Data Flow and Format Issues to Support a Variety of Real-time Services/Applications

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Abstract

IGS announced the upcoming operation of a real-time GNSS service. In the beginning it will comprise the dissemination of precise satellite orbits, clocks and code biases. The intention is to maintain a service free from outages and outliers and deliver products in a standard format so that manufacturers can finally implement their usage in firmware, e.g. for Precise Point Positioning.

The presentation shortly describes the RTCM State Space Representation (SSR) stream format and the Ntrip stream transport protocol used to disseminate our products over the open Internet. It then introduces the real-time network of broadcasters dedicated to enable accessing them. The concepts in place to minimize observation and product outages in the data flow through redundant reference station and Analysis Center resources are explained.

Feeling confident about an uninterrupted IGS real-time service is one pre-condition for making it part of receiver firmware. Following an open data policy with access to products without registration is another one. The presentation shows that the data flow and data formats in place allow reliable world-wide product access with low latencies although based on best effort contributions in kind. The BKG Ntrip Client (BNC) and Tomoji Takasu's RTKLIB are Open Source tools that can be used for real-time PPP applications till broader firmware support of SSR messages is realized.

Future work may include real-time stations from IGS densification networks like Europe's EPN. Considering regional and local atmospheric conditions through additional SSR messages could in the end make PPP an optional alternative to Network RTK.

Contents

- **Involved standards**
- **Broadcaster network**
- **Redundancy concept**
- **Broadcast workload**
- **Client Tools**

RTCM Standards Involved

- **SSR messages for orbit/clock products**
- **High Precision Multiple Signal Messages for observations**
- **Ntrip for stream transport**

RTCM SSR Messages - Concepts

- **SSR messages support**
  - **different applications**
  - **update rates**
  - **accuracy requirements**

- **Basic concepts are**
  - **additional SSR message type adds additional resolution and positioning accuracy**
  - **SSR parameter may consist of different constituents**
  - **disseminated in different SSR message types**
  - **all relevant information without dependencies (as far as possible)**

- **SSR consistency essential issue**
  - **due to correlation state parameters**
  - **consistent set of parameters defines complete and accurate correction**
  - **importance increases with resolution and additional messages**

- **SSR Update Interval and GNSS epoch time**
  - **defines change of parameters (i.e. at the end of a SSR Update Intervals)**
  - **ensures consistency of data and processing**

