GUIDELINES FOR EPOS-GNSS STATIONS AND OPERATIONAL CENTRES

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Available from the M³G-Bureau at https://gnss-metadata.eu/Guidelines/
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Updates:
Created: February 13, 2017
Updated:
July 17, 2017
- Moved more requirements to 'desired'
- Introduce M³G-bureau
- Clarify difference between OC, Station owner, and Data supplier

Jan. 23, 2018: Reflect decisions taken at WP10 meeting in Coimbra (15-16/01/2018)
- Only antenna calibration is mandatory (not antenna+radome)
- Information on 'deviation of true north' is not mandatory, but recommended for insertion in the station log
- Removed the submission of station pictures and individual antenna calibrations to the M³G-Bureau because this functionality is not active yet

Feb. 2, 2018: Revision of "Data Center/Node" and "Agency" terminology.
Feb. 19, 2018: Revision of "Data Supplier/OC" terminology.

GNSS stations participating to EPOS-GNSS must agree to adhere to certain standards and conventions which ensure the quality of the EPOS-GNSS services and data products.

*This document lists the **requirements** that **EPOS-GNSS Tracking Stations** and **Operational Centres** (OC) should follow, as well as some additional desirable characteristics, which are not mandatory, but enhance a station's or OC's value to EPOS-GNSS.*

CONTENTS

1 Network Components

GNSS Station: Permanent GNSS tracking receivers and antennae.

Data Supplier: The EPOS Data Supplier is the legal contact of the GNSS tracking station w.r.t. EPOS. It has the legal rights to distribute the GNSS data of the tracking station to a third party through EPOS. The Data Supplier signs the EPOS Data Supplier Letter.
Mostly, the Station Owner acts as Data supplier. If this is not the case, EPOS supposes the existence of an agreement between both to assure that the agency acting as Data Supplier has the rights to sign the EPOS Data Supplier Letter on behalf of the agency of the Station Owner.

Operational Centre (OC): The Operational Centre maintains the GNSS station metadata (e.g. site log, antenna calibrations, site pictures,…) within EPOS. It also performs conversion of raw GNSS data to the Receiver Independent Exchange Format (RINEX), and data upload to the agreed-upon EPOS-GNSS data node.
Mostly, the Station Owner acts as Operational Centre. If this is not the case, EPOS supposes the existence of an agreement between both to assure that the agency acting as Operational Centre has the rights to act in EPOS on behalf of the agency of the Station Owner .

Data Centre (DC): Physical location of the GNSS station observation/navigation data.

Data Node (DN): Virtualisation layer on top of one (or more) Data Centre(s). Using the GLASS software, the Data Node makes the GNSS station data at Data Centres (or data repositories) discoverable at the EPOS-GNSS data gateway.

M3G-Bureau: Receives the EPOS-GNSS station metadata, validates it and provides it to EPOS-GNSS; receives and validates the Operational Centre Forms, which indicate for each station the responsible persons who are allowed to submit site log updates. Collects also station pictures and individual antenna calibrations (*not available yet*).

Data Gateway (DGW): Provides access to the metadata and data from the EPOS-GNSS stations.

Data Monitoring Centre (DMC): Monitors EPOS-GNSS station observation data quality and metadata consistency and provides feedback to station operators (*not available yet*).

2 Requirements for Permanent Stations

EPOS-GNSS stations should fulfil the guidelines below.

2.1 Equipment

Receiver

The GNSS receiver must

2.1.1 Be known to the International GNSS Service (IGS), meaning a standard name must be available.

2.1.2 Record GPS phase and code measurements from at least two frequencies.

Antenna and Radome

2.1.3 The antenna (+radome, if any) must be known to the IGS, meaning a standard name must be available for both the antenna and radome.

2.1.4 Antenna calibrations must be available for the antenna (+radome, if any). These calibrations should be type mean calibrations available from the IGS phase centre variation file or individual antenna calibrations (performed by a calibration facility recognized by the IGS and available on-line).

2.1.5 The eccentricities (easting, northing, height) from the marker to the antenna reference point (ARP, defined for each antenna) must be surveyed and reported in the station log and RINEX headers to ≤ 1 mm accuracy.

