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Smart Spot: Firmware Specifications (0.6.3b)

The present document carries out a deep analysis about the SmartSpot device firmware development state, showing information about the already implemented functionalities, non completed functionalities or completely pending functionalities. The development calendar presents the approximated software releases date in order to help users to know when they where be able to use or integrate specific functionalities. The document introduces also information about the way on the some new features will be implemented such as the OMA Objects which will be used for integrate gas sensors. Since the device is currently using some non-standardized OMA Objects, until the standardization, the OMA Object specification for these objects is provided as an ANNEX at the end of the document.

Key Benefits

Through the document, users can be aware about the development state of the SmartSpot, follow its evolution and know about implementation details, useful for the integration of the device by third party backends.

1. Implementation features

Current device firmware version is 0.6.3b, which presents the following features:

- Running over **FreeRTOS**.
- The '**Connectivity Manager**' module implemented in the device allows enable GSM or WiFi interfaces independently. When both interfaces (GSM and WiFi) are enabled the device is capable to auto-exchange between them giving priority to WiFi.
 - SW Limitation: Single connection with GSM connectivity
- **DNS support** in both WiFi and GSM interface.
- **GPS support** in both WiFi and GSM connectivity modes
 - **AGPS** support in GSM mode
- Both main processor native and complementary external CC2541 **BLE interfaces** are supported and configurable via LwM2M
 - HW Limitation: CC2541 interface available when using Smart Spot main board >=v1.2
- **Gas sensors support:**
 - HW Limitation: Using Alphasense board in Smart Spot main board ==v1.1 or >=v1.3
- **Factory reset button**
 - HW Limitation: Button available when using Smart Spot main board >=v1.2
- **RGB LED** to recognize device state (boot, network attach, connected, etc)
 - HW Limitation: RGB LED available when using Smart Spot main board >=v1.2
- **LwM2M Client**
 - Bootstrap Server support
 - LwM2M Objects
 - OMA Device
 - hour related resources pending (NTP/SNTP support required (3/0/13, 3/0/14, 3/0/15))
 - OMA Connectivity Monitoring
 - last standard version resources implementation pending (4/0/4, 4/0/5)
 - OMA Connectivity Statistics
 - OMA Location
 - OMA Firmware upgrade
 - currently only using HTTP via WiFi interface, check under development features
 - IPSO Temperature/Humidity
 - IPSO Pressure
 - HW Limitation: Available when using Smart Spot main board >=v1.2
 - IPSO Concentration Sensor: Provides the result values from gas sensors
 - IPSO WLAN Connectivity: Add/remove new WiFi stations used by the device to achieve connectivity
 - Manufacturer SmartSpot: Manages the advertisement of BLE announces using Eddystone format.
 - non-standardized object - aligned with FIWARE Point of Interaction.
 - Manufacturer Near WiFi Devices: Detection of surrounding WiFi devices by analyzing probe requests.
 - non-standardized object.
 - Manufacturer Smart Spot Config: Allow control specific features of Smart Spot (not public yet since we desire carry out a reorganization but available in Homard)

2. Detailed list of features under development

The following features listed below are under development and they will be released as soon as possible:

- DTLS support in LwM2M (Future feature)
- Firmware upgrade:
 - Via WiFi using HTTPS/CoAP/CoAPS
 - Via GSM using HTTP/HTTPS/CoAP/CoAPS
- NPT/SNTP support
- Gas sensors using specific HOP Gas Expansion Board hardware (prototype in progress)
- Active AC Power Consumption (Software in progress (Uses Power Measurement OMA Object) - Hardware prototype in progress)
- Noise sensor (Software in progress (Uses Loudness OMA Object) - Hardware design in progress)
- AGPS support while using WiFi
- MPU6050 accelerometer/gyroscope integration
 - HW Limitation: Available when using Smart Spot main board >= v1.2
- ACL OMA Object
- Health Monitoring OMA Object (HOP Ubiquitous Object for monitoring)
- Secure Boot
- Flash encryption

3. Extra feature details

3.1 FIWARE Integration

Due to the integration of this device with the FIWARE platform, a new object denominated 'FIWARE Integration' will be developed. This object aims to contain resources with the specific format required by FIWARE data models. An example of this is the 'Location' value which appear in several data models and should have a geoJSON format not contemplated in any LwM2M OMA Object. There are two important points to note related with this:

- This object could disappear in a long future depending of the LwM2M-NGSI proxy behaviour.
- This object should not be used or taken in account by backends which integrate this device through LwM2M.

