



Federal Agency for
Cartography and Geodesy

Latency and Redundancy Aspects of Real-Time Data and Products

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Motivation

- **(Martín et al., 2015) reported the delays in IGS RTS single products, e.g. CLK11, as well as the large delays in combined products, e.g. IGS03, and the consequences for kinematic PPP**

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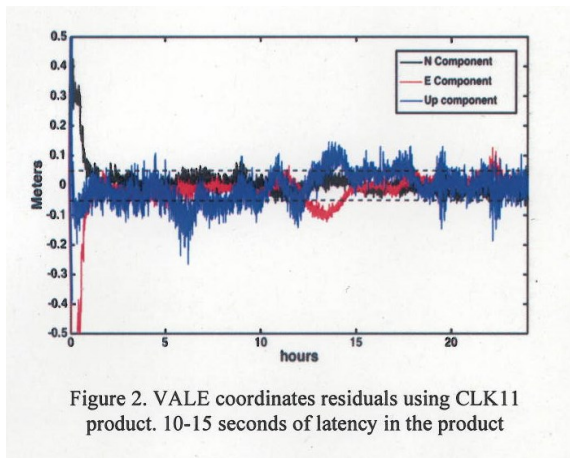


Figure 2. VALE coordinates residuals using CLK11 product. 10-15 seconds of latency in the product

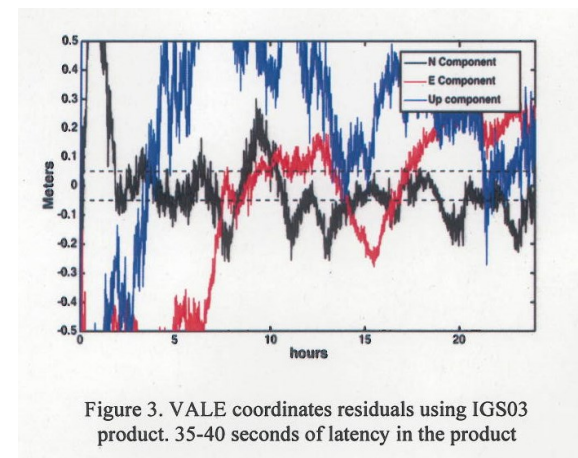
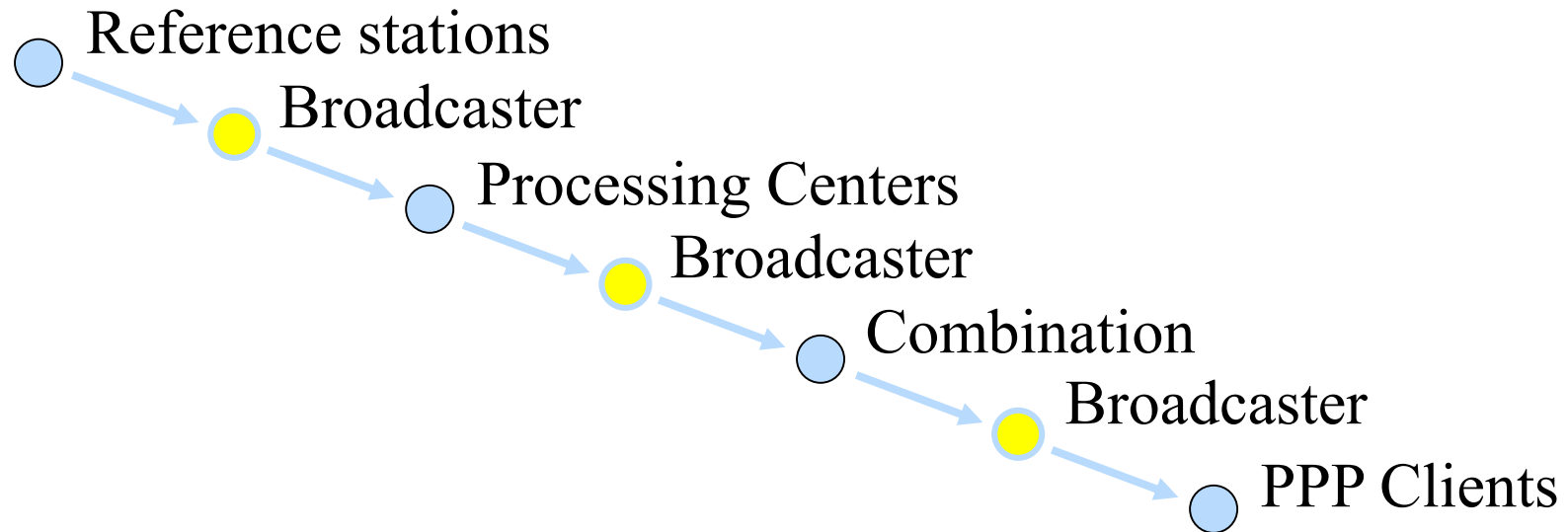


Figure 3. VALE coordinates residuals using IGS03 product. 35-40 seconds of latency in the product

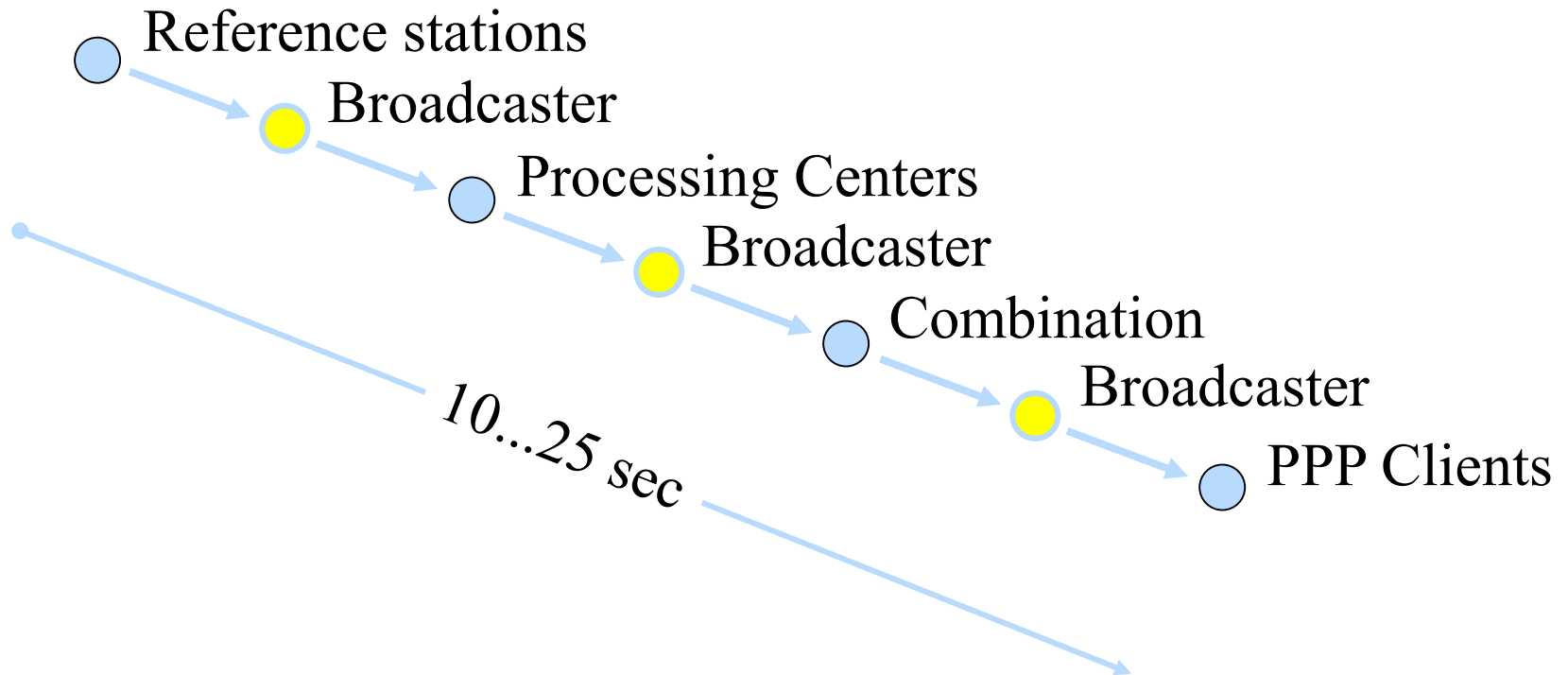
Motivation

- **(Martín et al., 2015) reported the delays in IGS RTS single products, e.g. CLK11, as well as the large delays in combined products, e.g. IGS03, and the consequences for kinematic PPP**
- **Review of complete processing chain to identify the main time consumers**
- **Examples for reducing the delay**
- **Review the status of the redundancy concept developed by EUREF**

