has become the primary source for maritime positioning, velocity and timing (PVT).
- GNSS data is used in many ship systems e.g. AIS, ECDIS, INS
- GNSS is vulnerable to unintentional and intentional interferences.

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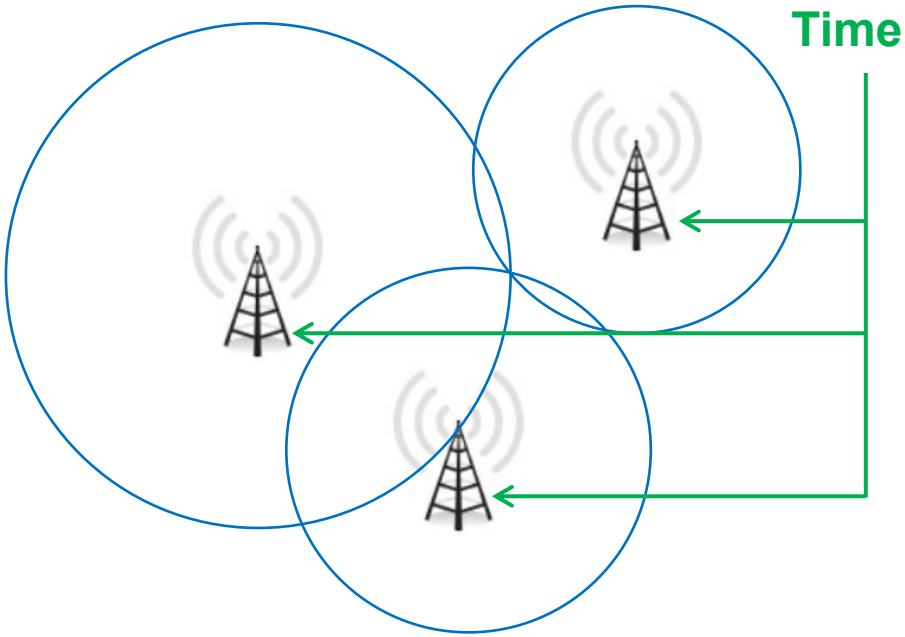
AIS

www.raymarine.com

R(anging)-Mode approach

R-Mode – civilian maritime backup system



DLR

Concept

- Add ranging capability to existing maritime communication channels: MF radio beacon (300 kHz) and VHF AIS (162 MHz)
- Synchronized stations provide signals with well known transmitting time dependency.
- Range estimation based on time of arrival (TOA).
- Positioning using method of trilateration.

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R-Mode Baltic

Main goals

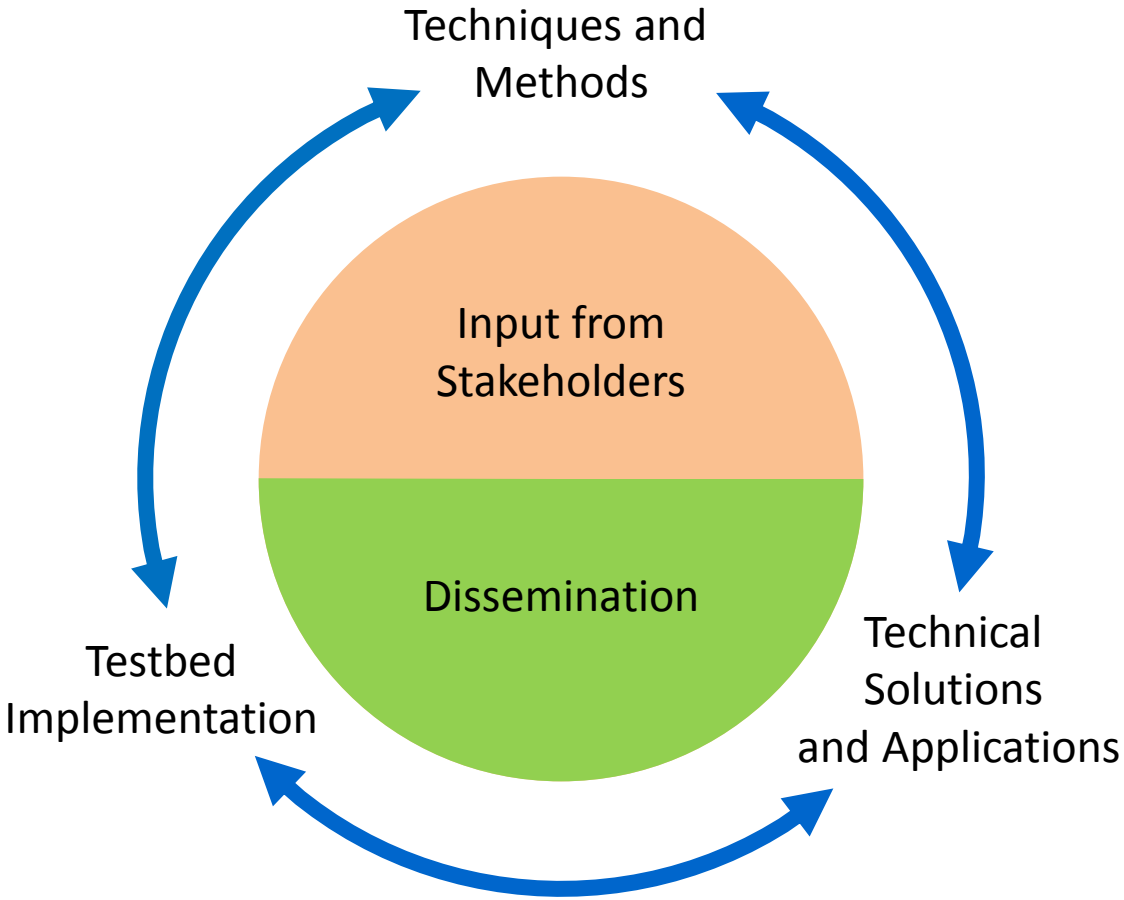
- User need driven development and demonstration of a new maritime backup system for PNT purposes

