GUIDELINES FOR IGS REAL-TIME BROADCASTERS AND STATIONS

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International GNSS Service (IGS)

IGS Real-Time Working Group (RTWG)

IGS Infrastructure Committee (IC)

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References

IGS. (2015, 07). *IGS Site Guidelines.* Retrieved from https://files.igs.org/pub/station/general/IGS%20Site%20Guidelines%20July%202015.pdf

IGS. (2020, 10 05). *IGS State Space Representation Format (SSR) Version 1.00.* Retrieved from https://files.igs.org/pub/data/format/igs_ssr_v1.pdf

RTCM Special Committee No. 104. (2020, 04 28). RTCM Standard 10403.3 - Differential GNSS (Global Navigation Satellite Systems) Services - Version 3.

Networked Transport of RTCM via Internet Protocol (Ntrip). (n.d.). Retrieved from BKG: https://igs.bkg.bund.de/root_ftp/NTRIP/documentation/NtripDocumentation.pdf

Terms and Definitions

Acronym/Term	Definition
APC	Antenna Phase Centre
ARP	Antenna Reference Point
BDS	BeiDou System: GNSS of the People's Republic China
CNR	Carrier to Noise Ratio
COM	Centre of Mass
DCB	Differential Code Bias
FCB	Fractional Cycle Bias
Galileo	GNSS of the European Union
GLONASS	Globalnaja Nawigazionnaja Sputnikowaja Sistema: GNSS of the Russian Federation
GNSS	Global Navigation Satellite System
GPS	Global Positioning System: GNSS of the United States
ITRF	International Terrestrial Reference Frame
IRNSS/NavIC	Indian Regional Navigation Satellite System/Navigation with Indian Constellation: GNSS of the Republic of India
MSM	Multiple Signal Messages

MT	Message Type (RTCM)
NMEA	National Marine Electronics Association
Ntrip	Networked Transport of RTCM via Internet Protocol
QZSS	Quasi-Zenith Satellite System: GNSS of Japan
RINEX	Receiver Independent Exchange Format
RT	Real-Time
RTCM	Radio Technical Commission for Maritime Services
RTK	Real-Time Kinematic
RTS	Real-Time Service
SBAS	Satellite Based Augmentation System
SSR	State Space Representation
SV	Space Vehicle
URA	User Range Accuracy
WG	Working Group

1 Introduction

1.1 Purpose and Scope

This document lists the conventions and processes that IGS Real-Time Data Centres (Broadcasters) should follow to ensure continuous and open access to high-quality real-time GNSS data and product streams provided by the IGS network and analysis centres. It is intended to be a useful reference to real-time data centre operators, contributing station operators, real-time analysis centres and other real-time user groups. The document should be read in conjunction with the current version of the *IGS Site Guidelines* (IGS, IGS Site Guidelines, 2015).

1.2 Definitions and Responsibilities

The IGS Real-Time infrastructure consists of the following network components:

IGS Real-Time Stations

Permanent GNSS tracking receivers and antennas on suitable geodetic markers providing real-time data using standardized formats.

IGS Real-Time Data Centres (Broadcasters)

1. Global Broadcasters receiving all the IGS real-time data and product streams and disseminating them, without changing them, on request to clients (e.g., users, monitoring tools, other global Broadcasters, Data Centres, or Analysis Centres).
2. Regional/Local Broadcasters receiving the real-time data streams from the stations in a local or regional network and disseminating them, without changing them, on request to clients (e.g., users, monitoring tools, global Broadcasters, Data Centres, or Analysis Centres).

IGS Real-Time Analysis Centres

This entity is responsible for deriving real-time products from the IGS real-time data.

IGS Real-Time Combination Centre

This entity is responsible for combining the individual contributions of the Real-Time Analysis Centres.

IGS Real-Time Analysis Coordinator

This entity is responsible for supervising the processing, analysis and combination of the individual Analysis Centres.

2 IGS Real-Time Stations

All IGS station operators are encouraged to contribute real-time data streams. To become an IGS real-time station, a station must follow the IGS Site Guidelines (IGS, IGS Site Guidelines, 2015). In addition to the requirements and recommendations given in the IGS Site Guidelines, Real-time station operators are asked to adhere to the following principles whenever possible.