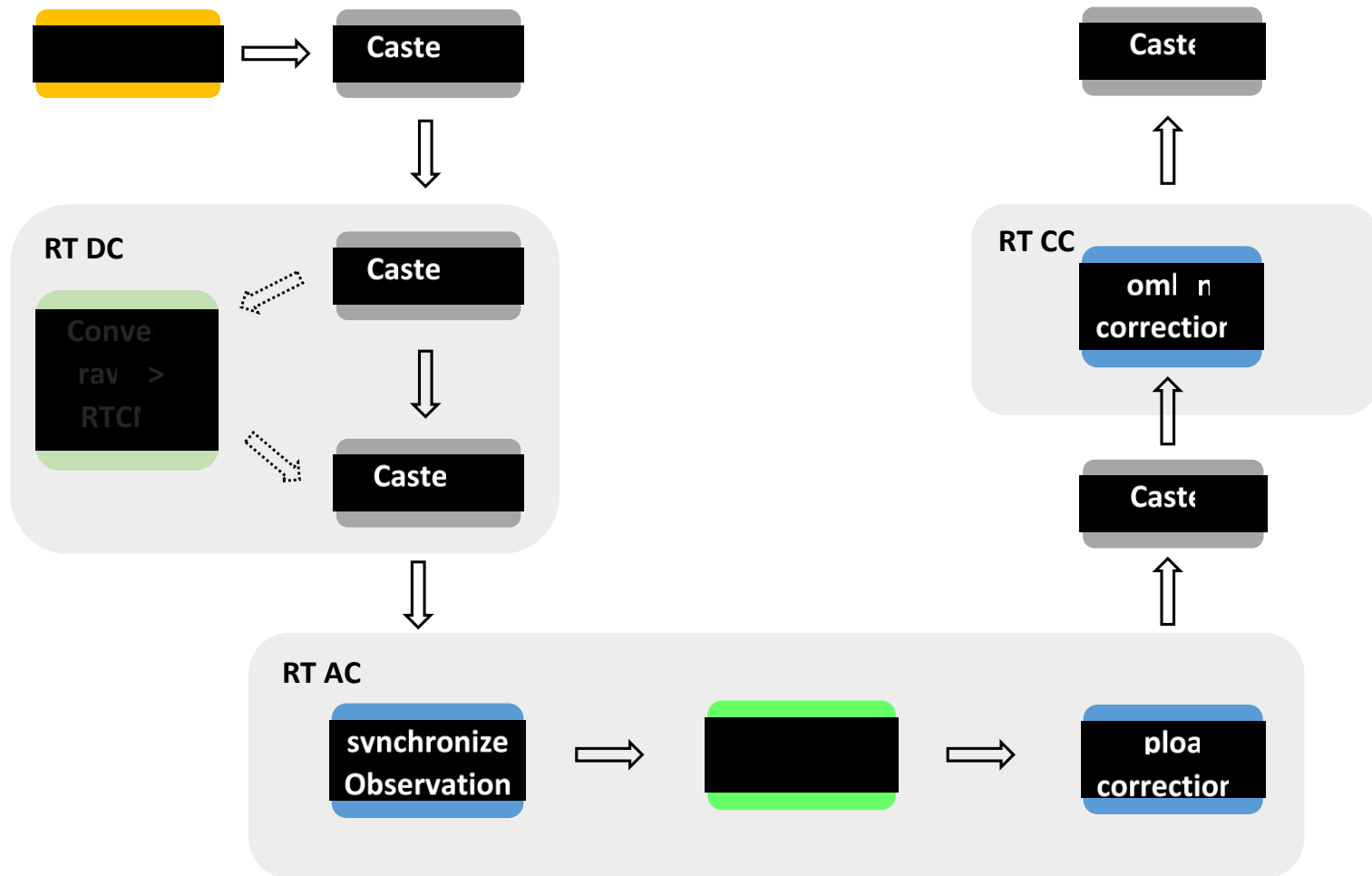
Processing chain of real-time GNSS processing



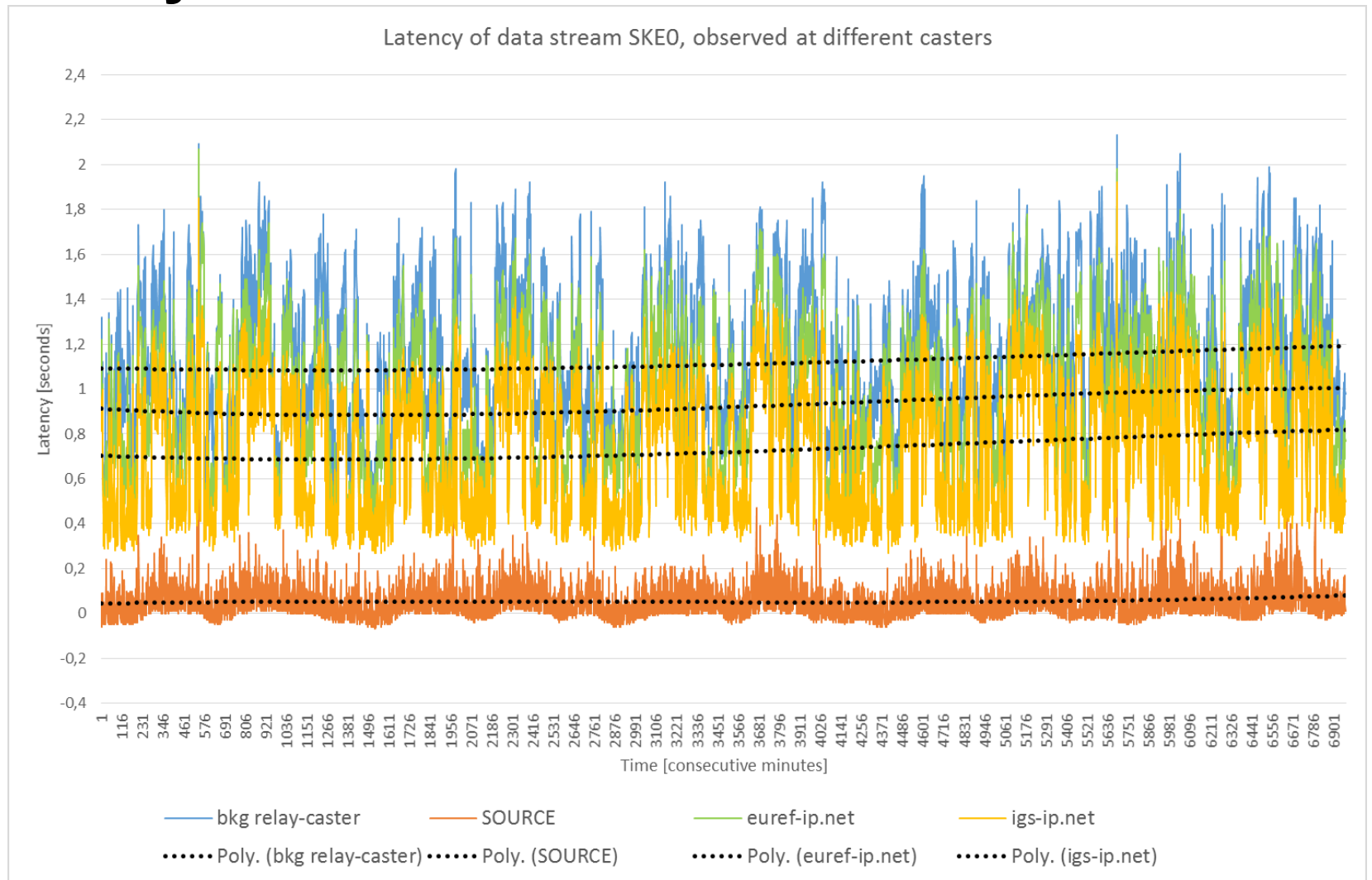
Processing chain of real-time GNSS processing



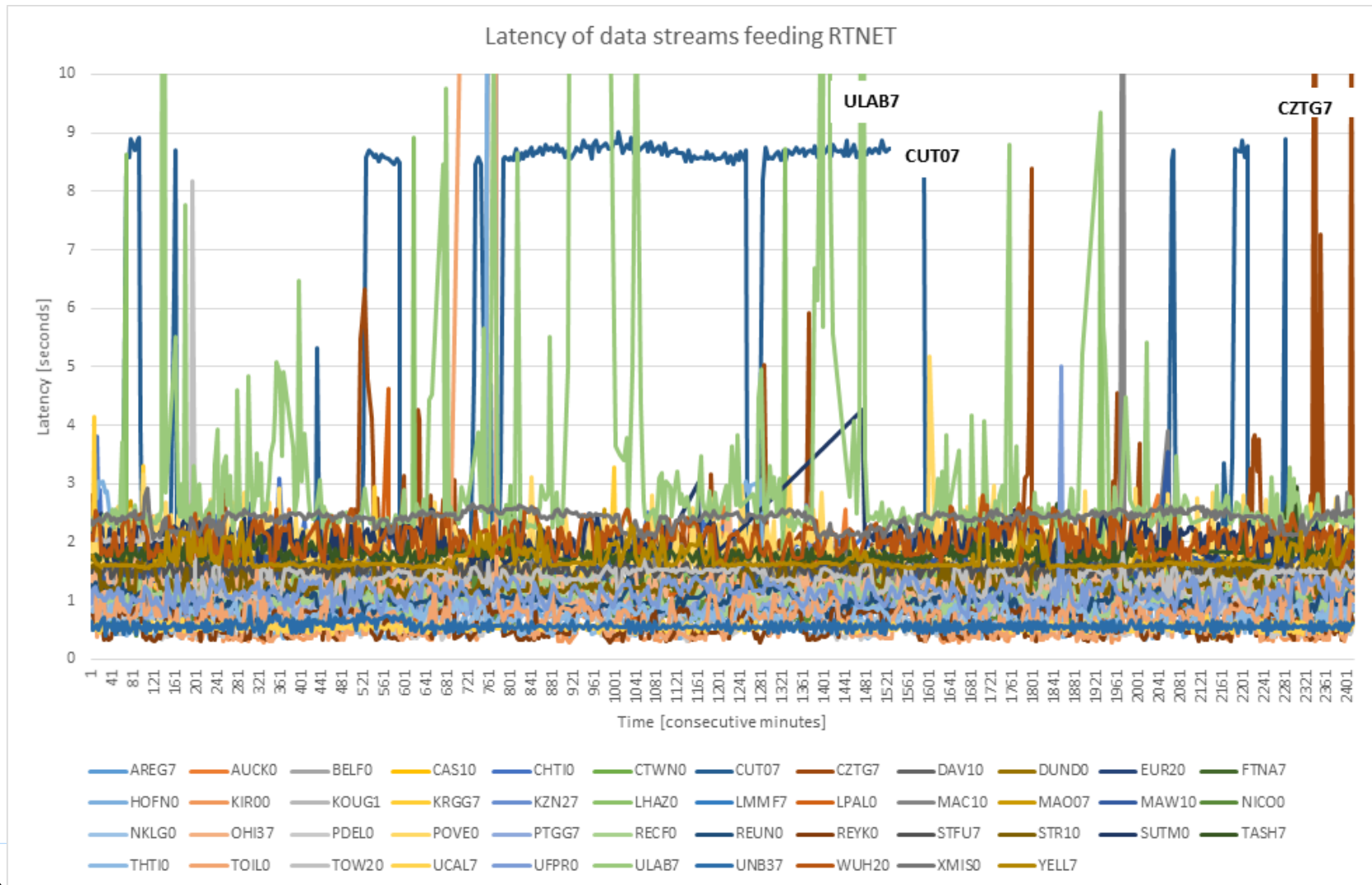
Processing chain of real-time GNSS processing



