DCN **22-18-0037-00-0003**

1. Sensing Manager

The SM is primarily responsible for forming the sensor network consisting of one or more SDs, for exchanging information about the capabilities and status of the sensor network to the SCOS Client, and for sensing task management.

* 1. Sensing Manager Definition
* **SM Control Service:** Provides access for SCOS Clients to access a set of sensing functions provided by the SCOS System.
  + Sensing Device Management: SM maintains the information from sensors obtained during the SD association message exchange. The sensor information is identified in Annex B. This information is communicated by the SM the SCOS Client for task scheduling by determining which attached sensors could be used for performing scans.
  + Sensing Task Management: Task management function maintains information about to-be-scheduled, scheduled, and on-going tasks. The information about to-be-scheduled tasks is used in task scheduling, the information about scheduled tasks is synchronized with the SDs. The information about the ongoing tasks is used in task query/coordination/notification with SCOS Client, and SDs.
* **SD Control Service:** the service that manages instructions from the SM to SDs, including the transfer of scheduling requests and acceptance status by the SD.
  + SCOS Tasking API: The SM communicates with SDs using the Tasking API, receives the sensor capabilities, and provides a spectrum scan schedule to the sensors along with necessary information for sending sensing data to the DM.
  + SCOS Status Request API: The SM communicates with the SDs using the Status Request API to query the status of the SDs and the status of any tasks they have scheduled, and provides notification to the SMs upon task completion or error events.
* **SM Data Distribution Service:**
  + This service transmits data to the appropriate end point specified by the SCOS Client. It receives completed scan data packages (sensor data and metadata) from the SDs on a listener service, and retransmits to the appropriate SCOS Client(s) as defined in the Client task request.
* **SM Administration Service:** system management functions to ensure security and management of the SCOS System. These are not defined in this standard as they are considered implementation specific.
  + Policy enforcement: A key part of SCOS administration is enforcing policies for spectrum sensing. The SM ensures that the SCOS Client issuing a scan request is authorized to perform the requested scan, the scanning parameters comply with the regulatory policy for the location, frequency, time, and resolution.
  + User authentication and user profile management: allows for permissions to be assigned to users defined by their Role to access Control and Administrative functions.
  + System administration functions such as software changes. These are out of scope for this standard as they are implementation specific.
  1. Sensing Manager Control Service
     1. Sensing Manager Control Service: Functions

The Sensing Manager’s Control service shall operate database services for:

* + Sensor Devices: store data as to each associated SD’s state, authentication data, capabilities, and the state and nature of scheduled tasks that have been accepted by SDs)
  + SCOS Resources: store data describing aggregated capabilities across all associated SDs, and the state and nature of scheduled tasks that have been requested of SDs
  + SCOS Users: a data store of user credentials, user role, SCOS role profiles and the relevant CRUD permissions
    1. Sensing Manager Control Service: Interfaces

The Sensing Manager’s Control System shall provide data interfaces for:

**SD Authentication and Registration:** Allow SDs to attach to the SM, be authenticated and made an active node in the SCOS system. These procedures define the association and authentication process for an SD and SM 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 SM, the SM can then discover the capabilities of the SD. A SM will have associated with it at least one SD. The SM may then assign appropriate sensing requests to the appropriate set of SDs in order to fulfil the sensing request of the Data Client.

SCOS Association Metadata

The following table enumerates sensing manager parameters toward associating with SCOS.

