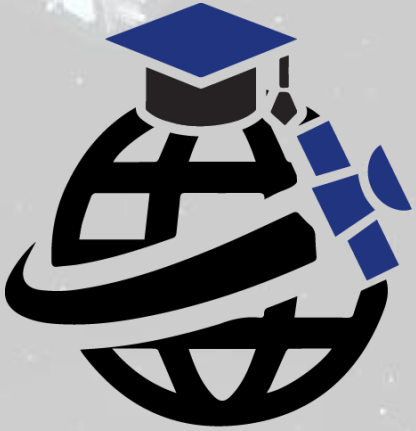
T4300 – Final User Forum

Spin-off: GNSS Vulnerabilities



BEYOND

Building EGNSS capacitY On EU & Neighbouring multimodal Domains

Tallinn, ESTONIA

14th/15th June 2017

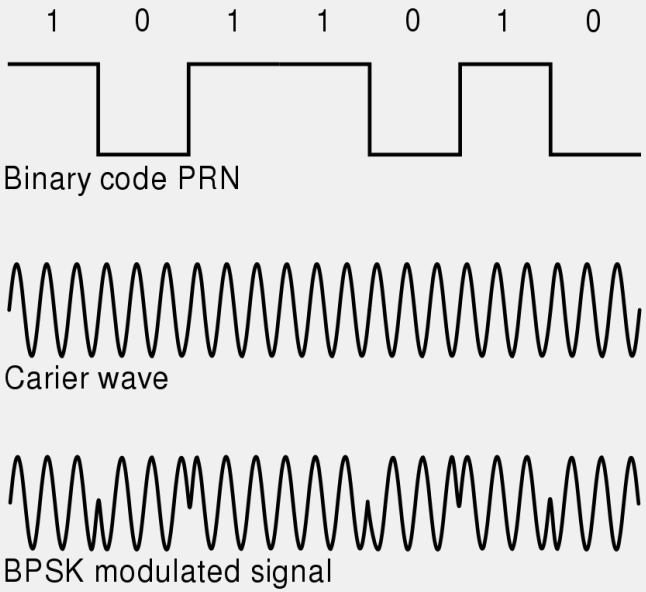
Bence Takács, BME

European GNSS Agency

HORIZON 2020

GNSS vulnerabilities

- **Received GNSS signals are extremely weak, like a 100W light bulb flying at a height of 20 000 km**
- **Pseudo random code on carrier wave**



- **GNSS blocking or GNSS jamming or GNSS interference**

Russian GPS jammer (1997)

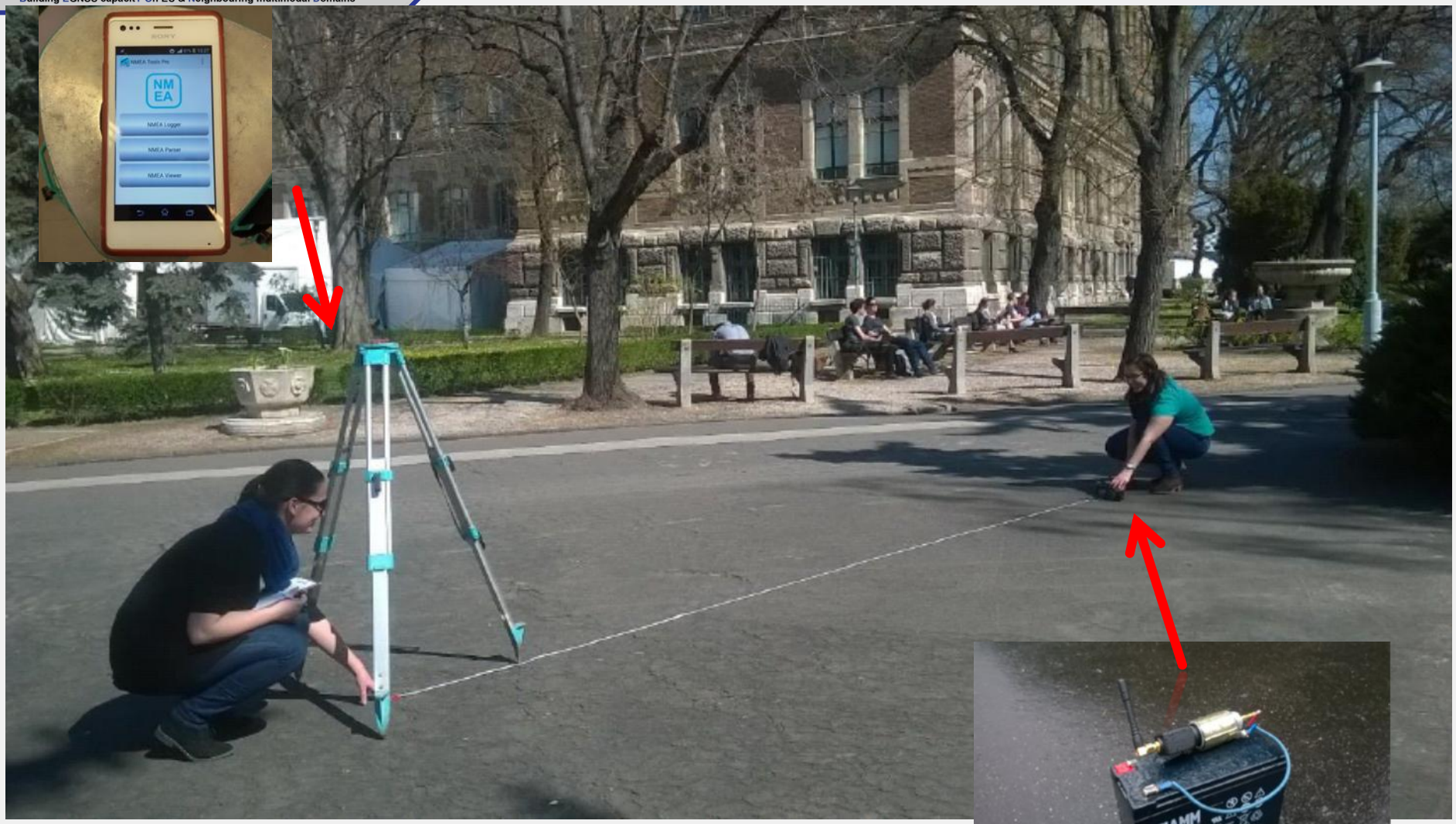
- **For military purposes**
  - Operating range: 150-200 km
  - Output power: 4 W
  - Weight: 5-10 kg