- Develop solutions
  - for so-called R-Mode transmitter and receiver prototypes,
  - for independent time synchronizations of broadcasting stations and
  - for a testbed concept and its deployment

- Develop and promote the first world-wide operational testbed for a new maritime system for PNT as a backup to GNSS

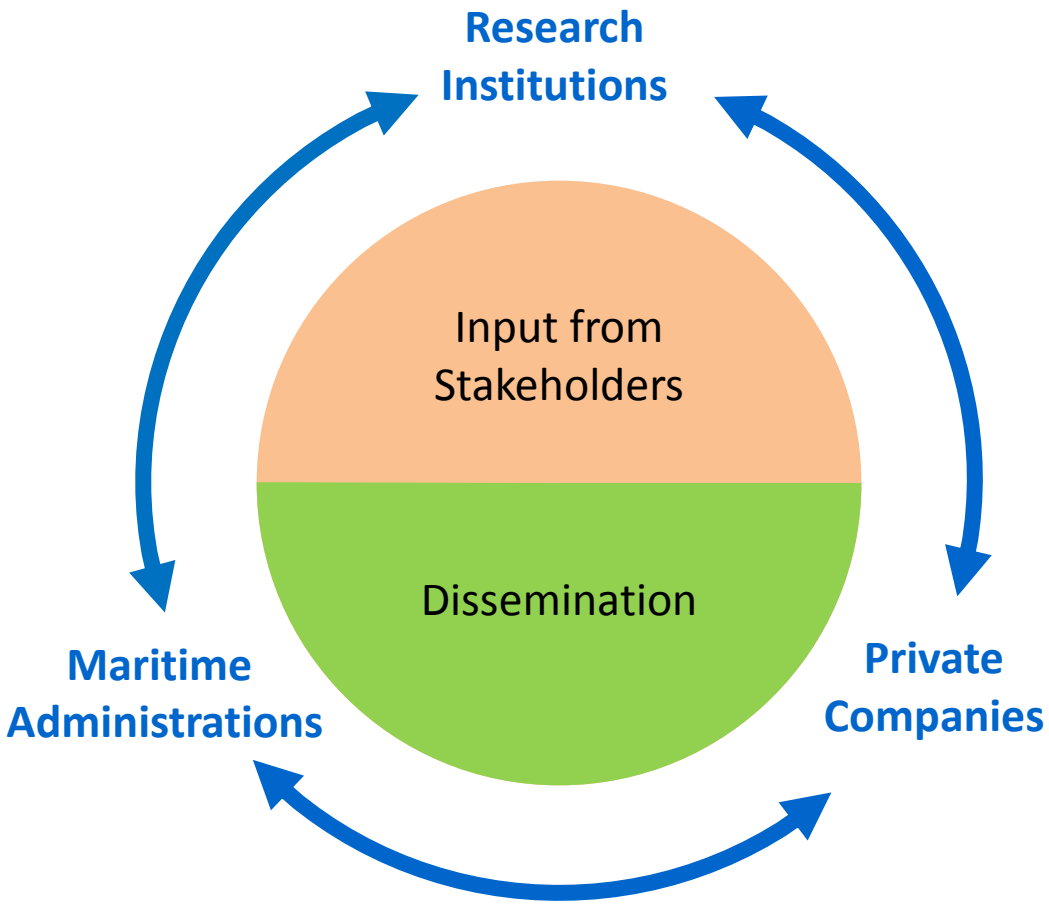
Project approach

At a glance



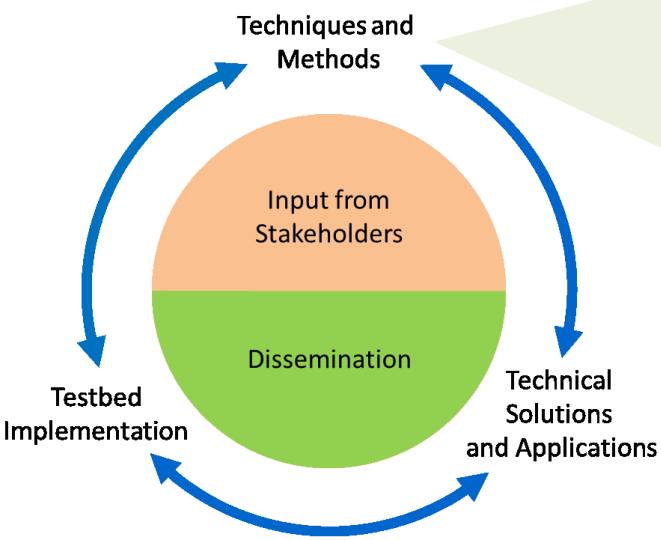
Project approach

At a glance



Project approach

Techniques and Methods

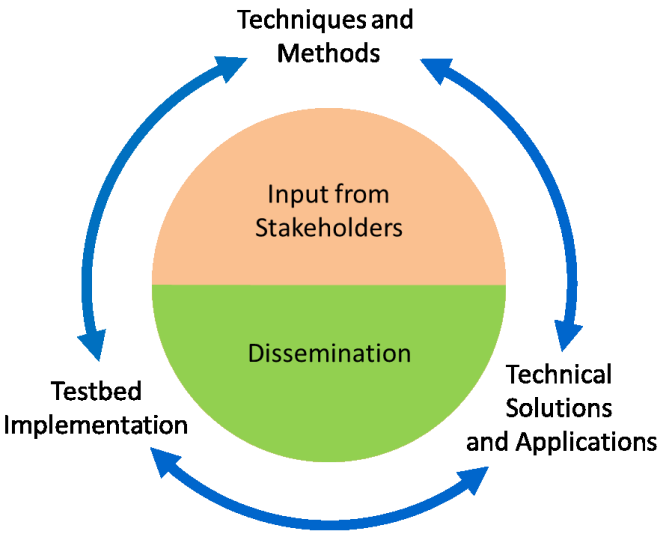


- Time synchronisation of R-Mode transmitting stations