RTCM SSR Messages
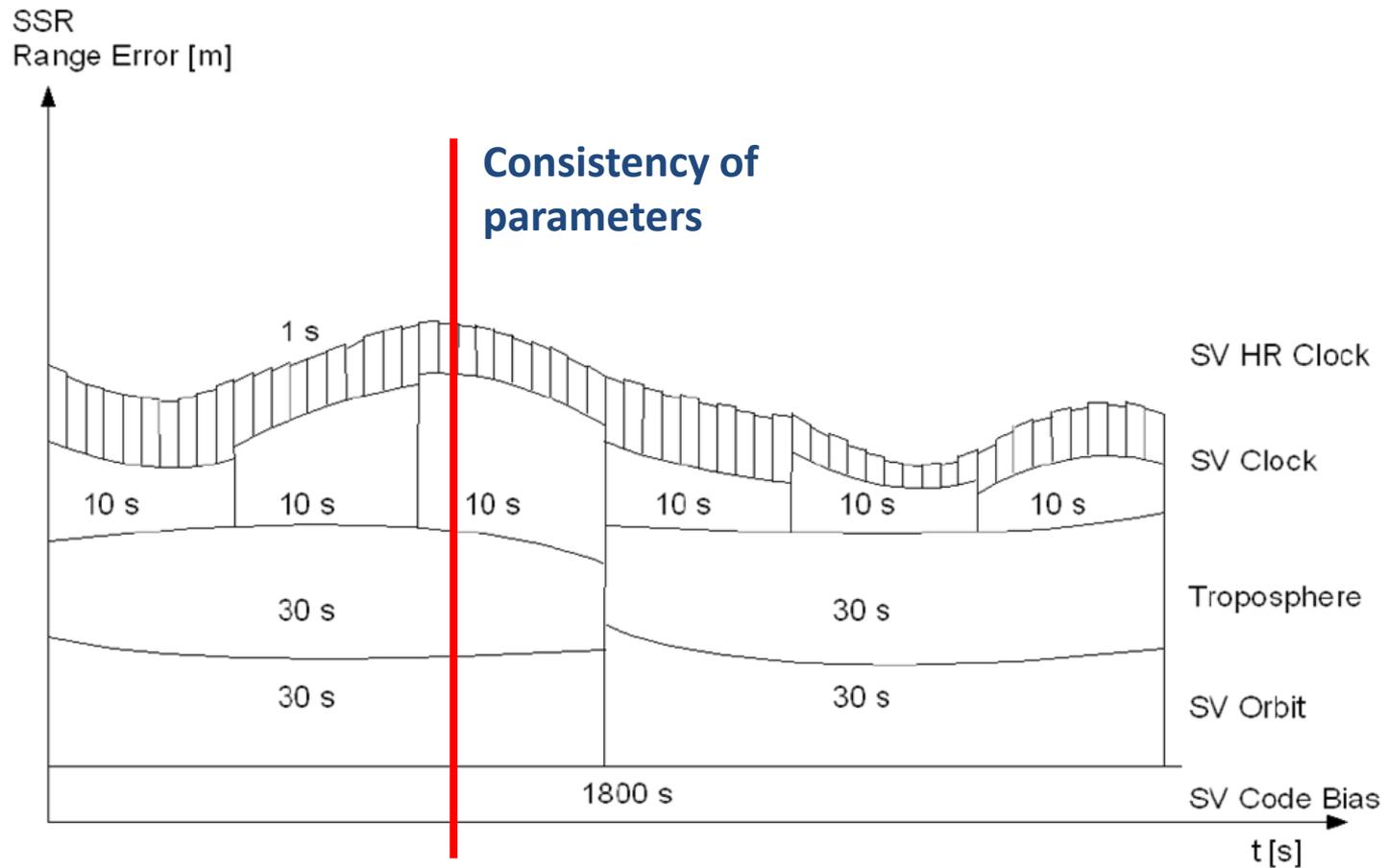
RTCM SSR Messages

- **Type 1057, GPS orbit corrections to Broadcast Ephemeris**
- **Type 1058, GPS clock corrections to Broadcast Ephemeris**
- **Type 1059, GPS code biases**
- **Type 1060, Combined orbit and clock corrections to GPS Broadcast Ephemeris**
- **Type 1061, GPS User Range Accuracy (URA)**
- **Type 1062, High-rate GPS clock corrections to Broadcast Ephemeris**

