**Comments and Suggested Revisions**

**Towards the Communication**

**of the 802.22.3 Standard Draft v1.0**

*Nilesh Khambekar, SpectrumFi, Inc.*

Comment

SCOS communication details should include
1. Communication model
2. Response codes
3. Message encoding structure
4. Message Transport
5. Details of the Message parameters

Suggested Revision

1. Interfaces, Messaging and Primitives

Figure 10: Simplified Interactions Model illustrates a simplified SCOS interactions model. Here, we re-iterate a few architectural details.

* A SCOS platform is composed of sensors and a sensor manager. SCOS system provides sensing as a service.
* The SCOS system control plane is responsible for sensing task management. It enables the clients to SCOS platform to make requests for sensing data. The SCOS system data plane collects the sensing data and enables the SCOS platform clients to consume the requested data. In this regard, the sensor manager is split into Task Manager and Data Manager. The SCOS control plane counterpart of a SCOS platform client making request to sensing data is Data Client. The SCOS data plane counterpart of a SCOS platform client consuming the sensing data is Data Consumer.
* A Data Client connects to Task Manager using well-known address of the Task Manager and *authenticates* itself with the Task Manager. Upon successful authentication, the Dcli performs query on SCOS platform using *Resource Discovery* mechanism. A DCli can the *request sensing data* from the SCOS platform. TM provides *notification* of the completed sensing tasks to the DCli. A Dcli may *request status* on the requested sensing data.
* An SD may actively connect to the sensor manager on the SCOS platform or may passively wait to be contacted by a sensor manager. The SD and TM perform mutual *authentication*. Upon successful authentication, the TM performs *capability discovery* on the SD. The TM *schedules sensing tasks* on the SDs. The TM maintains periodic heartbeat with the SDs.
* The SDs connect with the DM that handles the SCOS data plane functions. After successful mutual authentication, SD pushes the sensing data to the DM.
* The Data Consumers connect with the DM in order to consume the sensing data associated with the sensing request from its counterpart DCli. DCon authenticates itself with the DM. Upon successful authentication, the DCon can receive the sensing data published by the DM.



Figure 10: Simplified Interactions Model

* 1. SCOS Interfaces
		1. SCOS communication interfaces

The following are the key SCOS communication interfaces.

* DCli and TM Interface
	+ The interface between DCli and TM is asynchronous.
	+ The interactions on this interface are specified in the SCOS Data Request API.
* TM and SD Interface
	+ The interface between TM and SD is required to be synchronous.
	+ The interactions on this interface are specified in the SCOS Sensing API.
* SD and DM Interface
	+ The interface between SD and DM is asynchronous.
	+ The interactions on this interface are specified in the SCOS Data Collection API.
* DM and DCon Interface
	+ The interface between SD and DM is required to be asynchronous.
	+ The interactions on this interface are specified in the SCOS Data Consumer API.
		1. Data Client to TM Interface
			1. Authentication and Registration

These procedures define the association and authentication process for an TM and Data Client entity to connect and communicate. They include facilities to prevent spoofing based on shared key exchange. Once an TM is authenticated and registered to a Data Client, the Data Client can then discover the capabilities of the TM and its associated SD’s. The Data Client may then define and make sensing requests to the TM, which include a designation of the Data Consumer(s) to which the data is to be sent. The TM will notify the Data Client when measurements are successfully completed (or not) and available at the Data Consumer.

* + - 1. Resource Discovery

Resource Discovery is the process of informing the Data Client of what capabilities that the TM has with regard to what types of measurements, what bands can be measured and associated measurement parameters that can be specified and controlled and over what locations.

This takes the form of a resource/capability message object and the current scan schedule per SD.

* + - 1. Scan Request

The Scan Request message from the Data Client to the TM includes the parameters of the desired spectrum measurement to be made and any associated processing to be performed by either the SD or the TM. This scan request is wrapped in a scheduling task description, defining the time the scan is to be made, the repetition rate (if applicable), the locations, etc. When the scan parameters in their scheduling wrapper are received by the TM it will be validated as possible to be executed (i.e. the resources requested meet the SSMs schedule of resources available), and either acknowledged as being queue, or a refusal is returned to the Data Client. If a scan schedule is updated for a particular SD, it is then replicated down to that SD.

* + 1. TM to SD Interface
			1. Authentication and Registration

These procedures define the association and authentication process for an SD and TM entity to connect and communicate. They include facilities to prevent spoofing based on shared key exchange. Once an SD is authenticated and registered to a TM, the TM can then discover the capabilities of the SD. An TM will have associated with it at least one SD. The TM may then assign sensing requests to the appropriate set of SDs in order to fulfil the sensing request of the Data Client.

* + - 1. Status and Discovery

The Status and Discovery process serves two functions. The first is to inform the TM of what capabilities that the SD has with regard to what types of measurements, what bands can be measured and associated measurement facilities (such calibration, antenna control, mobility, storage, processing) that can be specified and controlled and over what locations. The SD will transmit a package describing its capabilities and available resources at time of authentication/discovery, and if there is any change in its configuration. The second function is to maintain association with the TM. It will transmit a heartbeat periodically to indicate it is still associated with the TM. If it is to disconnect, it will transmit a disassociation message (e.g. if it is rebooting or about to go into an offline mode).

* + - 1. Scan Request

The Scan Request message originating from the TM is sent to the appropriate SDs for execution as a scan schedule. It includes the parameters of the desired spectrum measurement to be made based on knowledge of the SD’s capabilities. This request will include the time to make the measurement, the repetition rate (if applicable), the locations, etc. and the format of the measured data. In the case of a single, once-off scan, the schedule will indicate no repetition.

Message Parameters are captured in Table 3.

