IGS RTCM-SC104 RINEX Working Group Report

Ken MacLeod,
Loukis Agrotis,
Nacho Romero

IGS Workshop July 24/2012 Olsztyn, Poland

Overview

- IGS/RTCM-SC104 RINEX Working Group Organization/ Composition
- Status of RTCM-Multiple Signal Message (RTCM-MSM) format.
- Reasons for the IGS to transition from RINEX 2.11 to 3.0x
- Status of the RINEX 3.02 Draft.
- Current Activities within the IGS/RTCM-SC104 RINEX Working Group
- RINEX WG requests IGS Community support to develop open source RTCM-MSM, RINEX 3.0x data: manipulation, analysis and quality control software.
- Overview of the IGS RINEX 3.0x Implementation Plan
- Summary

IGS/RTCM-SC104 RINEX Working Group

- IGS Joined RTCM-SC104 in 2009, RINEX WG established in 2011
- IGS has worked with RTCM to extend RTCM-MSM to meet the high resolution measurement needs of the IGS .
- Development and support of RINEX is now a shared IGS and RTCM-SC104 activity.
- Ken MacLeod (Chair) and Loukis Agrotis (Co-Chair).
- Currently 43 participants, roughly equal number from IGS and RTCM-SC104 communities.
- RTCM voting and conflict resolution procedures are used.
- RINEX documentation will continue to be freely distributed.

RTCM-Multiple Signal Message (RTCM-MSM) Status

- RTCM-MSM (binary format) designed to support all RINEX 3.0x defined observation tracking signals.
- Current MSM are defined to support GPS, GLONASS and Galileo Constellations.
- QZSS support is planned, Compass later.
- Acceptance and interoperability testing completed in May of 2012.
- Documentation prepared and is under final review.
- Final vote for acceptance as a RTCM-SC104 standard will take place in September, 2012.

RTCM-Multiple Signal Message (RTCM-MSM) Continued

- IGS have proposed additional messages that would allow the creation of a complete RINEX file from RTCM-MSM binary messages (no meta data stub file required).
- Proposed messages include: Station, Receiver, Antenna, Met. Sensor and Data.
- IGS have put these messages on hold until after the RTCM-MSM (observation data) messages are accepted and implemented.

RINEX 2.11 Vs RINEX 3.0x

RINEX 2.11	RINEX 3.0x
Designed many years ago and it's now difficult to extend the format to support multiple constellations and signals.	A generic format that can easily be extended to support new constellations and signals.
Phase alignment can be inconsistent between signals.	Phase alignment is consistent between signals (all aligned).
Complete observation sets (Code, Phase, Doppler, SNR and loss of lock (LOL)) for all signals NOT supported	Complete observation (Code, Phase, Doppler, SNR, LOL) sets for all signals supported.

RINEX 2.11 Vs RINEX 3.0x Continued…

RINEX 2.11	RINEX 3.0x
RINEX 2.11 format is not as readable.	RINEX 3.0x format is more readable.
GNSS Industry does not support extensions to RINEX 2.x.	GNSS Industry supports the adoption of RINEX 3.0x
Well established and supported in all IGS functional groups.	Not well supported within IGS. But it's time to renew the data infrastructure.

RINEX 3.02 Draft available to IGS/RTCM-SC104 WG

- Updated RINEX 3.02 documentation available
- RINEX 3.02 Latest Draft May 10/2012:
  - Added QZSS;
  - Added appendix table that enables users to convert aligned phase data back to non aligned phase;
  - Feedback being received from WG, et al;
  - Plan to submit release version to IGS-RTCM-SC104 for adoption by Dec. 2012.
- Current 3.02 Draft supports the IGS Multi-GNSS Experiment.

RTCM SC104/IGS RINEX WG Issues/Tasks

- New RINEX file and station naming convention.
- Defining new generic navigation format to support GPS CNAV and CNAV2.
- RINEX 3.02 supports Compass, which is very poorly documented/described.
  - Proposed solution is to support two RINEX documents: one for fully documented constellations and signals and another for constellation and signals under development.

