ION GNSS SDR Metadata
Standard Working Group

ION GNSS+ 2017
Wednesday, September 27, 17:30
Room: C123/C124
Content

• Introduction to the ION GNSS Metadata Standard
• Review of 2016 Meeting
• Request for Comment now open
• Introduction to reference implementation
• Open issues and new developments
• Review of early RFC responses
• List of attendees
• Minutes of Meeting
Background

• Proliferation of GNSS SDR technology in the past 5-10 years
  • Low-cost front-end hardware and data collection systems
  • Maturing GNSS SDR processors, receivers and software frameworks

• Today: no established standard to convey GNSS SDR metadata
  • Existing metadata standards not well suited for needs of GNSS SDR and PNT community

• ION SDR Metadata Standard
  • Objective: To promote/support interoperability between GNSS SDR data collection systems and processors
The Problem

- Some front-end/DCS and SDR processors are bound to one another
- Ad hoc metadata exchange – prone to human error
- Does not promote interoperability
- Does not promote data/resource sharing and re-use
Proposed Solution: Metadata Standardization

- Unambiguous transfer of all essential SDR metadata
- Standardization encourages vendors to support major formats
- Spurs community to develop open-source software handlers and plugins
- Promotes interoperability
- Promotes data portability, resource sharing and re-use
System Topologies

(a) single band, single-stream, single file
- Data Collection System (DCS) → Single SDR File

(b) single band, single-stream, multiple files
- DCS → File 0 → File 1

(c) multi-band, single stream, single file
- Bands at RF → DCS → Single SDR File

(d) multi-stream, single file
- Multi-stream DCS → Multiplexed SDR File

(e) multi-stream, single file
- Sensor → Multi-sensor DCS → Multiplexed SDR File

(f) temporal splitting of files
- DCS → Split SDR Files

(g) spatial splitting of files
- DCS 0 → File 0 → DCS 1 → File 1

(h) spatial-temporal splitting
- DCS 0 → File 0 → Δt → File 1
Metadata Domain Model

- Bands at RF
  - $f_{RF,0}$
  - $f_{RF,1}$
  - $f_{RF,N}$

- SDR Data Collection System
  - System

- SDR Files
  - File
  - FileSet

Core Metadata Classes
- Session
- System
- Cluster
- Source
- Band
- Stream
- Lump
- Chunk
- Block
- Lane
- File
- FileSet

The World’s Leading Professional Organization for the Advancement of Positioning, Navigation and Timing
Review of 2016 Meeting

Minutes of the Meeting:

• The group discusses the status of the activity and agrees that the standard is rather mature but final consolidation needs to be achieved before starting the public comment period.

• A number of people express their willingness to review the standard document (Word file).

• It is agreed that the GitHub C++ code shall be moved to the official ION repository
  • The old current content of the ION repository will be wiped
  • Large binary files (samples) will not be included within the ION repository
  • The Word document of the standard will be part of the new ION repository

• The site sdr.ion.org will be updated
  • Thomas Pany acts as contact point for sdr.ion.org.
  • The ION will be asked to provide a more efficient way to upload large IF samples.
  • Content of sdr.ion.org will be updated including text, xml-files, new IF sample files.
  • Publications and presentations might be included.
  • Group members are asked to provide more IF samples, including reference decoded sample files.
ION accepting comments on the standard through **December 31, 2017**.

- **master** branch of the standards document & reference implementation has been frozen for the RFC

- Public Comment Form:  [http://sdr.ion.org/public-comment.html](http://sdr.ion.org/public-comment.html)

- Types of feedback:

  **Feedback Type (select one)**

  **Critical**: Refers to performance parameter issues/concept of operational employment, etc. Provide convincing support for your critical comment in the RATIONALE section.

  **Substantive**: A section in the document appears to be, or is potentially unnecessary, incorrect, misleading, confusing, or inconsistent with other sections.