- **Type 1063, GLONASS orbit corrections to Broadcast Ephemeris**
- **Type 1064, GLONASS clock corrections to Broadcast Ephemeris**
- **Type 1065, GLONASS code biases**
- **Type 1066, Combined orbit and clock corrections to GLONASS Broadcast Ephemeris**
- **Type 1067, GLONASS User Range Accuracy (URA)**
- **Type 1068, High-rate GLONASS clock corrections to Broadcast Ephemeris**
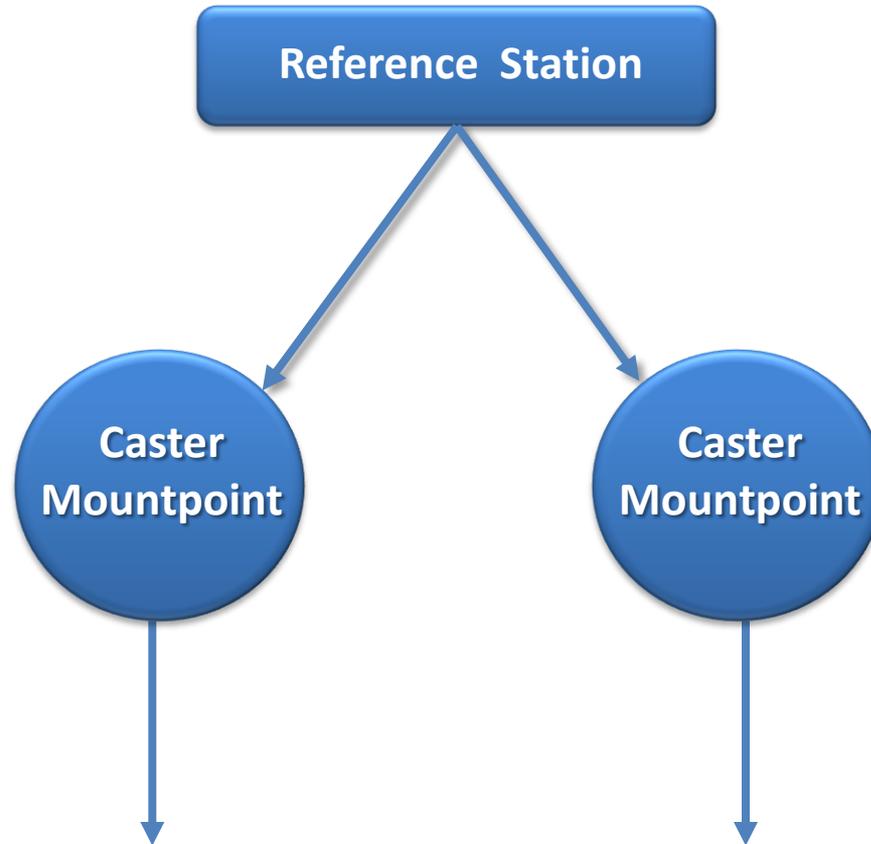
RTCM SSR Messages - Plans

- **SSR messages compliant to existing GPS, GLONASS messages (orbit, clock, code bias, URA) for**
  - **SSR Galileo Messages
    (requires e.g. decision on the two Galileo clocks)**
  - **SSR QZSS Messages**

