

EUREF-IP Real-time Data

Current Practice, Challenges, and Future Perspectives

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- EUREF-IP background and status
- EUREF-IP challenges
- EUREF-IP initial future scenarios
- Goals
 - get discussion started;
 - get more/better ideas and requirements;
 - get more people involved, also for implementation(!).

- EUREF-IP pilot project 2002–2007

(https://www.epncb.oma.be/organisation/WG/previous/euref_IP/index.php)

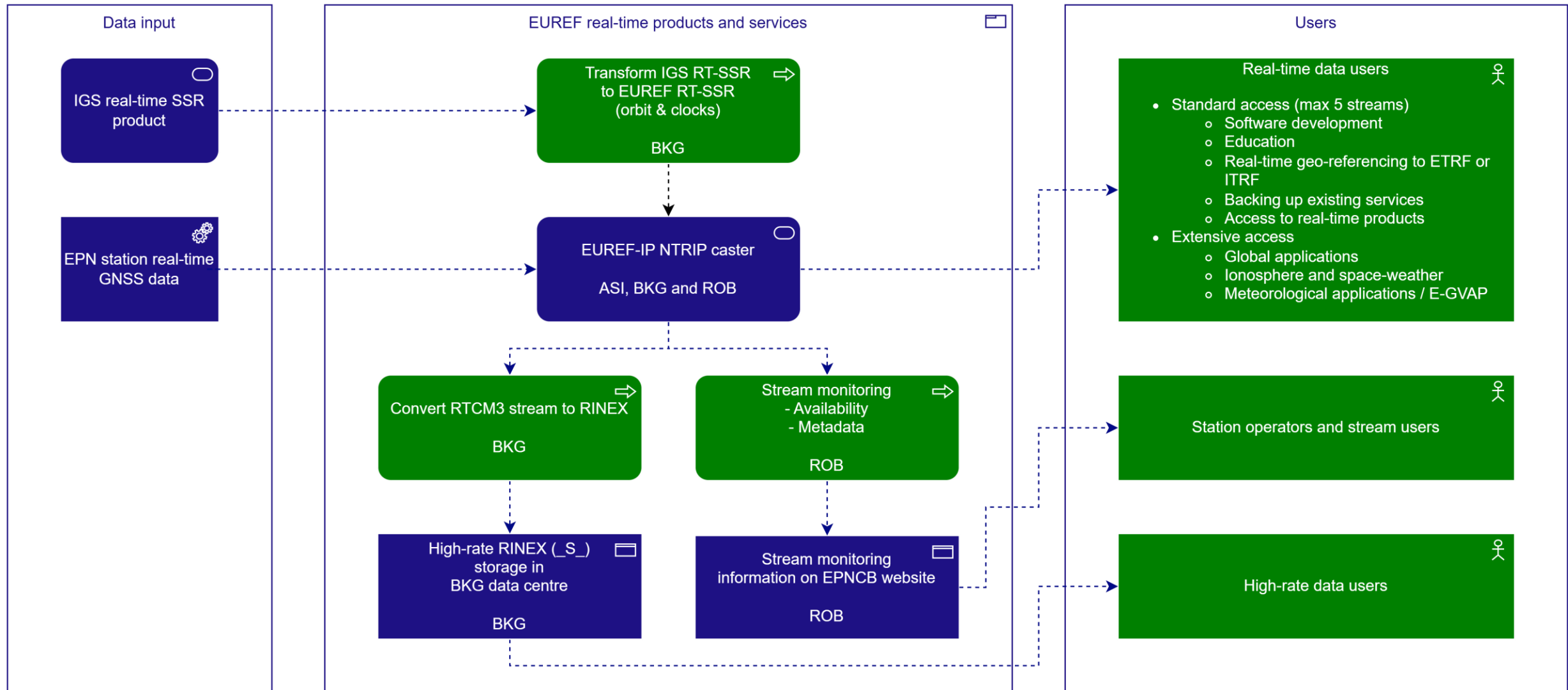
- Evaluate and promote NTRIP for real-time GNSS data transmission and use.
- Establish a well-distributed network of Ntrip Broadcasters for real-time GNSS applications across regions.

- EUREF-IP real-time operation

(https://www.epncb.oma.be/networkdata/data_access/real_time/)

- Integrate real-time data streams into the EPN framework.
- Provide homogeneous Europe-wide real-time access to ETRS89.
- Deliver accurate, reliable GNSS data for GGOS and geophysical/meteorological users.
- Enable new European applications in positioning, navigation, safety, science, and commercial/non-profit domains (e.g. EUREF RT clocks, orbits).
- Implement stream monitoring and validation.
- Support archiving and analysis for near-real-time processing.