2.1 General

1. Reference frame stations are to be operated as real-time stations. This is to increase the likelihood that IGS real-time products are accurately and precisely tied to the IGS reference frame.
2. The real-time data stream should be configured to meet the minimum performance standards to send 1-Hz data to at least one IGS Broadcaster with a latency of less than two seconds.
3. It must be ensured that the metadata reported in the data streams agree with the information provided in the IGS site logs.
4. Upon acceptance, it is the responsibility of the station operator to contact their preferred IGS Broadcaster(s) to arrange data submission[1].

2.2 Format and Distribution

1. The format of the data stream should be RTCM 3.x. It is recommended to use RTCM MSM7 (Multiple Signal Messages) as these messages provide the most precise observations. If the transmission bandwidth is limited, the usage of MSM4 or MSM5 is acceptable.
2. It is preferred that real-time data streams are made available to two broadcasters using the Ntrip[2]. If station operators can only provide one stream, then is should be broadcasted to the nearest Global or Regional Broadcaster.

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[1] A list of official IGS Broadcasters can be found at https://igs.org/rts/user-access/

[2] Networked Transport of RTCM via Internet Protocol, RTCM Paper 111-2009-SC104-STD (https://www.rtcm.org/, charged)

3. Alternatively, station operators may make the real-time data streams available from a local broadcaster that they operate.
4. The station operator needs to indicate whether the real-time streams are generated from the receiver's native data or an external software. It is recommended to use the receiver's native format.
5. The station operator needs to make the station's most complete and relevant RTCM stream available in the following format: `SSSSMRCCC0`, e.g., POTS00DEU0. A description of the mountpoint elements can be found in Table 2 of the Appendix.

2.3 Message Types

The station owner or operator should provide the RTCM message types listed in Table 1 in the real-time data streams. At the minimum, the stream must contain all messages available since RTCM 3.0. Stations streaming MSM (since RTCM 3.2) should stream additional information (all messages since RTCM 3.0 plus applicable observation and ephemeris data of the tracked satellite systems).

Table 1: Recommended RTCM 3 Message Types broadcasted from IGS Stations

Description	Message Type
Since RTCM 3.0	
GPS code and carrier phase observations + CNR + code ambiguity	1004 (if 1077 is not available)
Coordinates (X,Y,Z) of the ARP (+ height of antenna reference point above marker)	1005 (1006*)
Antenna and radome type description using IGS naming conventions (+ antenna serial number)	1007 (1008*)
GLONASS code and carrier phase observations + CNR + code ambiguity	1012 (if 1087 is not available)
Since RTCM 3.1	

GPS satellite broadcast ephemeris	1019
GLONASS satellite broadcast ephemeris	1020
Receiver and antenna descriptors	1033
Since RTCM 3.2	
QZSS satellite broadcast ephemeris	1044
Galileo F/NAV satellite broadcast ephemeris	1045
GPS MSM7 (MSM5, MSM4)	1077* (1075, 1074)
GLONASS MSM7 (MSM5, MSM4)	1087* (1085, 1084)
Galileo MSM7 (MSM5, MSM4)	1097* (1095, 1094)
QZSS MSM7 (MSM5, MSM4)	1117* (1115, 1114)
BeiDou MSM7 (MSM5, MSM4)	1127* (1125, 1124)
Since RTCM 3.3	
IRNSS/NavIC satellite broadcast ephemeris	1041
BeiDou satellite broadcast ephemeris	1042
Galileo I/NAV satellite broadcast ephemeris	1046
SBAS MSM7 (MSM5, MSM4)	1107* (1105, 1104)
IRNSS/NavIC MSM7 (MSM5, MSM4)	1137* (1135, 1134)

* Preferred RTCM Message Type

1. It is expected that the observation messages are updated with a frequency of 1 Hz.
2. It is recommended that message types containing metadata (1005, 1006, 1007, 1008, 1033) are streamed with an update rate of at least 60 seconds or higher.
3. RTCM code and phase observations **shall not** be corrected to refer to the antenna reference point (this correction is typically known as the antenna phase centre correction). If the correction is applied, the antenna type in the stream is typically set to `NULLANTENNA` (message types 1007/1008 for RTCM 3.x).
4. The metadata reported in the stream (receiver, antenna/radome, antenna height) must agree with the information provided in the IGS site log. It is encouraged that the most recent IGS coordinates, e.g., from the cumulative solution, are provided with the stream (message types 1005/1006). They should be the coordinates of the Antenna Reference Point (and not the Marker).