Latency of real-time observations

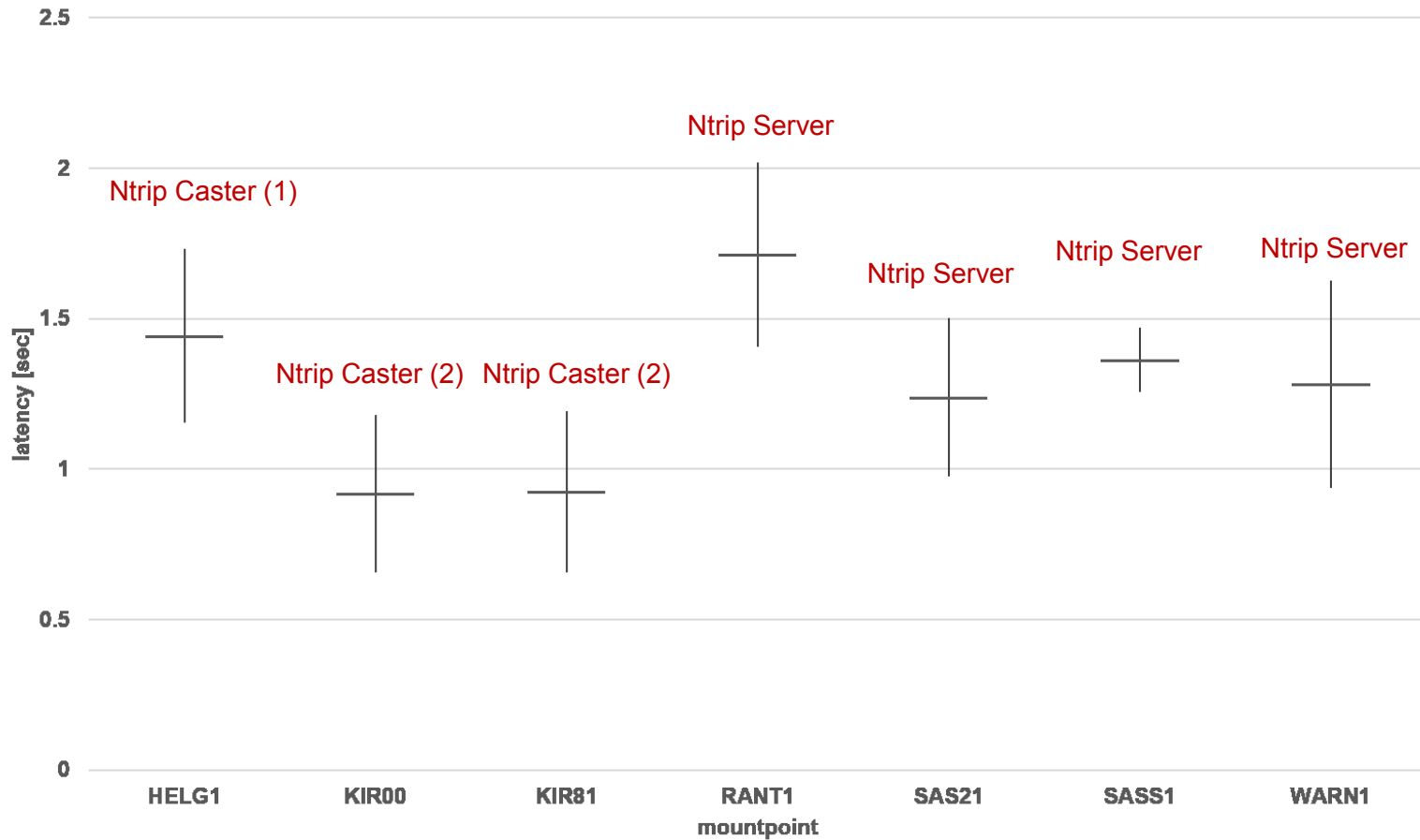


Latency of real-time observations



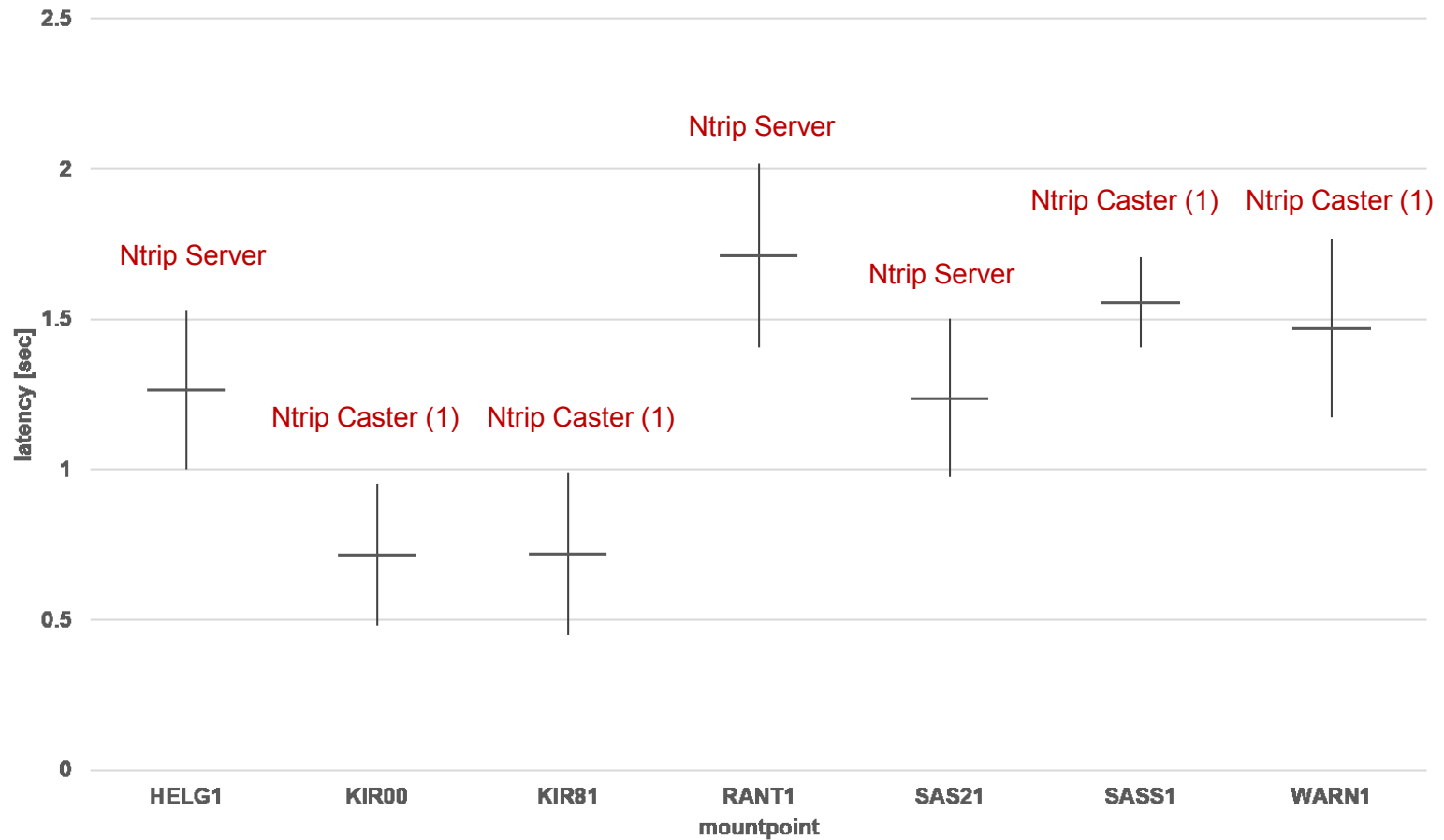
Latency of real-time observations

BNC2.12: latency of observation streams
(mean over 5 min, for 24 hours (2016-May-12/13))