Current architecture



- Statistics over 12 months

EUREF-IP caster (last 12 months)	unique_users	unique_ips	used_mountpoints	countries
ASI	79	2817	210	26
BKG	864	12889	232	77
ROB	147	<NA>	225	<NA>

- Many users only active for short time to test
- Large data users are
 - E-GVAP
 - Commercial providers
 - IGS real-time analysis centres (need few stations)
- EUREF orbit and clock products
 - 4 products based on IGS product
 - Maximum 37 users at BKG (ROB: 5, ASI: 1)

Monitoring

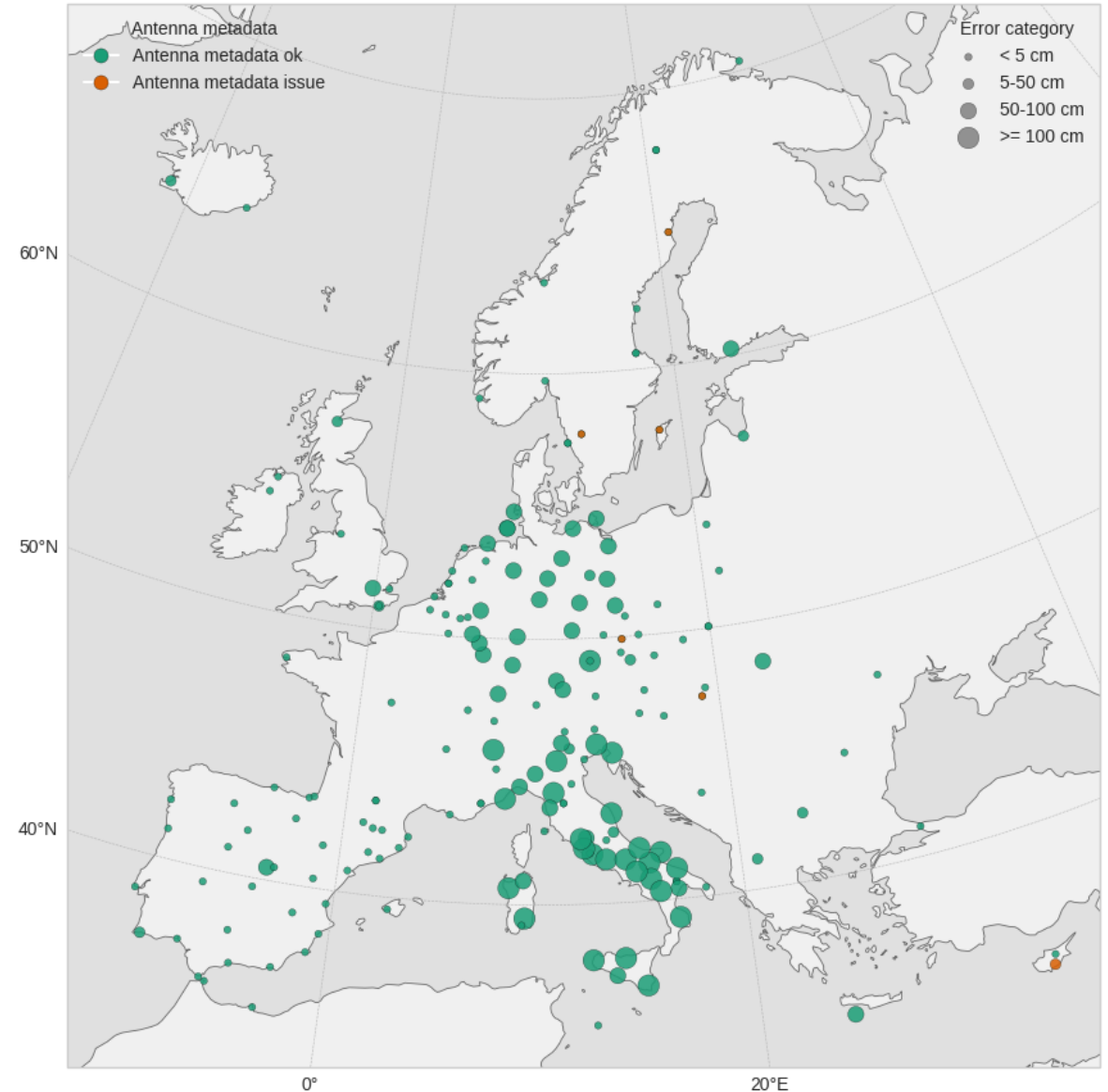
- Stream availability
- Metadata content
 - RTCM messages and interval
 - Receiver type, serial and firmware
 - Antenna type, serial and dome
 - Available constellation
 - Coordinates