3 IGS Real-Time Data Centres

3.1 Data and Products

Each Global Broadcaster should make all IGS real-time data and product streams publicly available. In particular, all official IGS real-time products must be available at each Global Broadcaster.

3.2 User Access

All Global Broadcasters use identical names for all IGS real-time data and product streams. Each IGS Global Broadcaster provides the following information to the station owner or operator:

- IP address or host name of the Ntrip caster,
- Ntrip version,
- TLS/SSL required,
- User and password (Ntrip version >= 2.0).

To ensure a maximum of consistency between them, the IGS Global Broadcasters should:

- Inform the other Global Broadcasters on changes with respect to data and product streams,
- Synchronize on a regular basis with the other Global, Regional and Local Broadcasters to ensure that they are broadcasting all stations. In case of identified missing data streams, contact the station owner or operator. If data streams are not directly available from the station, pull the data streams from other Global or Regional Broadcasters.

3.3 Sourcetable

The Broadcaster has to maintain a so-called *sourcetable* containing meta information. The sourcetable is made available on request, e.g., using an HTTP command. In general, a Ntrip sourcetable consists of three types of records: `CAS`, `NET` and `STR`. All three record types may appear more than once in a sourcetable.
While not all record types are necessary to build a valid sourcetable, an IGS sourcetable should contain all three record types `CAS`, `NET` and `STR`.

Each data field is separated by a *semicolon*: ";". In principle, some data fields could be left empty (i.e., two semicolons behind each other). However, for the IGS Broadcasters none of the data fields of each record type `CAS`, `NET` and `STR` should be left empty.
It is recommended that the mountpoint names within the sourcetables of all IGS Global Broadcasters are consistent.

The three types of records, `CAS`, `NET` and `STR` of the IGS Broadcasters should contain the following:

CAS

The record type `CAS` is the caster specification record. It comprises 11 mandatory and one optional data field, which can contain miscellaneous information as plain text. At a minimum, the caster itself must be described in the sourcetable with a record type `CAS`. Table 16 in section 5.5 describes the elements in more detail.

It is recommended that the IGS Global Broadcasters list as a minimum the `CAS` records for all other IGS Global Broadcasters. The caster "rtcm-ntrip.org" should be added to all IGS Broadcasters because it contains caster information for a great number of global, regional and local broadcasters. In data field `#2:<host>` it is recommended to use the domain name rather than the Internet Protocol (IP) address of a caster.

NET

The record type `NET` is the network specification record. It comprises eight mandatory and one optional data field, which can contain miscellaneous information as plain text. Network records are used to group data sources according to their type or data provider or other useful specifications. Record parameter `#6:<web-net>`, `#7:<web-str>` and `#8:<web-reg>` contain useful information with web or email addresses concerning the network or are even necessary for creating RINEX data from real-time data streams.

For IGS Broadcaster it is mandatory that record parameter `#7:<web-str>` of the NET record points to a valid directory containing the RINEX skeleton files of the IGS stations. `NET` records are not mandatory from the format description point of view. However, for the IGS Broadcasters it is mandatory to list `NET` records for all networks (record parameter `#2:<identifier>`), which are used in record parameter `#8:<network>` of the `STR` records used in the sourcetable.

All streams provided in the frame of the IGS for IGS stations must refer to the network "IGS" (STR data field #8:<network>). Streams of a proposed IGS station should refer to a NET record named "PROPOSED".

A complete list of defined network elements can be found in Table 17 of section 5.5.

STR

The record type STR is the stream specification record. It comprises 18 mandatory and one optional data field, which can contain miscellaneous information as plain text. Although the data field #2:<mountpoint> could contain almost any series of characters, for the IGS Broadcasters short and unique mountpoint names should be envisaged which strongly rely on the station abbreviation used in the IGS.