* + 1. Data Manager to Data Consumer Interface
			1. Authentication and Registration

These procedures define the association and authentication process for a Data Consumer and DM entity to connect and communicate. They include facilities to prevent spoofing based on shared key exchange. Once a Data Consumer is authenticated and registered with a DM, the DM is then authorized to cause data to be delivered to the Data Consumer based on the privileges of the Data Consumer and the DM. The Data Consumers can be grouped into Data Consumer Groups, where a transmission of data from the DM is delivered to multiple Data Consumers.

* + - 1. Data Manager

These procedures define and enable the storage of data from the DM to the Data Consumer. The successful reception of this data initiates a notification of the initiating Data Client that requested that data.

* 1. SCOS Messaging

The communication between each of the entities defined above can be grouped and defined within the Interface Categories shown in Figure 11: SCOS Message Sequence.



Figure 11: SCOS Message Sequence

* + 1. Message Encoding

SCOS messages are encoded in JavaScript Object Notation (JSON). JSON is a language-independent data-interchange format that is easy for humans to read and write. There are code and functions readily available in C, C++, C#, Java, JavaScript, MATLAB, Perl, and Python for parsing and generating JSON. It is a lightweight alternative to XML, commonly used to transmit data between server and browser application.

The first five fields are the same for all messages; they are:

1. Ver = Schema/data transfer version with the major.minor.revision syntax (string)

2. Type = Type of JSON message (string) {“Sys”, ”Loc”, or “Data”}

3. SensorID = Unique identifier of sensor (string of URL unreserved characters)

4. SensorKey = Authentication key given out by MSOD (integer)

5. t = Time [seconds since Jan 1, 1970 UTC] (long integer)

Each message begins with a header comprised of attribute-value pairs in ASCII characters.

If an attribute is not relevant to the sensor implementation, then the value is set to NaN or "NaN".

The following are specific formatting rules to be followed:

* All timestamps, i.e., t (defined above)and t1 (to be defined in Data message description) will be reported as seconds since 1/1/1970 midnight UTC in the UTC time zone.
* String values must only contain URL unreserved characters (i.e., uppercase and lowercase letters, decimal digits, hyphen, period, underscore, and tilde), and
* Field names cannot start with an underscore because that convention is reserved for internal implementation-specific uses.
	+ 1. Message Transport protocols

The SCOS standard is transport-agnostic. The standard defines requirements for the transport protocol. The implementers may choose appropriate transport protocol that meets these requirements and suits to the use-case.

* 1. Primitives

Each message (in general) will begin with a header as shown in the following table.

Table 9 SCOS Messages Header Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: versionDATA TYPE: String | Required | IEEE 802.22.3 SCOS protocol version.The maximum length is 64 octets. |
| NAME: scosmodeDATA TYPE: Integer | Required | The mode for SCOS system. |
| NAME: scosmethod DATA TYPE: String | Required | The SCOS method in the context of the communication. The scaos methods are listed in the message descriptions.The maximum length is 64 octets. |
| NAME: msgtype DATA TYPE: Integer | Required | The valid message types are request and response. (1=Request, 2=Response 3= Notification 4=AdminCmd 5=AdminCmdResponse)  |
| NAME: timestampDATA TYPE: Time | Required | Timestamp associated with the communication.. |

The following are specific formatting rules to be followed to avoid problems when messages are ingested into MSOD: (1) All timestamps, i.e., t (defined above)and t1 (to be defined in Data message description) will be reported as seconds since 1/1/1970 midnight UTC in the UTC time zone. (2) String values must only contain URL unreserved characters (i.e., uppercase and lowercase letters, decimal digits, hyphen, period, underscore, and tilde), and (3) Field names cannot start with an underscore because that convention is reserved for MSOD internal use.

*The data fields in the JSON message descriptions below are required fields. If an attribute is not relevant to the sensor implementation, then the value is set to NaN or "NaN".*

* + 1. Response Codes

0: success

100 – 199: error events related to the entity association and disassociation

200 – 299: error events related to the entity configuration and policy enforcement

300 – 399: error events related to the scanning procedures

400 – 499: error events related to the data dissemination procedures

500 – 599: error events related to the heartbeat procedure and SCOS entity/platform health

600 – 699: error events related to the SCOS infrastructure administrative procedures.

* 1. Messages
		1. SD<>TM Messages

Table 10 enumerate the messages exchanged between an SD and the TM.

Table 10 SCOS Messages between SD and TM

|  |  |  |
| --- | --- | --- |
| scos\_method\_name | JSON Array Name of Request Message | JSON Array Name of Response Message |
| “sd\_associate” | *sdAssociateRequest* | *sdAssociateResponse* |
| “sd\_capability” | *sdCapabilityRequest* | *sdCapabilityResponse* |
| “sd\_scan” | *sdScanRequest* | *sdScanResponse* |
| “sd\_heartbeat” | *sdHeartbeatRequest* | *sdHeartbeatResponse* |
| “sd\_disassociate” | *sdDisassociateRequest* | *sdDisassociateResponse* |

* + - 1. SD-TM Association Message Exchange

Table 11 describes the sdAssociateRequest JSON object.

Table 11 SD Association Request Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDName DATA TYPE: string | Required | The name of the sensing device registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: SDMode DATA TYPE: Integer | Required | The mode in which sensing device operates. (1=online, 2=offline)  |
| NAME: SDType DATA TYPE: Integer | Required | The type of the sensing device. (1=SDFull, 2=SDProxy)  |
| NAME: SDID DATA TYPE: string | Conditional | The unique ID assigned to the sensing device. If ID is not pre-assigned, this is left empty. The maximum length is 64 octets.  |
| NAME: SDCertFileDATA TYPE: String | Conditional | The path of the SD certificate file.The maximum length of the ID string is 256 octets. |
| NAME: SDKeyFileDATA TYPE: String | Conditional | The name of the SD certificate file.The maximum length of the ID string is 256 octets. |
| NAME: SDCAFileDATA TYPE: String | Conditional | The name of the trusted certificate authority.The maximum length of the ID string is 256 octets. |

Table 12 describes the sdAssociateResponse JSON object.

