

GNSS SDR Metadata Standard Working Group Report

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BIOGRAPHY

Dr. Sanjeev Gunawardena is a Research Assistant Professor with the Autonomy & Navigation Technology (ANT) Center at the Air Force Institute of Technology (AFIT). His research interests include RF design, digital systems design, reconfigurable computing, software-defined radio, and all aspects of GNSS receivers and associated signal processing.

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ABSTRACT

During its January 2014 Meeting in San Diego, the Council of the Institute of Navigation approved the formation of a working group to establish a free and open standard for the exchange of GNSS software radio metadata. The goal of this effort is to promote interoperability between GNSS software defined radio (SDR) data collection systems and SDR processors.

The initial report of the Working Group published in the ION GNSS+ 2014 proceedings described early activities, including efforts to involve a representative cross section of the navigation community, requirements capture of various interests represented, draft technical details and technical issues facing the committee.

This report summarizes Working Group activities from January 2015 to September 2015.

BACKGROUND

GNSS software-defined receivers (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, development platforms from several vendors, as well as a number of open-source projects.

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 current revolution in mobile device technology), 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 GNSS SDRs are used, samples from the receiver front-ends are stored and post-processed. These stored SDR files can also be used in RF playback systems for GNSS receiver testing. Several key front-end parameters (such as RF and IF center frequencies, sample rate, and sample resolution) as well as other information are required during post-processing and/or playback. We define this information as GNSS SDR metadata. Currently, for the most part, front-end parameters are entered manually (a process that is cumbersome and error prone to say the least) and no established method exists to exchange this metadata.

In January 2014, the Council of the Institute of Navigation approved the formation of a working group to establish a free and open standard for the exchange of GNSS software radio metadata. The goal of this effort is to promote interoperability between GNSS software defined radio (SDR) data collection systems and SDR processors. Initial activities of the working group are described in [1]. Follow-on activities from September 2014 to January 2015 are summarized in [2].

This report summarizes working group activities for the period January 2015 to September 2015.

SUMMARY OF ACTIVITIES FROM JANUARY 15 TO SEPTEMBER 2015

- A draft version of the technical document was made available on the ION GitHub repository [3]. This document should be used for information purposes only and shall not be interpreted to be an official ION-sanctioned version of the standard that is currently under development.
- A repository of SDR files was made available on the ION website [4]. This publicly accessible site contains representative GNSS SDR sampled data files to be used for testing against the draft standard

and the software normative references that are currently being developed.

- A standard-compliant generic SDR file reader/decoder software library and general-purpose data visualization application was developed [5]. Further details are provided below.
- The second in-person working group meeting was held on September 15 at the Tampa Convention Center, Tampa FL.

STANDARD-COMPLIANT SDR FILE READER/DECODER

During this reporting period, a software library to read and decode SDR data files was developed. A block diagram of this library is shown in Figure 1. This normative reference library was developed to further ease the process of adopting the standard into an SDR project.

The reader/decoder library uses the previously developed metadata parser object to retrieve the metadata information for the SDR file. This information is used to decode the raw data retrieved from the file into one or more sample streams. This decoded data can then be accessed by an SDR application.

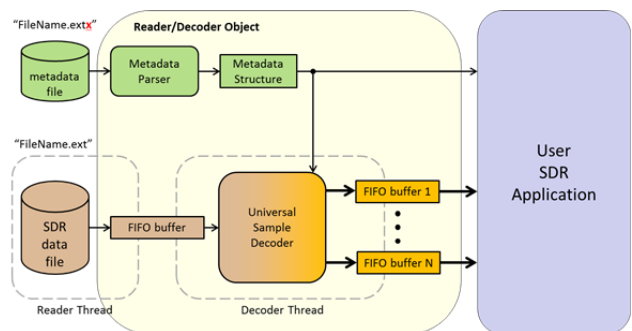


Figure 1 – Block Diagram of Standard-Compliant SDR File Reader/Decoder

An SDR data visualization application was also developed. This application is based on the Gqrx open source project [6]. It uses the standard-compliant reader/decoder library to retrieve decoded sample streams and display their power spectra as a waterfall plot. Figure 2 shows a screenshot of this application. As of this writing, the application is under code review and will be hosted on the ION GitHub repository.

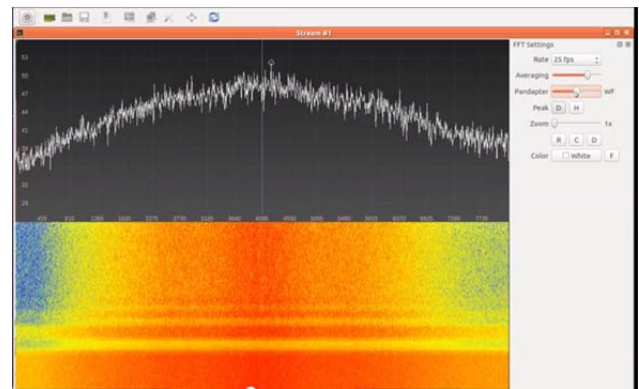


Figure 2 – Screenshot of Sample Data Visualization Application

Next Steps

The Working Group is currently preparing for the initial 90-day public comment process as stipulated in our Terms of Reference. The public comment process is planned to commence in January 2016 and will be accessible through the ION website.

The Working Group is hereby requesting those who produce GNSS SDR data files whose formats are significantly different to those currently available in the ION file repository to contact the working group co-chairs to work through potential standard compliance issues, and to host representative files in the repository to serve as examples of these formats.

ACKNOWLEDGEMENTS

On behalf of the Working Group, the co-chairs thank the following individuals and organizations for their significant efforts during this reporting period:

- AFIT ANT Center for sponsoring two undergraduate summer interns to work on the general purpose SDR file reader/decoder library and data visualization application.
- William Liddy (Case Western Reserve University, Cleveland OH) and Thomas Platt (Wright State University, Dayton OH): AFIT ANT Center summer interns who developed the software described above.
- Mark Carroll, AFIT ANT Center Research Engineer for performing code review of the software described above and coordinating the distribution of these projects on GitHub.
- Rick Buongiovanni of the Institute of Navigation for setting up the ION SDR file repository.
- All working group members who actively participated during this reporting period.

REFERENCES

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- [3] ION GNSS SDR Metadata Working Group, “GNSS SDR Sampled Data Metadata Standard”, Revision

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- [4] The Institute of Navigation, “Sample GNSS IF Data Files,” <http://sdr.ion.org/>.
- [5] GNSSReader, <https://github.com/IonMetadataWorkingGroup/GNSSReader>
- [6] Gqrx SDR, <http://gqrx.dk/>

All URLs validated September 2015.

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