RTCM SC104/IGS RINEX WG Issues/Tasks Continued…

- Support for RINEX 3.02 within the IGS :
  - Limited in commonly used IGS Analysis Software
  - TEQC does not support RINEX 3.0x and support is not planned
  - BKG currently provides open source software (Version 1.0 release) that translates RTCM 3 and RTCM-MSM to RINEX 2.11 and 3.0x;
- Most GNSS vendors currently provide Microsoft Windows software to translate their proprietary formats into RINEX 3.0x.
  - Some are considering or have under development LINUX software to translate to RINEX 3.0x;

RTCM SC104/IGS RINEX WG Issues/Tasks Continued…

- The RINEX Community needs tools (open source preferred) to support the adoption of RINEX 3.0x
- RINEX WG plans to support and coordinate the development of open source tools to facilitate the adoption of RTCM-MSM and RINEX 3.0x formats.

Software Tools Required to Support the Implementation of RINEX 3.0x

- Convert RTCM binary data into RINEX 3.02 with out loss of information.
- Convert RTCM binary data into RINEX 2.11 with loss of information.
- Read RINEX 3.0x and RTCM-MSM
- Support all current constellations and signals
- Quality Control (QC) tools such as: multipath analysis (MP1, MP2, MP5); cycle slip analysis and data completeness: number tracked vs. number visible.....
- RINEX file manipulation tools (header and body).
- SNR binning by elevation angle
- Phase vs. code time series
- DCB estimation
- Graphing tools / standard output formats
- Etc.

Proposed IGS RINEX 3.x Implementation Plan

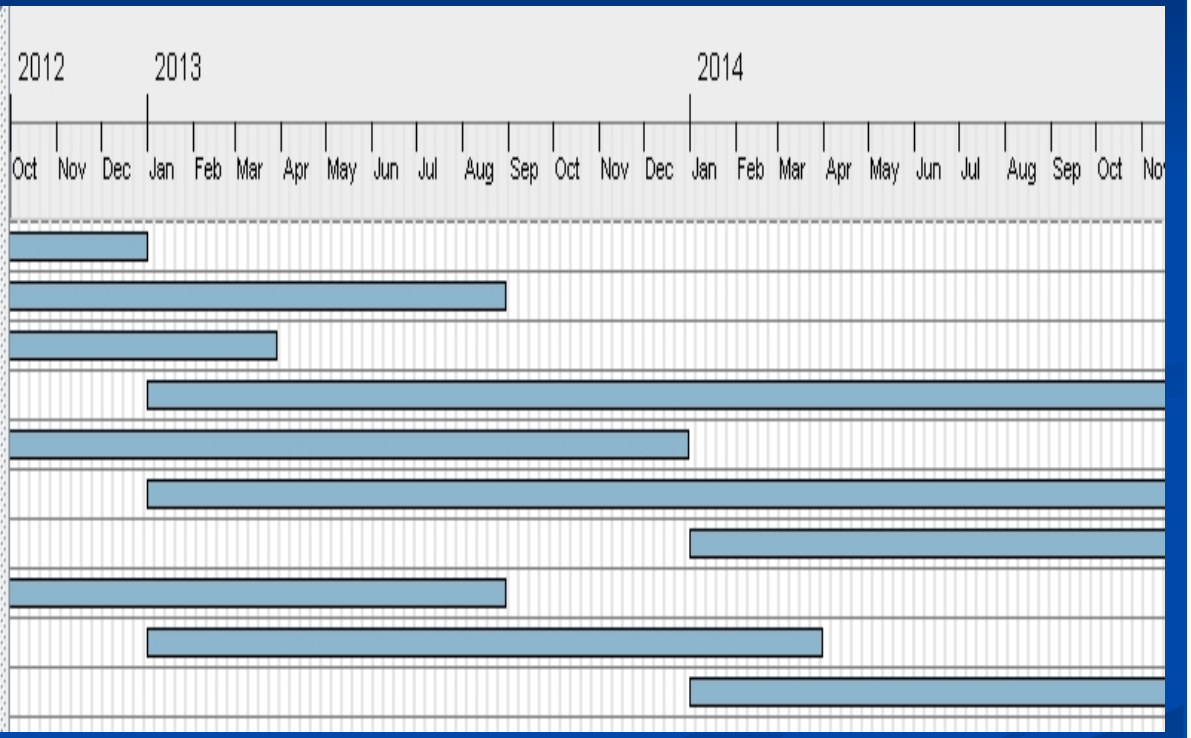
- Transition from RINEX 2.11 to RINEX 3.0x will require a significant effort over many years (2012-2015…).
  - Buy in from all IGS components and GNSS industry will be required. At this time the GNSS Industry as represented by RTCM-SC104 supports RINEX 3.0x.
  - A RINEX Implementation task force will be required to coordinate the activities within and between working groups.
  - A suite of software tools to support RINEX 3.0x will be required. Open source preferred but all will be accepted.
  - MGEX project can be used to prototype and test software and procedures.

