

GNSS data in SWEPOS

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In august 2016 SWEPOS consists of more than 370 permanent reference stations that provides GNSS data for both real-time and post processing applications. The stations are connected to the control centre in Gävle over private tcp/ip connections and 1 Hz data from GNSS receivers is streamed over the connection. In addition to the SWEPOS owned stations, real-time data from almost 70 external stations owned and operated by other organizations, both in Sweden and in neighboring countries is used. Data for these stations comes from Ntrip casters over internet. The data has many uses. It is used for real time services from SWEPOS (network RTK and DGNS) and also for services from other providers. A large number of rawdata files in RINEX format are produced. Over 30 000 files with observed data in different formats are handled every day. The stations are equipped with a mix of different receiver types from Javad, Leica and Trimble

Real-time data

All incoming data-streams normally go through a single server called StreamServer1. If the server goes offline, an active backup server, Streamserver2 automatically takes over.

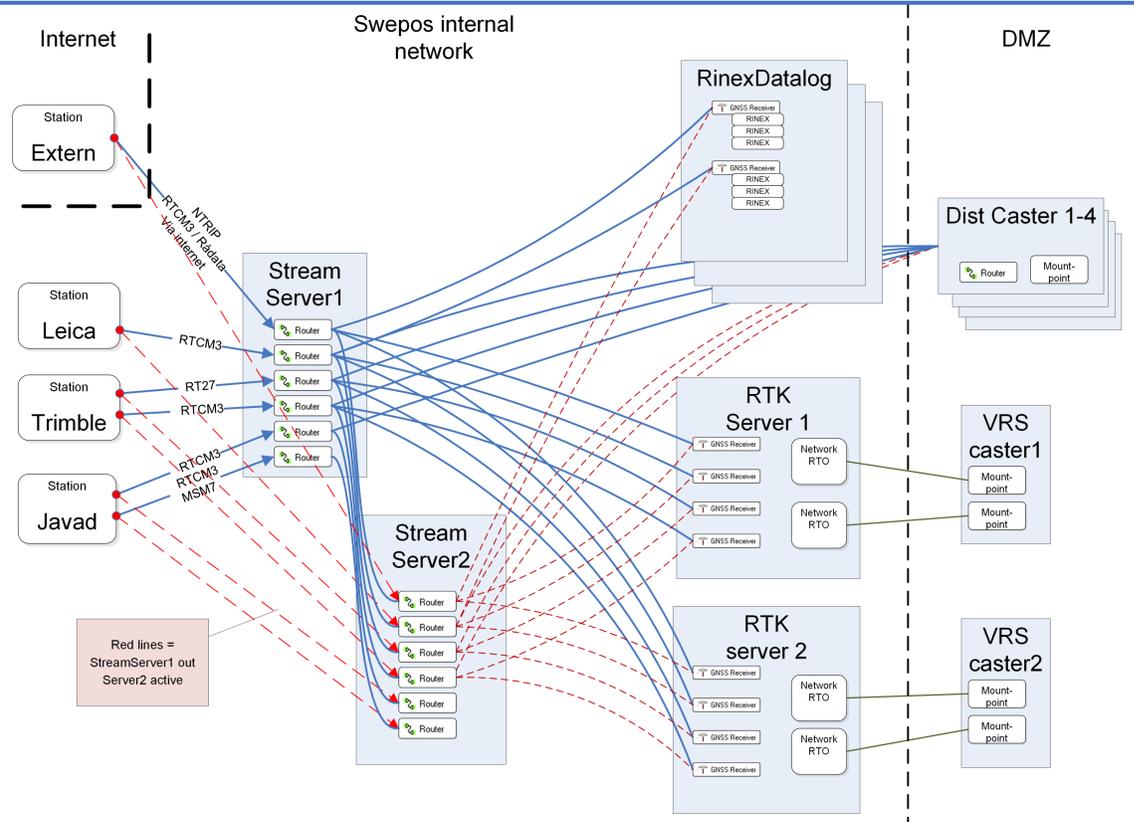
From all stations there is at least one stream with RTCM3 data for GPS and GLONASS (Message type 1004/1012). This is the format that is used for distribution to other service providers.

Most stations also send a stream with data for newer satellite systems in RTCM3 MSM7 or Trimble RT27 format.

From StreamServer different servers and applications can access the same data. There are three major uses for the data.

- Storage of data for post processing in RINEX
- Input to SWEPOS network RTK service
- Distribution of real time data to other service providers in Sweden and neighboring countries and to Euref regional broadcaster

The real-time data is also used by the Ionospheric monitor on SWEPOS webpage.