- **SSR Phase Bias Messages for all supported GNSS**
  - **demand from users of RTCM SSR Messages**
  - **supports use of phase observations**
  - **requires e.g. standardization of satellite orientation (yaw)**
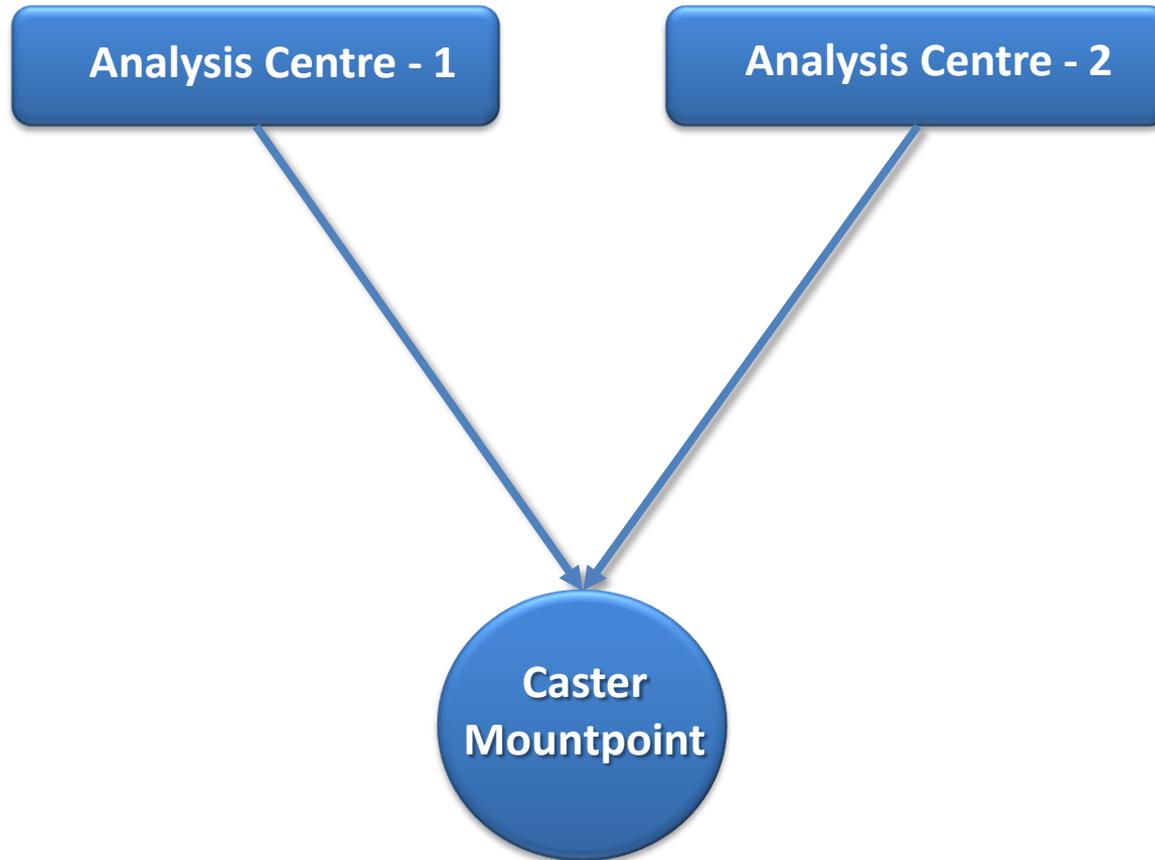
Ntrip Broadcast Concept
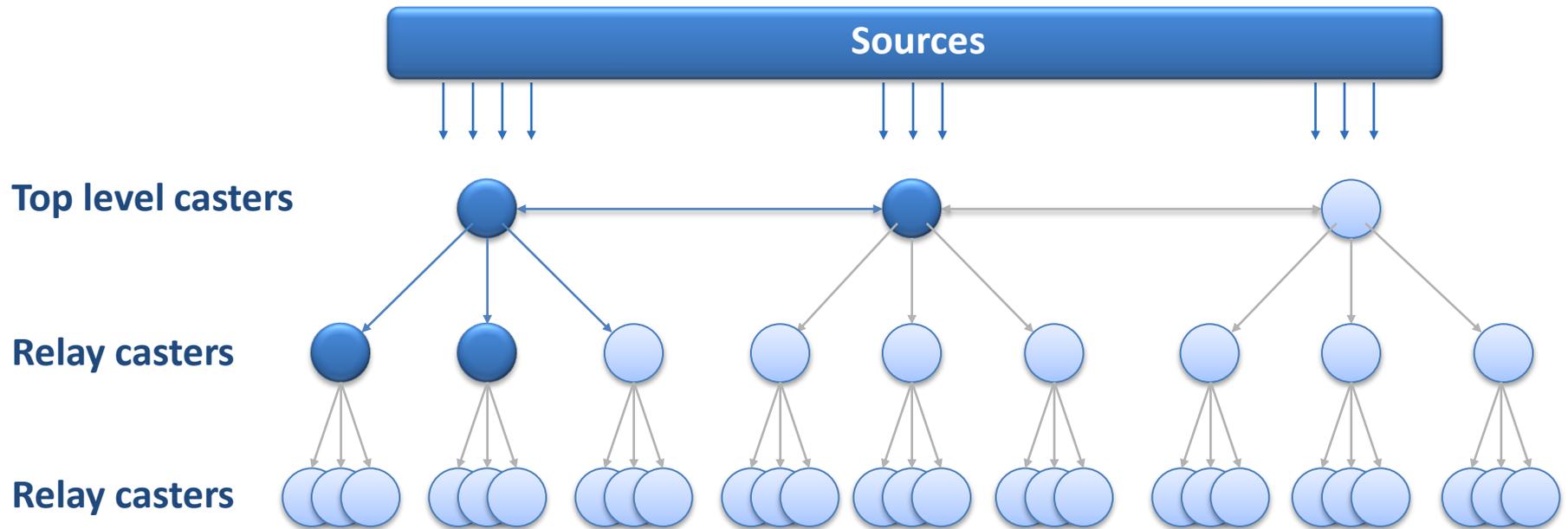
Redundancy in Observation Upload