http://www.qsl.net/n9zia/wireless/gps_jam-pics.html

Low-cost GPS jammers

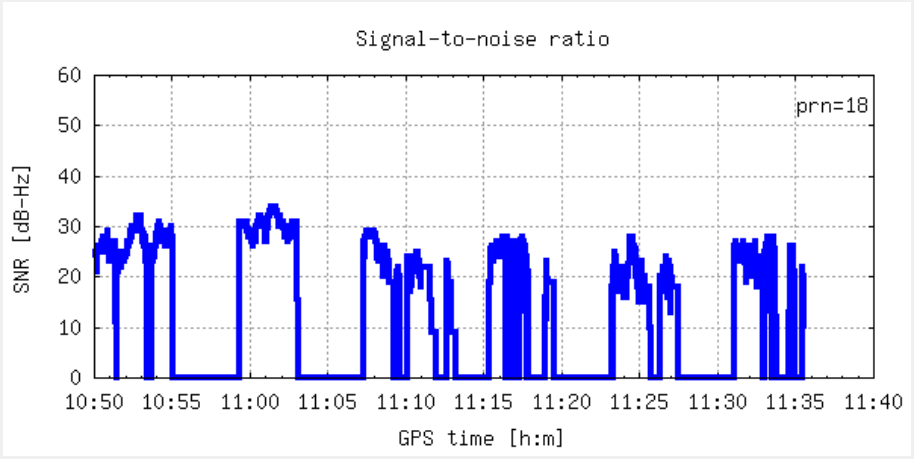
- **For civil usage**
  - Limited effective range, < 10 m (?)
  - To block navigation system of a car
  - Why?
    - To steal a car,
    - to hide the vehicle from the dispatchers,
    - To avoid paying toll,
    - ….
  - Multi device: GSM, wifi, GPS
  - Easy to buy on the black market (Internet)

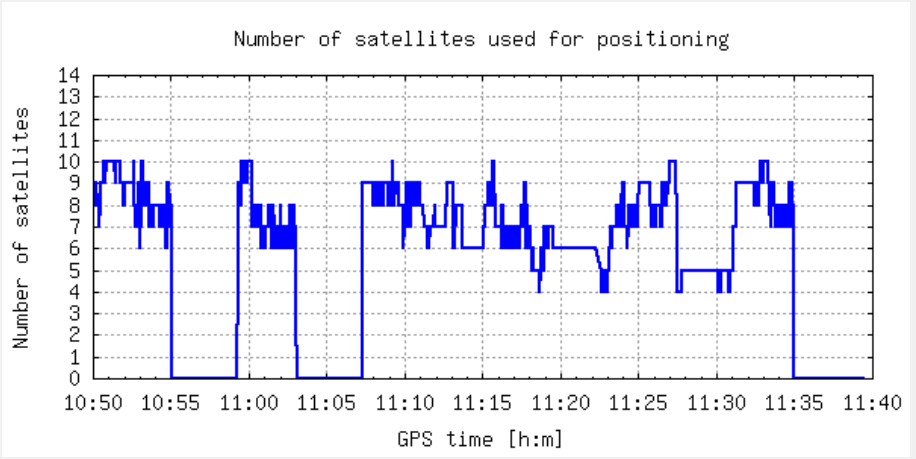
1st test: Effective range, everyday GNSS

