Real-Time IGS Protocol, Formats and Software Tools

Ken MacLeod(1), Mark Caissy(1), Ray Fong (2), Bob Twilley(3), Javier Perez Bartolome(4), Carlos.Garcia-Martinez(4), Roman Galas(5) and Ron Muellerschoen(6)

1) Geodetic Survey Division
Natural Resources Canada
615 Booth Street, Ottawa,
Ontario, K1A 0E9
Canada

2) tesserNet System Inc.
#410, 703 6th Ave. S.W.
Calgary, Alberta, Canada
T2P 0T9

3) Geosciences Australia
Earth Monitoring Group (GEM)
GPO Box 378,
Canberra, ACT 2601,
Australia

4) European Space
Operations Centre
Robert Bosch Str. 5, 64293.
Darmstadt, Germany

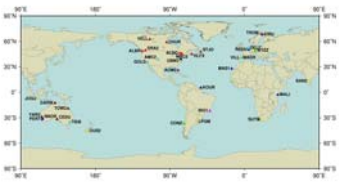
5) GeoForschungsZentrum
Potsdam(GFZ), Telegrafenberg, D-
14473, Potsdam,
Germany

6) Jet Propulsion Laboratory,
4800 Oak Grove Drive,
91109, Pasadena, California,
USA

Abstract

Members of the Real-Time IGS (RT-IGS) working group have spent the last two years designing, developing and implementing a prototype real-time network. During this period, message formats and an exchange protocol have been established. With a prototype infrastructure defined, data centres developed software tools to enable the transmission and reception of real-time data. This poster describes the existing RT-IGS architecture, formats, protocols and enabling software.

RT-IGS Stations (Current and Committed)



Contributing Agencies: GFZ, JPL, USNO, TUD, ESOC, NRCan, NGS, IBGE, GS Australia and BKG.

RT-IGS Message Protocol

All real-time IGS messages will be transmitted using the User Datagram Protocol (UDP). The UDP protocol does not guaranty delivery nor does it maintain message order. Therefore it is the responsibility of the user of the messages to validate the quality and quantity of the delivered data.

The RT-IGS protocol specifies message types and frequency. Message information is shown in the following table.

Message	Frequency	Comment
Station description	Twice per hour	Links to IGS station description
Observations	Once per second	Contains data pertaining to an integer second
Ephemeris	On issue by receiver	
Meteorological data	Once per 5-minute	Optional

RT-IGS Message Structure

Message Types

Each RT-IGS message type is assigned an identification number, specified in the following table:

ID Number	Message Type
100	Station
200	Observations
300	Ephemeris
400	Surface meteorological data

RT-IGS Station Identification

Every RT-IGS station is assigned a unique number. The following table assigns a block of station numbers to contributing agencies:

Agency	Unique Station Numbers
IPL	1-99
NRCan	100-199
NGS	200-299
ESOC	300-399
GFZ	400-499
BKG	500-599
GEOSCIENCE AUSTRALIA	600-699
OTHERS	700-

Message Dependencies:

All messages will be related to a station configuration indicated by the Issue of Data Station (IODS). The IODS will enable the user to identify the equipment and software that was used to derive the observation data. The Issue of Data Station (IODS) in both the station and observation records must match.

Message Data Payload:

The data payload of each message will consist of observations. The structures shown indicate a pointer to data but in fact the broadcast messages will not contain a pointer, only the data. Users will have to manage the data and the pointer is shown to illustrate where the data is located in the message and one possible data management option.

Byte Ordering:

All message data is in network byte order (Big Endian), i.e. IA32 users will have to swap bytes.

RT-IGS Messages Content

100 – RT-IGS Station Message (RTIGSS_T)

Content: Station information enables real-time users to link data to a specific station configuration. This record should contain information that is consistent with IGS Station logs.

Bytes	Name	Type	Description
2	rec_id	unsigned short	100 indicates station record, this message must be issued twice per hour
2	sta_id	unsigned short	Unique number assigned to each station. It is uniquely linked to an IGS Station log by the IGS UniqueID contained in this record
4	GPSTime	unsigned long	GPS time message issued, GPS time is seconds from the beginning of GPS (6 Jan-1980)
2	num_bytes	unsigned short	Total number of bytes in the message, including the header
1	IODS	unsigned char	6 flag indicating the current station configuration, this flag will change every time the station hardware changes
1	sta rec type	unsigned char	Various station data formats are possible: 0 indicates that there is no additional station data
1	IGS UniqueID[8]	char	IGS ID ex. "NRC1", this variable will use the IGS 4 character standard but c requires a 0 to terminate the string
	*data	unsigned char	Default station message Does Not contain data. The pointer is shown only to illustrate options.

200 - RT-IGS Observation Message (RTIGSO_T)

Content : GPS Observations in compressed SOC format (see description at http://gipsy.jpl.nasa.gov/iedg/papers/SOC_FORMAT.ppt)

SOC Compression

SOC compresses a complete observation epoch to 21 bytes. Each observation set is fully independent, this feature makes it ideally suited for real time data transmission from remote sites that may only have low bandwidth access to the Internet.

Bytes	Name	Type	Description
2	rec_id	unsigned short;	200 indicates rt-igs gps observation
2	sta_id	unsigned short	Unique number assigned to each station is linked to an IGS Station log by the station record
4	GPSTime	unsigned long	Observation time of issue, GPS time is seconds from the beginning of GPS (6 Jan-1980).
2	num_bytes	unsigned short	Total number of bytes in the message, including the header, but not the data pointer.
1	IODS	unsigned char,	Flag indicating the current station configuration that derived the observations. This value will change every time the station configuration changes.
1	num_obs	unsigned char	Number of GPS Observations in the data block
21/sat	*data	unsigned char	Pointer to SOC observation data (4 byte pointer), this pointer is not in the message the data starts here, the pointer is used to manage the SOC data once the RTIGSO_T message has been decoded.