The data stream mountpoint names of the IGS Broadcasters are restricted to ten characters. The first nine characters are identical to the IGS long site name, plus one integer number (Table 2). The data stream mountpoint name for one IGS station should be identical at all IGS Broadcasters. An identical mountpoint name at different broadcasters must be assumed to refer to the same real-time data.

The STR data field #5:<format-details> must reflect exactly the RTCM message types and update periods of the stream. This information must be consistent between the broadcasters.

STR data fields #10:<latitude> and #11:<longitude> should be consistent with the IGS site log information. It is recommended to extract the information from this source.

Data field #14:<generator> of the STR record allows naming of the hard- or software generating the data stream. For observational data this could be for example a GNSS receiver or a network software. For product data streams this could be the software used for processing. STR data field #14:<generator> for a real-time observation data stream should contain the name and type of the GNSS receiver used to create this data stream using the IGS naming conventions and in full agreement with the IGS site log information.

Within the IGS Global Broadcasters, the miscellaneous data field in the STR record should be used for the identification of the source of a data stream and the method coming to the respective broadcaster. If a real-time data stream is pulled from another broadcaster this must be reflected in the STR record data field #19:<misc>. The

information must contain the host name or IP address of the broadcaster (`CAS` record data fields `#2:<mountpoint>` and `#3:<identifier>`), the original mountpoint name and the number of pullings in brackets. If a real-time data stream is actively streamed to a broadcaster the `STR` record data field `#19:<misc>` should contain the name of the organisation uploading the stream. Table 18 in section 5.5 describes the structure of the stream record (`STR`).

A complete description of the content of a sourcetable, especially the three different record types, can be found on the wiki page of the RTCM-Ntrip software development group[3].

[3] http://software.rtcm-ntrip.org/wiki/Sourcetable

4 Rules for Becoming an IGS Real-Time Data Centre

IGS Broadcasters fall into three categories: Global, Regional, and Local Broadcasters. A list of currently available Real-Time data centres is available on the IGS Real-Time Service (RTS) website[4].

Global Broadcasters

Global Broadcasters are the main interfaces to the Analysis Centres and the user community in general. They receive all IGS data and product streams and disseminate them to the users. The IGS Real-Time Working Group decides, if necessary, on the implementation of additional Regional Broadcasters to support the distribution of real-time data and product streams.

Local Broadcasters

Local Broadcasters are in direct contact to the station managers and the Real-Time Service Station Providers. They are collecting real-time data on a local or national level and provide them to their local or national users as well as to the IGS RTS.

Requirements

1. Since latency is a critical factor for real-time data streaming, the IGS Global Broadcasters shall be distributed in such a way that every part of the world is covered by at least one IGS Global Broadcaster.
2. Since latency is a critical factor for real-time data streaming, the series of consecutive (local, national, regional, global) broadcasters used for providing a stream to the user should be as short as possible.
3. Since latency and continuity are critical factors for real-time data streaming, the IGS Global Broadcasters should pick up data streams as close by as possible to the source, e.g., from Regional or Local casters
4. The IGS Global Broadcasters have to take all means to provide enough bandwidth for properly supporting all current and future user needs.

[4] https://www.igs.org/rts/user-access/

5. Each IGS Global Broadcaster should be equipped with a redundant system, i.e., a (hot or cold) local standby.
6. Global Broadcasters need to provide access to IGS users without demanding extra fees and support all users who request access.

Proposals for a new Global Broadcaster should begin with a conversation with the IGS Real-Time Working Group (IGS-RTWG[5]). The RTWG and the Central Bureau can assist in bringing a letter stating the agency's qualifications, commitment, and plans to the Governing Board (GB). Based on recommendations of the RTWG, and demonstrated commitment of the host organization, the proposed Global Broadcaster will be evaluated and considered for approval by the GB.

[5] https://igs.org/wg/real-time/

5 Appendix

5.1 Station Mountpoint Names

The long station mountpoint names consist of 10 characters in the form of "`SSSSMRCCCF`" as described in Table 2.

