

Follow-On Report of Activities of the GNSS SDR Metadata Standard Working Group

Sanjeev Gunawardena, *Air Force Institute of Technology*
Thomas Pany, *IFEN GmbH*

BIOGRAPHY

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

Dr. Thomas Pany works for IFEN GmbH as a senior research engineer in the GNSS receiver department. He also works as a lecturer (Priv.-Doz.) at the University FAF Munich and for the University of Applied Science in Graz. His research interests include GNSS receivers, GNSS/INS integration, signal processing and GNSS science.

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 follow-on report summarizes Working Group activities from September 2014 to January 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].

This report summarizes working group activities for the period September 2014 to January 2015.

SUMMARY OF ACTIVITIES FROM SEPTEMBER 2014 TO JANUARY 2015

September 12: The initial report of the working group was presented at the Software Receiver Session of the ION GNSS+ 2014 conference [1].

September 12 to January 15:

- 15 members were added to the working group. As of this writing, the working group consists of 63 members, as listed at the end of this report.
- The working group continued to discuss standards related matters via the online discussion forum.

- A GitHub repository was created to host and disseminate draft documents, software specifications and source code [2].
- The initial draft specification presented at the first in-person meeting [1] was further revised based on discussions stemming from that meeting as well as online discussions. The revised draft specification document is available at the GitHub repository [3].
- Compliant to the draft specification document, a unified modeling language (UML)-based object model and XML schema definition (XSD) were developed [4].
- Compliant to the XSD schema, a C++ draft reference software framework was developed. The purpose of this is to ease the integration of the standard by providing a standard-compliant applications programming interface (API) to adopters. This API generates and reads standard-compliant XML metadata files. The API is fully open-source and available for anyone to use under the terms of the Lesser General Public License (LGPL) [5] and is available via the GitHub repository [6].

January 27: The follow-on report of the working group was presented at the GNSS Processing and Integration Session of the ION ITM 2015 conference [7].

NEXT STEPS

The group is currently working to release the first official standard and fully-compliant software API by the first half of 2015. We are also planning to setup a server hosting exemplary IF sample data sets including metadata to further develop the C++ API and demonstrate the benefits of the standard. Those wishing to make available GNSS SDR files and/or file formats for beta-testing are encouraged to contact the working group.

ACKNOWLEDGEMENTS

On behalf of the working group, the co-chairs thank the following individuals for their significant efforts during this reporting period:

- Michael Mathews of Loctronix Corporation for setting up GitHub repositories, developing the object model and XSD from the written specification, and writing the initial version of the C++ reference API.
- Dennis Akos (University of Colorado) and James Curran (Joint Research Center of the European Union) for developing a draft specification for representing oscillator parameters.

- Michael Braasch of Ohio University for his assistance in defining coordinate frame and coordinate frame transformation parameters.
- Rick Buongiovanni of the Institute of Navigation for managing the online discussion forum and for his assistance in setting up GitHub repositories and tentative URLs on the ION website.
- All working group members who actively participated in online discussions.

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All URLs validated February 2015.

WORKING GROUP MEMBERSHIP

AKOS, Dennis M. *University of Colorado*
AL-MASYABI, Walid *Raytheon*
* ARRIBAS, Javier *Centre Tecnològic de Telecomunicacions de Catalunya*
BAVARO, Michele *One Talent GNSS*
BELABBAS, Boubeker *German Aerospace Center (DLR)*
BHATTI, Jahshan *University of Texas at Austin*
BRAASCH, Michael *Ohio University*
CHANSARKAR, Mangesh *CSR plc.*
CHEN, Xin *Shanghai Jiao Tong University*
CHEN, Yu-Hsuan *Stanford University*
COSGROVE, Mathew *Northrop Grumman NSD*
CRAMPTON, Paul G. *Spirent Federal Systems*
CURRAN, James *Joint Research Center, European Commission*
DOVIS, Fabio *Politecnico di Torino*
FAVENZA, Alfredo *Istituto Superiore Mario Boella*
FERNÁNDEZ HERNÁNDEZ, Ignacio *Galileo Supervisory Agency*
FERNÁNDEZ-PRADES, Carles *Centre Tecnològic de Telecomunicacions de Catalunya*
GAVRILOV, Artyom *GNSS-SDR.com*
GLENNON, Eamonn *University of New South Wales*
GOODRICH, Brian *NavCom*
GUNAWARDENA, Sanjeev *Air Force Institute of Technology*
HODO, David *Integrated Solutions for Systems, Inc.*
KALYANARAMAN, Sai K. *Rockwell Collins Inc.*
KOU, Yanhong *Beihang University*
* KUBO, Nobuaki *Tokyo University of Marine Science and Technology*
LANGER, Markus *Karlsruhe Institute of Technology*
LEDVINA, Brent *Coherent Navigation*
* LITTLE, Jon C. *Applied Research Laboratories of the University of Texas at Austin*
LOHAN, Elena-Simona *Tampere University of Technology*
LÓPEZ-ALMANSA, José María *GMV*
LOPEZ-RISUEÑO, Gustavo *European Space Agency*
* MACDONALD, John C. *AFRL Sensors Directorate*
MATHEWS, Michael B. *Loctronix*
MORTON, Yu (Jade) *Colorado State University*
O'BRIEN, Andrew J. *Ohio State University*
PANY, Thomas *IFEN GmbH*
PARSONS, Bryan M. *Applied Research Laboratories of the University of Texas at Austin*
PELOSI, Lou *Cast Navigation*
PETOVELLO, Mark *University of Calgary*
PINCHIN, James *University of Nottingham*
PSIAKI, Mark L. *Cornell University*
* RIEDL, Bernhard *IFEN GmbH*
RUDRA, Angsuman *D-TA Systems*
RÜGAMER, Alexander *Fraunhofer IIS*
SAHMOUDI, Mohamed *University of Toulouse*
SCHIPPER, Brian *Honeywell*
SCHLEPPE, John B. *NovAtel*
SCOTT, Logan *LS Consulting*
SECO-GRANADOS *Gonzalo Universidad Autonoma de Barcelona*
SHIVARAMAIAH, Nagaraj *GNSS Labs*
SOLOVIEV, Andrey *Qunav*
* STAHL, Manuel *Fraunhofer IIS*
SUZUKI, Taro *Tokyo University of Marine Science and Technology*
TKATCH, Alex *Rohde & Schwarz USA Inc.*
UNWIN, Martin *Surrey Satellite Technology Ltd.*
VINANDE, Eric *AFRL Sensors Directorate*

WARD, Phillip W.
WESSON, Kyle
WON, Jong-Hoon
YANG, Ning
YAO, Zheng
YU, Jim
ZHU, Zhen

Navward GPS Consulting
Zeta Associates
University FAF Munich
Draper Laboratory
Tsinghua University
Trimble
East Carolina University

* indicates non-voting member