

Monitoring of Real-time GNSS Broadcasters: Application to the EPN

C. Bruyninx and E. Pottiaux

EPN Central Bureau, Royal Observatory of Belgium

<http://www.epncb.eu/>

EPN Regional Broadcasters

- EPN real-time streams available from three regional EPN broadcasters, operated by ASI, BKG and ROB (on Oct. 20, 2017)

Broadcaster	Streams set up	Running streams
ASI	161	117
BKG	170	157
ROB	180	172

- New or stopped streams are not added/removed in the same way by all broadcasters
 - No automated procedure
 - Broadcaster operators have to talk to each other
 - Stations do not inform broadcasters of a change in a stream (or inform just one broadcaster)

Set up of the streams at the broadcasters

Inserted in **sourcetable** of the broadcaster:

```
STR;POTS0;Potsdam;RTCM 3.2;  
1006(10),1007(10),1077(1),1087(1),1097(1);  
2;GPS+GLO+GAL;EUREF;DEU;52.19;13.07;0;0;  
JAVAD TRE_G3TH DELTA;none;B;N;3000;kg3-dmz.gfz-  
potsdam.de/POTS0(1)
```

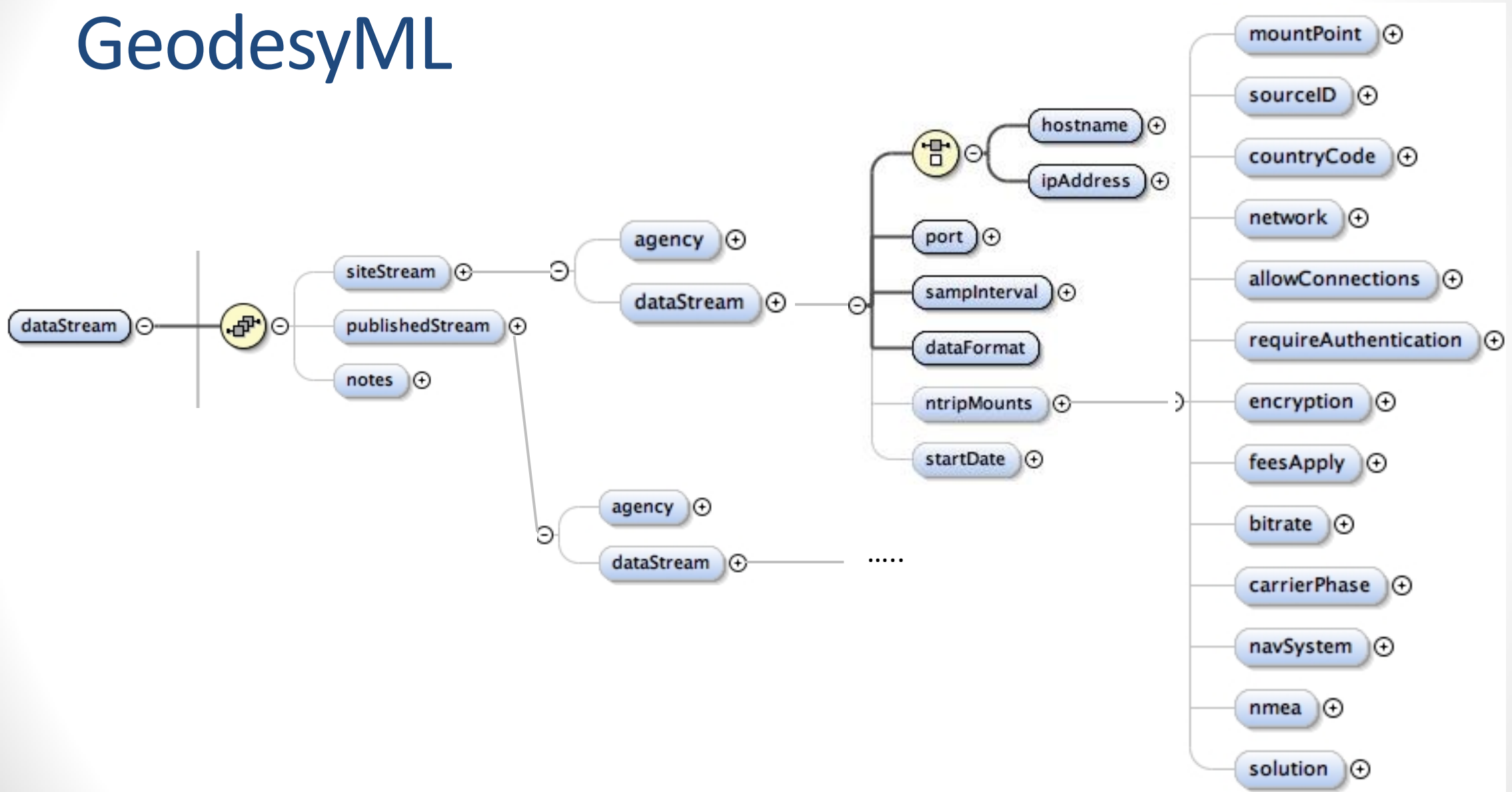
- Name of the **mountpoint** (station 4/9-Char ID + 0/1)
 - Identification of station
- **Format** that is streamed: RTCM 2.x, 3.x
 - Different format requires different decoding software
- **List of messages** that are streamed
- **Tracked constellations**
- **Receiver type**