3.2 Gas sensors integration:

The gas sensor integration will introduce the 'Concentration IPSO Object' (3325) where the values of the different gas sensors will be presented. Due to the integration of this device with FIWARE platform, there will be a fixed relationship between the gas and the instance number. Next table shows this relationship:

Instance ID	Related gas
/3325/0	NO ₂
/3325/1	SO ₂
/3325/2	O ₃
/3325/3	H ₂ S
/3325/4	CO

4. Detailed LwM2M Objects resource development state

Next table illustrates the object resources implementation state:

Device OMA Object (3)			
Resource ID	Resource name	Development state for WiFi interface	Development state for WiFi interface
0	Manufacturer	Implemented	Implemented
1	Model Number	Implemented	Implemented
2	Serial Number	Implemented	Implemented
3	Firmware Version	Implemented	Implemented
4	Reboot	Implemented	Implemented
5	Factory Reset	Implemented	Implemented
6	Available Power Sources	Implemented	Implemented
7	Power Source Voltage	Implemented	Implemented
8	Power Source Current	Implemented	Implemented
9	Battery Level	Implemented	Implemented
10	Memory Free	Implemented	Implemented
11	Error Code	Not implemented	Not implemented
12	Reset Error Code	Not implemented	Not implemented

13	Current Time	NTP/SNTP pending	NTP/SNTP pending
14	UTC Offset	NTP/SNTP pending	NTP/SNTP pending
15	Timezone	NTP/SNTP pending	NTP/SNTP pending
16	Supported Binding and Modes	Implemented	Implemented
17	Device Type	Implemented	Implemented
18	Hardware Version	Implemented	Implemented
19	Software Version	Implemented	Implemented
20	Battery Status	Implemented	Implemented
21	Memory Total	Implemented	Implemented

Connectivity Monitoring OMA Object (4)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
0	Network Bearer	Implemented	Implemented
1	Available Network Bearer	Implemented	Implemented
2	Radio Signal Strength	Implemented	Implemented
3	Link Quality	Implemented	Implemented
4	IP Addresses	Not implemented	Not implemented
5	Router IP Addresses	Not implemented	Not implemented
6	Link Utilization	Implemented	Implemented
7	APN	Implemented	Implemented
8	Cell ID	Implemented	Implemented
9	SMNC	Implemented	Implemented
10	SMCC	Implemented	Implemented

Firmware Update OMA Object (5)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
0	Package	Not implemented	Not implemented
1	Package URI	Implemented	Implemented
2	Update	Implemented	Implemented
3	State	Implemented	Implemented
5	Update Result	Implemented	Implemented
6	PkgName	Omitted	Omitted
7	PkgVersion	Omitted	Omitted

8	Firmware Update Protocol Support	Implemented	Implemented
9	Firmware Update Delivery Method	Implemented	Implemented

Location OMA Object (6)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
0	Latitude	Implemented	Implemented
1	Longitude	Implemented	Implemented
2	Altitude	Implemented	Implemented
3	Radius	Not implemented	Not implemented
4	Velocity	Not implemented	Not implemented
5	Timestamp	Implemented	Implemented
6	Speed	Implemented	Implemented

WLAN Connectivity OMA Object (12)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
0	Interface name	Implemented	Implemented
1	Enable	Implemented	Implemented
2	Radio Enabled	Implemented	Implemented
3	Status	Implemented	Implemented
4	BSSID	Implemented	Implemented
5	SSID	Implemented	Implemented
6	Broadcast SSID	Implemented	Implemented
7	Beacon Enabled	Implemented	Implemented
8	Mode	Implemented	Implemented

