1. SCOS Metadata Specification

According to SCOS architecture and components, there is the need to add additional pieces of data, i.e. metadata, able to identify a peripheral node, SSD, on the basis of its own capabilities, and to tag occupancy results with information such as location, swept frequency, sensing algorithm etc. (proper definition and detailed explanation of employed metadata is given in sections 1.1 and 1.1.8).

It is necessary to classify such information in order to give them a priority order and to reduce the amount of exchanged data for each scanning request.

Metadata can be categorized into Classes, having different purposes:

* Class A (System Metadata) includes all pieces of data that are related to factory information and remain constant for the entire lifespan of the component (SSD);
* Class B (Current Status Metadata) includes data describing the actual configuration of the device, in terms of hardware (positioning, antenna configuration, battery level) and software (frequency settings, sampling rate, sensing algorithm, available local memory etc.);
* Class C (data related metadata), specifying parameters strictly related to performed sensing action (scanned time, timestamp, atmosphere conditions, amount of data to be read, estimated noise level);

Class A and Class C metadata are not subjected to any change since they are offered as a response to a specific query (in SSD association process and Sensing request, respectively).

Class B metadata are provided to SSM, after a specific user request, and can be subjected to modification and special settings by the User actor. They must be provided to the SSM before a scanning section starts, and they must be accompanied by an additional information bit, indicating their editing property (0, non-editable parameter; 1, editable parameter).

Each metadata must respect JSON message syntax and each message must contain the following fields:

* Name
  + This is a text field that contains the metadata name;
* Type
  + This field contain the data type [string|float|int|boolean];
* Editable
  + This field contain a boolean information. In particular it indicates the status of being editable of a specific piece of metadata (set to 0 for Class A and C, settable to 0 or 1 for Class B);
* Content
  + This field contain the content of the metadata.
  1. SSD metadata specification
     1. Top level hardware metadata

|  |  |  |
| --- | --- | --- |
| Parameter | Values | Description |
| Antenna | 0 | Number of antennas |
| Calibration source |  | Present/absent |
| RF switch |  | Present/absent |
| RFFilter |  | Present/absent |
| LNA |  |  |
| Sensor |  | COTS/SDR |

* + 1. Antenna Metadata

Antenna metadata is reported in the table below. In the second column of the table the class of the metadata is specified.

|  |  |
| --- | --- |
| **Metadata Name** | **Metadata class** |
| Antenna Model | Class A |
| Freq. Range Min | Class A |
| Freq. Range Max | Class A |
| Type | Class A |
| Gain | Class A |
| Polarization | Class A |
| Height | Class A |
| Horz. Beam Width | Class A |
| Vert. Beam Width | Class A |
| Min Azi. Beam Dir. | Class A |
| Max Azi. Beam Dir. | Class A |
| Min Elev. Beam Dir. | Class A |
| Max Elev. Beam Dir. | Class A |
| Curr. Azi. Beam Dir. | Class B |
| Curr. Elev. Beam Dir. | Class B |
| Cable loss | Class A |

A detailed description of the field of each metadata is reported in the table below

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Editable | Content |
| Antenna Model | string | “0” | It contains a string with the model of the antenna that is installed. |
| Freq. Range Min | float | “0” | Min frequency value expressed in Hz |
| Freq. Range Max | float | “0” | Max frequency value expressed in Hz |
| Type | string | “0” | Antenna type |
| Gain | float | “0” | Antenna gain expressed in dBi |
| Polarization | string | “0” | Antenna polarization [“VL”|“HL”|“LHC”|“RHC”|“Slant”] |
| Height | float | “0” | Antenna heigh in m. |
| Horz. Beam Width | float | “0” | Horizontal 3-dB beamwidth expressed in degrees |
| Vert. Beam Width | float | “0” | Vertical 3-dB beamwidth expressed in degrees |
| Min Azi. Beam Dir. | float | “0” | minimum direction of main beam in azimuthal plane expressed in degrees from N |
| Max Azi. Beam Dir. | float | “0” | maximum direction of main beam in azimuthal plane expressed in degrees from N |
| Min Elev. Beam Dir. | float | “0” | minimum direction of main beam in elevation plane expressed in degrees from horizontal plane |
| Max Elev. Beam Dir. | float | “0” | maximum direction of main beam in elevation plane expressed in degrees from horizontal plane |
| Curr. Azi. Beam Dir. | float | “0” if fixed antenna is used  “1” if an antenna with beam steering capability is used. | Current direction of main beam in azimuthal plane expressed in degrees from N |
| Curr. Elev. Beam Dir. | float | “0” if fixed antenna is used  “1” if an antenna with beam steering capability is used. | Current direction of main beam in elevation plane expressed in degrees from horizontal plane |
| Cable loss | float | “0” | Cable loss expressed in dB of the cable connecting the antenna with the RF front-end |

* + 1. RF Front-end metadata

RF Front-end metadata is reported in the table below. In the second column of the table the class of the metadata is specified.