Table 2: Description of the Long Station Mountpoint Name

Field	Field Description	Comment
SSSS	4-character station code	e.g., POTS
M	1-digit marker identifier	e.g., 0-9
R	1-digit receiver identifier	e.g., 0-9
CCC	3-letter ISO country code	e.g., DEU
F	1-digit data stream format	0: RTCM3

Please note, that a station operator can provide more than one stream to the caster. It is expected that the most complete stream will be addressed with "0".

5.2 Product Mountpoint Names

The long product mountpoint names consist of 10 characters in the form "**`TTTTXXAAAF`**" as described in Table 3.

Table 3: Description of the Long Product Mountpoint Name

Field	Field Description	Comment
TTTT	4-character stream type	e.g., SSRA, SSRC (see Table 4)
XX	2-digit solution identifier	e.g., 00
AAA	3-letter agency code	e.g., DLR (see Table 5)
F	1-digit format ID	0: RTCM3, 1: IGS-SSR, 2-9: reserved

Possible stream types (`TTTT`) are described in Table 4.

Table 4: List of defined Stream Types

TTTT	Description
SSRA	State space correction stream (orbits, clocks, ...), orbits refer to APC
SSRC	State space correction stream (orbits, clocks, ...), orbits refer to COM
DCBS	State space correction stream (DCBs only)
IONO	Ionospheric correction stream
TROP	Tropospheric correction stream
BCEP	Broadcast navigation data (broadcast ephemeris) stream

Note: SSRA and SSRC may also contain differential code biases (DCBs), ionospheric corrections, tropospheric corrections and fractional cycle biases (FCBs).

Table 5 lists the three-character agency codes (`AAA`) for IGS real-time products defined at the date of issue of these Guidelines.

Table 5: List of defined Agency Codes for the IGS Real-Time Service used in the Product Names

AAA	Description
BKG	Federal Agency for Cartography and Geodesy (BKG)
CAS	Chinese Academy of Sciences (CAS)
CNE	National Centre for Space Studies (CNES)
DLR	German Aerospace Center (DLR)
ESA	European Space Agency (ESA)
GFZ	German Research Centre for Geosciences (GFZ)
GMV	GMV Innovating Solutions S.L. (GMV)
NRC	Natural Resources Canada (NRCan)
SHA	Shanghai Astronomical Observatory, CAS
UPC	Universitat Politècnica de Catalunya

5.3 RTCM 3.x Multi Signal Messages (MSM) Message Types

There are seven defined MSM message types that are reused with each GNSS as listed in Table 6.

Table 6: MSM Message Types (MSM1-MSM7)

Type	Description
MSM1	DGNSS uses, Pseudorange
MSM2	RTK uses, Pseudorange only
MSM3	RTK uses, Pseudorange and PhaseRange
MSM4	RTK uses, Pseudorange, PhaseRange, CNR (carrier-to-noise ratio)
MSM5	RTK uses, Pseudorange, PhaseRange, Doppler, CNR
MSM6	RTK uses, Pseudorange, PhaseRange, CNR (high-resolution)
MSM7	RTK uses, Pseudorange, PhaseRange, Doppler, CNR (high-resolution)

Table 7 shows how the seven message types from Table 6 are assigned to range groups for each Global Navigation Satellite System (GNSS).

Table 7: List of Multi Signal Messages (MSM) Ranges

MT Range	GNSS
1071 - 1077	GPS
1081 - 1087	GLONASS
1091 - 1097	Galileo
1101 - 1107	SBAS
1111 - 1117	QZSS
1121 - 1127	BeiDou
1131 - 1137	IRNSS/NavIC

Table 8 to Table 14 show the MSM message types as defined for GPS, GLONASS, Galileo, SBAS, QZSS, BeiDou and IRNSS/NavIC. The whole set of MSM messages for IRNSS/NavIC and SBAS is available since RTCM 3.3.

