

TERMS OF REFERENCE

Metadata Standard for GNSS Software-Defined Radio (SDR) Data

GNSS SDR Metadata Standard Working Group

Initial Committee Membership:

Position	Name	Organization	Telephone	Email
Co-Chair	Sanjeev Gunawardena	Ohio University	(740) 593-9960	gunaward@ohio.edu
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Background:

GNSS software-defined radios (SDRs) are a rapidly advancing area in GNSS receiver research and design. The last few years have seen tremendous growth in this field. Universities and other research institutions have developed and demonstrated advanced capabilities, particularly with respect to multi-constellation GNSS and GNSS-plus-multi-sensor navigation processing for challenging environments. This rapid pace of innovation is catalyzed by the recent commercial availability of numerous GNSS and multi-sensor data collection equipment and GNSS SDR development platforms from several vendors. Indeed, with today's ongoing deployment of multiple GNSS constellations (not to mention the various regional systems), coupled with the rapid advancements in massively-parallel low-power processors and inexpensive sensors (whose developments are fueled by the mobile-device revolution), it is foreseen that the SDR will likely be a significant commercial GNSS receiver architecture by the end of this decade.

In many non-realtime operational scenarios where SDRs are used, raw samples from the receiver front-ends are stored and post-processed. Several key front-end parameters (such as RF and IF center frequencies and sample rate) as well as other information (such as packed-sample format, antenna location and type) are required during post-processing. We define this information as GNSS SDR Metadata. There is currently no established standard for the exchange of metadata between such data collection equipment and GNSS SDR processors to support compatibility and interoperability of these subsystems. The use cases for GNSS SDRs within the PNT community are sufficiently unique such that existing metadata exchange standards do not fully address the community's requirements.

Objective:

The goal of this effort is to establish, through consensus, a free and open standard for the exchange of GNSS SDR metadata.

Deliverables, Summary of Activities and Tentative Schedule:

Deliverable	Activities	Due Date
Working Group	<ul style="list-style-type: none"> • Initial Committee shall form Working Group (WG) to develop standard. • WG shall comprise of qualified representatives from academia, government and industry. • To the extent possible, Initial Committee will seek to ensure WG membership has balanced international representation. • All WG participation and activities shall be voluntary. • Proposed WG membership and documented process to be reviewed by ION Executive Committee prior to materials being reviewed by ION's legal counsel. 	May 2014
Initial Report Document	<ul style="list-style-type: none"> • WG shall be charged to develop standard through consensus. • WG activities will be carried out primarily using online discussion forum/email distribution list through <ion.org> for formal documentation. Teleconference meetings may be held on an as-needed basis. • One formal meeting will occur just prior to ION GNSS+ to finalize Initial Report. • WG shall capture requirements of various interests represented and produce Initial Report. • Initial Report shall be presented at ION GNSS+ (for maximum awareness and member participation), and be available as a free download at <ion.org> for all ION members and general public. • Process shall be established for ION membership as well as general public to submit comments on Initial Report via a comment/feedback portal at <ion.org>. • Initial Report shall contain: <ul style="list-style-type: none"> ○ Background and objectives. ○ WG member listing ○ Overview of WG activities to date. ○ Draft technical details to date, including technical issues and proposed solutions. ○ To the extent possible, draft methods thus far achieved through consensus. ○ Invitation for comment including clearly-defined process thereof. ○ Invitation for participation in WG activities if one feels she/he has significant contribution to make (Co-chairs and active WG membership shall review based on applicant's qualifications and representation). 	Sept. 2014
Public Comments on Initial Report	<ul style="list-style-type: none"> • Machine-generated report from <ion.org> • Documented comments made to WG members • Public comments will be forwarded to WG email list as and when received (during 90-day open comment period) to allow for efficient handling by WG. 	Dec, 2014 (90 days from invitation for comment)
Follow-on Report Document containing Proposed Draft Standard	<ul style="list-style-type: none"> • WG shall review public comments, incorporate suggestions, and address concerns as appropriate. • WG shall further refine technical details through consensus and converge towards a Proposed Draft Standard. 	January 2015