  **Administrative**: Typographical, format grammatical error(s).

  **Proposal**: Should be included in the next revision of the standard.
Reference Implementation

A `normative reference' implementation of the standard is being developed.

It consists of two parts:
- A Metadata Interpreter: libapi
  - Provides interface to read/write xml Metadata files
- A binary data converter: libcnv
  - Provides an interface to read/convert GNSS IF data files

It is an open-source C++ implementation:
- Two branches: master (frozen for RFC) and devel (currently active)
- Cross platform: Windows 7, Mac OS, Ubuntu
- Reference IF datasets are also provided to test the code
Usage: in a software receiver

Interprets XML file and passes file description to converter

Description of packed data

Interprets XML file and passes file description to converter

Raw binary file(s)

Basic interface:
Open()
Load()
GetSource()->GetSamples()
Close()

Parses binary file and provides ‘streams’ of native-format data to user application

The World’s Leading Professional Organization for the Advancement of Positioning, Navigation and Timing
Usage: as a file-converter

Interprets XML file and passes file description to converter

Data Converter

Basic interface:
Open()
Convert()
Close()

Parses binary file and provides dumps IF data to file in native machine type (int8_t, int16_t, float, etc)

XML

Description of packed data

Binary

Raw binary file(s)

IF Samples

File-Converter Interface
Using the Software: download from github

IonMetadataWorkingGroup / GNSS-Metadata-Standard

GNSS Software Defined Receiver Metadata Standard

http://sdr.ion.org/

Add topics

69 commits 2 branches 0 releases 2 contributors

Branch: master New pull request

This branch is 15 commits ahead, 7 commits behind

Committed on GitHub: Merge pull request #12

Latest commit c0b4683 15 days ago

- Specifications
- install
- source
- .gitignore
- CMakeLists.txt
- LICENSE
- README.md

The World's Leading Professional Organization for the Advancement of Positioning, Navigation and Timing
Using the Software: generate build files

The project uses CMake to manage build configurations

Available:
• https://cmake.org/
• apt-get install cmake
• port install cmake

Windows:
```
cd GNSS-Metadata-Standard
mkdir build
cd build
cmake .. -G "Visual Studio 14 2015 Win64"
Then open the .sln project and build the 'Release' configuration
```

Mac OS (Xcode):
```
cd GNSS-Metadata-Standard
mkdir build
cd build
cmake .. -G Xcode
Then open the .xcodeproj project and build the 'Release' configuration
```

Unix (make) or Mac OS (make):
```
cd GNSS-Metadata-Standard
mkdir build
cd build
cmake .. -DCMAKE_BUILD_TYPE=Release
make
```
Using the Software: testing your build

• A Matlab/Octave script is included to test the code
• Six reference IF datasets are provided
• Test script runs the data converter and compares the output to references datasets

'check_converter.m'.
If everything has build OK then you should see the following output:

Deleting old files: .....Done.
Running the test converter ("TestConverter"): Done.
Checking the converted output:
FHG: OK
IFEN: OK
JRC: OK
TRIGR: OK
SJTU: SKIPPED
Test completed.
Using the Software: include in your build (1)

To add the "GNSS-Metadata-Standard Converter" to your CMake managed project, add the following lines to your CMakeLists.txt file:

```cpp
include_directories(
    path_to_where_you_copied_the_repository/GNSS-Metadata-Standard/source/api/inc,
    path_to_where_you_copied_the_repository/GNSS-Metadata-Standard/source/converter/inc
)
add_subdirectory(
    path_to_where_you_copied_the_repository/GNSS-Metadata-Standard/source
)

target_link_libraries( your_library_or_executable api xml cnv )
```

and include the following in your main.cpp file

```cpp
#include "GnssMetadata.h"
#include "Converter.h"
```
Using the Software: include in your build (2)