Table 12 SD Associate Response Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDName DATA TYPE: string | Required | The name of the sensing device registered with SCOS operator.The maximum length is 64 octets. |
| NAME: response DATA TYPE: string | Required | The response code for association. |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: heartbeatInterval DATA TYPE: Integer | Required | Heartbeat interval in seconds.  |

* + - 1. SD-TM Capability Information Exchange

Table 13 describes the sdCapabilityRequest JSON object sent by the TM to SD.

Table 13 SD Capability Request Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: sendBaseCapability DATA TYPE: boolean | Conditional | True or False. If false, base capability information is not required. |
| NAME: freqIntervals DATA TYPE: Array of freqInterval | Conditional | Array of freqInterval objects. Each freqInterval object denotes a frequency range as defined in Table 14. |
| NAME: timeIntervals DATA TYPE: Array of timeRange | Conditional | Array of timeInterval objects. Each timeInterval object denotes a time range as defined in Table 15 |
| NAME: scanPeriodicity DATA TYPE: Integer | Conditional | Supported scanPeriodicity interval. The periodicity interval is expressed in number of seconds.  |

Table 14 describes the freqInterval JSON object sent by the TM to SD.

Table 14 SCOS Frequency Interval Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: lowFreq DATA TYPE: Integer | Required | The low frequency of a frequency interval. |
| NAME: highFreqDATA TYPE: Integer | Required | The high frequency of a frequency interval. |

Table 15 describes the timeInterval JSON object sent by the TM to SD.

Table 15 SCOS Time Interval Definition Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: startTime DATA TYPE: Time | Required | The start of a time interval. |
| NAME: endTimeDATA TYPE: Time | Required | The end of a time interval. |

Table 16 SCOS Time Datatype Definition Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: time DATA TYPE: String | Required | UTC time expressed in the format YYYY-MM-DDThh:mm:ssZ as defined by [1] |

Table 17 describes the sdCapabilityResponse JSON object sent by the SD to TM.

Table 17 SD Capability Response Object Defiintion

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDIDDATA TYPE: string | Required | The name of the SD registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SDCapabilityInfo DATA TYPE: sdCapabilityInfo | Conditional | Object describing SD capability (class B SD metadata) as described in Annex B.  |
| NAME: freqIntervals DATA TYPE: Array of freqInterval | Conditional | Array of freqInterval objects. Each freqInterval object denotes a frequency range as defined in Table 14. |
| NAME: timeIntervals DATA TYPE: Array of timeRange | Conditional | Array of timeInterval objects. Each timeInterval object denotes a time range as defined in Table 15 |
| NAME: scanPeriodicity DATA TYPE: Integer | Conditional | Supported scanPeriodicity interval. The periodicity interval is expressed in number of seconds.  |

* + - 1. SD-TM Scan Message Exchange

Table 18 describes the sdScanRequest JSON object from TM to SD.

Table 18 SD Scan Request Message Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique ID for the Spectrum Scan.The maximum length of the ID string is 64 octets. |
| NAME: freqIntervals DATA TYPE: Array of freqInterval | Conditional | Array of freqInterval objects. Each freqInterval object denotes a frequency range as defined in Table 14. |
| NAME: scanResolution DATA TYPE: Integer | Conditional | The suggested frequency resolution for the scan. |
| NAME: TaskDurationDATA TYPE: number | Required | Duration of scan in milliseconds. |
| NAME: TaskStartTimeDATA TYPE: Time | Required | The start time for the task. |
| NAME: TaskRepeatIntervalDATA TYPE: Number | Optional | The interval in seconds after which the task needs to be repeated.  |
| NAME: TaskRepeatCountDATA TYPE: Number | Optional | The number of times the task needs to be repeated. |
| NAME: TaskEndTimeDATA TYPE: Time | Optional | The end time for the task. |

Table 19 describes the sdScanResponse JSON object from SD to TM.

Table 19 SD Scan Response Message Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique ID for the Spectrum Scan.The maximum length of the ID string is 64 octets. |
| NAME: scanStatus DATA TYPE: Array of Integer | Required | Array provides scan output status code for each of the freqIntervals. The status code is one of the response codes from Table. The freqIntervals should match with the freqIntervals from the request message. |
| NAME: timestamp DATA TYPE: Time | Required | Timestamp with the associated scanning output. |
| NAME: scanDataDATA TYPE: Array of scanData objects | Required | Array of scanData objects. Each object represents SD measurements for the freqInterval. The scanData is defined in B.3.27.2 |
| NAME: envInfo DATA TYPE: environMetadata | Required | The environmental data including GPS, temperature, and humidity as described in B.3.8  |

Table 20 describes the scanData JSON object sent by the TM to SD.

Table 20 SD Scan Data Message Definition Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: dataFormat DATA TYPE: Integer | Required | The format of the output data as specified in B.3.27.2. |
| NAME: sizeDataDATA TYPE: Integer | Required | The number of measurements. |
| NAME: measDataDATA TYPE: Array of Complex | Required | The complex measurement values. The size of the array is defined by sizeData. |

* + - 1. SD-TM Heartbeat Message Exchange

Table 21 describes the sdHeartbeatRequest JSON object from TM to SD.

Table 21 SD Heartbeat Request Message Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: calibrate DATA TYPE: boolean | Conditional | If true, SD is required to perform calibration. |
| NAME: calibrateTime DATA TYPE: Time | Conditional | If calibrate true, calibrateTime denotes the time for performing calibration. |

Table 22 describes the sdHeartbeatResponse JSON object from SD to TM.

Table 22 SD Heartbeat Response Message Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: calibrateStatus DATA TYPE: Integer | Conditional | The status code for the scheduled calibration. |
| NAME: envInfo DATA TYPE: envMetadata | Required | The type of DCli. The maximum length is 64 octets. |
| NAME: healthInfo DATA TYPE: healthMetadata | Required | The SD health metadata as described in B.3.8. |

Table 23describes the healthMetadata JSON object sent by the SD to TM.