RINEX data for post processing:

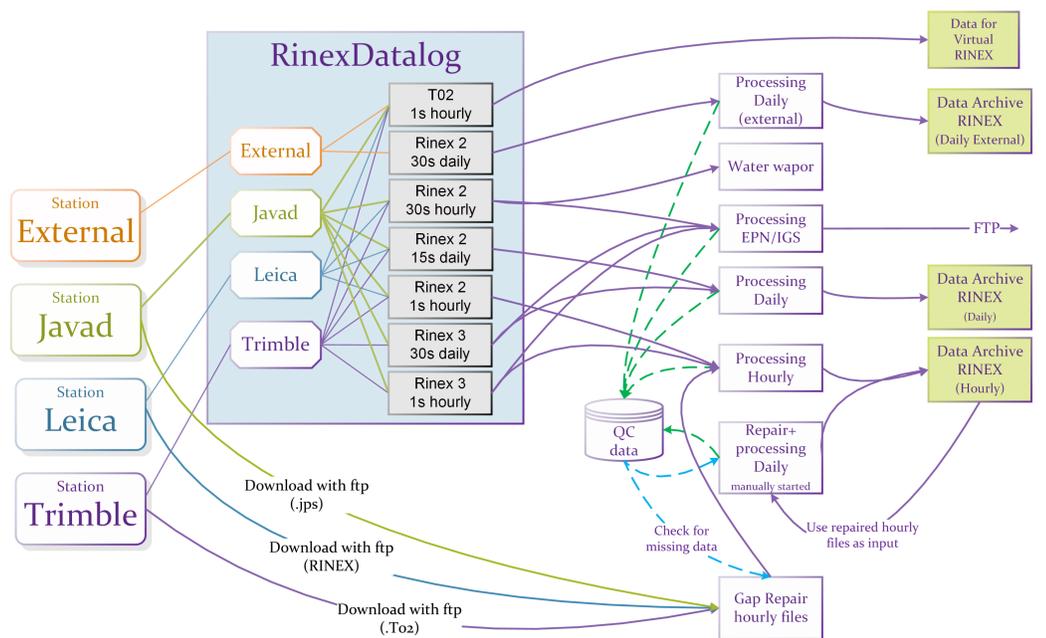
Data is normally stored to RINEX files from real-time streams using Trimble software TPP (Trimble Pivot Platform).

Data is also stored in the receivers at the stations. If data is missing in files logged from streamed data for a station (e.g. after problems with a connection to a station), complete data can be downloaded from the receiver and converted to RINEX.

Input format to TPP on the RinexDatalog server is RTCM3 (GPS+GLONASS only) from Leica receivers, from Javad receivers the format is RTCM3 MSM7 and from Trimble receivers proprietary format RT27 is used.

Several files with different interval, length and format is written in parallel for the same station.

- The primary format for SWEPOS stations is RINEX 2.11, hourly files with 1s interval and daily files with 15s interval. These RINEX files are available in an online archive that users can access with ftp. The RINEX files are also stored on two archive tapes as backup.
- Hourly 30s files for water vapor calculation. The files are removed after usage.
- Hourly and daily 30s files that are used for delivery to EPN
- For external stations daily 30s files are saved. The files are only used for stability monitoring in the daily processing of all stations with Bernese software.
- Besides RINEX files, hourly files in Trimble binary format T02 are also stored. The files are together with stored troposphere and ionosphere corrections used to create Virtual Rinex



Quality check and processing of the files:

At the end of each hour a number of activities start to move and process the files. The processing is divided on several servers that share the work.

- The files are first moved from the RinexDatalog server to one of the servers performing the work.
- The RINEX header is then edited with information from a reference station database.
- In the next step files are checked for completeness and some other parameters (e.g. MP1/MP2, signal strength) with teqc software. These parameters are also saved to a database.
- The files are first Hatanaka compressed and then further compressed to .zip or .gz format depending on what type of file it is.
- In the last step the files are moved to the file archive. EPN/IGS station files are automatically uploaded to EPN datacenters with ftp.

If a file is incomplete an automatic process will download data from a GNSS-receiver, and process it in the same steps. This data will then then replace the file with missing data

Ongoing development:

- RINEX 3 format- Almost all receivers in SWEPOS are capable of tracking all new satellite systems. For full use of the data it must be saved in RINEX3 format. In a test phase RINEX 3.0.2 hourly and daily files are today stored from 15 stations, the plan is to have RINEX 3.0.3 available from all SWEPOS stations before the end of 2016.
- The teqc software that is used to check RINEX 2.11 is not possible to use for RINEX 3 files. GNUT/ANUBIS developed at Geodetic Observatory Pecny (GOP) and BNC from BKG are considered as alternatives but further tests are needed.
- With increasing number of stations, observation types and file types the time to process all files is increasing. The scripts that handle the data processing are currently being rewritten to be more efficient