|  |  |
| --- | --- |
| **Metadata Name** | **Metadata class** |
| Low Freq Passband | Class A |
| High Freq Passband | Class A |
| Low Freq Stopband | Class A |
| High Freq Stopband | Class A |
| LNA Gain | Class A |
| LNA Noise Figure | Class A |

A detailed description of the field of each metadata is reported in the table below

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Editable | Content |
| Low Freq Passband | float | “0” | Low passband frequency evaluated at -1 dB and expressed in Hz |
| High Freq Passband | float | “0” | High passband frequency evaluated at -1 dB and expressed in Hz |
| Low Freq Stopband | float | “0” | Low stopband frequency evaluated at -60 dB and expressed in Hz |
| High Freq Stopband | string | “0” | High stopband frequency evaluated at -60 dB and expressed in Hz |
| LNA Gain | float | “0” | Low Noise Amplifier Gain expressed in dB |
| LNA Noise Figure | float | “0” | Noise Figure of LNA expressed in dB |

* + 1. Calibration Metadata

Calibration metadata is reported in the table below. In the second column of the table the class of the metadata is specified.

|  |  |
| --- | --- |
| **Metadata Name** | **Metadata class** |
| Cal. Sig. Freq. | Class A |
| Cal. Sig. Ampl. | Class A |
| Self Calibration flag | Class A |
| Last Cal. Date | Class A |

A detailed description of the field of each metadata is reported in the table below

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Editable | Content |
| Cal. Sig. Freq. | float | “0” | Frequency of the internal calibration source expressed in Hz |
| Cal. Sig. Ampl. | float | “0” | Amplitude of the internal calibration source expressed in dB |
| Self Calibration flag | boolean | “0” | This is set to “1” if the sensor performs a periodical self calibration procedure. Otherwise it is set to “0” if the self calibration is performed after a user request |
| Last Cal. Date | string | “0” | The time stamp of the last calibration expressed as HH:MM:SS YYYY/MM/DD |

* + 1. SDR Metadata

SDR metadata is reported in the table below. In the second column of the table the class of the metadata is specified.

|  |  |
| --- | --- |
| **Metadata Name** | **Metadata class** |
| SDR Manufacturer | Class A |
| SDR Model | Class A |
| Firmware version | Class A |

A detailed description of the field of each metadata is reported in the table below

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Editable | Content |
| SDR Manufacturer | string | “0” | Manufacturer of the sensor used |
| SDR Model | string | “0” | Model of the sensor used |
| Firmware version | string | “0” | Current firmware version |

* + 1. SSD Host Metadata

Host metadata is reported in the table below. In the second column of the table the class of the metadata is specified.

|  |  |
| --- | --- |
| **Metadata Name** | **Metadata class** |
| Manufacturer | Class A |
| Model | Class A |
| Installation Date | Class A |
| OS | Class A |

A detailed description of the field of each metadata is reported in the table below

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Editable | Content |
| Manufacturer | string | “0” | Manufacturer of the host |
| Model | string | “0” | Model of the host |
| Installation Date | string | “0” | The date when SSD has been installed expressed as YYYY/MM/DD |
| OS | string | “0” | Operating System installed on the host |

* + 1. Environmental Metadata

Environment metadata is reported in the table below. In the second column of the table the class of the metadata is specified.

|  |  |
| --- | --- |
| **Metadata Name** | **Metadata class** |
| GPS | Class C |
| Temperature | Class C |
| Humidity | Class C |

A detailed description of the field of each metadata is reported in the table below

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Type | Editable | Content |
| GPS | Array of float | “0” | [Latitude expressed in decimal degrees (-90°-90°)  Longitude expressed in decimal degrees (-180°-180°) |
| Temperature | float | “0” | Environment temperature expressed in K |
| Humidity | float | “0” | Environment relative humidity expressed in percentage |

* + 1. SSD Software configuration metadata
       1. Algorithm specification

|  |  |  |
| --- | --- | --- |
| Algorithm | Value | Notes |
| Unspecified | 0 |  |
| Energy Detection | 1 | Default |
| Direction Finding | 2 |  |
| Cyclostationary | 3 |  |
| Wideband | 4 |  |

* + 1. SSD Task Control metadata
       1. Scheduler Specification

|  |  |  |
| --- | --- | --- |
| Algorithm | Value | Notes |
| Unspecified | 0 |  |
| Host Controller | 1 |  |
| Embedded Job Controller | 2 |  |
| Multilevel | 3 |  |
|  |  |  |

* + - 1. SSD Output Specification

|  |  |  |
| --- | --- | --- |
| Algorithm | Value | Notes |
| Unspecified | 0 | Invalid |
| Time domain IQ | 1 | Default |
| Freq domain IQ | 2 |  |
| Time domain Amp, Phase | 3 |  |
| Freq domain Amp, Phase | 4 |  |