	<ul style="list-style-type: none"> • Follow-on Report shall be presented at ION ITM and be available as a free download at <ion.org> for all ION members and general public. • Shall follow same procedure as Initial Report to seek comment from ION membership and general public. • Follow-on Report shall contain: <ul style="list-style-type: none"> ○ Summary of WG activities to date ○ (Revised) WG member listing ○ Public comment summary and statistics ○ Specific steps taken to address/resolve issues raised through comments ○ Proposed Draft Standard ○ Invitation for public comment on Proposed Draft Standard 	
Public Comments on Proposed Draft Standard	<ul style="list-style-type: none"> • Machine-generated report from <ion.org> • Documented comments made to WG members • Public comments will be forwarded to WG email list as and when received (during 90-day open comment period) to allow for efficient handling by WG. 	April 2015 (90 days from invitation for comment)
Draft Standard Document Archival Records	<ul style="list-style-type: none"> • WG shall review public comments, incorporate suggestions, and address concerns as appropriate. • WG shall further refine technical details through consensus and converge towards a Draft Standard. • Draft standard shall be submitted to ION Council for approval. • Archival Records shall contain all email transactions, meeting minutes, comments records and WG publications. 	June 2015
Legal Review	<ul style="list-style-type: none"> • Following review and approval by ION Council, the draft standard and archival records shall undergo a legal review process. 	Aug. 2015
Final Report Formal Standard	<ul style="list-style-type: none"> • Following legal review and approval, ION Council formally approves standard at ION GNSS+ Council Meeting • Termination of WG and activities • Announcement and presentation of Final Report at ION GNSS+ technical session 	Sept. 2015

Scope:

It is anticipated that WG will bring forward several pre-existing or planned GNSS SDR data storage formats to be supported, such as:

- Multiple data streams stored where front-end parameters may be different across streams (e.g. GPS L1 and L2 samples at 2 MHz bandwidth and L5 samples at 20 MHz bandwidth).
- Multiple data streams written across different files.
- Data saved temporally across multiple files, to be spliced together at time of processing.
- Formats containing SDR data from other RF bands in addition to GNSS bands (such as terrestrial radionavigation systems and signals of opportunity).
- Formats containing auxiliary data embedded with (or in-between) GNSS SDR data (such as front-end AGC data, inertial data, and/or other sensor data).

The scope of this effort is limited to defining a metadata standard that addresses only the following:

- Conveys to a compliant SDR processor, all information required to correctly and unambiguously decode the GNSS signal(s) portion of any supported data file. Extension to non-GNSS signals is allowable only if that signal's metadata is not a superset of a GNSS signal's metadata.
- Provides for embedding low-rate 'tag' information in metadata file that may or may not have been generated with supported data file. Such 'tags' may or may not be timestamped. Examples include:
 - Anomalous events (determined at collection or during post-processing)
 - Front-end gain setting changes
 - User log entries

Specifically, WG shall not attempt to define file formats for storage of data. Nor shall WG endorse, favor, or otherwise prefer the use of any one or more established SDR data format(s) over or to the detriment of other(s) when defining metadata standard.

Envisioned Use of Deliverables:

While not required, it is envisioned that GNSS SDR data collection equipment vendors will adopt this standard to output compliant metadata files. Likewise, adoption of the standard by SDR processor developers is envisioned to make such tools agnostic to specific data collection hardware. Envisioned benefits to the community include: 1) interoperability between all compliant GNSS SDR equipment and tools, 2) ability to share GNSS SDR data files between user groups with no ambiguity pertaining to their correct decoding and use.

Termination:

The Metadata Standard Working Group will terminate when Draft Standard Document is submitted to ION Council for approval. Any change/extension to the WG's program requires prior Council approval.