Table 23 SD Health Meatadata Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: batteryLevel DATA TYPE: Integer | Required | The battery level in percentage rounded to closest integer.  |

* + - 1. SD-TM Disassociation Message Exchange

Table 24describes the sdDisassociateRequest JSON object from SD to TM.

Table 24 SD Disassociate Request Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDIDDATA TYPE: string | Required | The ID assigned to SD by the SCOS operator.The maximum length is 64 octets. |
| NAME: SDName DATA TYPE: string | Required | The name of the sensing device registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |

Table 25 describes the sdDisassociateResponse JSON object from TM to SD.

Table 25 SD Disassociate Response Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDNameDATA TYPE: string | Required | The name of the SD registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: statusDATA TYPE: string | Required | The response code for dissociation request.  |
| NAME: oldSDIDDATA TYPE: string | Required | The SD ID that has been dissociatedThe maximum length is 64 octets. |

* + 1. DCli<>TM Messages

Following table describes the SCOS Data Request API methods

Table 26 Messages Exchanged Between DCli and TM

|  |  |  |
| --- | --- | --- |
| scos\_method\_name | JSON Array Name of Request Message | JSON Array Name of Response Message |
| “ta\_associate” | *taAssociateRequest* | *taAssociateResponse* |
| “ta\_resource\_discovery” | *taResourceDiscoveryRequest* | *taResourceDiscoveryResponse* |
| “ta\_schedule\_scan” | *taScheduleScanRequest* | *taScheduleScanResponse* |
| “ta\_scan\_status” | *taScanStatusRequest* | *taScanStatusResponse* |
| “ta\_scan\_notify” | *taScanNotification* | *taScanNotificationResponse* |
| “ta\_dissociate” | *taDissociateRequest* | *taDissociateResponse* |

* + - 1. DCli-TM Association Message Exchange

Table 27 describes the taAssociateRequest JSON object from DCli to TM.

Table 27 DCli Associate Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliNameDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: SMNameDATA TYPE: string | Required | The name of the sensing manager to associate with.The maximum length is 64 octets. |
| NAME: DCliType DATA TYPE: string | Required | The type of DCli. Valid values include {“DCliTypeA”, “DCliTypeB”, “DCliTypeC”}  |
| NAME: DCliID DATA TYPE: string | Optional | The unique ID assigned to the Data Client. The maximum length is 64 octets. |
| NAME: DCliCertFileDATA TYPE: String | Optional | The path of the DCli certificate file.The maximum length of the ID string is 256 octets. |
| NAME: DCliKeyFileDATA TYPE: String | Optional | The name of the DCli certificate file.The maximum length of the ID string is 256 octets. |
| NAME: DCliCAFileDATA TYPE: String | Optional | The name of the trusted certificate authority.The maximum length of the ID string is 256 octets. |
| NAME: admPreferencesDATA TYPE: AdmPreferences | Optional | A DCli can optionally specify certain preferences related to how scanning task administration is performed. |

Table 28 describes the AdmPreferences object

Table 28 DCli Administrative Preferences

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: useNewTaskforRestart DATA TYPE: boolean | Optional | DCli chooses to have new TaskID for a restarted task. In the case of restarting a sensing task, TM provides old TaskID as well in order to associate the two. More details in the Section 7 administration. |
| NAME: useNewTaskforMigration DATA TYPE: boolean | Optional | DCli chooses to have new TaskID for a sensing task with change in SD resource. In the case of migrating a sensing task, TM provides old TaskID as well in order to associate the two. More details in the Section 7 administration. |

Table 29 describes the taAssociateResponse JSON object from TM to DCli

Table 29 DCli Associate Response Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliName DATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SMNameDATA TYPE: string | Required | The name of the sensing manager to associate the DCli with.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: statusDATA TYPE: string | Required | The response code for the DCli association request. The maximum length is 64 octets. |
| NAME: DCliID DATA TYPE: string | Required | The unique ID assigned to the Data Client. The maximum length is 64 octets. |
| NAME: SMID DADCli TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |

* + - 1. DCli-TM Resource Discovery Message Exchange

Table 30 describes the DCliResourceDiscoveryRequest JSON object from DCli to TM.

Table 30 DCli Resource Discovery Request

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliIDDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: perSDInfoRequestDATA TYPE: Boolean | Required | If True, per SD resource/capability information is requested. |
| NAME: freqIntervals DATA TYPE: Array of freqInterval | Optional | Array of freqInterval objects. Each freqInterval object denotes a frequency range as defined in Table 14. |
| NAME: scanDataFormat DATA TYPE: Array of timeInterval | Optional | The format of the scan data as described in B.3.27.2. The maximum length is 64 octets. |
| NAME: scanResolution DATA TYPE: Integer | Optional | The minimum desired scan resolution. |
| NAME: locations DATA TYPE: Array of Location objects | Optional | Array of Location objects for the specified scan frequencies. Each Location object denotes desired coordinates as defined in B.3.9. |
| NAME: locationAccuracy DATA TYPE: Integer | Optional | Desired accuracy for location in terms of maximum distance in meters from the specified coordinate. |

Table 31 describes the location for the DCliResourceDiscoveryResponse JSON object from TM to DCli.

Table 31 DCli Resource Discovery Location Descriptor Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: Latitude DATA TYPE: string | Required | Latitude is expressed in format DD°MM’SS’’ N/SThe maximum length is 64 octets. |
| NAME: Longitude DATA TYPE: string | Required | Longitude is expressed in format DD°MM’SS’’ W/EThe maximum length is 64 octets. |

Table 32 describes the DCliResourceDiscoveryResponse JSON object from TM to DCli.