To add the only the "GNSS-Metadata-Standard API" to your CMake managed project, add the following lines to your CMakeLists.txt file:

```cpp
include_directories(
    path_to_where_you/copied_the_repository/GNSS-Metadata-Standard/source/api/inc
)
add_subdirectory(
    path_to_where_you/copied_the_repository/GNSS-Metadata-Standard/source
)

target_link_libraries( your_library_or_executable api_xml )

and include the following in your main.cpp file

#include "GnssMetadata.h"
```
Open Issues & New Developments (1)

• Missing or untested features in the reference implementation:
  • temporal splitting of files has yet to be tested
  • various encoding/formatting features yet to be tested: e.g. gray-code, nlnQ
  • Others: suggestions from the floor / suggestions from the RFC

• Possible need to reduce format configurations
  • without loss of generality/flexibility
  • do we need to support multiple types of block per lane?
  • do we need to support multiple types of chunk per block?

• XML best practices:
  • There are often multiple ways of describing the same IF data
  • e.g. \{SizeWord=1,NumWords=2\} is equivalent to \{SizeWord=2,NumWords=1\}
  • Do we want to recommend a preferred way?
Open Issues & New Developments (2)

• Current use of the standard / code:
  • IFEN SX3 software receiver
  • MuSNAT (Multi-Sensor Navigation Analysis Tool) from Universität der Bundeswehr München
  • JRC Scintillation Repository (Joint Research Center of the European Commission)
  • Politecnico di Turino (NAVSAS Receiver)
  • UAB cloudGNSSrx (http://spcomnav.uab.es/cloudGNSSrx)
  • AFIT
  • Others?

• Possible modifications / enhancements / developments:
  • run-time optimization (speed)
  • Checking/Sanitizing XML files prior to data decoding
  • Data Encoder: pack multiple streams of IF data according to XML spec
  • Others?
Review of early RFC responses

• 15+ Comments received so far:

Topics:

1. **Comment #1 [type: critical]** discusses the VITA 49.2 standard, suggests it should be adoption rather than the ION Metadata Standard.
   
   *Way forward:* Discuss at WG Meeting

2. **Comments #3 to #14 [type: administrative]** discuss formatting, layout, typographical, and clarity of presentation of the standard document.

   *Way forward:* generally agreed/accepted, to be implemented

3. **Comment #15 [type: proposal]:** suggests LaTeX for document preparation.