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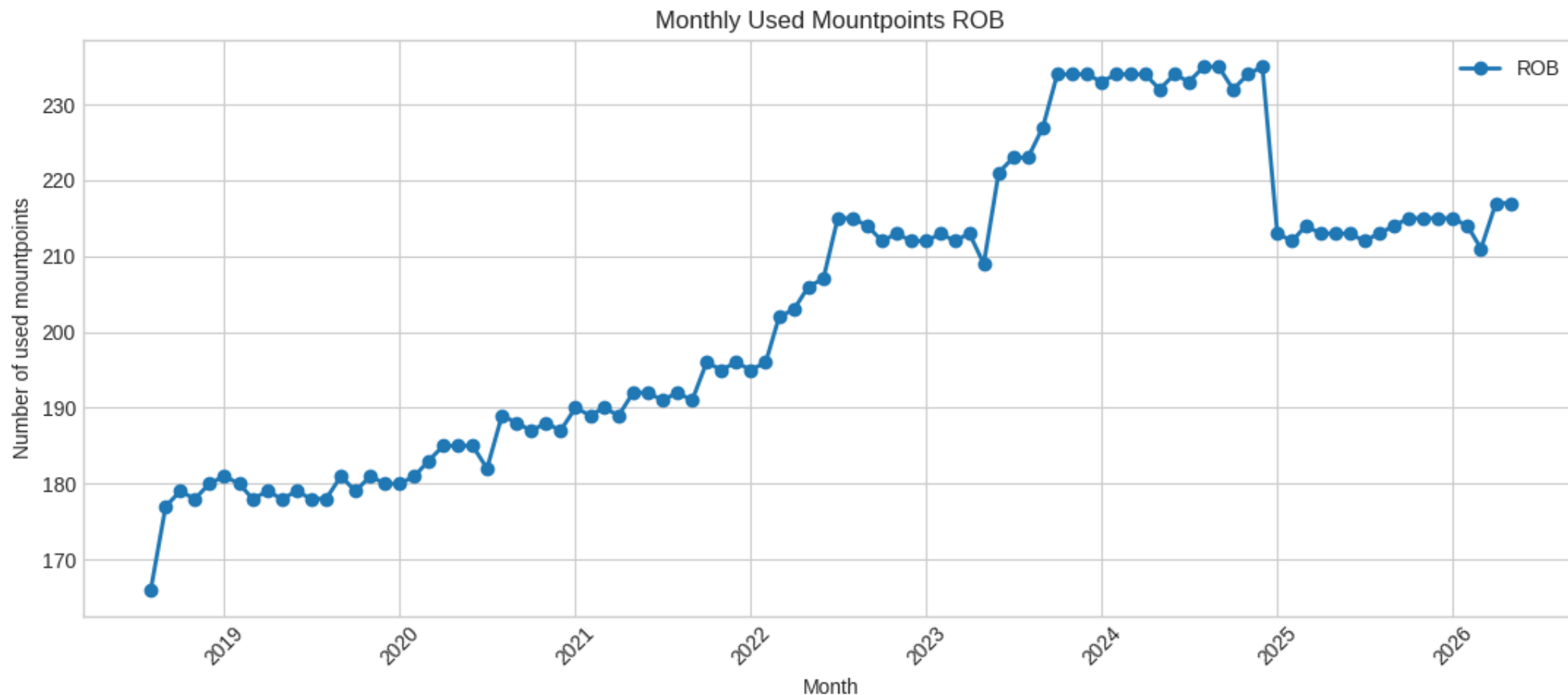
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2D difference between station position in real-time stream and EUREF C2385 for stations on BKG EUREF-IP NTRIP caster in June 2026



- Issues in coordinates and metadata
 - Most of the real-time data streams are belonging to different networks (national, European, global (IGS))
 - must (theoretically) provide (three) different streams with (three) different coordinates
 - Different type of station operators (mapping agencies, research institutes).
 - Not same interest/need in providing accurate ETRS89 coordinates
 - RTCM CRS messages 1300-1302 not really used in station streams
 - EUREF-IP can promote these?
 - NTRIP version 2.1 shall include a new reference to the CRSs:
 - The JSON sourcetable should contain information about the reference system
 - EUREF-IP needs to be prepared?