- Signal design for R-Mode on MF and AIS
- Error identification and mitigation on MF and AIS communication channel
- Comparison of different implementation methods of R-Mode signals
- Concepts for range and position estimation

Selection of most promising approaches

Project approach

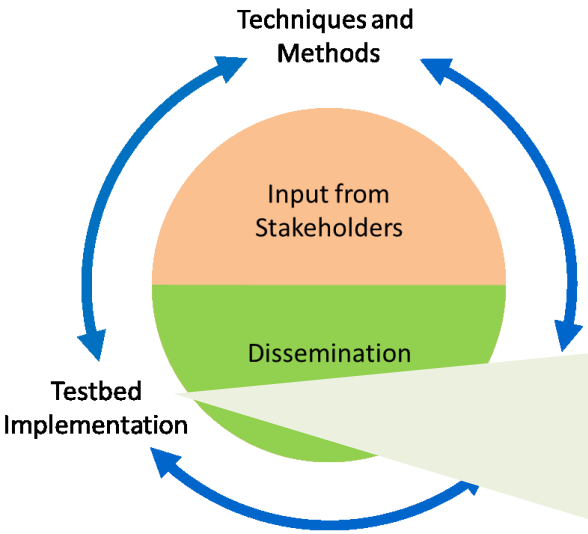
Technical solutions and Applications



- Develop R-Mode receiver prototypes for MF and MF + AIS
- Develop R-Mode AIS (VDES) signal generator prototype
- Develop pilot R-Mode applications
  - PNT data processing
  - PPU using R-Mode receiver
- (Cost-)benefit-analysis