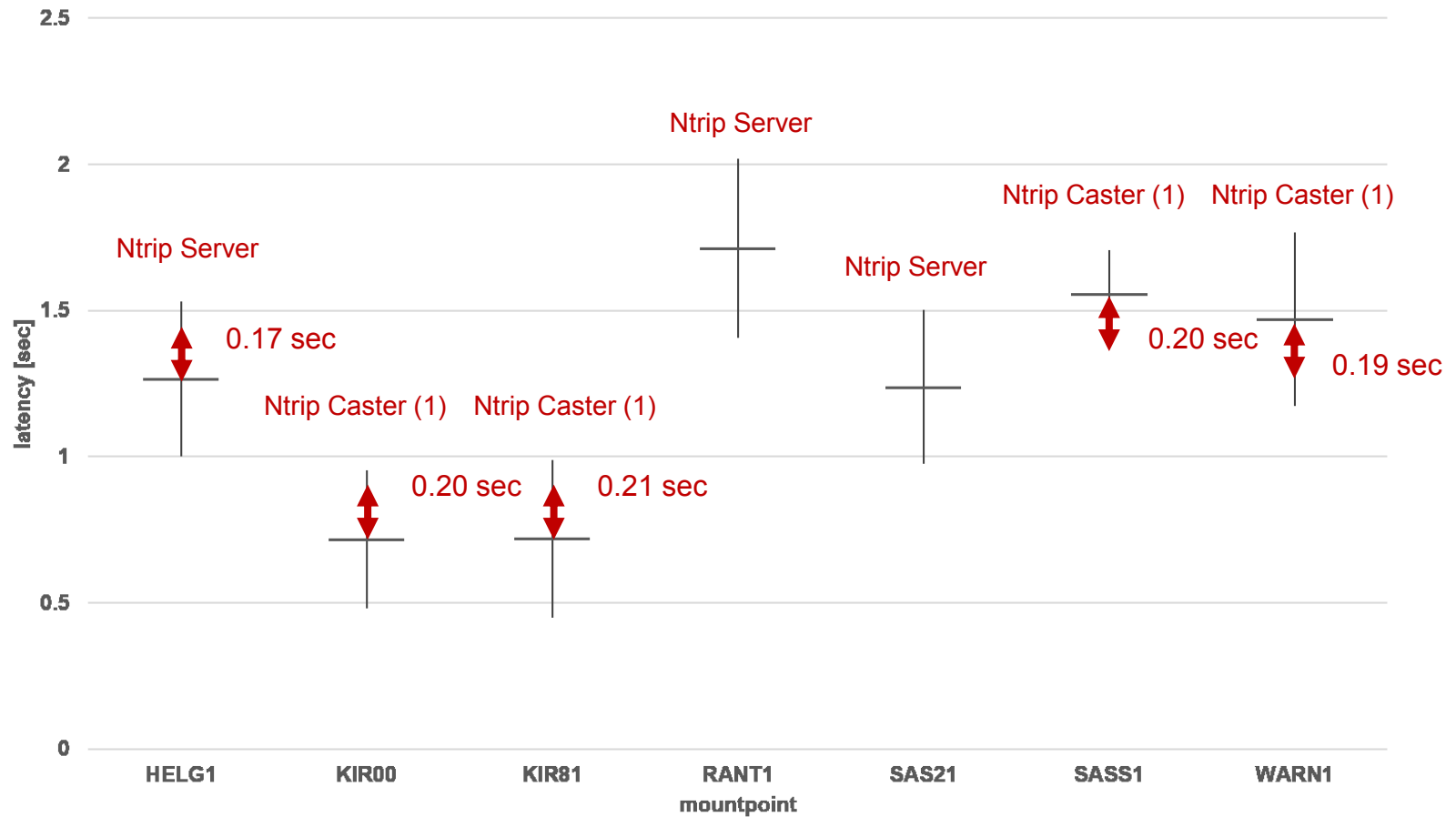
Latency of real-time observations

BNC2.12: latency of observation streams
(mean over 5 min, for 24 hours (2016-May-12/13))