Metadata of Real-Time GNSS Streams

<ul style="list-style-type: none"> • Station site log <ul style="list-style-type: none"> • Receiver type • Tracked constellations • Antenna (+Serial number)/radome type • Antenna height 	Maintained by Operational Center, submitted to EPN CB <i>unique</i>
<ul style="list-style-type: none"> • Source table of the broadcaster <ul style="list-style-type: none"> • Name of the stream mountpoint • Receiver type • Tracked constellations • Stream format • List of sent real-time messages 	Maintained by broadcaster operator <i>not necessarily the same for each broadcaster</i>
<ul style="list-style-type: none"> • Messages in real-time data stream <ul style="list-style-type: none"> • Receiver type • Antenna (+Serial number)/radome type • Antenna height • Reference position • To be derived from sent messages 	Maintained by the station operator (inserted in receiver) <i>unique</i>
<ul style="list-style-type: none"> • ETRS89 station reference position 	Maintained by EPN Reference Frame Coordinator <i>unique</i>

Not necessarily consistent!

Future Ntrip stream metadata in GeodesyML



Importance of Metadata

Selection of streams based on info in broadcaster source table:

- Name of mountpoint
- Tracked constellations
- Stream format
- Observation message types

Decode stream (binary format): requires that source table provides correct stream format

Analysist of real-time EPN data uses directly metadata in stream

- Antenna/radome type → necessary for correct application of antenna calibration models (NULLANTENNA problems! → 6 cm offsets)
- Antenna height → to link observables to marker
- Reference position in ETRS89 → if RTK, required to compute position of 'rover' in ETRS89

Prerequisites for Broadcaster Monitoring

- User account on the broadcaster
- First 4-char of name of mountpoint = first 4-char of station name
- Station site log is required (IGS, EPN, ...)

Monitoring of real-time data

For each broadcaster

Loop over streams in sourcetable, keep streams with valid site log

- a. Listens between 30s-900s to the stream
- b. Decodes the stream using stream format info in the broadcaster sourcetable
 - Unable to decode : wrong stream format description in sourcetable
 - Able to decode:
 - Compile list of message types in stream
 - Decode metadata in stream
- c. Listen again to the stream for 10-60s:
 - Decode the time stamp of the observables
 - Compute mean (computer time - observation time stamp) → data latency

Sourcetables

- **Format**

~6 streams with wrong formats indicated in sourcetable and which cannot be decoded
→ Impossible to use stream

- **Constellations**

Check done by verifying observation message types in stream

max ~20 streams info wrong (e.g. usage of GNSS instead of GPS+GLO+GAL+BDS+...)