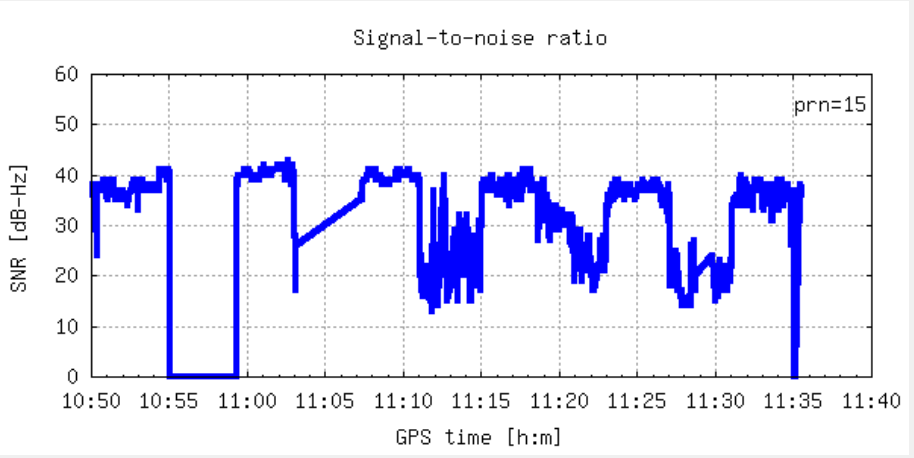


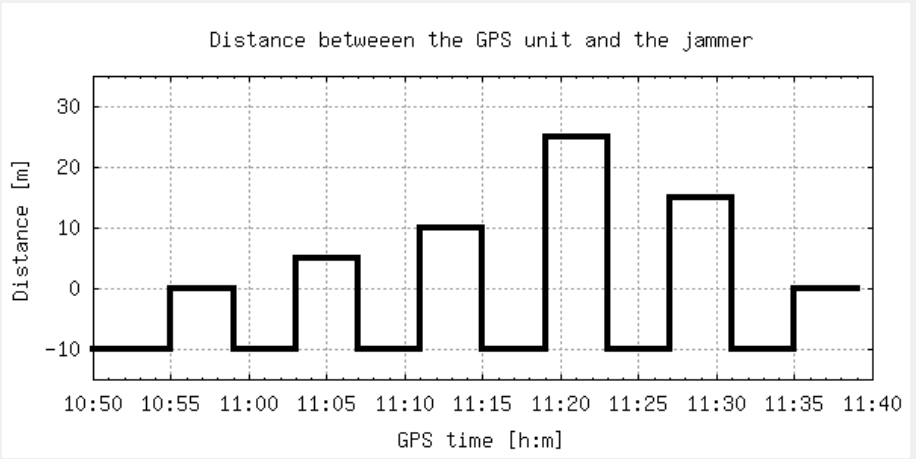
Effective range, everyday GNSS

- **about 10 m**





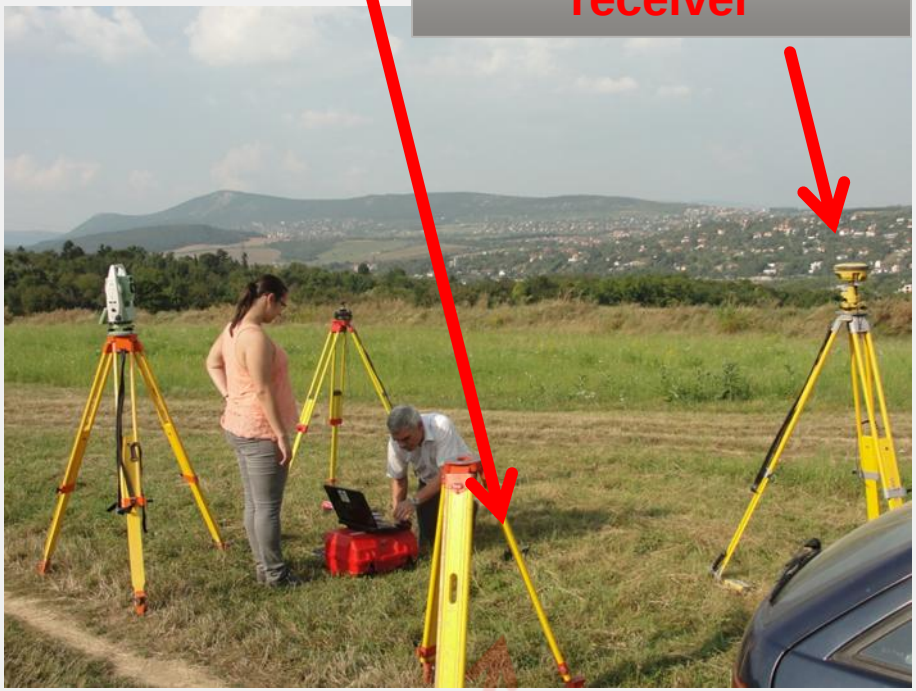


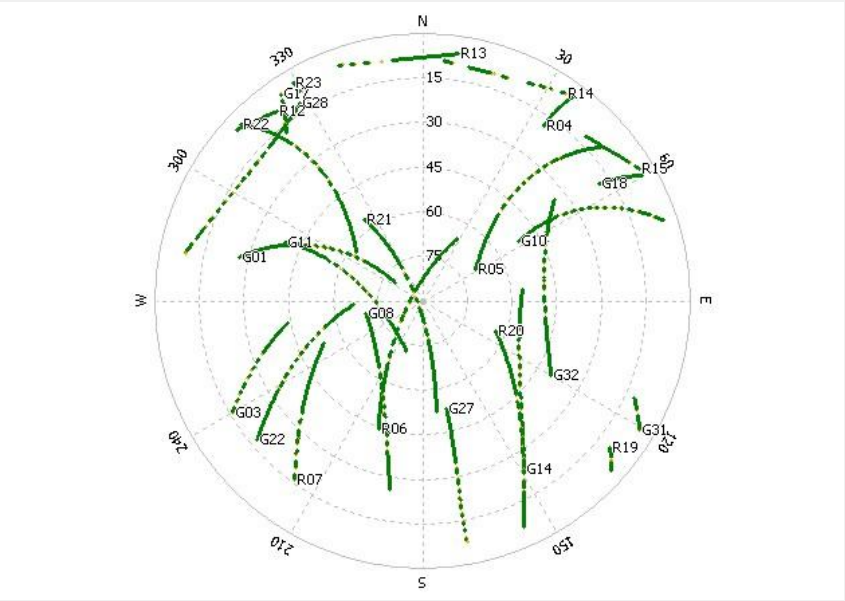


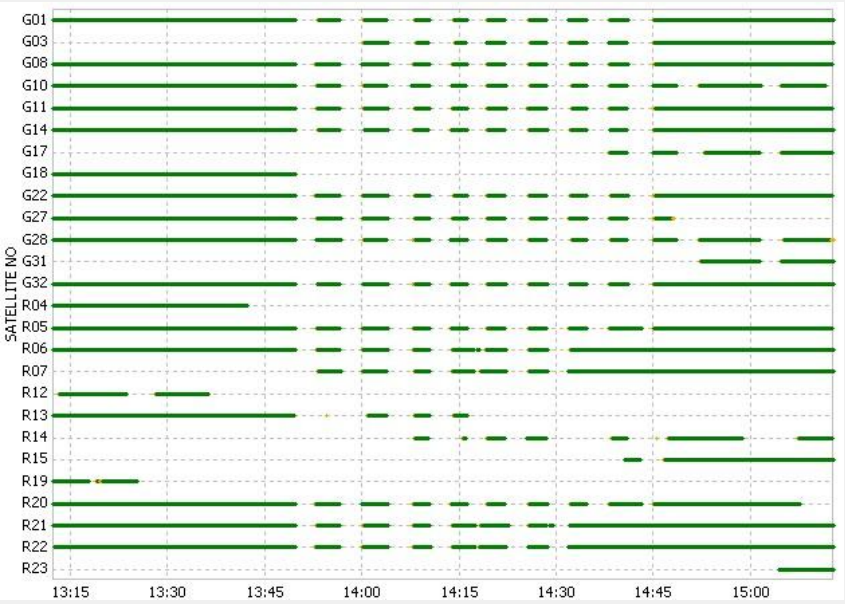
2nd test: Effective range, professional GNSS