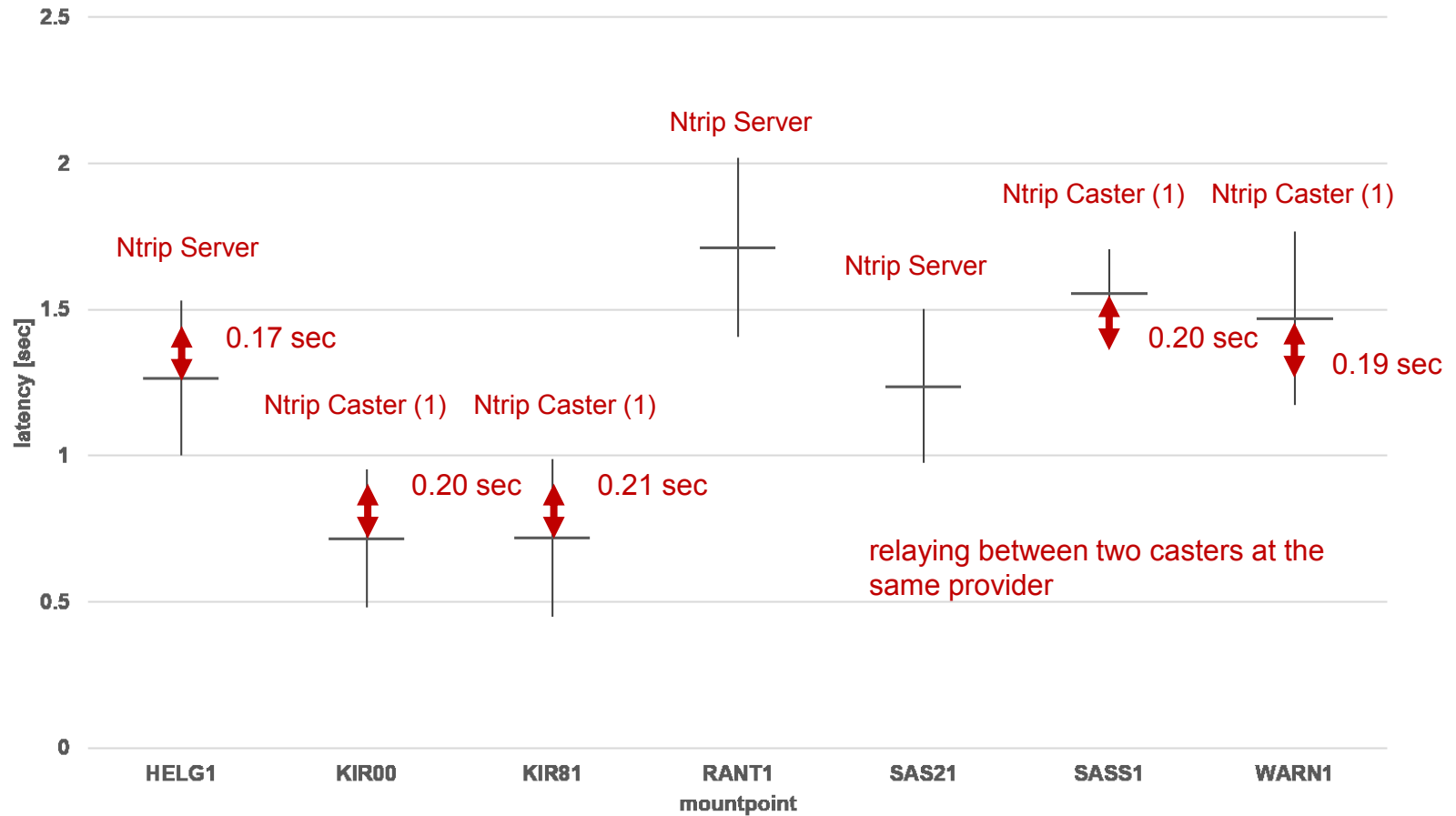
Latency of real-time observations

BNC2.12: latency of observation streams
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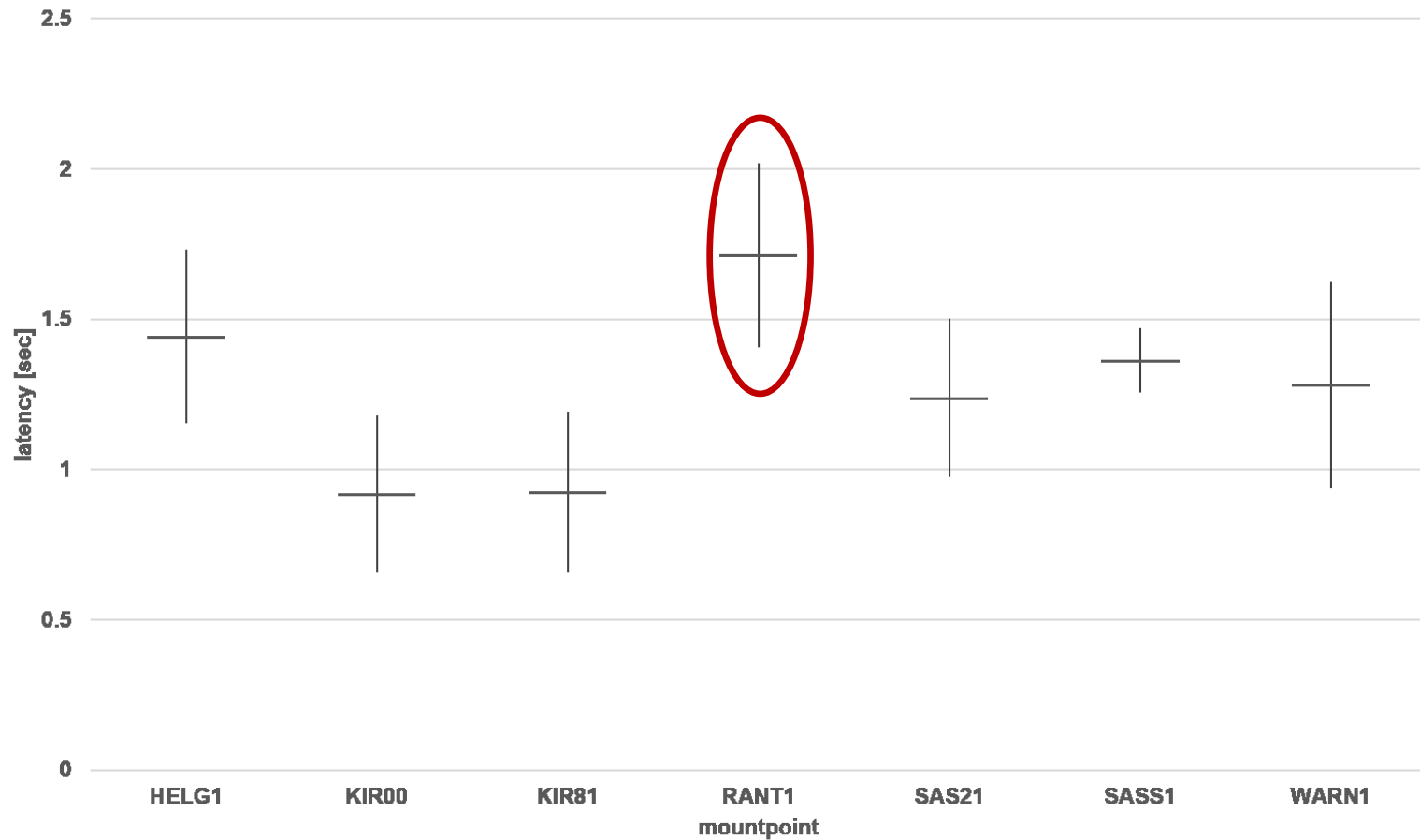
Latency of real-time observations

BNC2.12: latency of observation streams
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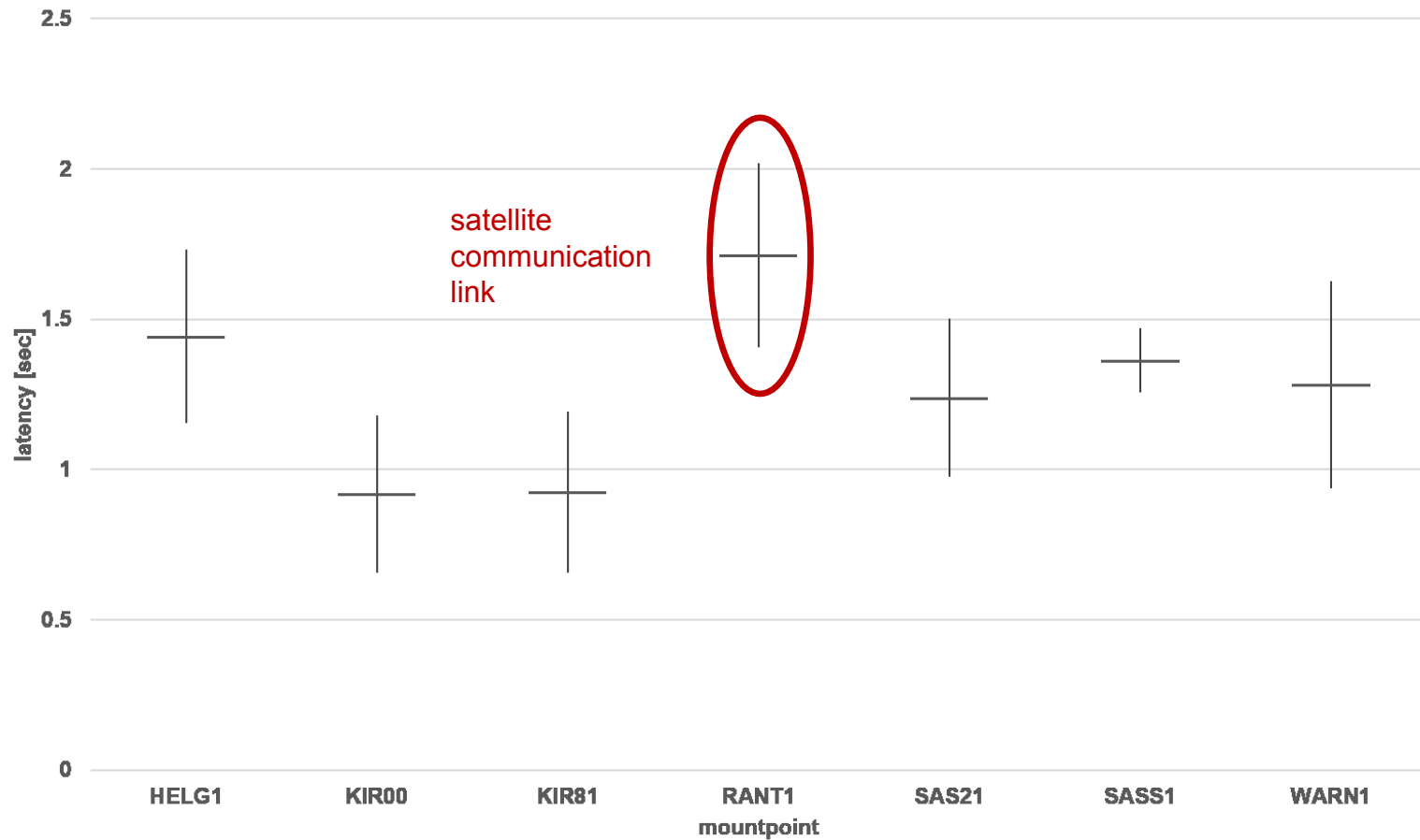
Latency of real-time observations

BNC2.12: latency of observation streams
(mean over 5 min, for 24 hours (2016-May-12/13))

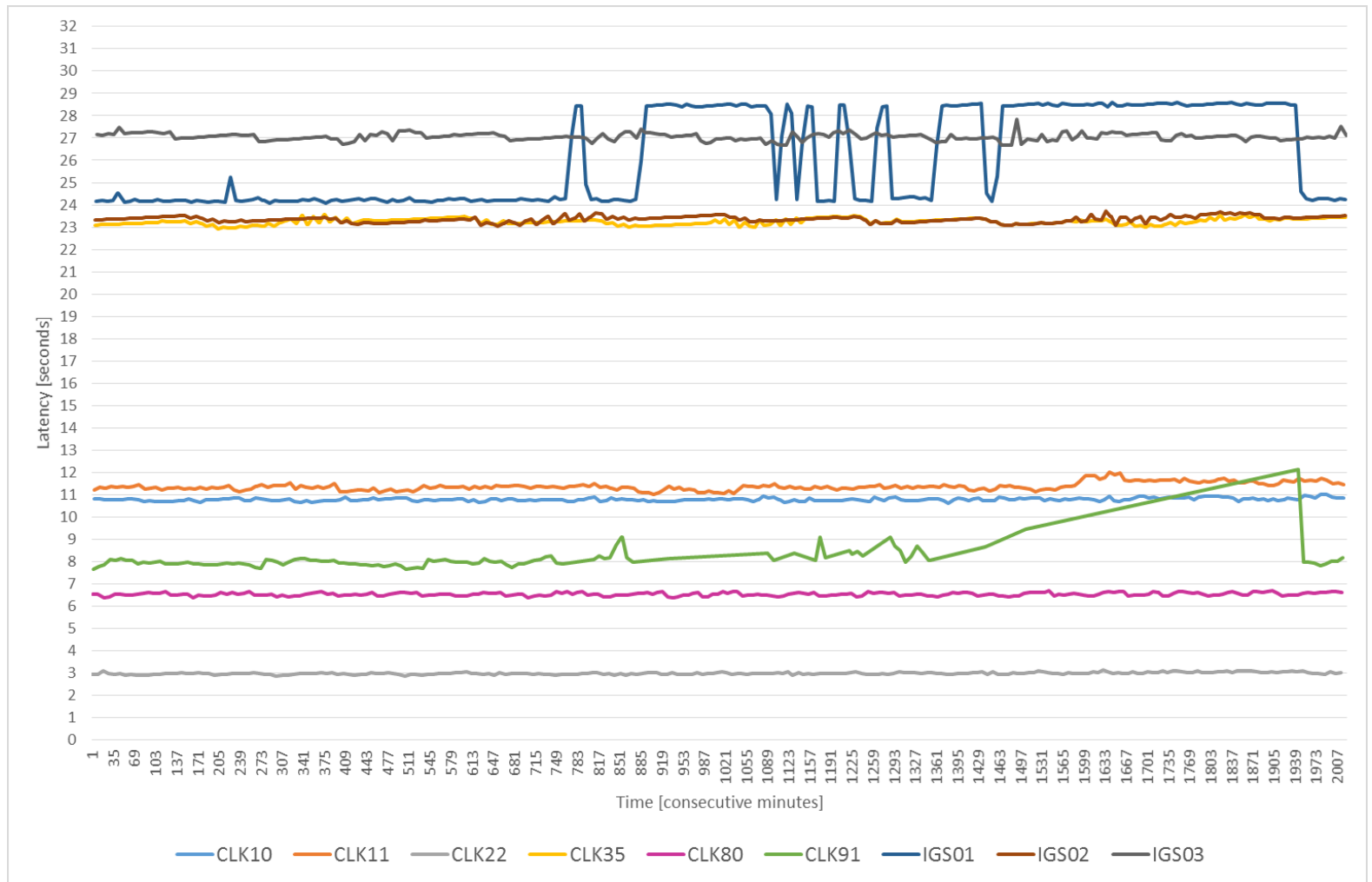


Latency of real-time observations

BNC2.12: latency of observation streams
(mean over 5 min, for 24 hours (2016-May-12/13))