Table 4 SM Parameter Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: SMID  DATA TYPE: String | Required | Unique ID for the Sensing Manager.  The maximum length of the ID string is 64 octets. |
| NAME: SMSID  DATA TYPE: String | Required | Unique ID for the SMS.  The maximum length of the ID string is 64 octets. |
| NAME: SCOSOperator  DATA TYPE: String | Required | The registered name of the SCOS operator.  The maximum length of the ID string is 64 octets. |
| NAME: SMURL  DATA TYPE: String | Required | The URL for reaching to the SM.  The maximum length of the ID string is 256 octets. |
| NAME: SMCertFile  DATA TYPE: String | Required | The path of the SM certificate file.  The maximum length of the ID string is 256 octets. |
| NAME: SMKeyFile  DATA TYPE: String | Required | The name of the SM certificate file.  The maximum length of the ID string is 256 octets. |
| NAME: SMCAFile  DATA TYPE: String | Required | The name of the trusted certificate authority.  The maximum length of the ID string is 256 octets. |

**SD Discovery:** Allow attached SD capabilities to be queried and exposed to SCOS Clients (by Role). Inform the SM 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.

**State Query:** Allows SD current tasks and state to be queried and exposed to SCOS Clients (by Role), and maintains association with the SM. It will transmit a heartbeat periodically to indicate it is still associated with the SM. 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. SD Control Service
     1. SD Control Service: Functions

**SCOS Tasking:** The Scan Request message originating from the SM 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.

**Task and State Request:** Allows the SCOS Client to query the state of any associated SD or the state of tasks currently being performed for that client.

* + - 1. SD Control Service: Interfaces

**Tasking API**

The following table enumerates the parameter definition object for scanTask.

Table 3 Sensing Scan Task Object Definition

|  |  |  |
| --- | --- | --- |
| Parameter | R/O/C | Description |
| NAME: TaskID  DATA TYPE: String | Required | Unique ID for the Spectrum Scan.  The maximum length of the ID string is 64 octets. |
| NAME: TaskDuration  DATA TYPE: number | Required | Duration of scan in milliseconds. |
| NAME: TaskStartTime  DATA TYPE: Time | Required | The start time for the task. |
| NAME: TaskRepeatInterval  DATA TYPE: Number | Optional | The interval in seconds after which the task needs to be repeated. |
| NAME: TaskRepeatCount  DATA TYPE: Number | Optional | The number of times the task needs to be repeated.  The maximum length of the ID string is 64 octets. |
| NAME: TaskEndTime  DATA TYPE: Time | Conditional | The end time for the task. If repeatInterval and repeatCount are specified, TaskEndTime is not required. |
| NAME: TaskAttributes  DATA TYPE: Integer | Optional | Currently following task attributes can be specified.  0 = Exact time.  1 = Nearest time. |
| NAME: TaskOptions  DATA TYPE: Integer | Optional | Custom options. |

**Task and Status Query API**

To go here...

* 1. Sensing Manager Data Distribution Service
     1. Sensing Manager Data Distribution Service: Functions

SCOS Data Distribution Service: manages the transfer of sensor data northbound to the eventual SCOS Client consuming the data.

* Sensing Data Management: The SDs send spectrum measurements as requested by the scheduled scan with Annex B.3.27.2 describing the sensing data. The sensing data is identified by ScanTaskId, SDID, and timestamp. The SD also provides envInfo which includes environmental data including location, humidity, and temperature. The DM validates the received data, consolidates the data with other received data for the scanning task, stores it internally for further distribution to DCs
* Policy enforcement: A key part of SCOS administration is enforcing policies on the sensing data. The Data Distribution Service ensures that the Data Consumers issuing a subscription request for the sensing data are authorized to receive the data.
* Data validation and consolidation: The Data Distribution Service validates the data received from the SDs against the specified details from the task such as location, frequency, time, and measured data format. It consolidates data based on scanning task requirements.
  + 1. Sensing Manager Data Distribution Service: Interfaces

The following are the key SCOS communication interfaces.

* SD Data Distribution Service listener: receives northbound data transfers coming from each associated SD’s Data Distribution Service into the SM, and provides acknowledgement that it received sensing data to the SDs.
* SM Data Distribution Interface: The interface between the Data Distribution Service of an SM is asynchronous. This interface is specified in terms of any accepted standard transport mechanisms, as specified in Annex D.9: Transport Mechanism Requirements.