Table 32 DCli Resource Discovery Response Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |
| NAME: DCliIDDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: sdResourceInfo DATA TYPE: Array of sdCapabilityInfo objects | Conditional | If perSDInfoRequest is true in the request, array of sdCapabilityInfo (Annex B) objects is included. |
| NAME: statusFreqIntervals DATA TYPE: Array of Integer | Conditional | Status codes for each of the freqIntervals from the request message that meet the scanDataformat and scanResolution. |
| NAME: AccuracyLocation DATA TYPE: Array of Integer | Conditional | Accuracy for each of the Locations from the request message in terms of distance (measured in meter). |

* + - 1. DCli-TM Scan Request Message Exchange

Table 33 describes the DCliScheduleScanRequest JSON object from DCli to TM.

Table 33 DCli Schedule Scan Request Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliIDDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: freqIntervals DATA TYPE: Array of freqInterval | Required | Array of freqInterval objects. Each freqInterval object denotes a frequency range as defined in Table 14. |
| NAME: scanDataFormat DATA TYPE: Array of timeInterval | Required | The format of the scan data as described in B.3.27.2. The maximum length is 64 octets. |
| NAME: scanResolution DATA TYPE: Integer | Required | The minimum desired scan resolution. |
| NAME: locations DATA TYPE: Array of Location objects | Required | Array of Location objects. Each Location object denotes desired coordinates as defined in B.3.9. |
| NAME: locationAccuracy DATA TYPE: Integer | Required | Desired accuracy for location in terms of maximum distance in meters from the specified coordinate. |

Table 34 describes the DCliScheduleScanResponse JSON object from TM to DCli

Table 34 DCli Schedule Scan Response Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |
| NAME: DCliIDDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: DCliScanIDDATA TYPE: string | Required | The unique ID assigned for the scan scheduled for the DCli.The maximum length is 64 octets. |
| NAME: status DATA TYPE: Array of Integer | Required | Status codes for each of the scan frequency ranges that support desired scan parameters and the desired locationAccuracy. |

* + - 1. DCli-TM Scan Status Inquiry Message Exchange

Table 35 describes the sdScanStatusRequest JSON object from DCli to TM.

Table 35 DCli Scan Status Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliIDDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |
| NAME: DCliScanIDDATA TYPE: string | Required | The unique ID assigned for the scan scheduled for the DCli.The maximum length is 64 octets. |

Table 36 describes the sdScanStatusResponse JSON object from TM to DCli

Table 36 DCli Scan Status Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliIDDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |
| NAME: DCliScanIDDATA TYPE: string | Required | The unique ID assigned for the scan scheduled for the DCli.The maximum length is 64 octets. |
| NAME: status DATA TYPE: Array of Integer | Required | Status codes for each of the scan frequency ranges that support desired scan parameters and the desired locationAccuracy. |

* + - 1. DCli-TM Scan Notification Message Exchange

Upon completion of the scan or upon error event, TM notifies the DCli of the status for the scan.

Table 37 describes the sdScanNotifyRequest JSON object from DCli to TM.

Table 37 SD Scan Notification Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliIDDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |
| NAME: DCliScanIDDATA TYPE: string | Required | The unique ID assigned for the scan scheduled for the DCli.The maximum length is 64 octets. |
| NAME: status DADCli TYPE: Array of Integer | Required | Status codes for each of the scan frequency ranges that support desired scan parameters and the desired locationAccuracy. |

* + - 1. DCli-TM Dissociation Message Exchange

Table 38 describes the DCliDissociateRequest JSON object from DCli to TM.

Table 38 DCli Dissociation Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliIDDATA TYPE: string | Required | The ID assigned to DCli by the SCOS operator.The maximum length is 64 octets. |
| NAME: DCliName DATA TYPE: string | Required | The name of the DCli registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |

Table 39 describes the sdDissociateResponse JSON object from TM to DCli

Table 39 DCli Dissociation Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCliNameDATA TYPE: string | Required | The name of the Data Client registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: statusDATA TYPE: string | Required | The response code for dissociation request.  |
| NAME: oldDCliIDDATA TYPE: string | Required | The DCli ID that has been dissociatedThe maximum length is 64 octets. |

* + 1. SD<>DM Messages

Table 40 denotes the messages exchanged between SD and DM.

Table 40 Messages Exchanged Between SD and DM

|  |  |  |
| --- | --- | --- |
| scos\_method\_name | JSON Array Name of Request Message | JSON Array Name of Response Message |
| “sd\_dm\_associate” | *sdAssociateRequest* | *sdAssociateResponse* |
| “sd\_dm\_publish” | *sdPublishRequest* | *sdPublishResponse* |
| “sd\_dm\_heartbeat” | *sdHeartbeatRequest* | *sdHeartbeatResponse* |
| “sd\_dm\_disassociate” | *sdDisassociateRequest* | *sdDisassociateResponse* |

* + - 1. SD-DM Association Message Exchange

Table 41 describes the sdAssociateRequest JSON object from SD to DM.

Table 41 SD Associate Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDName DATA TYPE: string | Required | The name of the sensing device registered with SCOS operator.The maximum length is 64 octets. |
| NAME: response DATA TYPE: string | Required | The response code for association. |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: heartbeatInterval DATA TYPE: Integer | Required | Heartbeat interval in seconds.  |

* + - 1. SD-DM Publish Message

Table 42 describes the sdPublishRequest JSON object from SD to DM.

Table 42 SD Publish Sensing Data Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique ID for the Spectrum Scan.The maximum length of the ID string is 64 octets. |
| NAME: scanStatus DATA TYPE: Array of Integer | Required | Array provides scan output status code for each of the freqIntervals. The status code is one of the response codes from Table. The freqIntervals should match with the freqIntervals from the request message. |
| NAME: timestamp DATA TYPE: Time | Required | Timestamp with the associated scanning output. |
| NAME: scanDataDATA TYPE: Array of scanData objects | Required | Array of scanData objects. Each object represents SD measurements for the freqInterval. The scanData is defined in B.3.27.2 |
| NAME: envInfo DATA TYPE: environMetadata | Required | The environmental data including GPS, temperature, and humidity as described in B.3.8  |

Table 43 describes the scanData JSON objects from SD to DM.