Project approach

Testbed Implementation

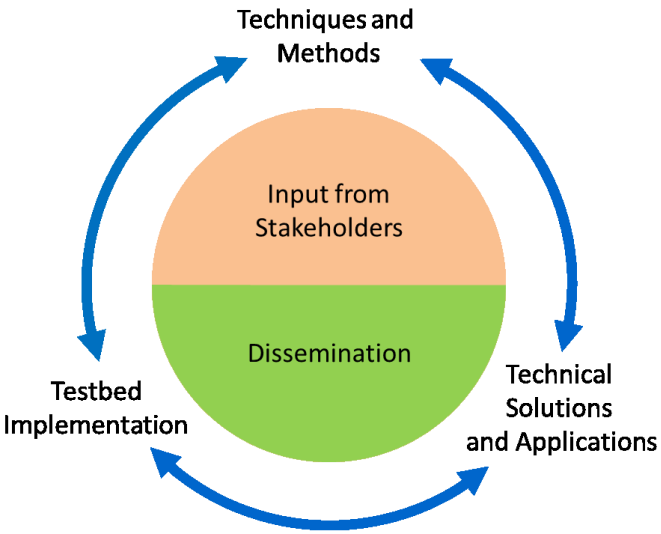


- Define requirements on R-Mode system
- Selection of testbed area
- Procurement of station equipment
- Installation of R-Mode equipment – test transmitting stations
- Develop transnational concept for operation, monitoring and maintenance of station network

Detailed documentation of all phases of testbed implementation and operation.

Project approach

Receiving input and dissemination



- Advisory Board
- Workshops with stakeholder per core activity
- Conferences, exhibitions

- Project reports as input to standardization committees (e.g. IALA, IMO, RTCM, ITU)
- Free available project publications
- Conferences, exhibitions, seminars, workshops
- Project website

R-Mode Baltic - Stakeholders

- Service provider
  - National maritime administrations
- User of positioning backup system
  - pilotage associations
  - Navigators
  - Ship owners
- Companies
  - Manufacturers of navigation relevant ship equipment
  - Manufacturers of MF and AIS station equipment
  - Navigation application developer
- Other
  - Research and education institutions
  - Non-Governmental Organisations

Project consortium

- **Research institutions**
  - German Aerospace Center - DE
  - National Institute of Telecommunications – PL
  - RISE Research Institutes of Sweden AB – SE

- **National maritime administrations**
  - Federal Waterways and Shipping Administration – DE
  - Swedish Maritime Administration – SE
  - Maritime Office in Gdynia – PL
  - Federal Maritime and Hydrographic Agency – DE

Project consortium

- **Small and medium enterprises**
  - Kongsberg Seatex AS – NO
  - Gutec AB – SE
  - NavSim Poland Ltd. – PL
  - navXperience GmbH – DE

- **Large enterprise**
  - Saab AB (publ) TransponderTech – SE

Project consortium

- 12 partner of 4 countries

Source: Interreg BSR

Advisory board

- Associated Administrations BSR
  - Danish Maritime Authority – DK
  - Finish Transport Agency – FI
  - Norwegian Costal Administration – NO
  - Lithuanian Maritime Safety Administration – LT
- Associated Administrations outside BSR
  - General Lighthouse Authorities – UK
  - Cerema – FR
  - Rijkswaterstaat – NL
- Associated Organizations / Companies
  - International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA)
  - E. R. Schiffahrt – DE

