



Real-time Monitoring Overview

BKG is operating various entities for the global, regional and national real-time GNSS infrastructure, see Fig. 1. The operation of a real-time GNSS service demands a high level of monitoring. At BKG, various tools or softwares are used (Fig. 2):

Opsview⁴ monitors:

- Hardware + Network: disk space, load, memory, FTP + HTTP to other DCs, etc.
- Status of most important processes and files
- Accumulation of files in specific directories
- Warnings or errors in logging files
- NtripCaster installations: number of client connections and data streams, availability of products, etc.

InfluxDB⁵ is used for storage of events and metrics. Perl scripts are used for processing logging files and for populating the data base with the extracted data. The stored metrics are coming from:

- BNC³ logging files: general logging files incl. combination, PPP logging files
- RTNet⁸ logging files
- All kind of timestamped data

Grafana⁶ is used for visualization.

PM2⁷ is used to manage and monitor all continuously running jobs, e.g. information about every managed job like CPU and memory usage, number of restarts and uptime (Fig. 3).

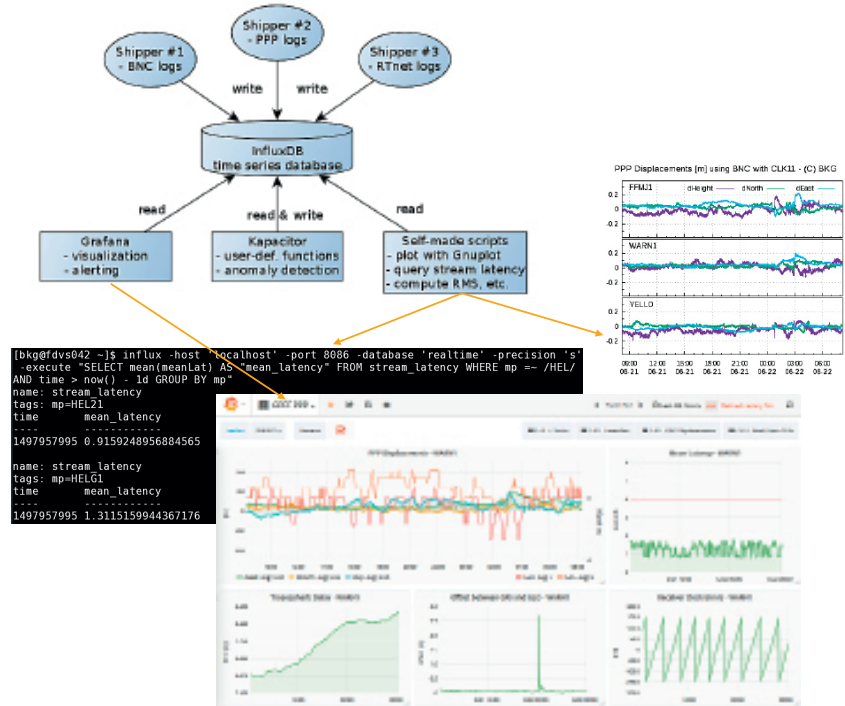


Fig. 2: Extract, Transform, Load (ETL) and visualization workflow

URL	Content
www.gnrf-ip.de	RTCM 3.2/2.3 Broadcast Ephemeris for BDS, GAL, GLONASS, GPS, SBAS (E14) RTCM 3.3 Orbit & Clock Corrections referred to national datum (E04) Specifications on record types (CAS, NET, STX) included in source table
www.euref-ip.net	RTCM 3.2/2.3/3.0/3.1/3.2/3.3 Navigator and Observation Data with short and long mount point names (E10) RTCM 3.3 Orbit & Clock Corrections, Code Issues referred to IGS05 (E04) Specifications on record types (CAS, NET, STX) included in source table
www.igs-ip.net	RTCM 3.2/3.0/3.1/3.2/3.3 Navigator and Observation Data with short and long mount point names (E10) Specifications on record types (CAS, NET, STX) included in source table
products.igs-ip.net	RTCM 3.2/2.3 Navigator and Observation Data with short mount point names (E10) Programmer's Manual for Real-time GNSS (RTM) (E10) RTCM 3.3 Broadcast Ephemeris for BDS, GAL, GLONASS, GPS, SBAS (E14) Specifications on record types (CAS, NET, STX) included in source table
products.igs-ip.net	RTCM 3.0/3.1 Orbit and Clock Corrections, Code Issues referred to IGS05 (E04) RTCM 3.0/3.1 Orbit and Clock Corrections, Code Issues referred to IGS05 (E04) RTCM 3.0 Orbit and Clock Corrections, Code and Phase Issues referred to IGS05 (E04) RTCM 3.0 Orbit and Clock Corrections, Code and Phase Issues referred to IGS05 (E04) RTCM 3.2/2.3 Broadcast Ephemeris for BDS, GAL, GLONASS, GPS, SBAS (E14) RTCM 3.0 Orbit & Clock Corrections referred to national datum (E04) Specifications on record types (CAS, NET, STX) included in source table

Fig. 1: Names and contents of BKG broadcasters (Goltz et al., 2018)



Fig. 3: PM2 manages BNC, RTNet and many other jobs, e.g. contribution to permanent processing within COST Action ES1206

Performance of Real-Time Broadcasting at BKG

The growing number of users applying for a bigger number of simultaneous data streams, the larger bandwidth connected with the RTCM Multiple Signal Message (MSM) data streams as well as erroneous connections are straining the real-time infrastructure.