GPS jammer, in varying position

professional GNSS receiver

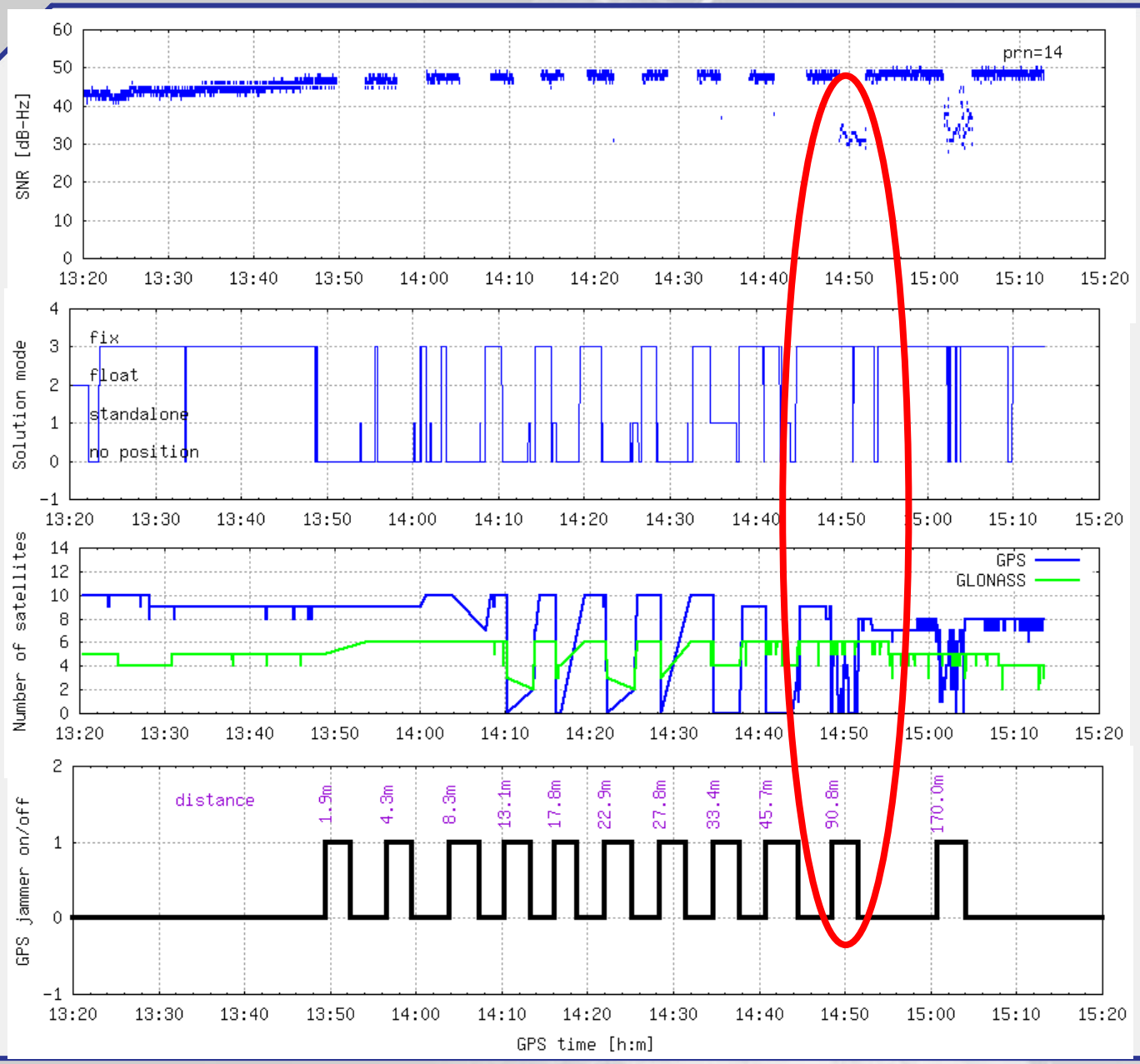






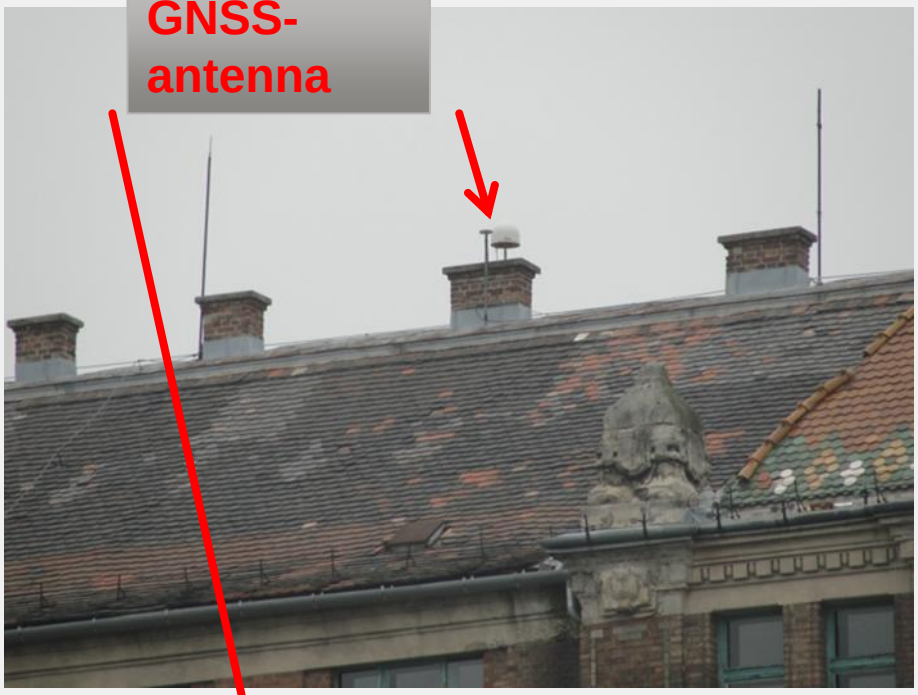
Effective range, professional GNSS

- up to 170 m



3rd test: Guided exercise with DINTEL

GNSS-antenna



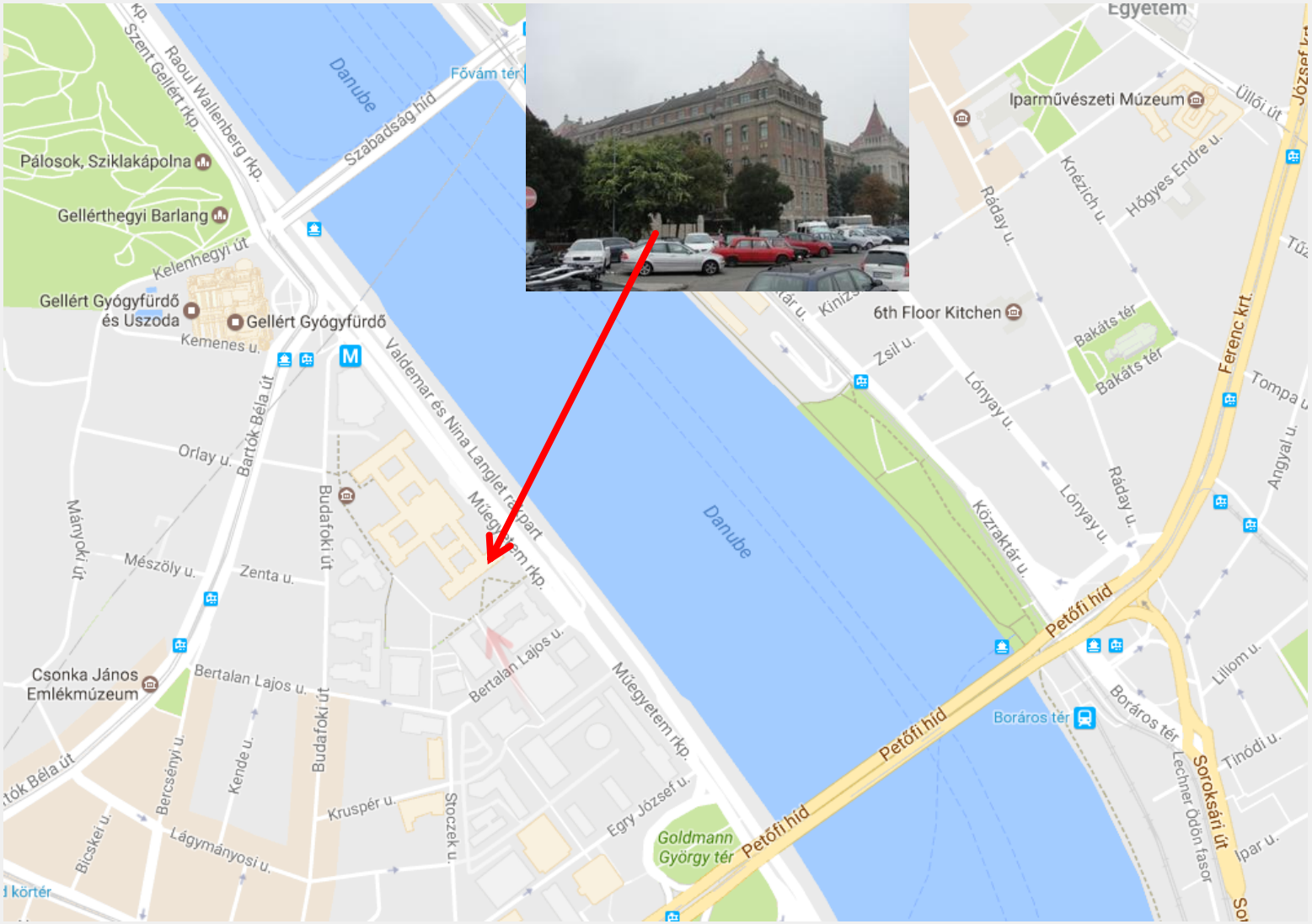
antenna splitter

GNSS receiver

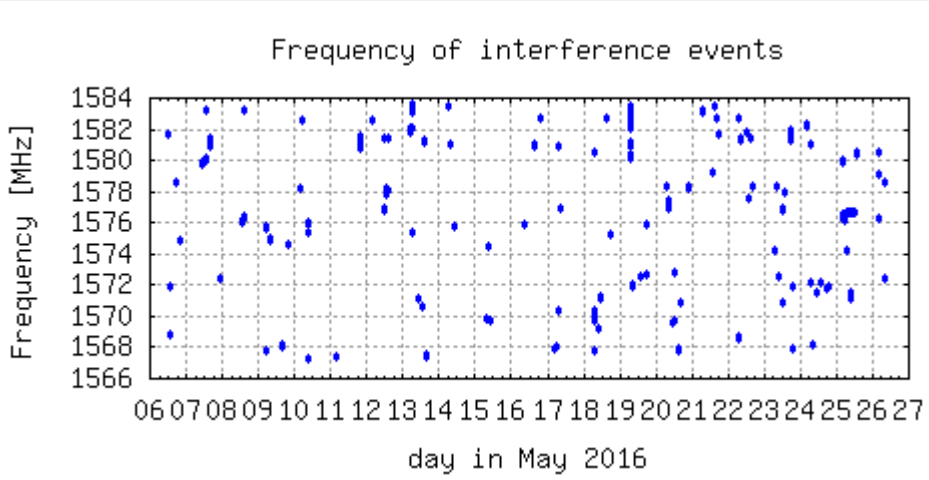
Spectrum analyzer (DINTEL)

DINTEL: http://www.gmv.com/en/Products/srx-10i/

Location of BME EGNOS monitor station



Detected interference events



GPS L1 frequency: 1575,42 MHz

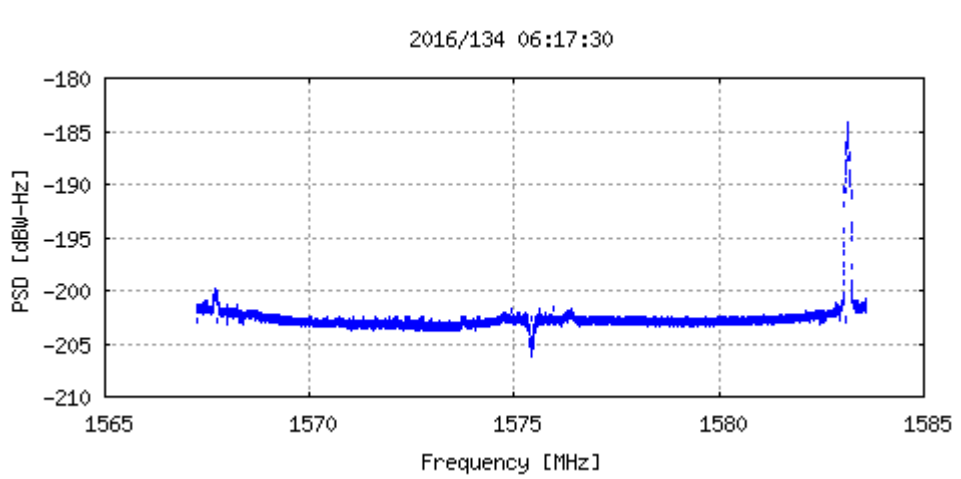
Measurement campaign

- 6th – 26th May 2016
- A few events per day
- Source???

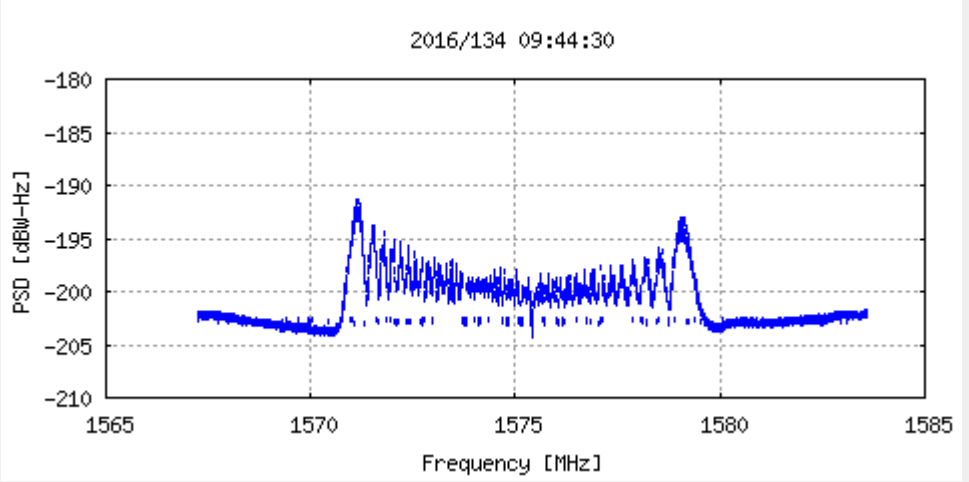
#event	date time	power [dBm]	frequency [MHz]	bandwidth [kHz]
1	2016-05-06 12:06:25	-118.2	1581.73	16.37
3	2016-05-06 12:45:07	-113.6	1568.86	12.98
14	2016-05-06 13:21:59	-120.3	1571.93	5.41
15	2016-05-06 17:00:41	-116.1	1578.54	31.85
17	2016-05-06 20:19:06	-120.1	1574.86	6.17
18	2016-05-07 10:25:18	-109.9	1579.93	42.11
32	2016-05-07 12:41:59	-111.0	1580.12	23.13
41	2016-05-07 13:12:01	-118.8	1583.24	17.60

Examples of detected interference events

time	frequency [MHz]	power [dBm]	bandwidth [kHz]
06:17:18	1583.47	-106.7	63.95
06:17:22	1583.40	-102.7	97.06
06:17:26	1583.19	-106.1	51.41
06:17:26	1583.36	-112.7	31.86
06:17:30	1583.14	-105.2	82.05
06:17:34	1583.17	-113.3	37.01