“GNSS” Inconvenient for analyst who is searching e.g. a GAL (Galileo) stream

- **Receiver type**

Check done by cross-checking with site log

max. 3 errors seen

EPN CB notifies broadcaster operator upon receiver change in site log

- **Message types**

Impossible to maintain up-to-date list of message types

Sourcetables - Message types

		Time that stream is listened to					Ephemeris messages, provided when new nav. info is received
BORJ1	SOURCE TABLE	2017/10/18 06:44	RTCM 3.1:	1004 (1) ,1006 (10) ,1008 (10) ,1012 (1) ,	1019 ,1020 ,	1033 (10)	
BORJ1	STREAM	125s	RTCM 3.1:	1004 (1) ,1006 (10) ,1008 (10) ,1012 (1) ,	1033 (10)		

Extract from ftp://epncb.oma.be/ftp/station/real_time/monitor_ROB.str

Stream Content

Antenna Type and Serial Number

~43 streams with errors

no antenna/radome info at all: 10 streams:

incorrect antenna and radome: 1 stream

incorrect radome: 3 streams

other: incorrect/missing antenna serial number

Antenna Height

Incorrect antenna height (more than 10cm): 5 stations/streams

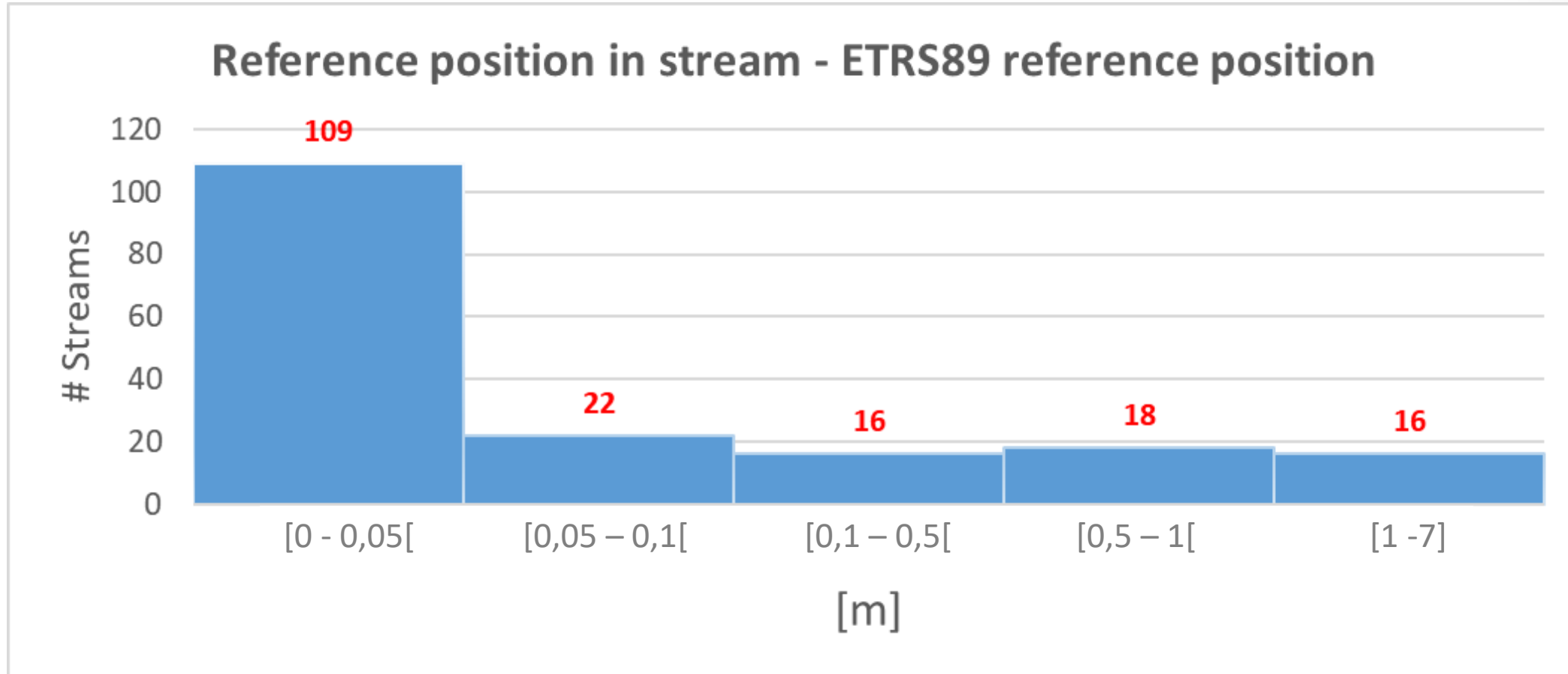
Missing antenna height : 12 stations/streams