Proposed IGS RINEX 3.x Implementation Plan Continued…

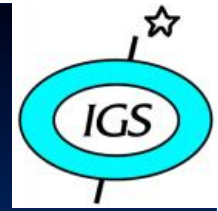
- IGS will continue to accept RINEX 2.11 files for the foreseeable future in order to support:
  - Existing IGS infrastructure;
  - Legacy users including non-IGS users.
  - All IGS functional units are encouraged to support both RINEX 2.11 and 3.02.

RINEX 3.0x Implementation Time Line

Name	Begin d...	End date
Finalize RINEX 3.02 Documentation	03/09/12	01/01/13
IGS WG Develop RINEX 3.02 Software	03/09/12	30/08/13
Data Centres Prepare for RINEX3.02	03/09/12	29/03/13
Data Centres Accepts Both RINEX 2.11 and 3.02 Files	01/01/13	01/01/15
MGEX Project supports: RTCM-MSM and RINEX 3.02	03/09/12	31/12/13
Station Operator update firmware and software	01/01/13	31/12/14
Many Station Operators fully converted to RINEX 3.02	01/01/14	31/12/14
Analysis Software Updated to Support 3.02	03/09/12	30/08/13
Analysis Centres update software and proceedures	01/01/13	31/03/14
AC's support both RINEX 2.11 and 3.02	01/01/14	31/12/14



Infrastructure Com./ RINEX WG Splinter Group Topics



- Request support from all IGS functional units and discuss how we should organize ourselves to implement the transition from RINEX 2.11 to 3.0x.
- Discuss proposal to create an IGS collaborative development team to write open source RTCM-MSM and RINEX 3.0x software tools.
- Discuss the proposal to update the RINEX file and station naming conventions.
- Discuss the proposal to update RINEX 3.02 nav. data format to support CNAV/CNAV2.
- Discuss how we manage the RINEX 3.0x documentation to support both production processing requirements and also meet the needs of researchers who collect data from experimental signals and constellations.

Summary

- IGS/RTCM-SC104 RINEX Working Group is up and running.
- IGS is working with the RTCM-SC104 to develop a phase aligned binary format that is fully compatible with RINEX 3.0x.
- Draft version of RINEX 3.02 released to support QZSS and IGS M-GEX project
- Planning to add a few new features to the 3.02 release to make it more flexible i.e. new file naming convention and generic navigation messages (CNAV/CNAV2).
- Planning a collaborative open source software development team to support RTCM-MSM and RINEX 3.0x format tools.
- Overview of IGS RINEX 3.0x Implementation plan presented.
- Infrastructure Comm. / RINEX WG Splinter Meeting please attend.
- Comments? Questions?

Proposed IGS RINEX 3.0x Implementation Plan Continued…

- Station operators are asked to:
  - continue to support RINEX 2.11.
  - Add RINEX 3.02 support in the coming year (2013), to as many existing stations as possible.
  - New and updated stations should support RINEX 3.02 and RTCM-MSM (Real-Time).
  - Support as many constellations and signals as possible.
  - Continue to improve station installations and management.

Proposed IGS RINEX 3.0x Implementation Plan Continued…

- IGS Data Centres will be asked to support RINEX 3.02 data starting in January 2013.
  - Issues related to duplicate data archival and doubling the input bandwidth will have to be considered.
  - Data centres could receive only RINEX 3.0x and then generate RINEX 2.11 from RINEX 3.0x.
  - Issues related to compression (Hatanaka vs gz or bz2) and file naming conventions have been discussed but not resolved etc.

Proposed IGS RINEX 3.0x Implementation Plan Continued…

- Analysis Centres and solution providers are asked to update software packages and procedures to:
  - Provide Beta support for RINEX 3.02 by June 2013.
- IGS Working Groups and Infrastructure Committee will start the collaborative development of open source tools to enable the creation and QC of RINEX 3.0x files.
  - Target date of Jan. 2013 for first release of translation and manipulation software tools.