2.1.6 The antenna must oriented to True North using the defined antenna reference marker (see vendor instructions).

2.1.7 The antenna must be rigidly and securely attached to the top of the station monument.

2.2 Marker and Monument

2.2.1 The station should not be moved to a different monument unless absolutely necessary. Moving to a new monument would require that a new station be established with a separate station ID and station log. This new station will then have to follow again the "Procedure for Including GNSS Stations in EPOS".

2.2.2 If upgrading a station from a bad monument design to a better antenna mount, involving moving the original marker, then the upgrade is essentially the commissioning of a new station.

2.3 New Stations

In addition to 2.1 - 2.2, new stations should respect the requirements below.

2.3.1 New stations can only be integrated in EPOS-GNSS after following the "Procedure for Including GNSS Stations in EPOS".

2.3.2 The station location should not

- suffer from significant changes to the surroundings (changes to buildings or trees; new construction, etc…) foreseen or likely
- have excessive radio frequency interference
- have excessive RF reflective surfaces (fences, walls, etc.) and other sources of signal multipath
- have excessive natural or man-made surface vibrations from ocean waves or heavy vehicular traffic.

2.3.3 The station monument

- is conform with current best practices. A drilled-braced tripod structure or tapered pillar type monument are typically constructed. Roof or structure mounted antennas should be avoided when possible.
- foundation shall extend to bedrock or be deeply embedded into the stable subsurface and isolated from surface effects where bedrock is not accessible.

2.3.4 Co-location with other geodetic techniques such as SLR, VLBI, DORIS, absolute or superconducting gravimeters, Earth tide gravimeters, seismometers, strain meters, and ocean tide gauges are also desirable and will enhance the value of the station for multi-disciplinary studies.

2.4 Recommended characteristics

Receiver

2.4.1 The receiver should track as many satellites, healthy and unhealthy (all-in-view tracking), from as many constellations as possible (within receiver limitations), always including all GPS satellites as a minimum.

2.4.2 The receiver should track satellites down to a cut off of 0°. The receiver cut off must be indicated in the station log and provided to the M³G-Bureau at each change.

2.4.3 The receivers shall be upgraded with firmware upgrades from the manufacturer within 6 months of the firmware publication. Firmware updates shall be noted in the station log and provided to the M³G-Bureau at each change.

2.4.4 Disable pseudorange and/or phase smoothing. If activated by mistake, any changes in the receiver setting shall be reported in the station log.

Antenna

2.4.5 It is recommended that antenna+radome calibrations are available. These calibrations should be type mean calibrations available from the IGS phase centre variation file or individual antenna calibrations (performed by a calibration facility recognized by the IGS and available on-line).

2.4.6 It is recommended to document any deviations of the antenna with respect to the True North in the station log.

2.4.7 If available, new individual absolute antenna calibrations for an antenna+radome pair have to be made available on-line prior to installing the antenna+radome pair or including the station into the EPOS-GNSS network.

2.4.8 The antenna must be setup to minimize code and phase reflections (multipath), by mounting it away from close reflecting surfaces or by applying some passive protection directly below the antenna (microwave absorbing material, etc).

2.4.9 It is recommended to clean the antenna (without changing its position or removing it!) at least once a year. During wintertime, remove snow coverage as frequently as possible. Report the cleaning in the station log.

Obstructions and interferences

2.4.10 Obstruction should be minimal above 5° elevation, but satellite visibility at lower elevations is encouraged whenever possible.

2.4.11 Signal reception quality has to be verified by counting the number of observations on each frequency that is set to be tracked. A reduced number of observations can indicate interference of external signal sources like radars.

Marker documentation

2.4.12 The marker description should be fully documented in the EPOS-GNSS station log file.

2.4.13 The 3-dimensional local ties between the GNSS marker, co-located instrumentation (e.g. DORIS, SLR, VLBI, gravity, tide gauge, levelling) and other monuments should be re-surveyed as frequently as practical (ideally each 2 years) to an accuracy of 1-mm and reported in ITRF:

- The marker → antenna reference point eccentricities should be re-verified during such a survey.
- Repeat the survey after known motion incidents such as earthquakes.