Redundancy in Product Delivery

24/7 Real-time Product Data Flow

Analysis Centres

AC-1 AC-2 *AC-3* AC-n

Combination Centers

COMBI-1 Backup-1 COMBI-2 Backup-2 COMBI-3 Backup-3

NtripCasters

IGS01 IGS02 IGS03   IGS01 IGS02 IGS03

NtripClients

Rover Rover Rover   Rover Rover Rover
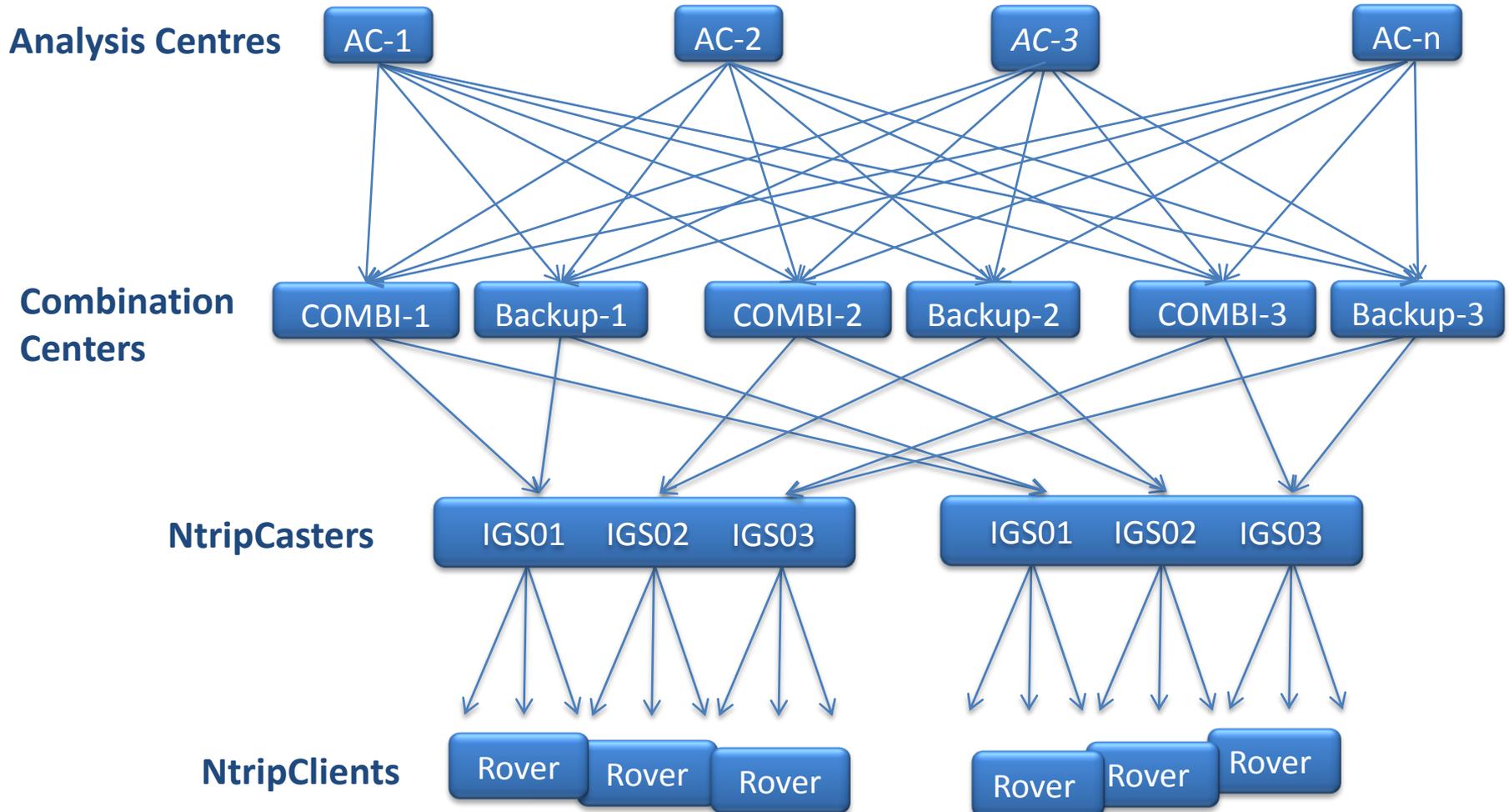
IGS Casters