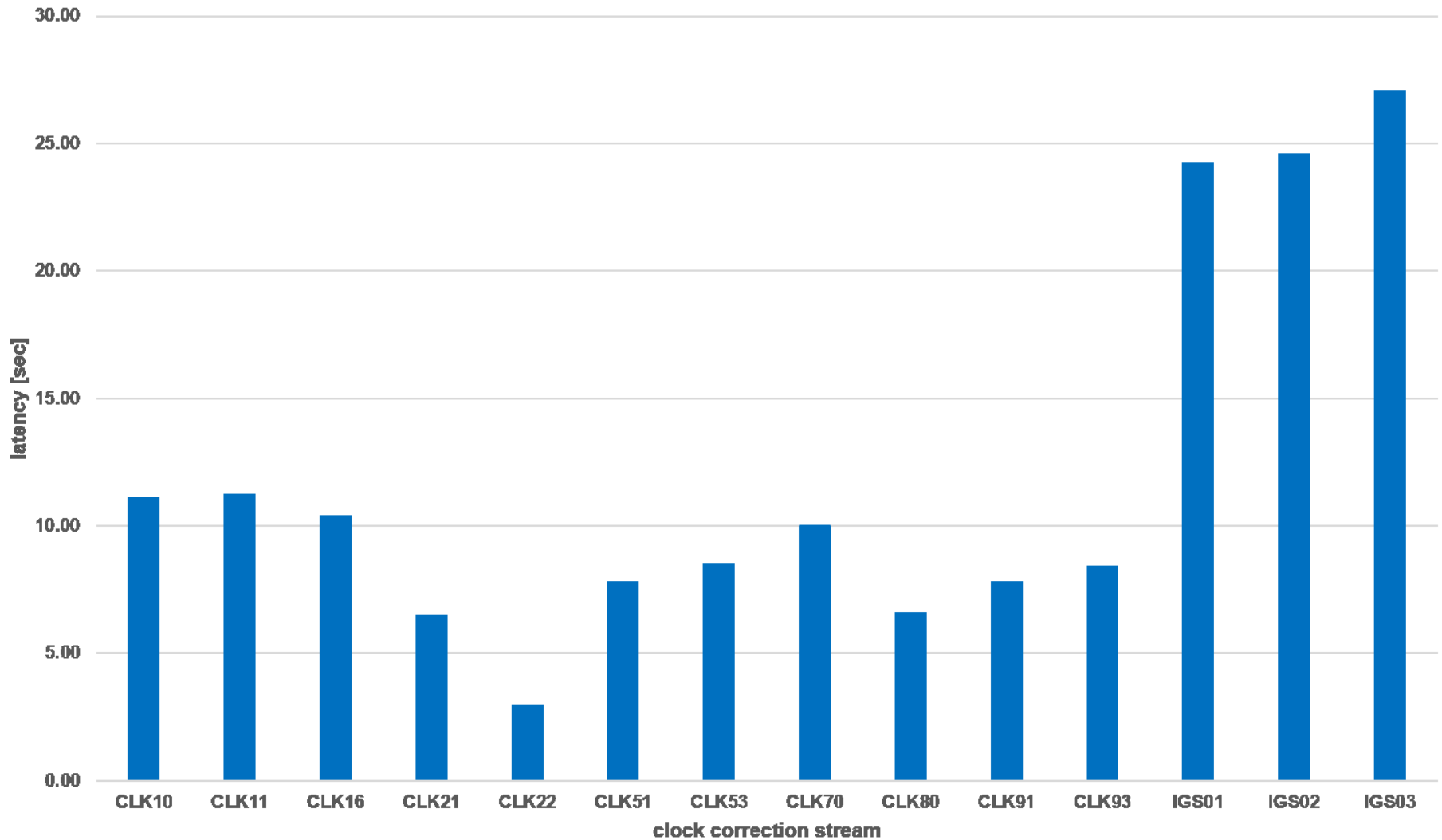


Latency of real-time products

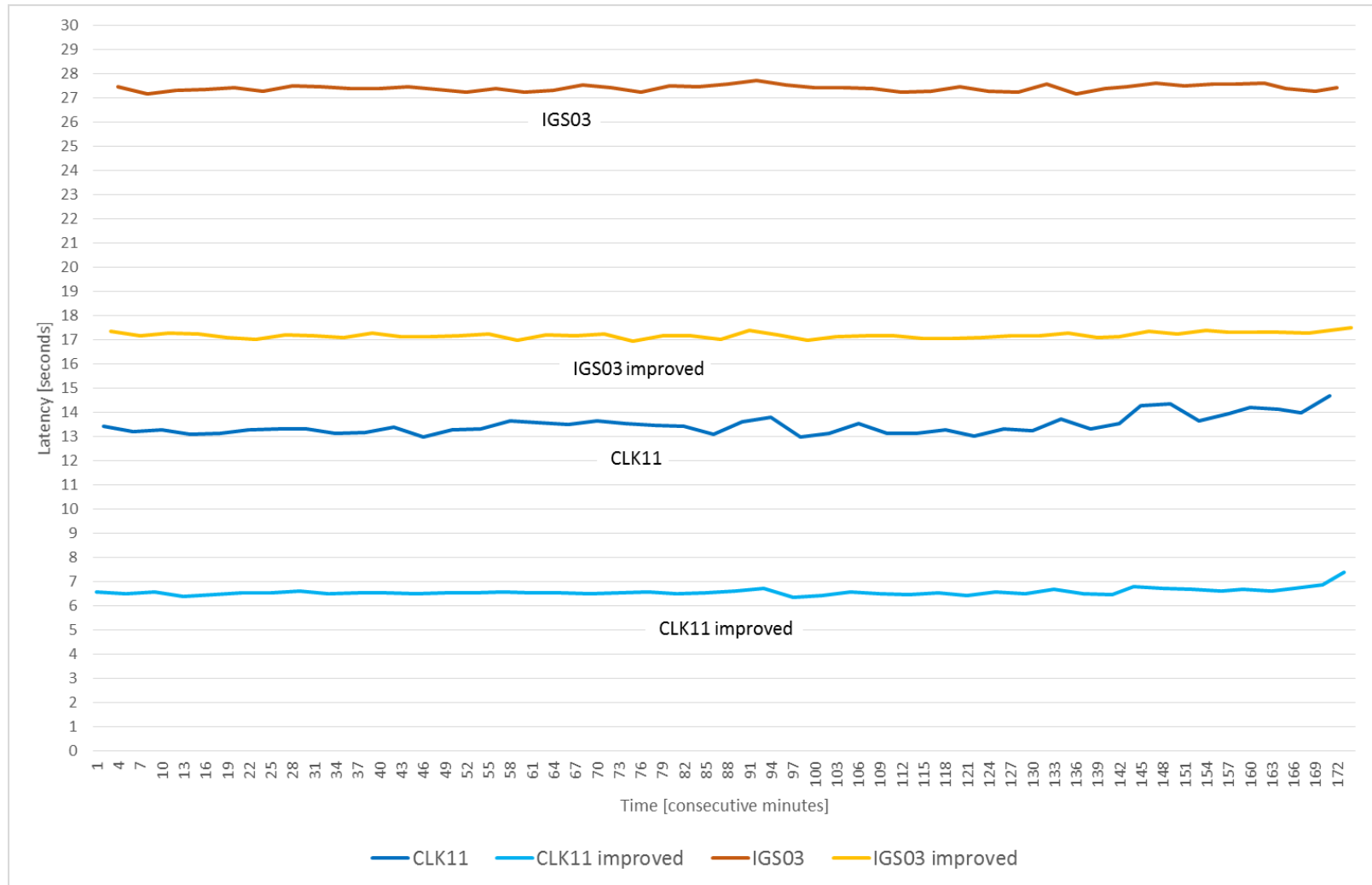


Latency of real-time products

BNC2.12: mean latency of clock correction streams
(mean over five minutes, over two hours, 2015-Nov-11)



Latency of real-time products



Redundancy aspects

- **Observations**
 - **Uploading (streaming) real-time data directly to (at least) two different casters in parallel**
 - **Necessary (double) bandwidth must be available**
- **Local / national broadcaster**
 - **Allowing access to all regional casters**
- **Regional broadcasters**
 - **Identical set of (core) stations**
 - **Identical mountpoint naming**
 - **Identical sourcetable settings**
 - **Sharing of workload**
- **Users**
 - **Mixing data and products streams from different broadcasters**
 - **Switching between casters without degradation, jumps, gaps**

