

The future datacenter:

Motivation and Vision of the newly installed
IGS Pilot Project on Data Architecture

Helmut Titz (BEV), Markus Bradke (GFZ), David Mencin (Earthscope), Brandon Owen (GA)

BEV – Federal Office of Metrology and Surveying

June, 2026 - EUREF Symposium 2026 in Paris

The AC perspective

Example: BEV AC routine processing (150 stations, daily solution)

- Processing time: 2 hours 30 minutes
- RINEX-Handling: **35 minutes !!!**
 - Gunzip (*.crx.gz)
 - Crx2rnx (*.crx)
 - Gfzrnx (*.rnx); Subsampling 30 Sec.; Deleting BDS; QZSS, IRNSS; ...
 - Bernese SW: RNXSMT (Code smoothing)
 - Bernese SW: RXOBV3 (import of RINEX into binary Bernese files)
 - At BEV: no FTP download necessary but NFS connection to BEV DC available

IDEA: Download Bernese binary files directly from the DC via API using filters and do code smooting later

The DC perspective

RINEX files are limiting factors

- Different sampling rates 01, 15, 30 Sec – files
- Hourly and daily files
- R and S files parallel possible
- Different rinex versions have to be handled (v2, v3, v4)
- Metadata in RINEX filenames, RINEX headers and sitelogs

Redundant information in data and metadata (waste of disk space)

Need checking, reporting and correction mechanisms to handle these redundancies

IDEAS:

- Use database systems to get rid of the redundancies
- Separate data and metadata
- Use API and filtering at the DC to speed up the processing at the ACs

Two prototype implementations have been developed in 2025 and presented

Earthscope

- TileDB in combination with S3-Object Stores for data storage
- PostgreSQL for metadata storage
- Output GIPSY files via API

GFZ

- Apache IceBerg – Datalakes for storing data and metadata
- New Output formats based on Apache Parquet and Apache Arrow replacing RINEX

„Technical Workshop on Datastorage and Dataformats“
in February 2026 in Coimbra, Portugal
(Organised by the IGS Infrastructure Committee and EPOS)

Output: **White Paper**

The IGS Pilot Project on Data Architecture

has been installed at the last IGS GB Meeting

- **Chair:** David Mencin (Earthscope)
- **Vice:** Brandon Owen (GA, GGOS)
- **Working on the „Terms of Reference“**
- **Preparing a „Call for Participation“**

Comment of Rolf Dach at the IGS WS in Santiago de Chile

„There are people that don't like RINEX in the IGS“

Question: Is this PP interresting or relevant for EUREF DCs?

The LEO-PNT perspective

ESA ist planning to install and additional PNT-System based on 275 LEO satellites in addition to GALILEO

- Today: RINEX 3.0.5 and RINEX 4.0.2; 40-50 satellites parallel, many signals per satellite stored
 - RINEX 4.0.3 planned for Q4/2026
- RINEX 5.x will allow the inclusion of LEO-PNT data
 - 5 – 7 satellite more in RINEX files
 - L-, C-, S-Band data
 - 4 or 5 digit satellite numbers

The RINEX will grow only 10-15% per LEO-Constellation – Not relevant for current DCs.

Question: Do we need this data for our reference frame realisation?

Today: Deleting BDS, QZSS, ...
POD of LEO satellites is based on onboard GNSS receiver not on additional ground infrastructure

The Reference Frame perspective

- Fast moving LEO satellite have a
 - Fast changing geometry and therefore
 - Possibly will lead to better and more detailed troposphere estimates

LEO-PNT observations will possibly improve the accuracy of the troposphere products and therefore will improve the GNSS derived ellipsoidal heights

Because of the short satellite passing time the calculation will require high rate data (1 Hz or below)

This increase of the sampling rate is of course a DC topic!

Conclusions

- LEO-PNT has the potential to improve the troposphere parameters and the height component of GNSS solutions and may therefore be relevant for future reference frames realisations
- The improved troposphere products can be a basis for a new climate product
- Need to store high rate data at least for the LEO-PNT measurements
 - RINEX 5 should allow the storage of MEO and LEO data with different sampling rates in one file
- We need new ideas to handle the enormous amount of data at the DCs in the future and to speed up the analyses by avoiding the RINEX handling in the processing (IGS Pilot Project)
- RINEX will be reduced to an input format for DCs, the output formats should be binary
- @IGS: This approach requires precise orbits for LEO-PNT satellites