- Issues in coordinates and metadata
- Data policy on EUREF-IP is not meeting country needs
 - For example Finland, Estonia (see EUREF mails 11966 and 12367)



- Issues in coordinates and metadata
- Data policy on EUREF-IP is not meeting country needs
- Real-time data content not meeting user needs

EUREF-IP users ask for:

- real-time access to national reference frames
- support to configure ntrip clients, receivers and many more
- lost passwords
- problems with RTK fix
- GNSS data for 'random' project
- the reference frame of the coordinates

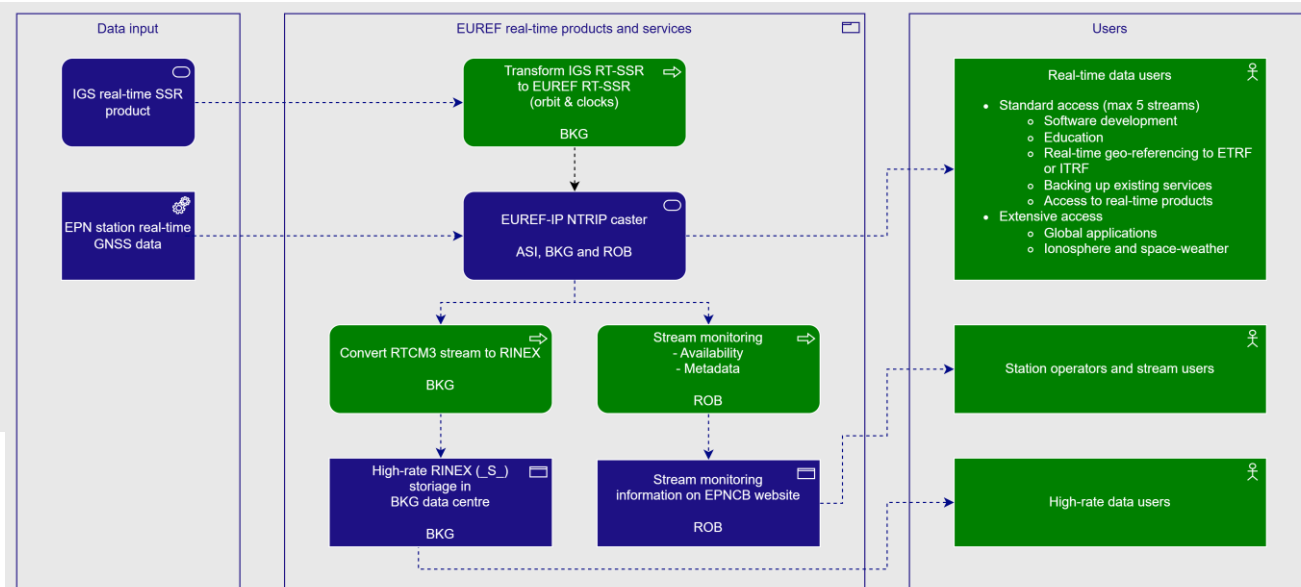
- Issues in coordinates and metadata
- Data policy on EUREF-IP is not meeting country needs
- Real-time data content not meeting user needs
- Real-time data from EPN stations not used for EUREF products
 - Except for monitoring and making the data available

- Issues in coordinates and metadata
- Data policy on EUREF-IP is not meeting country needs
- Real-time data content not meeting user needs
- Real-time data from EPN stations not used for EUREF products
- Data access for large data users, monitoring and high rate RINEX
 - Getting data streams from one central caster is highly preferred over getting data directly from each provider instead (seems to be quite challenging)

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- Real-time data from EPN stations not used for EUREF products
- Data access for large data users, monitoring and high rate RINEX
- Information on real-time data center not available in station metadata
 - not defined in sitelogs
 - is defined in geodesymml
 - implementation in M3G only possible if requirements (and benefits?) are clear

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→ Issues are mainly related to 'Data input' and 'User' columns, not the 'Euref real-time products and services'



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- ✓ • Support archiving and analysis for near-real-time processing.

