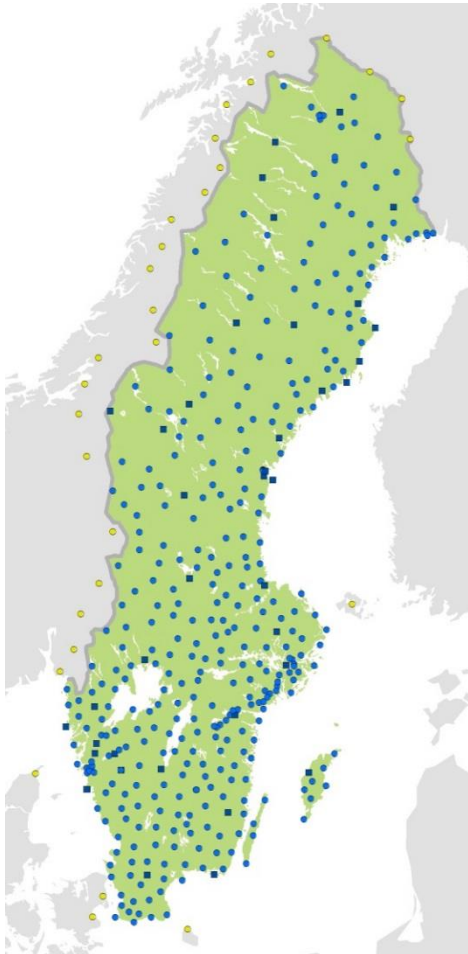# Contribution from Galileo in RTK surveying

Kartdagar 2016
Gävle, April 26th–28th 2016

Dan Norin, Lantmäteriet

SWEPOS

SWEPOS Network RTK Service

- GLONASS included since April 2006
- Time for inclusion of Galileo and the modernised GPS signals (L2C and L5)
  – Possible improvements in terms of availability and position uncertainty
- RTCM 3.1 is used, but RTCM 3.2 (10403.2) with Multiple Signal Messages (MSM) is needed
- Galileo test measurements with **network RTK** with *Trimble Pivot Platform GNSS Infrastructure Software (TPP)* not possible yet

Galileo test measurements with single-station RTK

- Diploma work by Anna Berggren, Stockholm University
- April 1st–15th 2016
- Stockholm City Planning Administration control point No 136335 (Vita Bergs-parken)
- Single-station RTK data RTCM 3.2 distributed through mobile Internet over SWEPOS control centre in Gävle with TPP
- Mosebacke SWEPOS station
  - Distance 1.2 km

SWEPOS stations in Stockholm

Mosebacke SWEPOS station

SWEPOS – control centre

Galileo test measurements with single-station RTK

- **Rover:** Trimble R8-3 (also other manufacturers planned, but not yet possible)
- **Strategy:** Disconnection from mobile Internet between each measurement
- **Mean value:** Each measurement an average of 10 positions
- **Cut-off angle:** 10 degrees
- **Fixed solution:** If an ambiguity fixed solution was not obtained within 3 minutes, the measurement was considered not successful
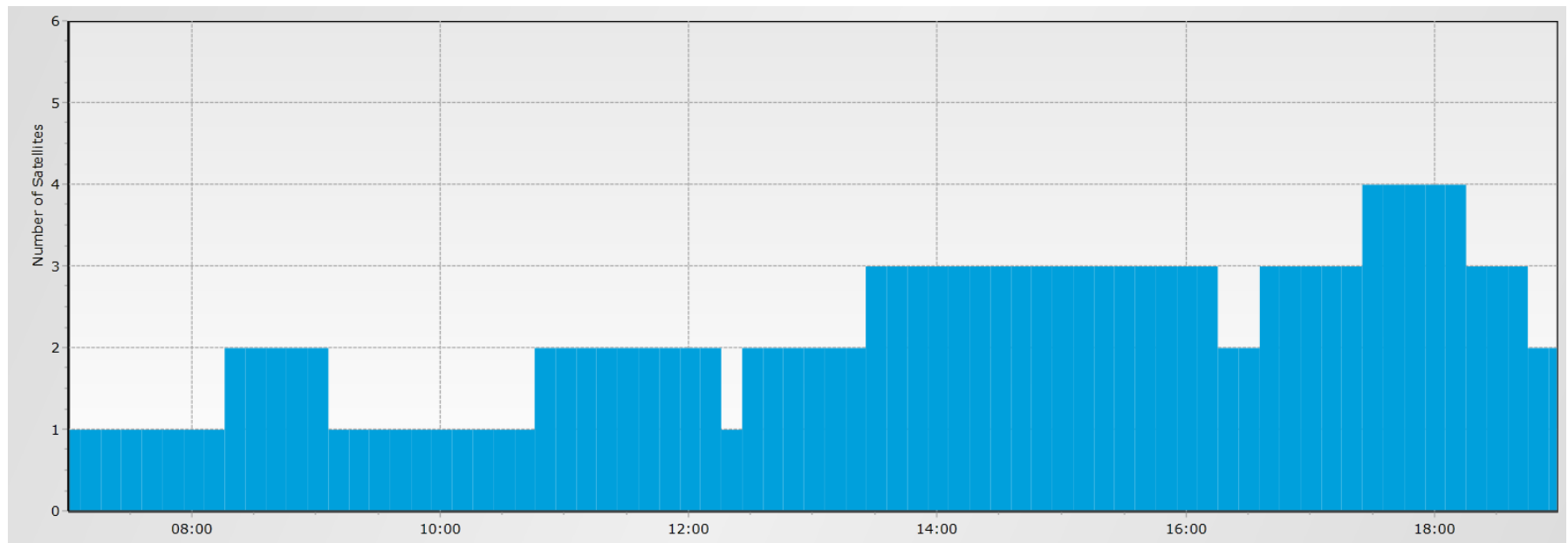
Galileo test measurements with single-station RTK

- Use of signals:
  - **GLONASS:** No satellites were used
  - **GPS:** Some satellites were manually disabled with still good PDOP (5 or 6 satellites were mainly used)
  - **Galileo:** All available satellites were used (0–4)

Galileo availability on April 1ˢᵗ 2016

– Based on totally seven available Galileo satellites

Remarks from the test measurements

- Fixed solution with four or less GPS satellites was not possible independent of number of Galileo satellites
- During periods with one Galileo satellites, this satellite was automatically disabled

Results (still a bit preliminary)

GPS + Galileo	Measurements (number)	Successful fixed solutions (%)	Mean value of time to fixed solution (s)	Standard uncertainty horizontally (mm)	Standard uncertainty vertically (mm)	Mean value of PDOP (-)
5 + 0	41	88	28	7	16	4.1
5 + 2	62	94	16	11*	17	3.2
5 + 3	43	100	23	7	15	2.6
5 + 4	7	100	13	8	8	2.2
6 + 0	35	94	10	6	12	3.0
6 + 2	41	98	12	8	14	2.4
6 + 3	27	96	8	5	11	2.2
6 + 4	5	100	8	4	4	2.1

*8 mm if an outlier of 57 mm is removed

Conclusions

- The test measurements show small variations in position uncertainty depended on if Galileo satellites are added to five–six GPS satellites
- The test measurements indicate improvements in availability depended on if Galileo satellites are added to five–six GPS satellites
  - More fixed solutions and shorter initialisation time
- More test measurements desirable

Questions?

Thank you for your attention!

Contribution from Galileo in RTK surveying

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