Redundancy aspects

- **Streaming data directly from station to caster**
 - **ASI: 5 (LAMP, MATG, MATE, USAL, VEN1)**
 - **BKG: ~ 53 (e.g. BRUX, DENT, DOUR, WARE)**
 - **ROB: 4 (BRUX, DENT, DOUR, WARE)**
- **Pulling data directly from station**
 - **MOP2, TORI (, MOSE?)**
- **Pulling from other (local, national) broadcasters**
 - **from approx. 25 local or national casters in Europe, e.g.**
 - **ASI: ~ 35**
 - **BKG: ~ 65**
 - **ROB: ~ 80**

Redundancy aspects

Regional Broadcaster: ROB

Link: <http://www.euref-ip.be>

Located: Royal Observatory of Belgium

Number of mountpoints at all: 146

Registration Link:

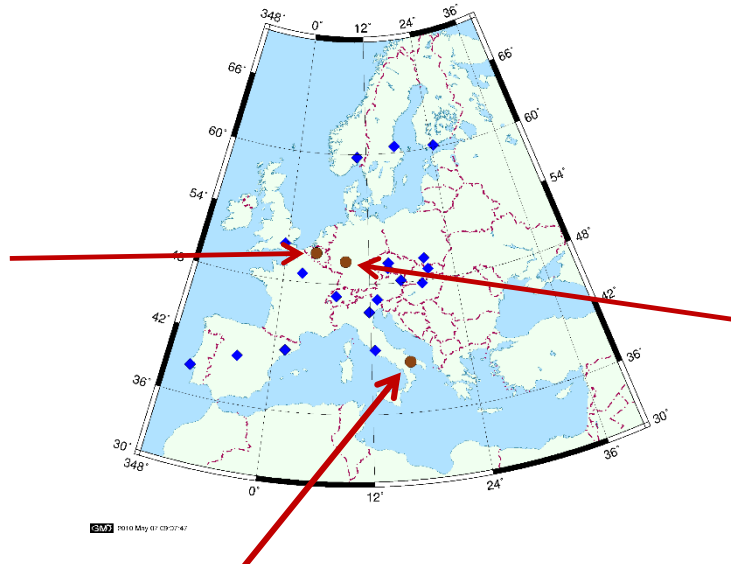
<http://www.gnss.be/data.php#NTRIPAccess>

3.2 Access

The NTRIP caster run by the ROB is available at <http://www.euref-ip.be>. It is essentially a thematic EUREF relay caster, to retrieve streams once and duplicate the streams locally for further use. This decreases the load on the top casters and reduces overall internet traffic.

In order to be able to contact the streams, one has to apply for an account, by filling in the form below. By default you will get simultaneous access to 5 streams. If you need more, indicate this in the remarks field.

Last Name:	
First Name:	
Affiliation:	
Address:	
City:	
3 char Country Code:	(ISO 3166-1 alpha-3)
E-mail:	
Username:	
Password:	
Purpose, application for which the NTRIP streams will be used:	
Remarks, comments:	
☐ grant permission to include me in the online users list on the website of the NTRIP caster.	
Send Registration Form	



Blue diamonds: Local, national or other (e.g., IGS) Ntrip Broadcaster supporting EUREF activities
Red dots: EPN Regional Broadcaster (see http://www.epncb.oma.be/_dataproducs/data_acc/ess/real_time/broadcasters.php for a complete list of Ntrip Broadcasters)

Regional Broadcaster: ASI

Link: <http://192.106.234.7:2101/>

Located: ASI/CGS Centro di Geodesia Spaziale

Number of mountpoints at all: 137

Registration mail: geodaf@hp835.mt.asi.it

Regional Broadcaster: BKG

Link: <http://www.euref-ip.net>

Located: external provider

Number of mountpoints at all: 145

Guidelines

- ◆ “EPN Stations and Operational Centres”
(http://www.epncb.oma.be/_documentation/guidelines/guidelines_station_operationalcentre.pdf)
- ◆ “EPN Data Centres & EPN Broadcasters”
(http://www.epncb.oma.be/_documentation/guidelines/guidelines_data_centres.pdf)

Redundancy aspects – monitoring

← →

http://www.epncb.oma.be/_networkdata/data_access/real_time/status.php

EUREF Permanent GNSS Ne...

Datei Bearbeiten Ansicht Favoriten Extras ?

Vorgeschlagene Sites ▼

EPN CB
HOME

EUREF PERMANENT NETWORK

ROB *****
GNSS RESEARCH GROUP *****
EUREF 

ORGANISATION

NETWORK & DATA

PRODUCTS & SERVICES

DOCUMENTATION

NEWS, EVENTS & LINKS

About | Components | Working groups | Management | Contributors | Collaborations | Site map

Station list | Maps | Tracking status | Data access | Proposed stations | Station log submission | Station picture submission

Data analysis | Daily/weekly positions | Positions & velocities | Tropospheric delays | ETRF/ITRF transformation | Position time series | Satellite orbit & clock correction streams

Formats | Guidelines | Equipment & calibration | Papers | FAQ

News | Mails | Calendar | Workshops | FTP server | Web history | Links

NETWORK & DATA > DATA ACCESS > REAL-TIME > **PRODUCTS & DATA STREAMS**

REAL-TIME PRODUCTS

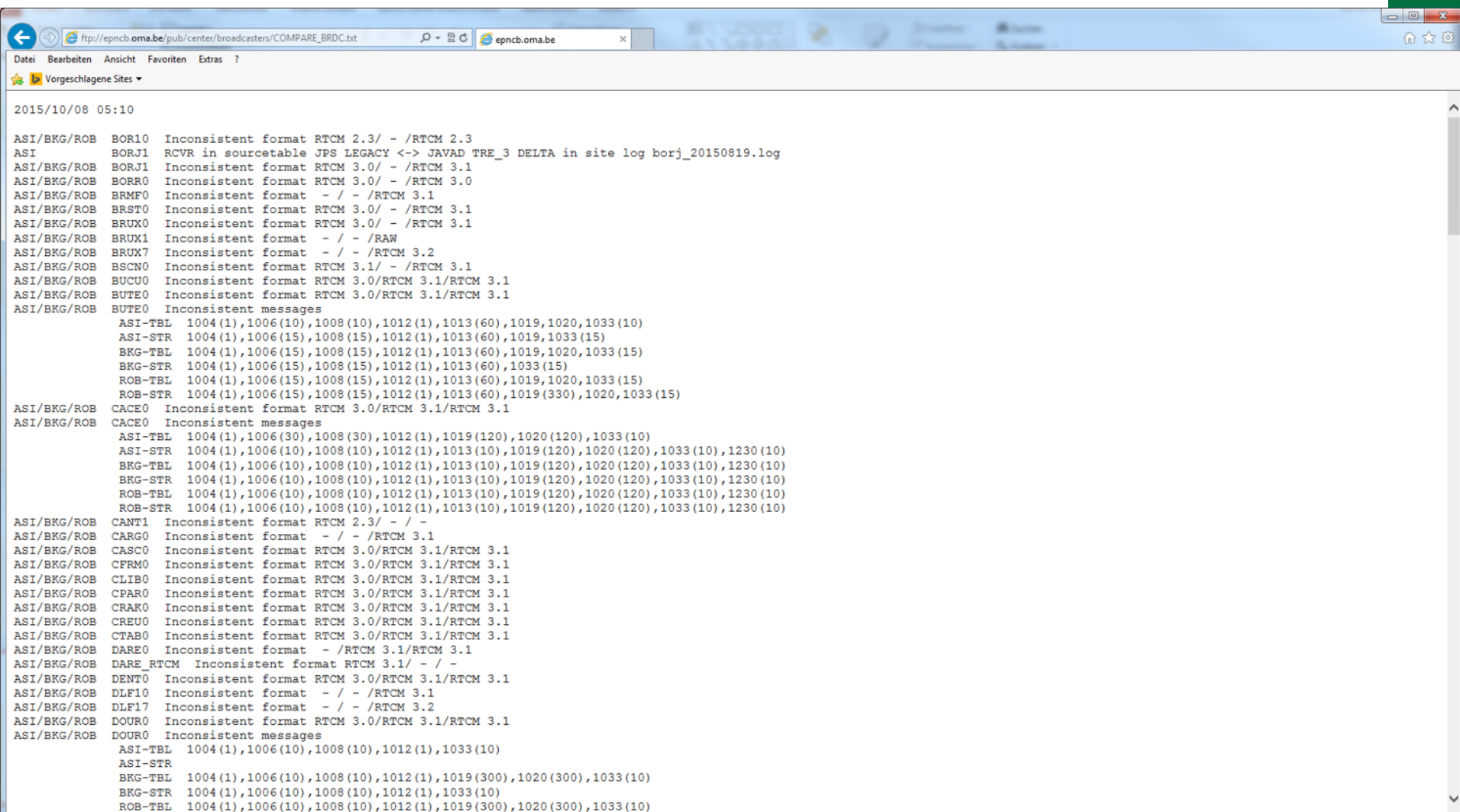
Mountpoint	ASI (status: 2016-01-28 07:55 UTC)	BKG (status: 2016-01-28 07:55 UTC)	ROB (status: 2016-01-28 07:55 UTC)
EUREF01	RTCM 3.0 - BKG	RTCM 3.0 - EUREF filter combination	RTCM 3.0 - EUREF filter combination
EUREF02	RTCM 3.0 - BKG	RTCM 3.0 - EUREF filter combination	RTCM 3.0 - EUREF filter combination
RTCM3EPH	RTCM 3 - products.igs-ip.net:2101/RTCM3EPH(1)	RTCM 3.0 - products.igs-ip.net/RTCM3EPH(1)	RTCM 3.0 - products.igs-ip.net/RTCM3EPH(1)