Ideas on scenarios EPN real-time station data

- Keep EUREF-IP as is
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 - clarify open data policy to station operators;
 - urge station operators to improve the metadata;
 - clarify service level (data is provided as is) to users.
- Only provide streams with correct metadata:
 - block streams with incorrect coordinates / hardware in comparison to EUREF Reference Frame solution and M3G
- Modified EUREF-IP concept:
 - stop real-time data provision (stop EPN casters, decentralized data access);
 - provide central information on how to access data directly from operators instead;
 - keep providing high-rate RINEX and monitoring of metadata based on streams.
- Stop EUREF-IP

- Provide your input to us, especially station operators and users
- Get involved:
 - Each scenario other than keep EUREF-IP as is requires additional work
 - For this work we ask your help
 - Without clear ownership, scenarios cannot be implemented/considered

Backup slides

Ideas on scenarios EPN real-time station data

1. Keep EUREF-IP as is, and:

- clarify open data policy to station operators;
- urge station operators to improve the metadata;
- clarify service level (data is provided as is) to users.

Impact:

- Might lose more real-time stations;
- No real change for users, station and broadcaster operators;
- Low impact for large data users.

2. Only provide streams with correct metadata:

block streams with incorrect coordinates / hardware in comparison to EUREF Reference Frame solution and M3G

Impact:

- Effort to implement;
- Impact for station and broadcast operators (stream unavailability);
- Users can rely on ETRS89 coordinates in stream;
- Could promote new RTCM CRS messages and NTRIP2.1 JSON sourcetable for reference frame metadata

3. Modified EUREF-IP concept:

- stop real-time data provision (stop EPN casters, decentralized data access);
- provide central information on how to access data directly from operators instead;
- keep providing high-rate RINEX and monitoring of metadata based on streams.

Impact:

- User support moves to station operators;
- Effort to implement/maintain EUREF-IP products/services:
 - Providing information on real-time access per station;
 - Modify monitoring system;
 - Access to streams for creating RINEX from streams (_S_);
- Large impact for large data users (no single point of access);
- Does not improve access to ETRS89 for users, but questions go to national operators in stead of EUREF-IP operators.
- Unclear situation with data provision for global (IGS) broadcasters

4. Stop EUREF-IP

EUREF real-time product (https://www.epncb.oma.be/_productsservices/realtimecorrections/):

- EPN real-time network not dense enough for deriving products for cm accuracy
- EUREF-related products are not original EUREF products but derived from global (IGS) products by transformation
 - 14 parameter transformation of combination of orbits corrections from ITRF2020 to ETRF2020
 - Scale induced biases not an issue anymore as scale ITRF2020 = scale ETRF2020

- Alternative product:
 - Use IGS combined product
 - Add transformation message MT1300-1302 to this product instead of applying 14 parameter transformation at broadcaster side
 - This would promote the RTCM messages for reference systems to the EUREF community
 - Allows products free from scale induced bias for ITRF*aaaa* to ETRF*bbbb*
- Implementation
 1. With the SSR corrections information on the system is already sent out.
 2. Next step would be to send out a stream with transformations parameters for ITRF2020 to ETRF*bbbb*.
 - a) Needs the currently valid parameters and
 - b) An ascii format for BNC to read the parameters.
 - a) Finally transform ITRF2020 coordinates from PPP with the transformation parameters into ETRF*bbbb*.

2.9.2.1 Coordinate Reference System (CRS) Support

When expressing a stream record (STR) in JSON a method has been defined to express the frame of reference (the coordinate reference system, or CRS) which the precise antenna phase center location messages are in (MT1005 and MT1006). This work follows the joint RTCM and NMEA development of a common method to document the CRS developed by RTCM SC 104 NMEA working group (WG).

Example:

```
{  
  "mountpoint": "myMountPt",  
  "format": "RTCM3",  
  "format-details": [ "1005(10)", "1004(1)", "1012(1)" ],  
  "identifier": "Dallas, Tx",  
  "country": "USA",  
  "carrier": "2",  
  "service-area": [ "point": { "lat": 12.345, "lon": 45.7890 } ],  
  "nav-sys": [ "GPS", "GLO" ]  
  "CRS": { "Authority": "EPSG.CRS", "Identifier": "10605", "Name": "WGS84 (G2296)", "Epoch": "2024.5" }  
}
```

- EPN real-time station data:
 - EPN real-time streams (56.6% of EPN stations)
 - Conversion to high-rate (not daily) RINEX if not provided by station operator (70 EPN stations)
 - Monitoring metadata of streams
- EUREF real-time SSR product:
 - EUREF Satellite Orbit & Clock Correction Streams (via transformation from global corrections)