Table 8: RTCM 3.x (x=2,3) GPS MSM Message Types

Message Type	Content	MSM Type
1071	Compact GPS Pseudoranges	MSM1
1072	Compact GPS PhaseRanges	MSM2
1073	Compact GPS Pseudoranges and PhaseRanges	MSM3
1074	Full GPS Pseudoranges and PhaseRanges plus CNR	MSM4
1075	Full GPS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR	MSM5
1076	Full GPS Pseudoranges and PhaseRanges plus CNR (high resolution)	MSM6
1077	Full GPS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)	MSM7

Table 9: RTCM 3.x (x=2,3) GLONASS MSM Message Types

Message Type	Content	MSM Type
1081	Compact GLONASS Pseudoranges	MSM1
1082	Compact GLONASS PhaseRanges	MSM2
1083	Compact GLONASS Pseudoranges and PhaseRanges	MSM3
1084	Full GLONASS Pseudoranges and PhaseRanges plus CNR	MSM4
1085	Full GLONASS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR	MSM5
1086	Full GLONASS Pseudoranges and PhaseRanges plus CNR (high resolution)	MSM6
1087	Full GLONASS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)	MSM7

Table 10: RTCM 3.x (x=2,3) Galileo MSM Message Types

Message Type	Content	MSM Type
1091	Compact Galileo Pseudoranges	MSM1
1092	Compact Galileo PhaseRanges	MSM2
1093	Compact Galileo Pseudoranges and PhaseRanges	MSM3
1094	Full Galileo Pseudoranges and PhaseRanges plus CNR	MSM4
1095	Full Galileo Pseudoranges, PhaseRanges, PhaseRangeRate and CNR	MSM5
1096	Full Galileo Pseudoranges and PhaseRanges plus CNR (high resolution)	MSM6
1097	Full Galileo Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)	MSM7

Table 11: RTCM 3.3 SBAS MSM Message Types

Message Type	Content	MSM Type
1101	Compact SBAS Pseudoranges	MSM1
1102	Compact SBAS PhaseRanges	MSM2
1103	Compact SBAS Pseudoranges and PhaseRanges	MSM3
1104	Full SBAS Pseudoranges and PhaseRanges plus CNR	MSM4
1105	Full SBAS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR	MSM5
1106	Full SBAS Pseudoranges and PhaseRanges plus CNR (high resolution)	MSM6
1107	Full SBAS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)	MSM7

Table 12: RTCM 3.x (x=2,3) QZSS MSM Message Types

Message Type	Content	MSM Type
1111	Compact QZSS Pseudoranges	MSM1
1112	Compact QZSS PhaseRanges	MSM2
1113	Compact QZSS Pseudoranges and PhaseRanges	MSM3
1114	Full QZSS Pseudoranges and PhaseRanges plus CNR	MSM4
1115	Full QZSS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR	MSM5
1116	Full QZSS Pseudoranges and PhaseRanges plus CNR (high resolution)	MSM6
1117	Full QZSS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)	MSM7

Table 13: RTCM 3.x (x=2,3) BeiDou MSM Message Types

Message Type	Content	MSM Type
1121	Compact BeiDou Pseudoranges	MSM1
1122	Compact BeiDou PhaseRanges	MSM2
1123	Compact BeiDou Pseudoranges and PhaseRanges	MSM3
1124	Full BeiDou Pseudoranges and PhaseRanges plus CNR	MSM4
1125	Full BeiDou Pseudoranges, PhaseRanges, PhaseRangeRate and CNR	MSM5
1126	Full BeiDou Pseudoranges and PhaseRanges plus CNR (high resolution)	MSM6
1127	Full BeiDou Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)	MSM7

Table 14: RTCM 3.3 IRNSS/NavIC MSM Message Types

Message Type	Content	MSM Type
1131	Compact IRNSS/NavIC Pseudoranges	MSM1
1132	Compact IRNSS/NavIC PhaseRanges	MSM2
1133	Compact IRNSS/NavIC Pseudoranges and PhaseRanges	MSM3
1134	Full IRNSS/NavIC Pseudoranges and PhaseRanges plus CNR	MSM4
1135	Full IRNSS/NavIC Pseudoranges, PhaseRanges, PhaseRangeRate and CNR	MSM5
1136	Full IRNSS/NavIC Pseudoranges and PhaseRanges plus CNR (high resolution)	MSM6
1137	Full IRNSS/NavIC Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)	MSM7

5.4 IGS SSR Message Types

Table 15 is an overview of all IGS SSR message types and the corresponding RTCM 3.x SSR message type as described in the IGS SSR format description (IGS, IGS State Space Representation Format (SSR) Version 1.00, 2020) and the RTCM Standard 10403.3 (RTCM Special Committee No. 104, 2020). Please note that RTCM 3.x SSR message types are only defined for GPS and GLONASS.