Agency	Country	URL:Port
BKG	Germany	www.igs-ip.net:2101
BKG	Germany	products.igs-ip.net:2101
CNES	France	178.33.109.250:2101
GA	Australia	192.104.43.25:2101
GFZ	Germany	139.17.3.112:4080
GMV	Spain	igs-ip.gmv.com:2101
IGSCB	USA	www.igs.org:2101
Wuhan	China	ntrip.gnsslab.cn:2101

Caster Workload

Listeners on Casters dedicated to EUREF & IGS - (c) BKG

24h Sliding Window, last epoch 12-07-17 17:19:04 UTC
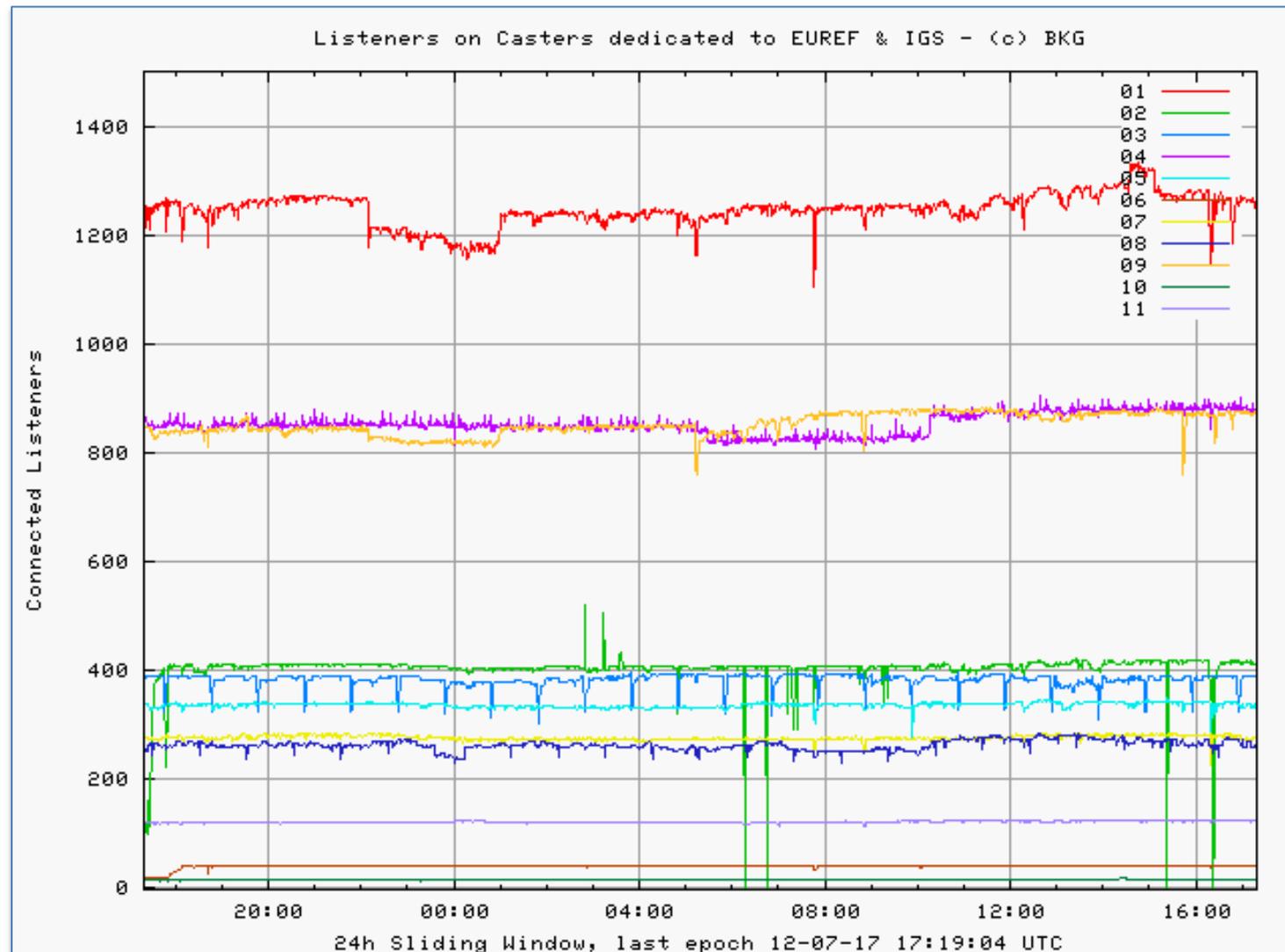
Monthly Streamed Volume