Table 43 SD ScanData Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: dataFormat DATA TYPE: Integer | Required | The format of the output data as specified in B.3.27.2. |
| NAME: sizeDataDATA TYPE: Integer | Required | The number of measurements. |
| NAME: measDataDATA TYPE: Array of Complex | Required | The complex measurement values. The size of the array is defined by sizeData. |

Table 44 describes the sdPublishResponse JSON object from SD to DM.

Table 44 SD Publish Sensing Data Response Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique ID for the Spectrum Scan.The maximum length of the ID string is 64 octets. |
| NAME: status DATA TYPE: Array of Integer | Required | Each entry shows status for the publish request of the scanning data for each of the freqIntervals. |
| NAME: timestamp DATA TYPE: Time | Required | Timestamp for the associated scanning data that DM is acknowledging. |

* + - 1. SD-DM Heartbeat Message

Table 45Table 45 describes the heartbeat message exchanged between SD and DM

Table 45 SD Heartbeat Request Message With DM

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: CmdDATA TYPE: Time | Optional | If nonzero, SD is given a command. Currently, two command codes are defined. If cmd is 1, DM is asking SD to list all topics for which the SD is publishing. If cmd is 2, DM is asking to stop publishing for a topic or all topics as suggested by next object in the message. |
| NAME: topicDATA TYPE: string | Conditional | If cmd is 2, this field denotes the topic for which DM is asking SD to stop publishing. If no topic is specified, DM is asking to stop publishing for all the topics. |

 Table 46 denotes the topic details exchanged in the heartbeat response message from SD and DM.

Table 46 Topic Details Exchange in Heartbeat Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: activeTopics DATA TYPE: Array of string | Required | Each entry in the list describes an active topic. The maximum length is 64 octets. |

* + - 1. SD-DM Dissociation Message Exchange

Table 48 describes the sdDissociateRequest JSON object from SD to DM.

Table 47 SD Dissociate Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDIDDATA TYPE: string | Required | The ID assigned to SD by the SCOS operator.The maximum length is 64 octets. |
| NAME: SDName DATA TYPE: string | Required | The name of the sensing device registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |

Table 48 describes the sdDisassociateResponse JSON object from DM to SD.

Table 48 SD Dissociate Response Object

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDNameDATA TYPE: string | Required | The name of the SD registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: statusDATA TYPE: string | Required | The response code for dissociation request.  |
| NAME: oldSDIDDATA TYPE: string | Required | The SD ID that has been dissociatedThe maximum length is 64 octets. |

* + 1. DCon<>DM Messages

Following Table 49 enumerates the messages exchanged between DM and DCon.

Table 49Messages Exchanged Between DCon and DM

|  |  |  |
| --- | --- | --- |
| scos\_method\_name | JSON Array Name of Request Message | JSON Array Name of Response Message |
| “dc\_associate” | *dcAssociateRequest* | *dcAssociateResponse* |
| “dc\_subscribe” | *dcSubscribeRequest* | *dcSubscribeResponse* |
| “dc\_topicdata” | *dcTopicData* | *dcTopicDataResponse* |
| “dc\_unsubscribe” | *dcUnSubscribeRequest* | *dcUnSubscribeResponse* |
| “dc\_heartbeat” | *dcHeartbeatRequest* | *dcHeartbeatResponse* |
| “dc\_disassociate” | *dcDisassociateRequest* | *dcDisassociateResponse* |

* + - 1. DCon-DM Association Message Exchange

Table 50 describes the dcAssociateRequest JSON object from DC to DM.

Table 50 DCon Associate Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCNameDATA TYPE: string | Required | The name of the data-consumer registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: DMNameDATA TYPE: string | Required | The name of the data manager to associate with.The maximum length is 64 octets. |
| NAME: DCID DATA TYPE: string | Optional | The unique ID assigned to the data-client. The maximum length is 64 octets. |
| NAME: DCCertFileDATA TYPE: String | Optional | The path of the DCli certificate file.The maximum length of the ID string is 256 octets. |
| NAME: DCKeyFileDATA TYPE: String | Optional | The name of the DC certificate file.The maximum length of the ID string is 256 octets. |
| NAME: DCCAFileDATA TYPE: String | Optional | The name of the trusted certificate authority.The maximum length of the ID string is 256 octets. |

Table 51 describes the dcAssociateResponse JSON object from DM to DCon

Table 51 DCon Associate Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCName DATA TYPE: string | Required | The name of the DCli registered with SCOS operator.The maximum length is 64 octets. |
| NAME: DMNameDATA TYPE: string | Required | The name of the data manager to associate the DC with.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: statusDATA TYPE: string | Required | The response code for the DCli association request. The maximum length is 64 octets. |
| NAME: DCID DATA TYPE: string | Required | The unique ID assigned to the Data Client. The maximum length is 64 octets. |
| NAME: DMID DATA TYPE: string | Required | The unique ID of the data manager. The maximum length is 64 octets. |

* + - 1. DCon-DM Subscribe Message Exchange

Table 52 describes the dcSubscribeRequest JSON object from DC to DM.

Table 52 DCon Subscribe Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCID DATA TYPE: string | Required | The unique ID assigned to the DCon. The maximum length is 64 octets. |
| NAME: TopicIDDATA TYPE: String | Required | Unique TopicID for the spectrum sensing data to associate the DC with.The maximum length of the ID string is 128 octets. |
| NAME: TAID DATA TYPE: String | Required | ID of Data Client associated with the scan.The maximum length of the ID string is 64 octets. |

Table 53 describes the dcSubscribeResponse JSON object from DM to DC.