   *Way forward:* Discuss at WG Meeting
<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pablo Dovis</td>
<td>Politecnico di Torino</td>
<td><a href="mailto:fabio.dovis@polito.it">fabio.dovis@polito.it</a></td>
</tr>
<tr>
<td>Gonzalo Seco</td>
<td>Univ. Autonoma de Barcelona</td>
<td><a href="mailto:gonzalo.seco@uab.es">gonzalo.seco@uab.es</a></td>
</tr>
<tr>
<td>Nicola Linty</td>
<td>Politecnico di Torino</td>
<td><a href="mailto:nicola.Linty@polito.it">nicola.Linty@polito.it</a></td>
</tr>
<tr>
<td>Alex Minetto</td>
<td>Politecnico di Torino</td>
<td><a href="mailto:alex.minetto@polito.it">alex.minetto@polito.it</a></td>
</tr>
<tr>
<td>Javier Arribas</td>
<td>CTTC</td>
<td><a href="mailto:jarribas@cttc.es">jarribas@cttc.es</a></td>
</tr>
<tr>
<td>Heidi Kuusniemi</td>
<td>Finish Geospatial Research Institute</td>
<td><a href="mailto:heidi.kuusniemi@nls.fi">heidi.kuusniemi@nls.fi</a></td>
</tr>
<tr>
<td>Alexander Kügamer</td>
<td>Fraunhofer IIS</td>
<td><a href="mailto:alexander.vuegamer@iis.fraunhofer.de">alexander.vuegamer@iis.fraunhofer.de</a></td>
</tr>
<tr>
<td>Thomas Junique</td>
<td>CNES (French Space Agency)</td>
<td><a href="mailto:thomas.junique@cnes.fr">thomas.junique@cnes.fr</a></td>
</tr>
<tr>
<td>Soeren Zorn</td>
<td>RWTH Aachen University</td>
<td><a href="mailto:soeren.zorn@nav.rwth-aachen.de">soeren.zorn@nav.rwth-aachen.de</a></td>
</tr>
<tr>
<td>Xin Chen</td>
<td>Shanghai Jiao Tong University</td>
<td><a href="mailto:xin.chen@sjtu.edu.en">xin.chen@sjtu.edu.en</a></td>
</tr>
<tr>
<td>Carles Fernandez-Prades</td>
<td>CTTC</td>
<td><a href="mailto:carles.fernandez@cttc.es">carles.fernandez@cttc.es</a></td>
</tr>
<tr>
<td>Eric Shyn</td>
<td>MITRE</td>
<td><a href="mailto:eshyun@mitre.org">eshyun@mitre.org</a></td>
</tr>
<tr>
<td>Jason Pontisos*</td>
<td>Riverside Research</td>
<td><a href="mailto:jponitious@riversideresearch.org">jponitious@riversideresearch.org</a></td>
</tr>
<tr>
<td>Mark Carrol</td>
<td>AFRL</td>
<td><a href="mailto:mark.carroll.10@us.afrlil">mark.carroll.10@us.afrlil</a> *</td>
</tr>
<tr>
<td>Adam Shapiro</td>
<td>MITRE</td>
<td><a href="mailto:aashapiro@mitre.org">aashapiro@mitre.org</a></td>
</tr>
<tr>
<td>Gouluen Eynand</td>
<td>DGA</td>
<td><a href="mailto:gouluen.eynand@intradef.gouv.fr">gouluen.eynand@intradef.gouv.fr</a> *</td>
</tr>
<tr>
<td>Salomon Honkala</td>
<td>FGI (NLS)</td>
<td><a href="mailto:salomon.honkala@nls.fi">salomon.honkala@nls.fi</a></td>
</tr>
<tr>
<td>Martti Kirkko-Jaakkola</td>
<td>Finnish Geospatial Research Institute</td>
<td><a href="mailto:martti.kirkkojakollka@nls.fi">martti.kirkkojakollka@nls.fi</a></td>
</tr>
<tr>
<td>Cillian O’Driscoll</td>
<td>Consultut</td>
<td><a href="mailto:cillian@ieee.org">cillian@ieee.org</a></td>
</tr>
<tr>
<td>Wim De Wilde</td>
<td>Septentrio</td>
<td><a href="mailto:dewilde@septentrio.com">dewilde@septentrio.com</a></td>
</tr>
<tr>
<td>Chris Bartone</td>
<td>Ohio University</td>
<td><a href="mailto:bartone@ohio.edu">bartone@ohio.edu</a></td>
</tr>
</tbody>
</table>

* Doubt about the surname or email domain
Minutes of Meeting

- Meeting started at 5:50 pm
- James Curran presented the slides
- The following questions and comments have been made:
  - Why JSON was not considered instead of XML?
    - XML has been the baseline from the beginning and XML/JSON converters are readily available.
  - Is it possible to foresee parameter changes (e.g. IF) at a certain epoch?
    - Currently not, but possibly in next revision with the help events.
  - Comment period shall be kept open for a longer time
    - Was agreed! Initially it was only for 30 days.
  - Is there a standard file extension for the xml metadata file?
    - No really, but the proposal is to append an ‘x’ to the stream file name
  - Syntax and content check within the metadata parser is encouraged to detect inconsistencies of within the XML file.
  - Further examples on sdr.ion.org are encouraged.
  - More support from vendors might be possible, if vendors can use a logo claiming support of the standard.
  - New use cases of the standard are encouraged.
- Next steps:
  - Further work on C++ code and document within a branch (trunk is kept unchanged during the public comment period)
  - Update sdr.ion.org with publications, papers, presentations and more example data
  - Keep sdr.ion.org up to date
  - Wait for outcome of the public comment period
- Meeting ended at around 6:30 pm