9	Channel	Implemented	Implemented
10	Auto Channel	Implemented	Implemented
11	Supported Channels	Implemented	Implemented
12	Channels In Use	Omitted	Omitted
13	Regulatory Domain	Omitted	Omitted
14	Standard	Implemented	Implemented
15	Authentication Mode	Implemented	Implemented
16	Encryption Mode	Implemented	Implemented
17	WPA Pre Shared Key	Implemented	Implemented
18	WPA Key Phrase	Omitted	Omitted
19	WEP Encryption Type	Omitted	Omitted
20	WEP Key Index	Implemented	Implemented
21	WEP Key Phrase	Omitted	Omitted
22	WEP Key 1	Implemented	Implemented
23-48	-	Omitted	Omitted

Connectivity Statistics OMA Object (7)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
0	SMS Tx Counter	Not applicable	Not applicable
1	SMS Rx Counter	Not applicable	Not applicable
2	Tx Data	Implemented	Implemented
3	Rx Data	Implemented	Implemented
4	Max Message Size	Implemented	Implemented
5	Average Message Size	Implemented	Implemented

6	Start	Implemented	Implemented
7	Stop	Implemented	Implemented
8	Collection Period	Implemented	Implemented

SmartSpot Non-standardized Manufacturer Object (10000) TO BE STANDARDIZED			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
0	Physical Web URL	Implemented	Implemented
1	Availability	Not implemented	Not implemented
2	Signal Strength	Implemented	Implemented
3	Area	Implemented	Implemented
4	Advertisement interval	Implemented	Implemented
5	Default Channel	Implemented	Implemented

Near WiFi Devices Non-standardized Manufacturer Object (10001) TO BE STANDARDIZED			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
0	Last Device information	Implemented	Implemented
1	Devices found in the last min	Implemented	Implemented
2	Devices found in the last 10min	Implemented	Implemented
3	Devices found in the last hour	Implemented	Implemented
4	Restrict last device info	Implemented	Implemented
5	Restrict detection with RSSI threshold	Implemented	Implemented
6	Reset Values	Implemented	Implemented

Temperature IPSO Object (3303)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
5700	Sensor Value	Implemented	Implemented
5601	Min Measured Value	Implemented	Implemented
5602	Max Measured Value	Implemented	Implemented
5603	Min Range Value	Implemented	Implemented
5604	Max Range Value	Implemented	Implemented
5701	Sensor Units	Implemented	Implemented
5605	Reset Min and Max Measured Values	Implemented	Implemented

Humidity IPSO Object (3304)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
5700	Sensor Value	Implemented	Implemented
5601	Min Measured Value	Implemented	Implemented
5602	Max Measured Value	Implemented	Implemented
5603	Min Range Value	Implemented	Implemented
5604	Max Range Value	Implemented	Implemented
5701	Sensor Units	Implemented	Implemented
5605	Reset Min and Max Measured Values	Implemented	Implemented

Barometer IPSO Object (3315)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
5700	Sensor Value	Implemented	Implemented
5601	Min Measured Value	Implemented	Implemented
5602	Max Measured Value	Implemented	Implemented
5603	Min Range Value	Implemented	Implemented
5604	Max Range Value	Implemented	Implemented
5701	Sensor Units	Implemented	Implemented
5605	Reset Min and Max Measured Values	Implemented	Implemented

Concentration IPSO Object (3325)			
Resource ID	Resource name	Development state for WiFi interface	Development state for GSM interface
5700	Sensor Value	Implemented	Implemented
5601	Min Measured Value	Implemented	Implemented
5602	Max Measured Value	Implemented	Implemented
5603	Min Range Value	Implemented	Implemented
5604	Max Range Value	Implemented	Implemented
5701	Sensor Units	Implemented	Implemented
5605	Reset Min and Max Measured Values	Implemented	Implemented
5821	Current Calibration	Omitted	Omitted
5750	Application Type	Omitted	Omitted

**Power Measurement IPSO Object (3305)
WILL BE INCLUDED**

**Loudness IPSO Object (3300)
WILL BE INCLUDED**

5. ANNEX 1: Non-Standardized object specification

Two already mentioned objects are not standardized yet, that because this ANNEX includes the specification of these objects in JSON format in order to allow the inclusion of these objects in third party backends until the finalization of the standardization process. These objects are:

Near WiFi Devices Non-standardized Manufacturer Object (10001) TO BE STANDARDIZED

```
{
  "name": "Near WiFi Devices",
  "id": 10001,
  "instancetype": "single",
  "mandatory": false,
  "description": "This Object will be used for counting devices around the SmartSpot.",
  "resourcedefs": [{
    "id": 0,
    "name": "Last Device information",
    "operations": "R",
    "instancetype": "single",
    "mandatory": false,
    "type": "string",
    "range": "",
    "units": "",
    "description": "Shows up the information of the latest device found."
  }, {
    "id": 1,
    "name": "Devices found in the last min",
    "operations": "R",
    "instancetype": "single",
    "mandatory": false,
    "type": "integer",
    "range": "",
    "units": "",
    "description": "Number of devices found in the last minute."
  }, {
    "id": 2,
    "name": "Devices found in the last 10min",
    "operations": "R",
    "instancetype": "single",
    "mandatory": false,
    "type": "integer",
    "range": "",
    "units": "",
    "description": "Number of devices found in the last 10 minutes."
  }, {
    "id": 3,
    "name": "Devices found in the last hour",
    "operations": "R",
    "instancetype": "single",
    "mandatory": false,
    "type": "integer",
    "range": "",
    "units": "",
    "description": "Number of devices found in the last hour."
  }, {
    "id": 4,
    "name": "Restrict last device info",
    "operations": "RW",
    "instancetype": "single",
    "mandatory": false,
    "type": "boolean",
    "range": "",
    "units": ""
  }
}
```

```

        "description": "If enabled, last device information resource will push
observations about a device only one time at minute instead of each time is seen"
    }, {
        "id": 5,
        "name": "Restrict detection with RSSI threshold",
        "operations": "RW",
        "instancetype": "single",
        "mandatory": false,
        "type": "integer",
        "range": "",
        "units": "",
        "description": "Only WiFi detected devices with an RSSI value under this
threshold will be considered"
    }, {
        "id": 6,
        "name": "Reset Values",
        "operations": "E",
        "instancetype": "single",
        "mandatory": false,
        "type": "opaque",
        "range": "",
        "units": "",
        "description": "Reset the values of the three counters."
    }
}
}

```

SmartSpot Non-standardized Manufacturer Object (10000) TO BE STANDARDIZED

```

{
    "name": "SmartSpot",
    "id": 10000,
    "instancetype": "single",
    "mandatory": false,
    "description": "",
    "resourcedefs": [{
        "id": 0,
        "name": "Physical Web URL",
        "operations": "RW",
        "instancetype": "single",
        "mandatory": true,
        "type": "string",
        "range": "",
        "units": "",
        "description": "Shows URL advertised"
    }, {
        "id": 1,
        "name": "Availability",
        "operations": "RW",
        "instancetype": "single",
        "mandatory": true,
        "type": "string",
        "range": "",
        "units": "",
        "description": "Shows the advertisement availability"
    }, {
        "id": 2,
        "name": "Signal Strength",
        "operations": "RW",
        "instancetype": "single",
        "mandatory": false,
        "type": "string",

```

```
        "range": "",
        "units": "",
        "description": "Shows device Signal strength"
    }, {
        "id": 3,
        "name": "Area",
        "operations": "RW",
        "instancetype": "single",
        "mandatory": false,
        "type": "integer",
        "range": "",
        "units": "",
        "description": "Shows device area"
    }, {
        "id": 4,
        "name": "Advertisement interval",
        "operations": "RW",
        "instancetype": "single",
        "mandatory": false,
        "type": "integer",
        "range": "",
        "units": "",
        "description": "Shows device advertisement interval"
    }, {
        "id": 5,
        "name": "Default Channel",
        "operations": "RW",
        "instancetype": "single",
        "mandatory": false,
        "type": "string",
        "range": "",
        "units": "",
        "description": "Shows device advertise channel"
    }
}
```