Legend:
- Observations, www.igs-ip.net
- Orbits/clocks, products.igs-ip.net
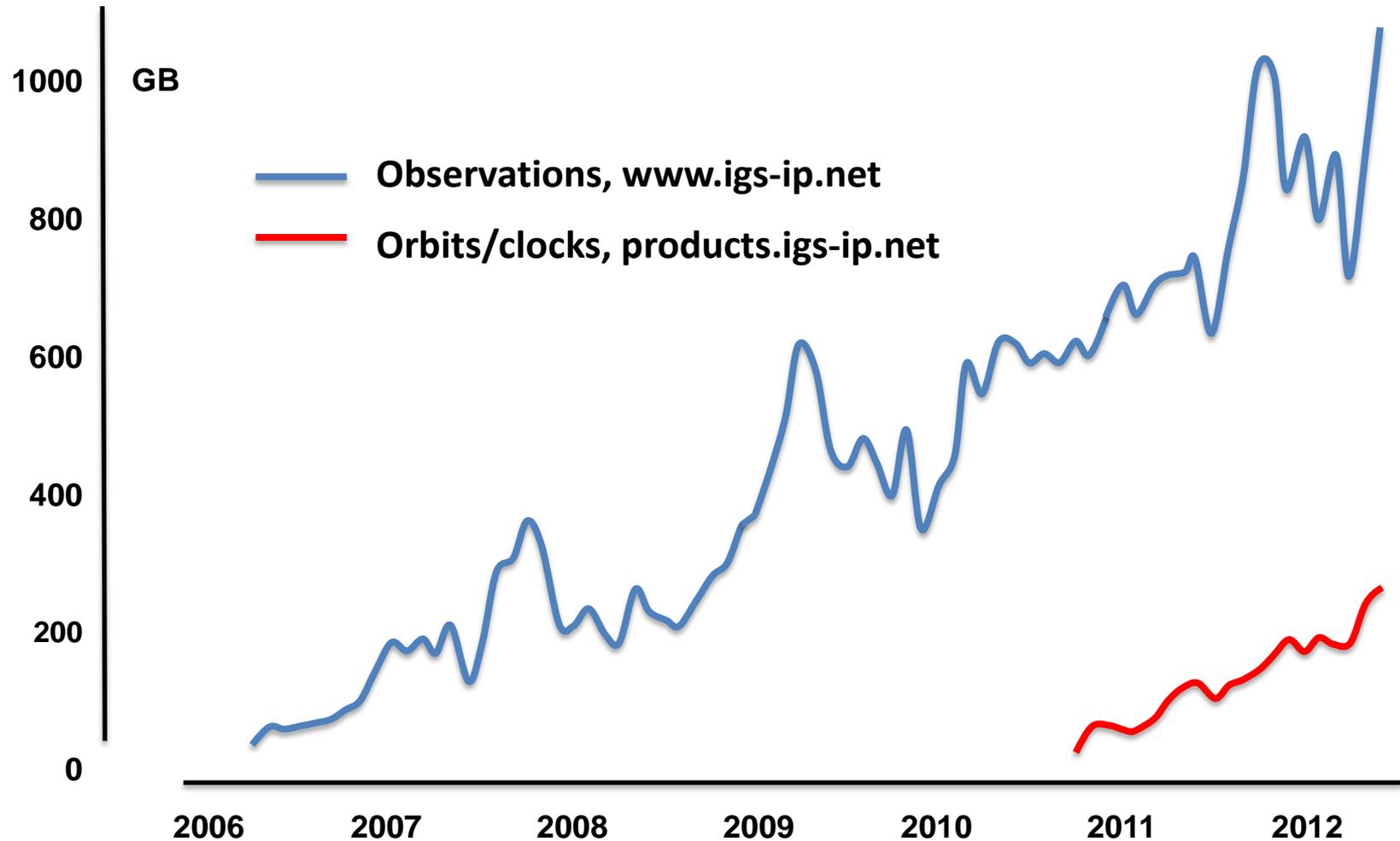
Registrations & Applications