- All survey data, but especially ties to other IERS/IGS/EPN/EPOS-GNSS markers, should be rigorously reduced in a geocentric frame related to ITRF (preferably ITRF itself) and the results be made available in SINEX format, including full variance-covariance information.
- Survey notes and intermediate results of the 3D ties shall be preserved and made available publicly.

3 Requirements for Operational Centres

The Operational Centre controls the station(s) of a particular (local) network from the operational point of view. It is the link between on one hand the stations and on the other hand the EPOS-GNSS Data Nodes and M³G-Bureau.

3.1 Responsibilities

The OC must

3.1.1 Ensure responsibility for reliable data handling and transmission to the relevant EPOS-GNSS Data Nodes(ies) (according to the guidelines in 3.2)

3.1.1 Take appropriate action if the station performance degrades, e.g. the alert/engagement of on-site staff, especially after receiving an alert from the Data Monitoring Centre.

3.1.2 Correct the metadata in the RINEX header (see 3.2.4), or station log (see 3.1.5) as soon as possible, if an inconsistency advisory is received.

3.1.3 Ensure that the GNSS equipment, and its surroundings, is not disturbed or changed unless a clear benefit outweighs the potential for discontinuities in the time series. Accepted disturbances include: equipment failure, planned upgrade of obsolete equipment or vendor-recommended firmware updates

Station Metadata

The OC must

3.1.4 Document changes at the station (or its environment) by updating the station metadata within one business day at the M³G-Bureau.

3.1.5 Correct the station metadata at the M³G-bureau as soon as possible if an advisory of station metadata inconsistencies is received.

Operational Centre Form

The OC must

3.1.6 Maintain the Operational Centre (OC) form at the M³G-Bureau by completing the 'User Profile'. This includes contact information, the list of operated stations and the EPOS-GNSS data nodes to which data are uploaded.

3.1.7 A correctly completed and up-to-date OC form, available at the M³G-Bureau, is a pre-requisite for uploading station metadata!

3.2 Format and Distribution of Hourly and Daily Data

EPOS-GNSS stations make their RINEX data routinely available at a designated EPOS data node.

3.2.1 The station must provide observation files to the designated EPOS-GNSS data in the RINEX format, directly generated from the receiver's native data files.

Check the currently used standard RINEX formats.

Stations tracking more than two frequencies or tracking satellite systems in addition to GPS and GLONASS must submit data files in both the RINEX 2 (dual frequency GPS and GLONASS) and RINEX 3 format (GPS, GLONASS plus other GNSS, SBAS, etc.).

Observation files will normally be exchanged in the Hatanaka Compact form.

- All observation files are then compressed (UNIX compressing .Z – for RINEX 2 format) or gzipped (.gz – for RINEX 3 format).
- The RINEX navigation files are prepared in a compressed (or gzipped) form.
- File naming conventions set forth in the RINEX 2 and 3 format descriptions must be used.

3.2.2 The daily observation files contain the observations collected between GPS time 00:00:00 and 23:59:59.

3.2.3 The hourly observation files data contain the observations collected between GPS time 00:00 and 59:59 of each hour.

3.2.4 RINEX observation header information, especially the station ID, receiver and antenna information, DOMES number (if available), and antenna eccentricities, must be up-to-date and must match the information in the station log. The following conventions are used:

- The 4-character station ID (or 9-character for RINEX 3 data) must be found in the "MARKER NAME" field
- If available, the DOMES number must appear in the "MARKER NUMBER" field.
- The receiver serial number, type and firmware must be found in the "REC # / TYPE / VERS" fields.
- The antenna serial number, antenna type and radome type (if no radome, use "NONE") must be found in the "ANT # / TYPE" fields. If individual calibrations are available, this serial number must be in agreement with the serial number in the individual antenna calibration file.
- The RINEX headers must begin showing an equipment change at the actual time of the change.

Additionally-desired characteristics are:

3.2.5 After a communication outage between the station and the EPOS-GNSS data node, all recovered data files should be submitted to the node as quickly as possible. The usage of automated procedures is strongly recommended. Missed hourly data files should be transmitted only for files less than 3 days old.

3.2.6 The signal-to-noise observables (S1, S2, etc…) should be included in RINEX files.