GNSS-aktiviteter på Chalmers och RISE

- Projekt redovisade av Stefan Nord (RISE)
- CLOSE RTK III (Chalmers, RISE och Lantmäteriet)
- GRC Galileo Monitoring (NLR, FGI och Chalmers)
- Jonosfärmonitorering (Chalmers)
- Solpaneler och GNSS (RISE och Lantmäteriet)
- R-Mode Baltic (RISE, SjöV m fl)
- Övervakning av Galileo System Time (RISE m fl)



Signal-in-Space Error + User Error => UERE



 $SISE_{GlobalAverage} = \sqrt{0.9673 \cdot R^2 + CLK^2 + 0.01632 \cdot (A^2 + C^2) + 1.967 \cdot CLK \cdot R}$ $UERE = \sqrt{SISE^2 + UEE^2}$

ERROR SOURCE	[METERS]
Signal In Space Ranging Error (SISE)	0.67
Residual Ionosphere error	6 (5°) -3 (90°)
Residual Troposphere error	1.35 (5°) – 0.14 (90°)
Thermal noise, Interfer, Multipath	0.35 (5°) – 0.23 (90°)
Multipath bias error	0.59
Satellite BGD error	0.30
Code-Carrier Ionospheric divergence error	0.30
Total (1-sigma error [cm])	6.26 (5°) – 3.10 (90°)

Table 23. Single Frequency E1 – Rural Pedestrian (RP) User Environment (*)



R-MODE BALTIC

RISE Maritima Dag

Carsten Rieck

Mars 2017

Research Institutes of Sweden

Safety & Transport Measurement Science & Technology



Resilient Navigation in the Baltic Sea

- The Baltic Sea is one of the most frequented waters within Europe
 - safe and secure shipping is an essential for economic prosperity of the Baltic Sea states
 - ecologically very sensitive area
- accidents caused by collisions and groundings
 - larger vessels, and therefore, a substantial increase of the traffic situations complexity
- the demand for reliable systems for position, navigation and time (PNT) still remains as one of the key issues in the user community
 - GNSS (GPS) based PNT supported by
 - on-board sensors and supporting systems for position and navigation purposes,
 - IALA/DGPS

4

 international bodies such as IMO and IALA strengthen their efforts for more reliable systems

R-Mode Baltic: development and demonstration of a new maritime backup system for PNT purposes.

Towards Legacy PNT

- GNSSs are highly vulnerable to jamming and interference
 - no other system can take the task for absolute positioning in case of a temporal loss of GNSS
- user-driven testbed in the Baltic Sea
 - based on broadcast signals transmitted via modified differential MF radio beacon or AIS base stations,
 - No utilization constraints,
 - potential for a world-wide in the vicinity of such stations.
- safer shipping in case of jamming, spoofing or unintended interferences of GNSS;
- dissemination of results by workshops, forums, conferences or other medias within the whole maritime community
- appropriate inputs to relevant recommendations on new and updated standards on MF radio beacons, AIS stations in order to include new R-Mode functionalities
- the usage of the R-Mode at European and world-wide level
- an enhanced recognition of the Baltic Sea Region for innovative solutions for the whole world.



RISE input

- Time synchronization of R-Mode stations
 - Wired, White Rabbit, PTP
 - TWSTFT, passive mode
 - Requirements on station clocks, time base design
 - Clock combinations and common clock
 - UTC traceability
- System design
- Wave propagation
 - Simulations, error modeling
 - Ionosphere modeling and forecasting



Partners

- Submitted Jan 15th 2017
- Feedback end of May 2017



Name	Country	Overall Budget	Funding	Feedback on WP
German Aerospace Center (DLR)		800,000	600,000	yes
German Maritime Administration (WSV)		340,000	255,000	Yes
Maritime Office of Gdynia (MOG)		100,000	85,000	Yes
Swedish Maritime Administration (SMA)		350,000	262,500	Yes
Federal Maritime and Hydrographic Agency (BSH)		63,500	47,250	Yes
Alberding GmbH		300,000	225,000	x
GMV Innovation Solution Spz.o.o.o		200.000	170.000	<u>x</u>
Gutec AB (Gutec)		<mark>266,000</mark> (300,000)	200,000 (225,000)	Yes
Kongsberg Seatex AS (KON)		350,000	175,000	Yes
National Institute of Telecommunications (NIT)	-	350,000	297,500	Yes
NavSim (NavSim)		235,000 (250,000)	200,000 (212,500)	Yes
navXperience GmbH (navX)		220,000	154,000	Yes
Saab AB (Saab)		<mark>266,000</mark> (550,000)	200,000 (412,500)	Yes
SP Technical Research Institute of Sweden (SP)		~266,000	~200,000	Yes
Overall		<mark>3,606,500</mark> (4,203,000)	<mark>2,676,250</mark> (3,154,750)	

RI. SE

TSP and Galileo Service Operator (GSOp)

- GSA tender under 2015 won by Spaceopal, which is is a joint venture between the German Aerospace Agency (DLR) and Italy's Telespazio
- Time Service Provider is an essential part of the GSOp and was previously operated by GMV as part of Timing Validation Facility (TVF)
- UTC(k) provision
 - TWSTFT and GNSS (GPS/GAL)
 - Daily data delivery
 - ITU, CGGTTS
 - Calibrations
 - KPI and SLA
 - |UTC-UTC(k)| < 30 ns
 - 8 + 80 measurements per day
 - Data transfer by 1:10 UTC
 - Quarterly reviews
- GST steered to mean of UTC(k) with k = OP, PTB, ROA, SP, INRIM



UTC-UTC(SP) by Circular T



RI. SE Specifically, under GSA management, the contract awarded to Spaceopal includes:

- Specifically, under GSA management, the contract awarded to Spaceopal includes:
- Secure operations of Galileo from two mission control centres (GCC), located in Germany and Italy, and the European GNSS Service Centre (GSC) for user support services in Spain;
- Management of the Galileo Data Distribution Network (GDDN);
- Integrated logistics support and maintenance for the entire space and ground infrastructure;
- Monitoring of the system performance;
- Support the completion of the Galileo infrastructure and associated launches.
- <u>https://www.gsa.europa.eu/newsroom/news/gsa-signs-galileo-service-operator-contract</u>





Innventia, SP & Swedish ICT går samman i RISE – för en samlad svensk institutssektor och en starkare innovationspartner för näringsliv och samhälle.

THANK YOU!

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