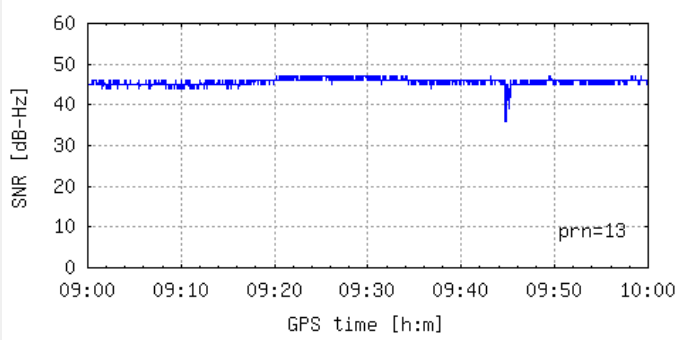


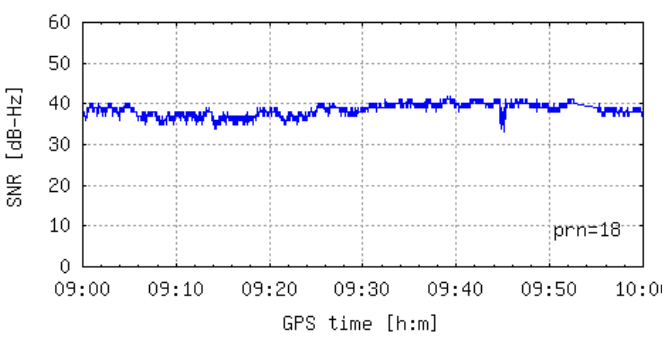
time	frequency [MHz]	power [dBm]	bandwidth [kHz]
09:44:26	1571.14	-108.9	141.71
09:44:30	1571.13	-119.8	14.79