Antenna info

Site log versus stream content

Stream Content

Reference Position



40% of EPN streams → more than 5 cm error

19% of EPN streams → more than 50 cm of error

Stream Latencies

		% of streams		
Latency		ASI	BKG	ROB
[0 - 1]	s	3	5	3
] 1 - 2]	s	25	21	26
] 2 - 3]	s	53	69	66
] 3 - 4]	s	19	5	5

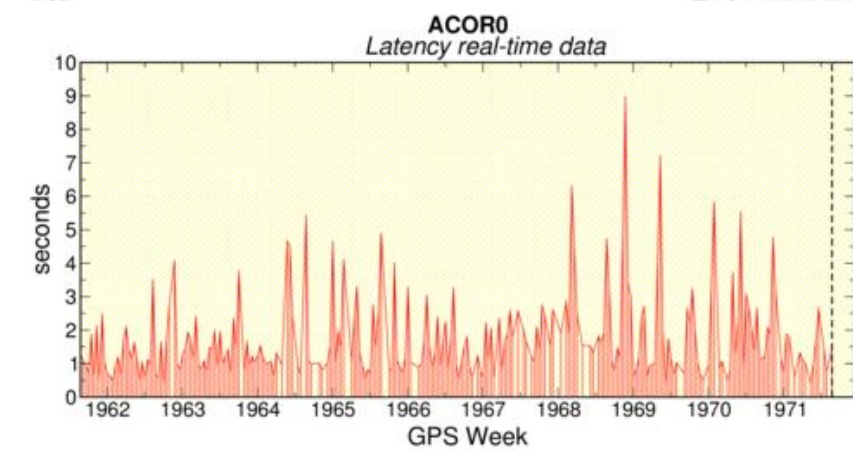
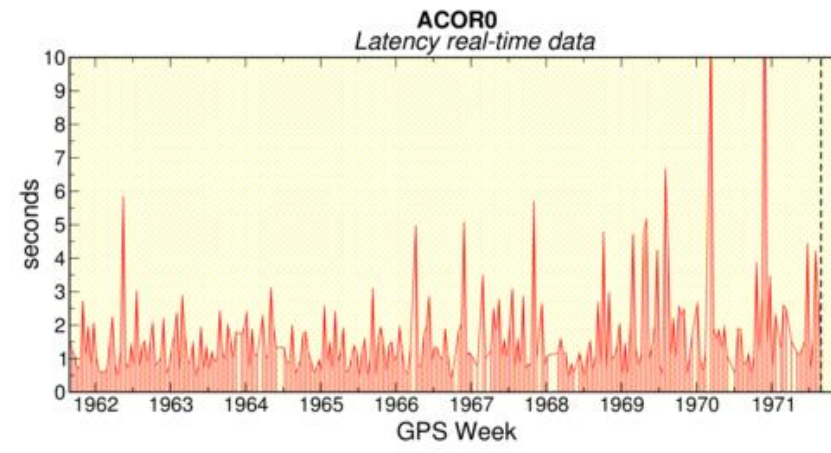
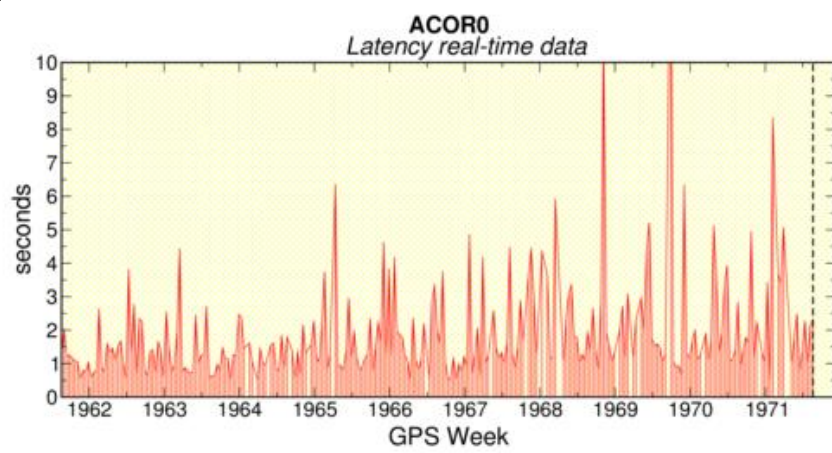
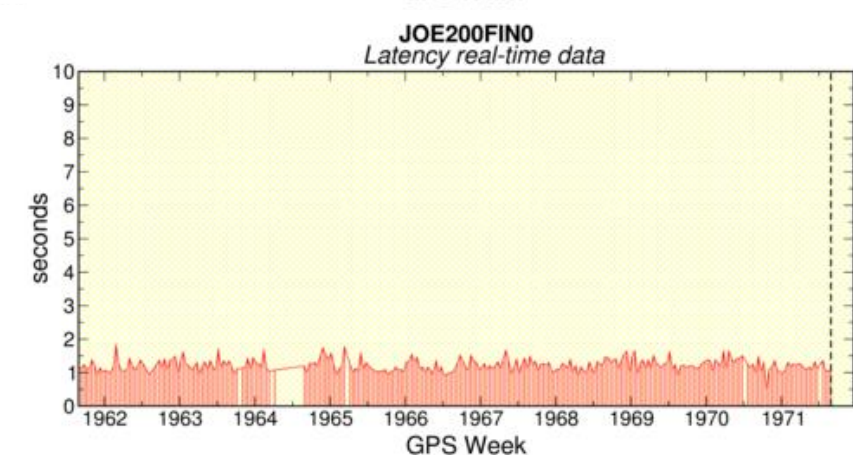