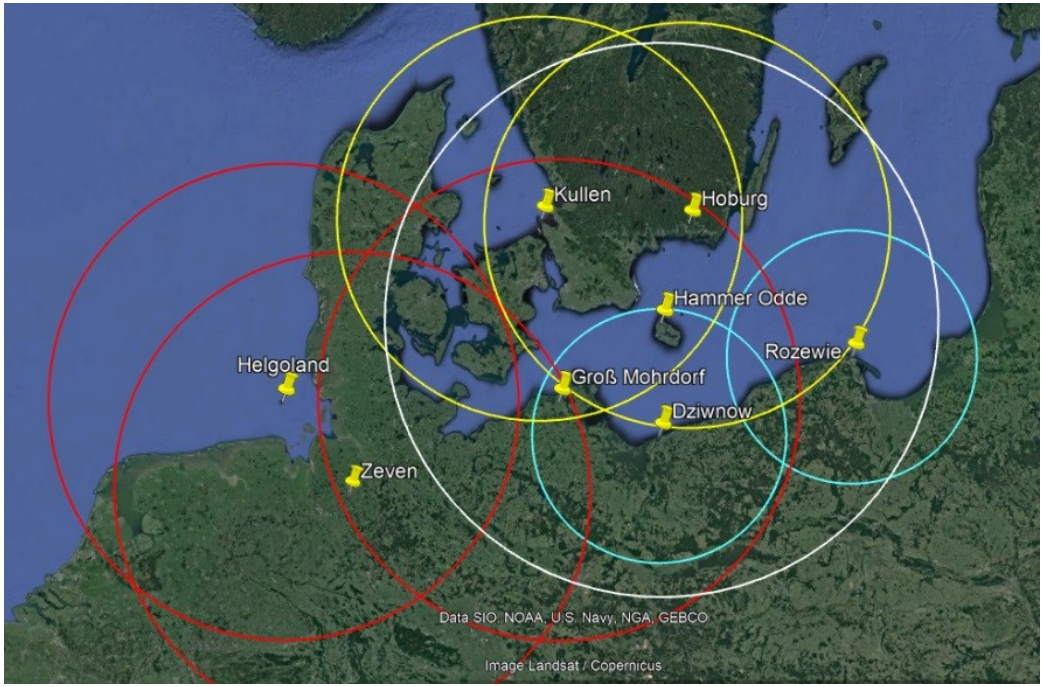
Source: Interreg BSR

Transnational project

- R-Mode based positioning requires 3 to 4 stations with good geometry
- Navigation at Baltic Sea only possible with transnational network of R-Mode enabled stations
- R-Mode stations has to be very well synchronised in time and transmit same signals
- Project approach: start standardisation of R-Mode at IALA, IMO, RTCM, IEC, ITU

➢Sustainability of project results

IALA Beacons - MF stations



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Contribution of project to EUSBSR

- *Objective: Save the Sea - Clean and safe shipping*
  - Implementation of R-Mode testbed supports robust and resilient navigation (reduce dependence on GNSS) within BSR
  - R-Mode availability reduces risk of collisions and groundings
  - When used as source for AIS this increases the reliability of situation awareness

- *Objective: Connect the Region - Connecting people in the region*
  - Implementation and operation of transnational network of well synchronised R-Mode transmitting stations require cooperation of system provider

Interreg BSR

Contribution of project to EUSBSR

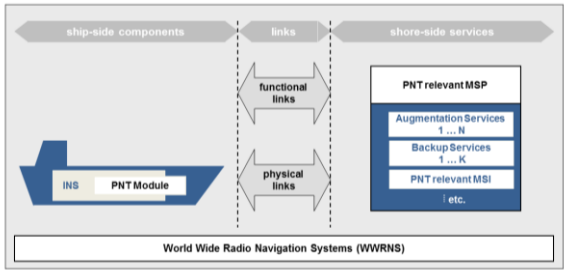
- *Objective: Increase Prosperity - Improved global competitiveness of the Baltic Sea region*
  - Pilot implementation makes BSR to a leading area for R-Mode technology with a specific focus on maritime safety
  - User driven e-Navigation testbed development will gain actors of the projects a comparative advantage
  - Increased effectiveness of maritime infrastructure

Interreg BSR

Reinforcement of PA Safe actions

- **Improve safety of navigation by means of e-Navigation and new technology**
  - Increase of reliability and robustness of navigation with installation of testbed and R-Mode standardization
  - Support for maritime positioning and navigation for AIS, port approaches, ports and restricted waters

Generic PNT architecture



- **Develop co-operation in maritime surveillance and information exchange**
  - Reliable navigation data are precondition for maritime surveillance when based on R-Mode supported AIS

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Reinforcement of PA Safe actions

- **Winter navigation**
  - Improvement of reliability towards vessels positioning information and therefore better navigation
  - System may contributes to the optimisation of infrastructures for winter navigation

Source: pixabay.com

- **Enhancing the safety of transportation of oil, hazardous and noxious substances**
  - Higher safety standards possible
  - Risk reduction of maritime accidents by reliable navigation
  - Improved risk assessment for navigational aspects possible => Increase efficiency of oil, hazardous and noxious substances transport

Source: pixabay.com

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Summary

- R-Mode is a backup system of GNSS based on existing maritime communication infrastructure.

- R-Mode Baltic:
  - Project that implements a R-Mode testbed until 2020 at Baltic Sea in the vicinity of Sweden, Poland and Germany.
  - R-Mode testbed will provide increased safety for shipping traffic in this region.
  - Development, implementation and operation of pilot testbed will give input to standardization committees to enable other administration to upgrade there infrastructure to R-Mode capable stations as well.

- R-Mode Baltic contributes to EUSBSR and included PA safe actions.

Thank you for your attention!

Contact

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Project partner