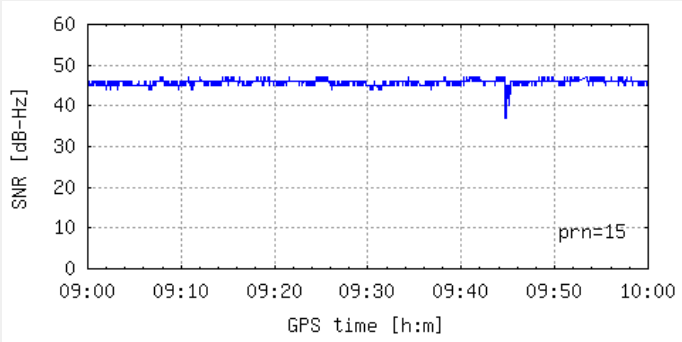


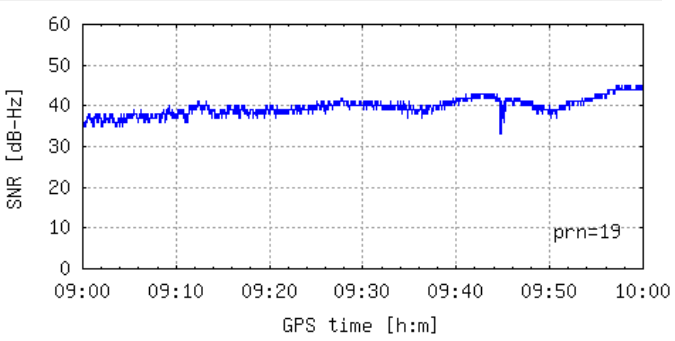
GPS L1 frequency: 1575,42 MHz

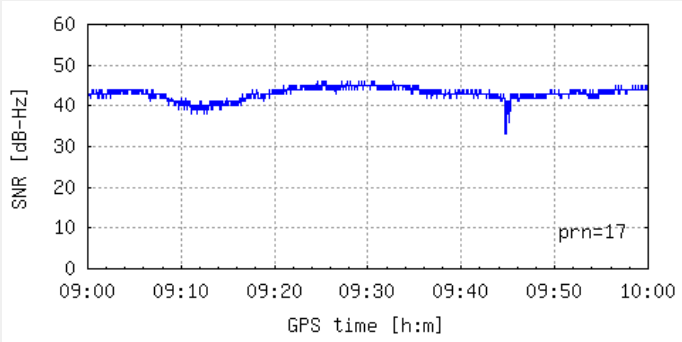
SNR during an interference event

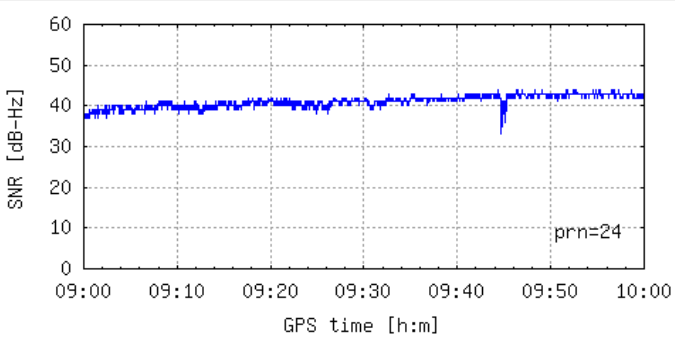


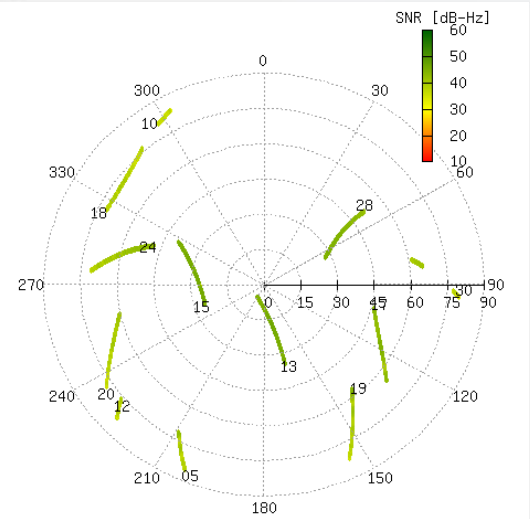




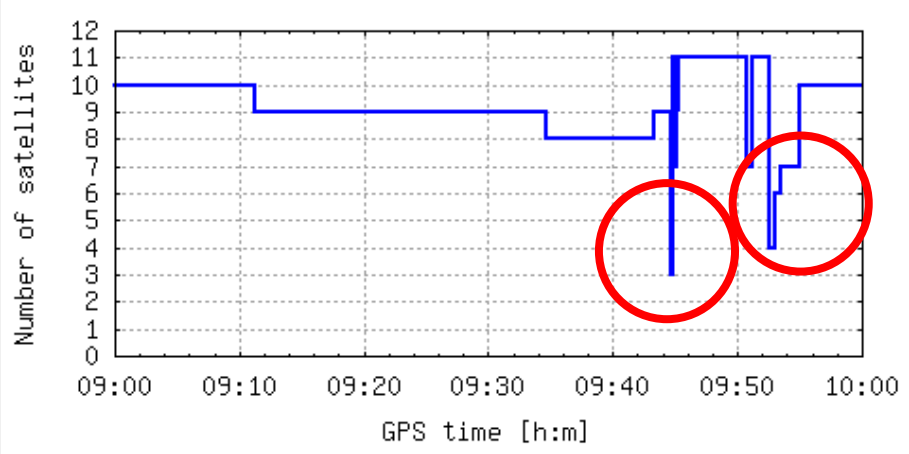


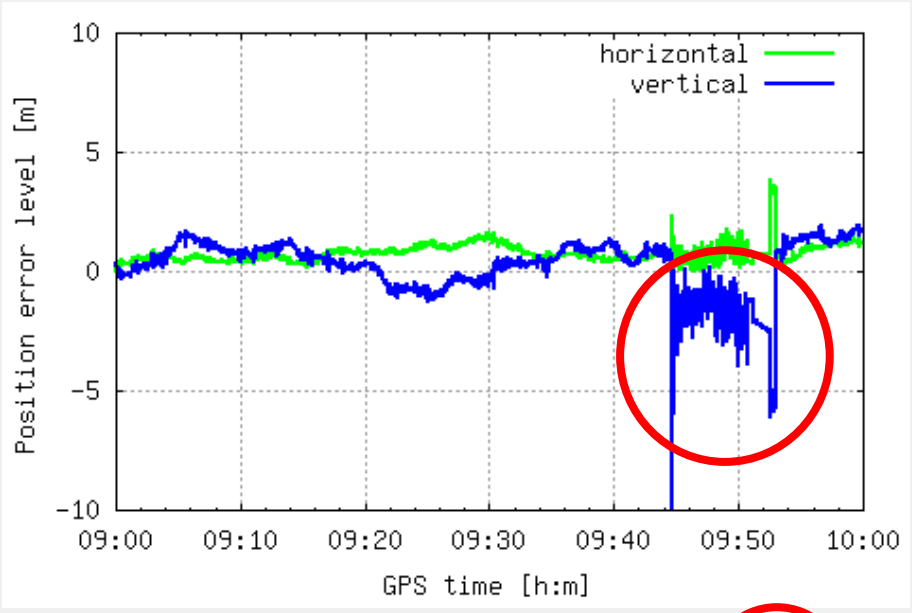


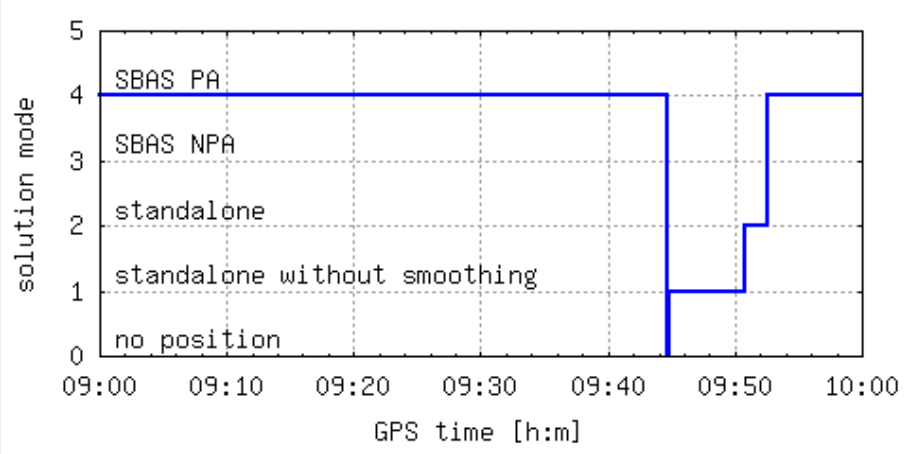


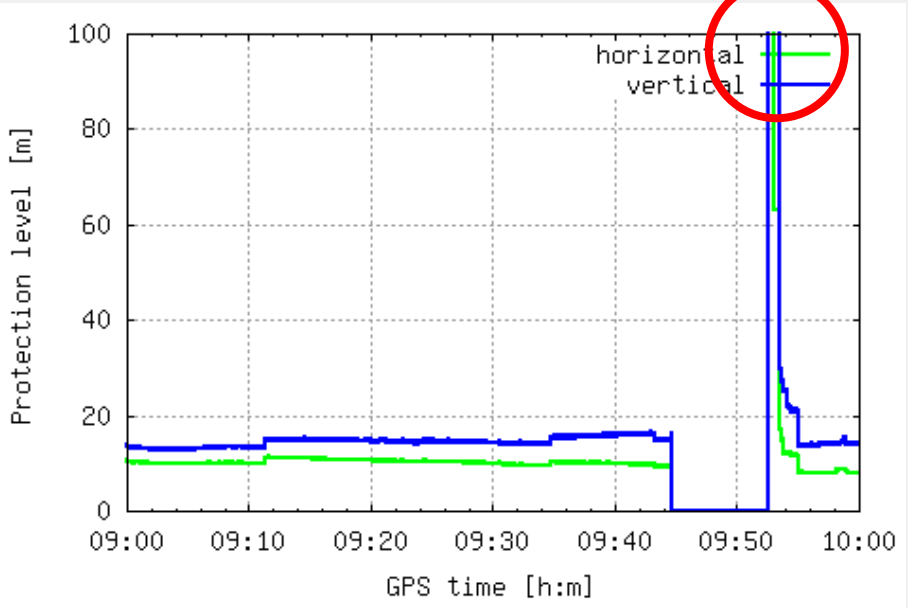


Performance during an interference event



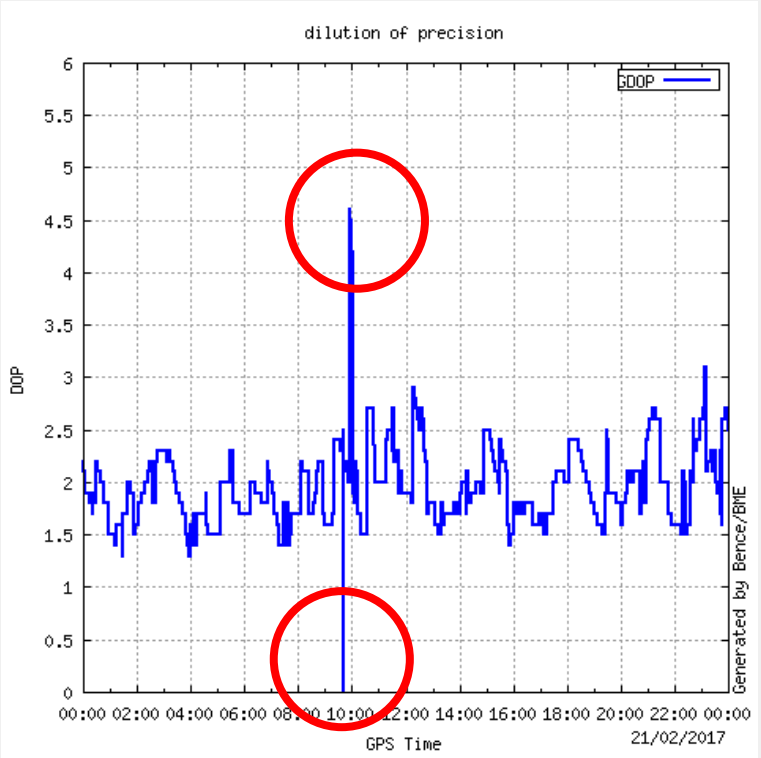


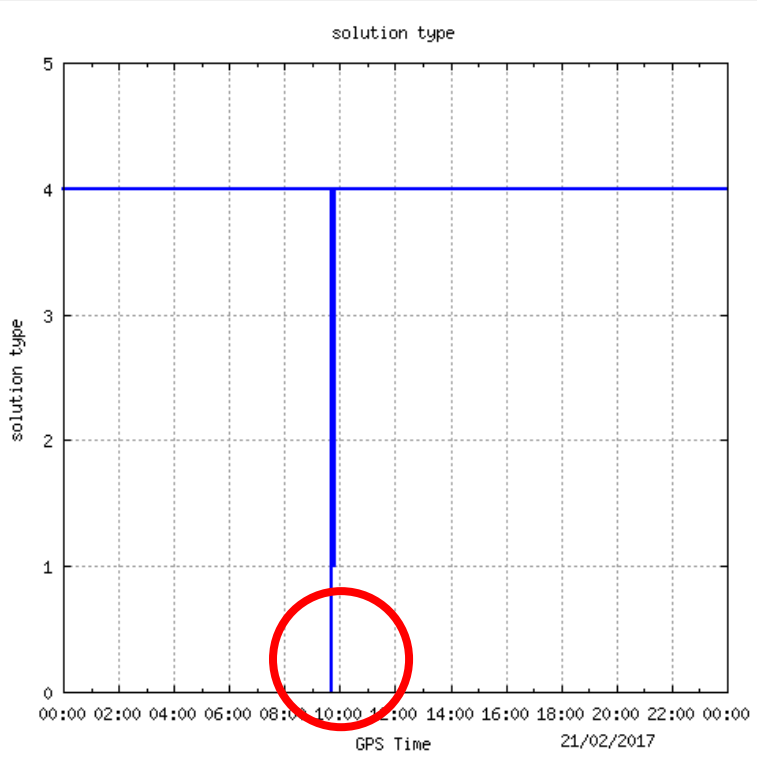




Performance during an interference event

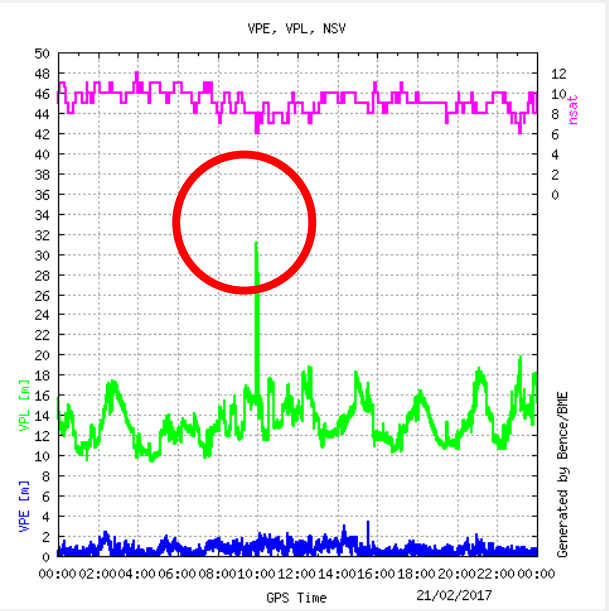
- **Another example at BME EGNOS monitor station (21st February 2017)**
- **No SBAS PA position for a short period**

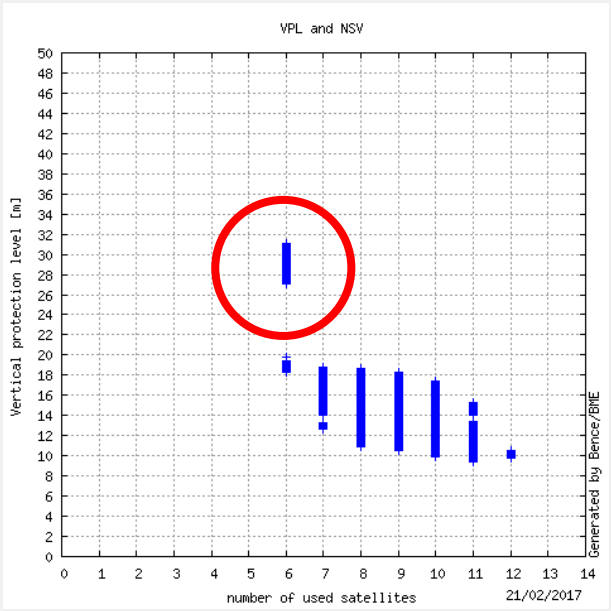