2012-03-06 # 1577	**Denmark**	**National survey and cadastre is testing PPP solutions with the BKG software BNC and the opensource program RTKLib.**
2012-03-03 # 1576	**Indonesia**	**We would like to use these innovations to enhance the accuracy of our GNSS equipment for Topographic mapping and mining exploration.**
2012-02-29 # 1575	**Poland**	**Research related to real time GNSS signal processing using PPP methods. Algorithms development for GNSS software receiver operating in real time using external IGS and own products.**
2012-02-28 # 1574	**Germany**	**Develop high precision navigation in agriculture with simple receiver technics and low end antenna to develop new products.**
2012-02-28 # 1573	**Canada**	**We are a receiver manufacturer. We design and manufacture OEM GNSS positioning cards for a wide variety of applications. We also have post processing and real-time software products. Our primary interest in this data is for interoperability testing of RTCM messages.**
2012-02-24 # 1572	**Norway**	**Tests and evaluation of GPS and software in a workshop. We use GPS receivers for marine in Dynamic Positioning Systems and Integrated bridge systems for offshore vessels.**
2012-02-24 # 1571	**Germany**	**Locate and document the course of sewer pipes. To find the points we use a radio detection system and Mobile Mapper 100.**

Extract from http://igs.bkg.bund.de/ntrip/applications

Stream Access Control

- **Open Data Policy**

- **Observations: Registration required**

- **Products: No registration for combination streams**

- **Client SW: Disclaimer, no warranty, no guaranty**

Client Tools Supporting SSR Messages

BKG Ntrip Client, BNC, Open Source

    - http://software.rtcm-ntrip.org/svn/trunk/BNC

RTKLIB, Tomoji Takasu, Open Source

    - http://www.rtklib.com

So far no support of IGS Real-time products in receiver firmware

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