Table 53 DCon Subscribe Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCID DATA TYPE: string | Required | The unique ID assigned to the DCon. The maximum length is 64 octets. |
| NAME: TopicIDDATA TYPE: String | Required | Unique TopicID for the spectrum sensing data to associate the DC with.The maximum length of the ID string is 128 octets. |
| NAME: status DATA TYPE: Integer | Required | Response code to subscribe request.  |

* + - 1. DCon-DM TopicData Message Exchange

Table 54 describes the dcTopicData JSON object from DM to DM.

Table 54 DCon Topic Data Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCID DATA TYPE: String | Required | The unique ID assigned to the DCon. The maximum length is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique ID for the Spectrum Scan.The maximum length of the ID string is 64 octets. |
| NAME: scanStatusDATA TYPE: Array of Integer | Required | Array provides scan output status code for each of the freqIntervals. The status code is one of the response codes from Table. The freqIntervals should match with the freqIntervals from the request message. |
| NAME: timestamp DATA TYPE: Time | Required | Timestamp with the associated scanning output. |
| NAME: scanDataDATA TYPE: Array of scanData objects | Required | Array of scanData objects. Each object represents SD measurements for the freqInterval. The scanData is defined in B.3.27.2 |
| NAME: envInfo DATA TYPE: environMetadata | Required | The environmental data including GPS, temperature, and humidity as described in B.3.8 |

Table 55 describes the scanData JSON object from DM to DCon.

Table 55 DM Published Data Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: dataFormat DATA TYPE: Integer | Required | The format of the output data as specified in B.3.27.2. |
| NAME: sizeDataDATA TYPE: Integer | Required | The number of measurements. |
| NAME: measDataDATA TYPE: Array of Complex | Required | The complex measurement values. The size of the array is defined by sizeData. |

Table 56 describes the dcTopicDataResponse JSON object from DCon to DM.

Table 56 Topic Data Acknowledgement Message from DCon

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCIDDATA TYPE: string | Required | The unique ID assigned to the Data Consumer. The maximum length is 64 octets. |
| NAME: TopicIDDATA TYPE: String | Required | Unique ID for the Topic.The maximum length of the ID string is 128 octets. |
| NAME: statusDATA TYPE: Array of Integer | Required | Each entry shows status for the TopicData request of the scanning data for each of the freqIntervals. |
| NAME: timestamp DATA TYPE: Time | Required | Timestamp for the associated scanning data that DC is acknowledging. |

* + - 1. DC-DM Unsubscribe Message Exchange

Table 57 describes the dcUnSubscribeRequest JSON object from DC to DM.

Table 57 DCon Unsubscribe Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: TopicIDDATA TYPE: String | Required | Unique TopicID for the spectrum sensing data the DC wants to unsubscribe.The maximum length of the ID string is 128 octets. |
| NAME: TAID DATA TYPE: String | Required | ID of Data Client associated with the scan.The maximum length of the ID string is 64 octets. |

Table 58 describes the dcUnSubscribeResponse JSON object from DM to DC.

Table 58 Dcon Unsubscribe Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: TopicIDDATA TYPE: String | Required | Unique TopicID for the spectrum sensing data the DC wants to unsubscribe.The maximum length of the ID string is 128 octets. |
| NAME: status DATA TYPE: Integer | Required | Response code to unsubscribe request.  |

* + - 1. DC-DM Heartbeat Message

Table 59describes the dcHeartbeatRequest JSON object from DM to DC.

Table 59 DCon Heartbeat Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCID DATA TYPE: string | Required | The unique ID assigned to the sensing device. The maximum length is 64 octets. |
| NAME: InfoDATA TYPE: Integer | Optional | If DM intends to notify DC certain information related to specific topic or DM/connectivity specific health information.Information codes:0-15: DM/connectivity specific information>15: Topic specific information |
| NAME: topicDATA TYPE: string | Conditional | If information code > 15, this field denotes the topic for which DM is providing additional information. |

Table 60 describes the dcHeartbeatResponse JSON object from DC to DM.

Table 60 DCon Heartbeat Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCID DATA TYPE: string | Required | The unique ID assigned to the data-client. The maximum length is 64 octets. |
| NAME: topicsNeedAttention DATA TYPE: Array of string | Optional | Each entry in the list describes an active topic that needs attention.The maximum length of each topic entry is 128 octets. |

* + - 1. DC-DM Dissociation Message Exchange

Table 61 describes the dcDissociateRequest JSON object from DC to DM.

Table 61 DCon Dissociation Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DCIDDATA TYPE: string | Required | The ID assigned to DC by the SCOS operator.The maximum length is 64 octets. |
| NAME: DCName DATA TYPE: string | Required | The name of the DC registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |

Table 62 describes the dcDissociateResponse JSON object from DM to DC

Table 62 DCon Dissociation Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: TANameDATA TYPE: string | Required | The name of the DC registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: statusDATA TYPE: string | Required | The response code for dissociation request.  |
| NAME: oldDCIDDATA TYPE: string | Required | The DC ID that has been dissociatedThe maximum length is 64 octets. |

* + 1. TM<>DM Messages

The SCOS control plane is managed by the TM and the data plane is managed by DM. The DM and TM communicate in order to synchronize the control plane and data plane. Table 63 describes the messages exchanged between the TM and the DM.

Table 63 Messages Exchanged Between TM and DM

|  |  |  |
| --- | --- | --- |
| scos\_method\_name | JSON Array Name of Request Message | JSON Array Name of Response Message |
| “sm\_dm\_associate” | *smAssociateRequest* | *smAssociateResponse* |
| “sm\_task\_coordinate” | *smTaskCoordinationRequest* | *smTaskCoordinationResponse* |
| “sm\_task\_moderation” | *smTaskModerationRequest* | *smTaskModerationResponse* |
| “sm\_dm\_heartbeat” | *smHeartbeatRequest* | *smHeartbeatResponse* |
| “sm\_dm\_disssociate” | *smDisassociateRequest* | *smDisassociateResponse* |

* + - 1. TM-DM Association Message Exchange

Table 64 describes the smAssociateRequest JSON object from DC to DM.