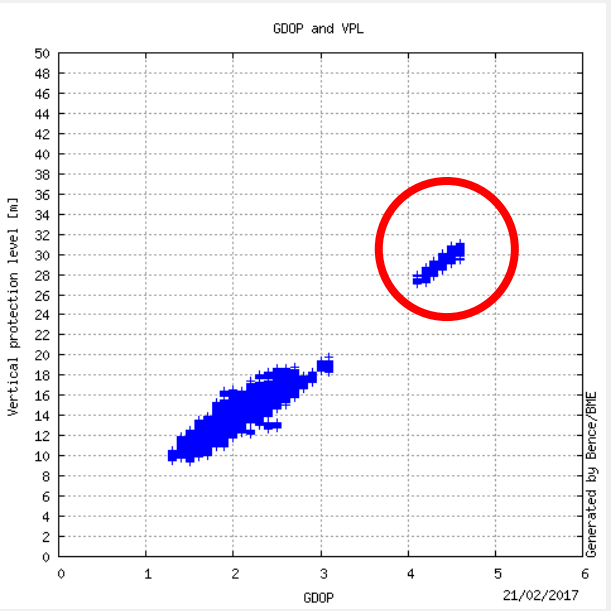


Performance during an interference event

- **Right after the event: less satellites used, higher DOP and higher vertical protection level**







Summary

- A low cost GPS jammer can block everyday GPS within 10 m.
- It has effect on professional GNSS receivers even in 170 m range.
- Several interference events have been detected at BME EGNOS monitor station. Their source has not yet been proven, but these events might be caused by low cost GPS jammers installed in vehicles passing nearby.
- Outage in positioning may take up to a few minutes due to the initialization of smoothing.

Thank you

?

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BEYOND

Building **E**GNSS capacit**Y** **O**n EU & **N**eighbouring multimodal **D**omains