Table 15: RTCM 3.x (x=1,2,3) SSR and IGS SSR Message Types

IGS SSR Message Type	RTCM 3.x SSR Message Type	GNSS	Content
IM021	1057	GPS	**SSR Orbit Correction** A state space representation message which provides per-SV data. It contains orbital error / deviation from the current broadcast information.
IM022	1058	GPS	**SSR Clock Correction** A state space representation message which provides per-SV data. It contains SV clock error / deviation from the current broadcast information.
IM023	1060	GPS	**SSR Combined Orbit and Clock Correction** A state space representation message which provides per-SV data. It contains both the orbital errors and the clock errors from the current broadcast information.
IM024	1062	GPS	**SSR High-Rate Clock Correction** A state space representation message which provides a higher update rate than message

			1058. It provides more precise data on the per-SV clock error / deviation from the current broadcast information.
IM025	1059	GPS	**SSR Code Bias** A state space representation message which provides per-SV data. It contains code biases.
IM026	N/D	GPS	**SSR Phase Bias** A state space representation message which provides per-SV data. It contains phase biases.
IM027	1061	GPS	**SSR URA** A state space representation message which provides per-SV data. It contains User Range Accuracy (URA).
IM041	1063	GLONASS	**SSR Orbit Correction** A state space representation message which provides per-SV data. It contains orbital error / deviation from the current broadcast information.
IM042	1064	GLONASS	**SSR Clock Correction** A state space representation message which provides per-SV data. It contains SV clock error / deviation from the current broadcast information.
IM045	1065	GLONASS	**SSR Code Bias** A state space representation message which provides per-SV data. It contains code biases.

IM046	N/D	GLONASS	**SSR Phase Bias** A state space representation message which provides per-SV data. It contains phase biases.
IM043	1066	GLONASS	**SSR Combined Orbit and Clock Corrections** A state space representation message which provides per-SV data. It contains both the orbital errors and the clock errors from the current broadcast information.
IM047	1067	GLONASS	**SSR URA** A state space representation message which provides per-SV data. It contains User Range Accuracy (URA) data.
IM044	1068	GLONASS	**SSR High-Rate Clock Correction** A state space representation message which provides a higher update rate than message 1064. It provides more precise data on the per-SV clock error / deviation from the current broadcast information.
IM061	N/D	Galileo	**SSR Orbit Correction** A state space representation message which provides per-SV data. It contains orbital error / deviation from the current broadcast information.
IM062	N/D	Galileo	**SSR Clock Correction** A state space representation message which provides per-SV data. It contains SV clock error / deviation from the current broadcast information.

IM065	N/D	Galileo	**SSR Code Bias** A state space representation message which provides per-SV data. It contains code biases.
IM066	N/D	Galileo	**SSR Phase Bias** A state space representation message which provides per-SV data. It contains phase biases.
IM063	N/D	Galileo	**SSR Combined Orbit and Clock Corrections** A state space representation message which provides per-SV data. It contains both the orbital errors and the clock errors from the current broadcast information.
IM067	N/D	Galileo	**SSR URA** A state space representation message which provides per-SV data. It contains User Range Accuracy (URA) data.
IM064	N/D	Galileo	**SSR High-Rate Clock Correction** A state space representation message which provides a higher update rate than message 1064. It provides more precise data on the per-SV clock error / deviation from the current broadcast information.
IM101	N/D	BeiDou	**SSR Orbit Correction** A state space representation message which provides per-SV data. It contains orbital error / deviation from the current broadcast information.
IM102	N/D	BeiDou	**SSR Clock Correction** A state space representation message which

			provides per-SV data. It contains SV clock error / deviation from the current broadcast information.
IM105	N/D	BeiDou	**SSR Code Bias** A state space representation message which provides per-SV data. It contains code biases.
IM106	N/D	BeiDou	**SSR Phase Bias** A state space representation message which provides per-SV data. It contains phase biases.
IM103	N/D	BeiDou	**SSR Combined Orbit and Clock Corrections** A state space representation message which provides per-SV data. It contains both the orbital errors and the clock errors from the current broadcast information.
IM107	N/D	BeiDou	**SSR URA** A state space representation message which provides per-SV data. It contains User Range Accuracy (URA) data.
IM104	N/D	BeiDou	**SSR High-Rate Clock Correction** A state space representation message which provides a higher update rate than message 1064. It provides more precise data on the per-SV clock error / deviation from the current broadcast information.
IM201	N/D	GNSS	SSR Ionosphere VTEC Spherical Harmonics