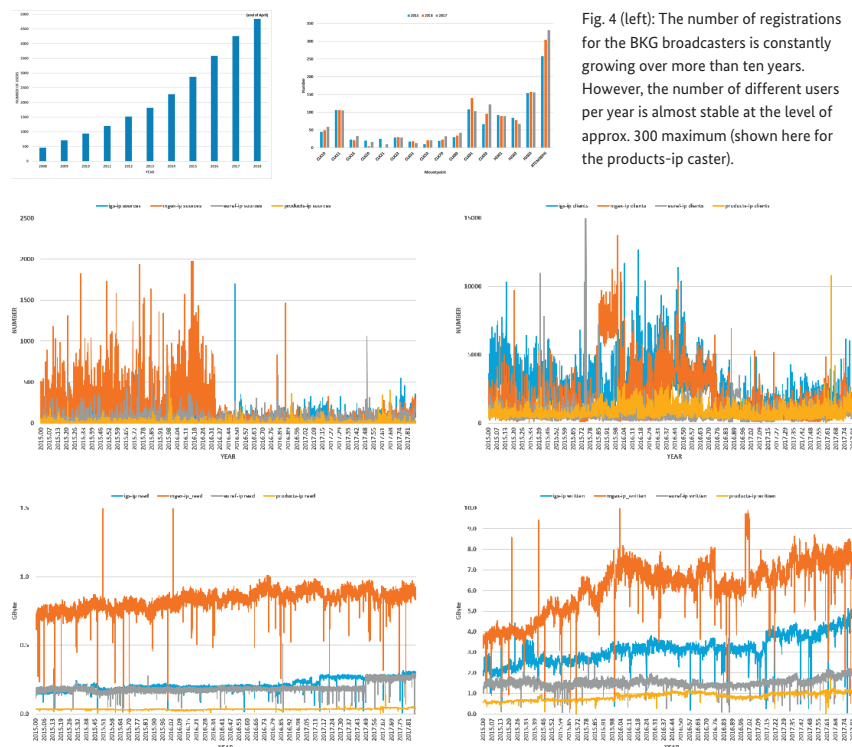


Fig. 4 (left): The number of registrations for the BKG broadcasters is constantly growing over more than ten years. However, the number of different users per year is almost stable at the level of approx. 300 maximum (shown here for the products-ip caster).

Fig. 6, up: number of sources (left) and clients connected to each broadcaster each hour for the years 2015 to 2017. Bottom: Gbytes read (i.e., upload to) and written (i.e., download from) BKG broadcasters each hour for the years 2015 to 2017. While the upload is quite constant because the number of mount points (or sources) did not grow too much, the download has been increasing significantly over the years

Information about the availability of real-time streams of all BKG casters (summary or verbose mode), as well as station maps can be found at <https://bkgmonitor.gnssonline.eu>.

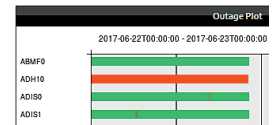


Fig. 5: Example for stream outages



Fig. 7: The availability of the data and combination products streams is monitored for all three IGS broadcasters. Currently, short and long mount-point names are used in parallel. For the three EUREF regional broadcasters at ASI, BKG and ROB a more sophisticated monitoring showing some more details, e.g. format type, last connection etc. is implemented at the EPN Central Bureau on http://www.epncb.oma.be/_networkdata/data_access/real_time/status.php.

Upcoming tasks

- Applying the GDPR, e.g. handling of registrations, logging files etc.
- Completing usage of long mount-point names; stopping intermediate parallel streaming with short mount-point names
- Testing capabilities of broadcasting streams with sampling rates > 1 Hz

References and links:

- ³BKG Ntrip Client (BNC) <https://igs.bkg.bund.de/ntrip/bnc>
 - ⁴Opsview community version <https://www.opsview.com/>
 - ⁵InfluxDB <https://www.influxdata.com/>
 - ⁶Grafana <https://grafana.com/>
 - ⁷PM2 Process Manager <https://github.com/Unitech/pm2>
 - ⁸Real Time NETWORK Processing Engine (RTNET) http://www.gps-solutions.com/rtnet_software
- Goltz et al., 2018: M. Goltz, P. Neumaier, W. Söhne, A. Stürze, E. Wiesensarter, J. Dostal – BKG Regional Data Center, in: IGS Technical Report 2017, Eds. A. Villiger, R. Dach, pages 138 – 145, May 2018

Further information

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