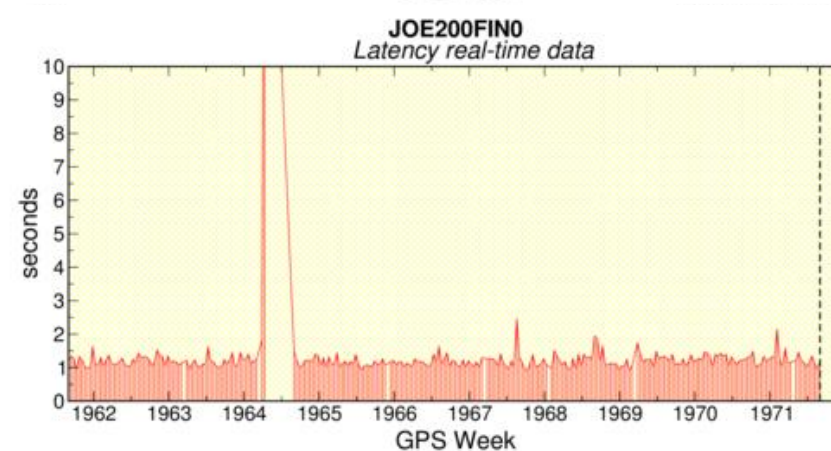
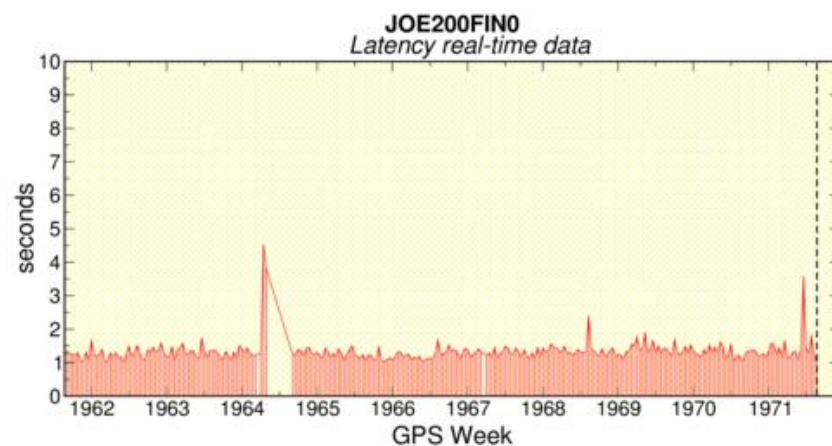
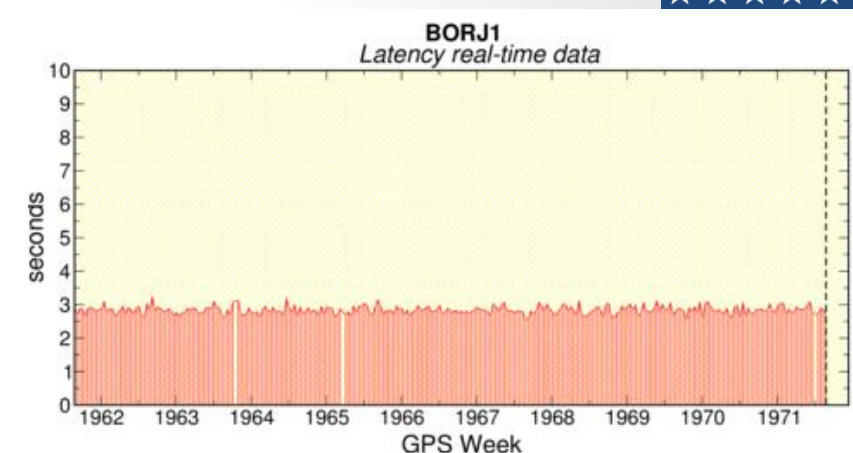
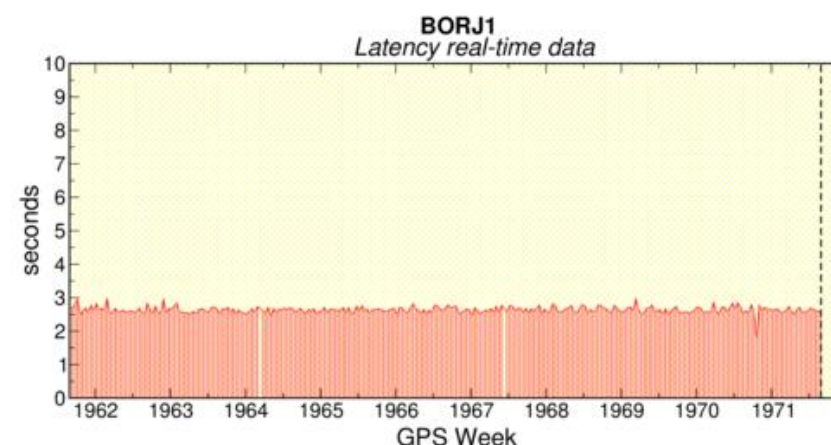
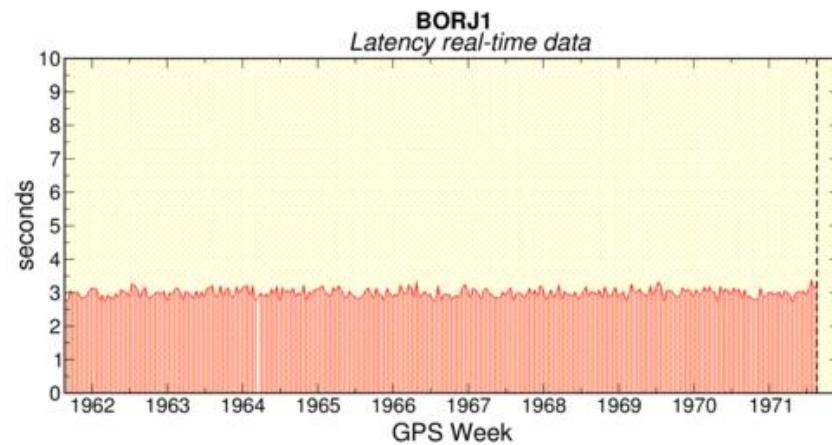
Snapshot of stream latency on Oct.
19, 2017