Table 64 DM Association Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMNameDATA TYPE: string | Required | The name of the sensing manager registered with SCOS operator.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: DMNameDATA TYPE: string | Required | The name of the data manager to associate with.The maximum length is 64 octets. |
| NAME: SMID DATA TYPE: string | Optional | The unique ID assigned to the sensing manager. The maximum length is 64 octets. |
| NAME: SMCertFileDATA TYPE: String | Optional | The path of the TM certificate file.The maximum length of the ID string is 256 octets. |
| NAME: SMKeyFileDATA TYPE: String | Optional | The name of the TM certificate file.The maximum length of the ID string is 256 octets. |
| NAME: SMCAFileDATA TYPE: String | Optional | The name of the trusted certificate authority.The maximum length of the ID string is 256 octets. |

Table 65 describes the smAssociateResponse JSON object from TM to DM

Table 65 DM Associate Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SDName DATA TYPE: string | Required | The name of the sensing manager registered with SCOS operator.The maximum length is 64 octets. |
| NAME: DMNameDATA TYPE: string | Required | The name of the data manager to associate the SD with.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: statusDATA TYPE: string | Required | The response code for the TM-DM association request. The maximum length is 64 octets. |
| NAME: DMID DATA TYPE: string | Required | The unique ID of the data manager. The maximum length is 64 octets. |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |

* + - 1. TM-DM Sensing Task Coordination Message Exchange

Table 66 describes the dmTaskCoordinationRequest JSON object from TM to DM.

Table 66 DM Task Coordination Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique TaskID for the spectrum sensing data to associate the DM with.The maximum length of the ID string is 128 octets. |
| NAME: DMID DATA TYPE: String | Required | ID of data manager associated with the scan.The maximum length of the ID string is 64 octets. |

Table 67 describes the dmTaskCoordinationResponse JSON object from DM to TM.

Table 67 DM Task Coordination Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DMID DATA TYPE: string | Required | The unique ID assigned of the DM handling the sensing data distribution for the sensing task. The maximum length is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique TaskID for the spectrum sensing task.The maximum length of the ID string is 128 octets. |
| NAME: status DATA TYPE: Integer | Required | Response code to subscribe request.  |

* + - 1. TM-DM TopicData Message Exchange

Table 68 describes the dmTaskModeration JSON object from DM to TM.

Table 68 DM Task Moderation Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |
| NAME: DMID DATA TYPE: String | Required | ID of data manager associated with the scan.The maximum length of the ID string is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique TaskID for the spectrum sensing data to associate the DM with.The maximum length of the ID string is 128 octets. |
| NAME: ModCmd DATA TYPE: Integer | Required | Sensing task moderation command code. Following are the defined command codes.0: Invalid cmd1: Data validation errors2: Data rate mismatch3: Switch the sensing task to another DM4-31: reserved commands>31: custom command codes |

Table 69 describes the dmTaskModerationResponse JSON object from TM to DM.

Table 69 DM Task Moderation Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DMID DATA TYPE: string | Required | The unique ID assigned of the DM handling the sensing data distribution for the sensing task. The maximum length is 64 octets. |
| NAME: TaskIDDATA TYPE: String | Required | Unique TaskID for the spectrum sensing task.The maximum length of the ID string is 128 octets. |
| NAME: status DATA TYPE: Integer | Required | Response code for the task moderation request.  |

* + - 1. TM-DM Heartbeat message

Table 70 describes the dmHeartbeatRequest JSON object from DM to TM.

Table 70 DM Heartbeat Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMID DATA TYPE: string | Required | The unique ID of the sensing manager. The maximum length is 64 octets. |
| NAME: DMID DATA TYPE: string | Required | The unique ID of the data manager. The maximum length is 64 octets. |
| NAME: InfoDATA TYPE: Integer | Optional | If DM intends to notify DC certain information related to specific topic or TM/connectivity specific health information.Information codes:0-15: TM/connectivity specific information>15: Topic specific information |
| NAME: topicDATA TYPE: string | Conditional | If information code > 15, this field denotes the topic for which TM is providing additional information. |

Table 71 describes the dmHeartbeatResponse JSON object from TM to DM.

Table 71 DM - TM Heartbeat Exchange

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: DMID DATA TYPE: string | Required | The unique ID assigned to the data-client. The maximum length is 64 octets. |
| NAME: topicsNeedAttention DATA TYPE: Array of string | Optional | Each entry in the list describes an active topic that needs attention.The maximum length of each topic entry is 128 octets. |

* + - 1. TM-DM Dissociation Message Exchange

Table 72 describes the dmDissociateRequest JSON object from DC to DM.

Table 72 DM Dissociate Request Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMIDDATA TYPE: string | Required | The ID of the sensing manager.The maximum length is 64 octets. |
| NAME: SMName DATA TYPE: string | Required | The name of the sensing manager.The maximum length is 64 octets. |
| NAME: DMIDDATA TYPE: string | Required | The ID of the data manager.The maximum length is 64 octets. |
| NAME: DMName DATA TYPE: string | Required | The name of the data manager.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |

Table 73 describes the dmDissociateResponse JSON object from DM to DC

Table 73 DM Dissociate Response Message

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMNameDATA TYPE: string | Required | The name of the DC registered with SCOS operator.The maximum length is 64 octets. |
| NAME: DMName DATA TYPE: string | Required | The name of the data manager.The maximum length is 64 octets. |
| NAME: SCOSOperator DATA TYPE: string | Required | The name of the SCOS operator.The maximum length is 64 octets. |
| NAME: statusDATA TYPE: string | Required | The response code for dissociation request.  |