300 – RT-IGS Ephemeris Message (RTIGSE_T)

Content : SV Broadcast Ephemeris (Subframes 1-3, parity removed)

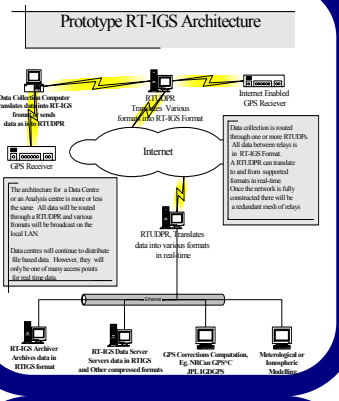
Bytes	Name	Type	Description
2	rec_id	unsigned short	300 indicates rt-igs eph message
2	sta_id	unsigned short	Unique number assigned to each station.
4	CollectedGPSTime	unsigned long	Time ephemeris received at station, GPS time is seconds from the beginning of GPS (6-Jan-1980).
2	num_bytes	unsigned short	Total number of bytes in the message, including the header, but not the size of the data pointer.
1	IODS	unsigned char	A flag indicating the current station configuration that derived the observations, this will change ever time the station configuration changes.
1	Prn	unsigned char	PRN for the data in the message
72	*data	unsigned char	In the RTIGSE_T message the data starts here, the pointer is used to manage the ephemeris data once the RTIGSE_T message has been decoded The RTIGSE_T ephemeris format consists of the 3 broadcast sub frames with the parity bits removed so 3 subframes = 72 bytes per eph.

400 – RT-IGS Meteorological Message (RTIGSM_T)

Content: Station Meteorological observations

Bytes	Name	Type	Description
2	rec_id	assigned short	400 indicates rtigs meteorological message
2	sta_id	assigned short	Unique number assigned to each station.
4	GPSTime	assigned long	Time of issue, GPS time is seconds from the beginning of GPS (6-Jan-1980).
2	num_bytes	assigned short	Total number of bytes in the message, including the header, but not the size of the data pointer.
1	IODS	assigned char	The IODS is a flag indicating the current station configuration that derived the met. Observations. The IODS flag will change every time the station configuration changes
1	Numobs	assigned char	If only temp, press, relative humidity then 3
	*mets	long	Temp (Deg C), press (mb), rel humid (%), zenith Wet (metres), Zenith Dry (metres), Zenith Total (metres) and each scaled by 1000 as 1000.123 mb = 1000123 if the zenith observations are not present only enter 3 for the number of observations.

Prototype RT-IGS Architecture



Available Software Tools

Real-Time Ashtech Reader (RTAR)

Natural Resources Canada, Geodetic Survey Division and Geosciences Australia have cooperatively developed a software package that collects real-time data from Ashtech GPS receivers. This software performs the following functions: receiver control, real-time data collection and validation, real-time data transmission and data archival. The Real Time Ashtech Data Collection Software runs on the Linux platform.

Key Features:

1) Configures the Ashtech receiver.
2) Reads and validates the GPS data in real-time from the receiver serial port.
3) Archives, Ashtech B, E and S files in user defined file sizes.
4) Converts the Ashtech Data into the Real-Time IGS (RTIGS) format.
5) Transmits the RT-IGS data to a specified IP address (UDP or IP Multicast).
6) Provides a client package to monitor tracking performance.
7) Logs performance and error messages in daily log files.
8) Communicates with NRCan's RTUDPR to enable robust real-time data distribution.
9) Runs on the LINUX operating system

Real-Time BenchMark Reader (RTBR)

NRCan has developed a software package that reads the real-time data from AOA BenchMark receiver. This software provides features that are very similar to the RTAR software described in the RTAR section above

GFZ Data Collection and Archival Software

GFZ have developed a suite of RT software tools for AOA BenchMark receivers. The GFZ tools support: GPS receiver configuration and monitoring; real-time data transmission using UDP and on site data archival. A data center tool collects remote site data. Similar software for NovAtel receivers is currently in the final stages of acceptance testing. All tools run on the LINUX operating system.

To contribute software to the RTIGS contact: mark.caissy@nrcan.gc.ca.

Real-Time UDPRelay (RTUDPR)

The real-time UDP relay developed by Natural Resources Canada, Geodetic Survey Division, functions as a specialized software router. It is designed to route GPS data from data collection software, through a network of UDP relays and finally to either end users or a data archival server.

Key Features:

1) Robust transmission of messages using UDP with ack's and retries
2) Real-time data translation and compression
3) Real-time configuration
4) Real-time performance monitoring
5) Real-time data authentication or encryption
6) Remote administration
7) Message Broadcast using IP Multicast or UDP
8) Supports the RT-IGS message protocol and formats
9) Open source translation libraries (C++)
10) Executable freely available to RT-IGS contributors

The UDPRelay currently runs on: LINUX, HP-UX and Sun platforms.

RT-IGS Archival Software (RTIGSA)

Natural Resources Canada, Geodetic Survey Division, has developed software that reads NRCan (format) IP Multicast messages and creates 15 minute data files. One instance of the archival software is run for each station.

The current NRCan archival software is being modified to support RT-IGS formatted data. This task will be completed shortly.

A version of TEQC that supports the RT-IGS format is being developed. The new version of TEQC will enable the translation of RT-IGS files to RINEX and complete the RT-IGS data collection, distribution and archival system.

For more information or to contribute to any of these RT-IGS projects contact: ken.macleod@nrcan.gc.ca or mark.caissy@nrcan.gc.ca

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