N/D: Not Defined

5.5 Sourcetable Definitions

Table 16, Table 17, Table 18 describe the structure of a sourcetable as defined in the Ntrip specification (Networked Transport of RTCM via Internet Protocol (Ntrip)).

Table 16: Structure of a Caster (CAS) Record in the Sourcetable

Data Field #	Element	Description	Content
1	type=CAS	Indicator of a caster description	**CAS**
2	host	Internet address of the caster	Host name or IP address
3	port	Port number	Integer
4	identifier	Name of the caster provider	Characters, undefined length
5	operator	Name of the agency operating the caster	Characters, undefined length
6	nmea	Capability of the caster to accept NMEA[6] message with approximate position from client **0**: Caster is not able to handle incoming NMEA message **1**: Caster is able to handle incoming NMEA message	Integer
7	country	ISO 3166 country code, e.g., DEU	3 characters
8	latitude	Latitude (Position)	Floating point number, two digits after decimal point

[6] Acronym for National Marine Electronics Association

9	longitude	Longitude (Position)	Floating point number, two digits after decimal point
10	fallback_host	Fallback caster internet address 0.0.0.0: No fallback	Host name or IP address
11	fallback_port	Fallback caster port number 0: No fallback	Integer
12	misc	Miscellaneous information	Characters, undefined length

Table 17: Structure of a Network (NET) Record in the Sourcetable

Data Field #	Element	Description	Content
1	type=NET	Indicator of a network description	**NET**
2	identifier	Name of the station network	Characters, undefined length
3	operator	Name of the agency operating the network	Characters, undefined length
4	authentication	Access protection for data streams **N**: None **B**: Basic **D**: Digest	**B**, **D**, **N** or comma-separated list of these
5	fee	User fee for data access: **Y**: Yes **N**: No	1 character
6	web-net	Web address for network information	URL
7	web-str	Web address for stream information	URL
8	web-reg	Web or mail address for registration	URL or Email
9	misc	Miscellaneous information	Characters, undefined length

Table 18: Structure of a Stream (STR) Record in the Sourcetable

Data Field #	Element	Description	Content
1	type=STR	Indicator of a stream description	**STR**
2	mountpoint	Data stream mountpoint	Max. 100 character
3	identifier	Source identifier, e.g., Site Name or Site Location	Characters, undefined length
4	format	Data format, e.g., RTCM, RAW	Characters, undefined length
5	format-details	Specifics of the data format	Characters, undefined length
6	carrier	Carrier phase information 0 = No 1 = Yes, L1 2 = Yes, L1&L2	Integer
7	nav-system	Navigation System	Characters, undefined length
8	network	Network Name (see `NET`)	Characters, undefined length
9	country	ISO 3166 country code	3 characters
10	latitude	Latitude (Position)	Floating point number, two digits after decimal point
11	longitude	Longitude (Position)	Floating point number, two digits after decimal point

12	nmea	Caster requires NMEA message with approximate position from client **0**: Client must not send NMEA message **1**: Client must send NMEA message	Integer
13	solution	Stream generated from single reference station or from networked reference stations **0**: Single base **1**: Network	Integer
14	generator	Soft- or hardware generating data stream	Characters, undefined length
15	compression	Compression algorithm	Characters, undefined length
16	authentication	Access protection for data streams **N**: None **B**: Basic **D**: Digest	**B**, **D**, **N** or comma-separated list of these
17	fee	User fee for data access: **Y**: Yes **N**: No	1 character
18	bitrate	Data rate in Bits/s	Integer
19	misc	Miscellaneous information	Characters, undefined length