REAL-TIME DATA STREAMS

Mountpoint	ASI (status: 2016-01-28 07:55 UTC)	BKG (status: 2016-01-28 07:55 UTC)	ROB (status: 2016-01-28 07:55 UTC)
ACOR0	RTCM 3.1- ergnss-ip.ign.es:2101/ACOR0(1)	RTCM 3.1- ergnss-ip.ign.es:2101/ACOR0(1)	RTCM 3.1- ergnss-ip.ign.es:2101/ACOR0(1)
AJACO	Last received on 2015-11-27 14:55 UTC	Last received on 2015-11-27 14:55 UTC	Last received on 2015-11-27 14:55 UTC
ALACO	RTCM 3.1- ergnss-ip.ign.es:2101/ALACO(1)	RTCM 3.1- ergnss-ip.ign.es:2101/ALACO(1)	RTCM 3.1- ergnss-ip.ign.es:2101/ALACO(1)
ALBA0	RTCM 3.1- ergnss-ip.ign.es:2101/ALBA0(1)	RTCM 3.1- ergnss-ip.ign.es:2101/ALBA0(1)	RTCM 3.1- ergnss-ip.ign.es:2101/ALBA0(1)
ALME0	RTCM 2.3- ergnss-ip.ign.es:2101/ALME0(1)	RTCM 2.3- ergnss-ip.ign.es:2101/ALME0(1)	RTCM 2.3- ergnss-ip.ign.es:2101/ALME0(1)
AUT10	Last received on 2016-01-13 11:35 UTC	Last received on 2016-01-13 11:35 UTC	Last received on 2016-01-13 11:35 UTC
BCLN0	RTCM 3.1- ergnss-ip.ign.es:2101/BCLN0(1)	RTCM 3.1- ergnss-ip.ign.es:2101/BCLN0(1)	RTCM 3.1- ergnss-ip.ign.es:2101/BCLN0(1)
BELF0	RTCM 3.1- www.euref-ip.net:2101/BELF0(1)	RTCM 3.1- OSNI	RTCM 3.1- www.euref-ip.net:2101/BELF0(1)
BELL0	RTCM 3.0- www.euref-ip.net:2101/BELL0(1)	RTCM 3.0- ICGC	RTCM 3.0- www.euref-ip.net:2101/BELL0(1)
BOGI0	Last received on 2015-03-12 12:15 UTC	RTCM 3.0- IGIK	RTCM 3.0- www.euref-ip.net:2101/BOGI0(1)
BOR10	RTCM 2.3- www.euref-ip.net:2101/BOR10(1)	RTCM 2.3- SRCPAS	RTCM 2.3- www.euref-ip.net:2101/BOR10(1)
BORJ1	RTCM 3.0- www.euref-ip.net:2101/BORJ1(1)	RTCM 3.1- BKG	RTCM 3.1- www.euref-ip.net:2101/BORJ1(1)
BORR0	RTCM 3.0- icverva.icv.qva.es:2101/RTBO1(1)	RTCM 3.0- IGE	RTCM 3.0- icverva.icv.qva.es:2101/RTBO1(1)
BRMF0		RTCM 3.1- rqp-ip.ign.fr:2101/BRMF(1)	RTCM 3.1- rqp-ip.ign.fr:2101/BRMF(1)
BRST0	RTCM 3.0- rqp-ip.ign.fr:2101/BRST1(1)	RTCM 3.1- www.igs-ip.net:2101/BRST0(2)	RTCM 3.1- rqp-ip.ign.fr:2101/BRST1(1)
BRUX0	Last received on 2015-03-12 09:45 UTC	RTCM 3.1- www.igs-ip.net:2101/BRUX0(2)	RTCM 3.1- ROB
BRUX1			RAW- ROB
BRUX7			RTCM 3.2- mgex.igs-ip.net:2101/BRUX7(1)
BSCN0	RTCM 3.1- rqp-ip.ign.fr:2101/BSCN1(1)	RTCM 3.1- rqp-ip.ign.fr:2101/BSCN1(1)	RTCM 3.1- rqp-ip.ign.fr:2101/BSCN1(1)
BUCU0	Last received on 2015-07-30 10:55 UTC	Last received on 2015-08-04 10:25 UTC	Last received on 2015-07-30 10:55 UTC
BUTE0	RTCM 3.0- www.euref-ip.net:2101/BUTE0(1)	RTCM 3.1- BUTE	RTCM 3.1- www.euref-ip.net:2101/BUTE0(1)

2

Redundancy aspects – monitoring



```
2015/10/08 05:10

ASI/BKG/ROB BOR10 Inconsistent format RTCM 2.3/ - /RTCM 2.3
ASI BORJ1 RCVR in sourcetable JPS LEGACY <-> JAVAD TRE_3 DELTA in site log borj_20150819.log
ASI/BKG/ROB BORJ1 Inconsistent format RTCM 3.0/ - /RTCM 3.1
ASI/BKG/ROB BORR0 Inconsistent format RTCM 3.0/ - /RTCM 3.0
ASI/BKG/ROB BRMF0 Inconsistent format - / - /RTCM 3.1
ASI/BKG/ROB BRST0 Inconsistent format RTCM 3.0/ - /RTCM 3.1
ASI/BKG/ROB BRUX0 Inconsistent format RTCM 3.0/ - /RTCM 3.1
ASI/BKG/ROB BRUX1 Inconsistent format - / - /RAW
ASI/BKG/ROB BRUX7 Inconsistent format - / - /RTCM 3.2
ASI/BKG/ROB BSCN0 Inconsistent format RTCM 3.1/ - /RTCM 3.1
ASI/BKG/ROB BUCU0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB BUTE0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB BUTE0 Inconsistent messages
    ASI-TBL 1004(1),1006(10),1008(10),1012(1),1013(60),1019,1020,1033(10)
    ASI-STR 1004(1),1006(15),1008(15),1012(1),1013(60),1019,1033(15)
    BKG-TBL 1004(1),1006(15),1008(15),1012(1),1013(60),1019,1020,1033(15)
    BKG-STR 1004(1),1006(15),1008(15),1012(1),1013(60),1033(15)
    ROB-TBL 1004(1),1006(15),1008(15),1012(1),1013(60),1019,1020,1033(15)
    ROB-STR 1004(1),1006(15),1008(15),1012(1),1013(60),1019(330),1020,1033(15)
ASI/BKG/ROB CACE0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB CACE0 Inconsistent messages
    ASI-TBL 1004(1),1006(30),1008(30),1012(1),1019(120),1020(120),1033(10)
    ASI-STR 1004(1),1006(10),1008(10),1012(1),1013(10),1019(120),1020(120),1033(10),1230(10)
    BKG-TBL 1004(1),1006(10),1008(10),1012(1),1013(10),1019(120),1020(120),1033(10),1230(10)
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    ROB-STR 1004(1),1006(10),1008(10),1012(1),1013(10),1019(120),1020(120),1033(10),1230(10)
ASI/BKG/ROB CANT1 Inconsistent format RTCM 2.3/ - / -
ASI/BKG/ROB CARG0 Inconsistent format - / - /RTCM 3.1
ASI/BKG/ROB CASC0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB CFRM0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB CLIB0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB CPAR0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB CRAK0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB CREU0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB CTAB0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB DARE0 Inconsistent format - /RTCM 3.1/RTCM 3.1
ASI/BKG/ROB DARE RTCM Inconsistent format RTCM 3.1/ - / -
ASI/BKG/ROB DENT0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB DLF10 Inconsistent format - / - /RTCM 3.1
ASI/BKG/ROB DLF17 Inconsistent format - / - /RTCM 3.2
ASI/BKG/ROB DOUR0 Inconsistent format RTCM 3.0/RTCM 3.1/RTCM 3.1
ASI/BKG/ROB DOUR0 Inconsistent messages
    ASI-TBL 1004(1),1006(10),1008(10),1012(1),1033(10)
    ASI-STR
    BKG-TBL 1004(1),1006(10),1008(10),1012(1),1019(300),1020(300),1033(10)
    BKG-STR 1004(1),1006(10),1008(10),1012(1),1033(10)
    ROB-TBL 1004(1),1006(10),1008(10),1012(1),1019(300),1020(300),1033(10)
```

Redundancy aspects – monitoring

Browser window showing the GNSS Data Center (GDC) website. The address bar displays `https://igs.bkg.bund.de/ntrip/chksourcetable`. The page title is "GNSS Data Center".

The website header includes the GDC logo, a navigation menu (Home, About Us, Data & Products, Real-Time, Links), and a login section with fields for "User:" and "Password:" and a "login" button. A "Project Filter: ALL" dropdown is also present.

Sourcetable Validation Service

This service checks a Ntrip sourcetable referring to the format described at <http://software.rtcn-ntrip.org/>.

Enter address here

Security question: 4 less than ninethynine is:

Conclusions

■ Latency

- Each relay adds 0.2 – 0.3 seconds to the delay
 - Flat hierarchy recommended
 - But (negative) influence limited
- Processing centers can reduce their latency by some seconds
 - Loosing few stations only
 - But mostly remote stations in sparse regions
- Combination of orbits and clocks seems to have the most room for improvement

■ Redundancy

- Parallel streaming of RT data to two different broadcasters still a challenging task
- Dissemination of workload between casters still sub-optimal

Thank you for listening !

Contact:

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