Stream latency depends on numbers of relays of stream

Stream → broadcaster

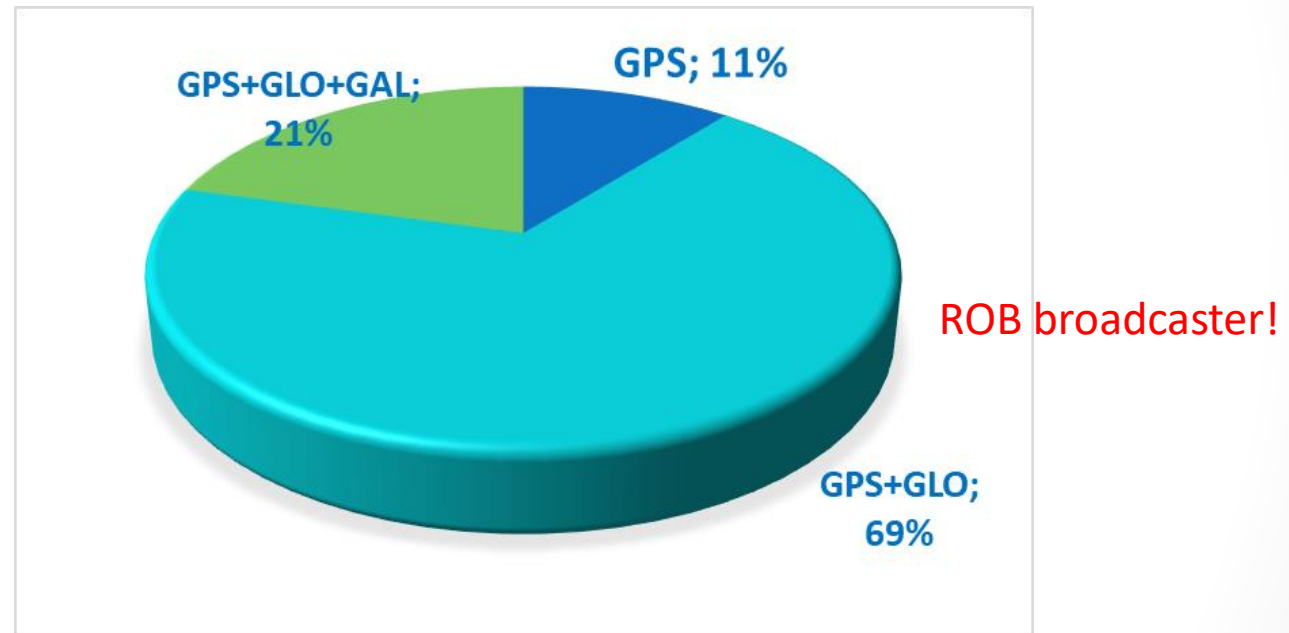
Stream → local broadcaster → regional broadcaster 1 → regional broadcaster 2

But also on quality of LOCAL network

ASI**BKG****ROB**

EPN real-time streams

- ~ 160 EPN stations provide their data in real-time (50% of EPN)
- Growth of RT stations does not keep the pace w.r.t. increase of EPN stations in general



- We have the potential to stream more RTCM 3.2/3 streams (with Galileo):
~50% of the stations that provide Galileo in RNX 3 and also stream Galileo real-time data

STATUS

Network Status

Station List **UPDATED**

Maps **UPDATED**

Tracked Frequencies

Data Quality

DATA ACCESS

Introduction

Daily & Hourly

Real Time

Highrate

TOOLS

Station Log Submission

Station Picture Submission

Introduction

Map **NEW**

Broadcasters

Products & Data Streams Status **UPDATED**

Latency & Metadata **UPDATED**

FUTURE

Proposed Stations **UPDATED**

Users

The real-time GNSS data and product streams from the EPN stations can be downloaded using [Ntrip](#) or [RTSP](#) (available for several platforms). The broadcaster request that you first complete a user registration to grant you the authorization (user-ID and password) to access the EPN streams they provide: User registration for [ASI](#) (Italy), [BKG](#) (Germany) and [ROB](#) (Belgium).

The most recent overview of the EPN streams presently available is provided by the [product & data stream status](#); it also provides detailed information on the stream content. The EPN Central Bureau monitors also [stream meta-data content](#) and [stream latency](#).

Conclusions

- ROB has a tools to monitor broadcasters
 - Results shown for EPN broadcasters
 - Also running on request for other broadcasters, e.g. DLR
- Cross-checks Site log, source table, stream content
- EPN results demonstrate
 - Difficulty of keeping broadcaster source tables up to date
 - DLR has developed a tool to retrieve, decode and analyze the content of each RTCM3 stream on a broadcaster and create the sourcetable.
 - Contact: andre.hauschild@dlr.de for use in IGS and EPN
 - A lot of issues with stream metadata
 - Galileo real-time streams under represented compared to number of Galileo stations

Thank you

Contact:

Carine Bruyninx

C.Bruyninx@oma.be

epncb@oma.be

Royal Observatory of Belgium

Av. Circulaire 3

B-1180 Brussels

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