

## SCA11H CLOUD SERVER INTERFACE SPECIFICATION



### SCA11H

Doc. No. 1325 Rev. 4

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## 1 Introduction

Cloud Server Interface API contains interfaces for

- sending sensor measurements to the cloud
- upgrading BCG and WiFi FW
- updating BCG calibration parameters
- sending notifications about BCG Sensor Node BSN calibration
- sending notifications about BSN upgrade via local HTTP interfaces
- requesting timestamp using httpdate for synchronizing BSN's time with the cloud

## 2 Service information

HTTP REST API is supported for data access. Following connections are supported.

**Table 1** Supported connections

Base URL	Default Port	Connection type
http://your_service_domain/	80	Unsecure
https://your_service_domain/	443	Secure

URL can be modified through the SCA11H sensor node configuration. BSN firmware version 2.4.0 and later support also non-default ports in the URL configuration. E.g. if the port is 8443, URL is "https://your\_service\_domain:8443".

Please note that the BCG doesn't support any TLS extensions (SNI etc.). Contact Murata sales for further information regarding the HTTPS capabilities.

Only root folders on URL are supported, e.g. "http://your\_service\_domain/" is a valid entry. However, http://your\_service\_domain/some/folder/ is not supported.

Requests use HTTP POST method [RFC 2616]. Data contents are expressed with WSN OpenA-PI/XML format [WOA]. The WSN OpenAPI [1] message goes to the HTTP request content.

A POST request must contain the following headers:

**Table 2** POST request header

Header	Value
Authorization	As defined in HTTP Basic Access Authentication [RFC 2617]

The authorization header contains the string "Basic credentials" (without quotes), where credentials contain username and password, separated by a single colon (":") character, within a base64 [RFC 3548] encoded string. For example, if the username and password are user and pass, the authorization header would be "Basic dXNlcjpwYXNz".

Server's HTTP HEAD response header must include date and time in GMT format to sync time. Example response is below.

```
Date: Wed, 25 Mar 2015 10:06:24 GMT
```

### 3 Writing Data

#### 3.1 Header

**Table 3** HTTP Endpoint

<b>Method</b>	POST
<b>Endpoint</b>	data/push/

**Table 4** HTTP Headers

<b>Authorization</b>	HTTP Basic Access Authentication [RFC 2617]
<b>Content-Type</b>	application/x-openapi-sidf+xml

Example POST header is below.

```
POST /data/push/ HTTP/1.1
Host: your.cloud.server
Authorization: Basic dXNlcjpwYXNz
Content-Type: application/x-openapi-sidf+xml
Content-Length: LEN
```

#### 3.2 Message body

The following parameters can be modified through the SCA11H sensor node configuration

**Table 5** Sensor node configuration parameters

<b>Network ID</b>	Sensor network identifier
<b>Node ID</b>	Sensor node ID
<b>Report Interval</b>	Number of samples in one message (5...90)
<b>Timestamp Reset Multiplier</b>	Time sync / timestamp reset parameter (1...3600)

Message body contains WSN OpenAPI SIDF messages in XML format. A typical XML message is below.

```

<Data version="1.7" xmlns="urn:wsn-openapi:sidf">
  <Network id="Network ID">
    <Node id="Node ID">
      <Sensor id="0">
        <Measurement quantity="BioSignal" time="Time">
          <Component id="heart rate" unit="bpm" />
          <Component id="respiration rate" unit="rpm"/>
          <Component id="relative stroke volume" unit="µl"/>
          <Component id="heart rate variability" unit="ms"/>
          <Component id="measured signal strength"/>
          <Component id="status"/>
          <Component id="beat-to-beat time" unit="ms"/>
          <Component id="beat-to-beat time -1" unit="ms"/>
          <Component id="beat-to-beat time -2" unit="ms"/>
          <Values tick="sec">
            Timestamp, HR, RR, SV, HRV, SS, Status, B2B,
            B2B', B2B''
            ...
          </Values>
        </Measurement>
      </Sensor>
    </Node>
  </Network>
</Data>

```

Time format follows the XSD-specification: YYYY-mm-ddTHH:MM:SS+00:00.

YYYY is the year (4 digits), mm is the month (2 digits), DD is the day of month (2 digits), T is the letter T, HH hours (2 digits), MM are the minutes (2 digits), SS are the seconds (2 digits).

Time is synced with server (section 2) and timestamp is reset after sending number of messages defined by Timestamp Reset Multiplier. E.g. Report Interval of 60 and Timestamp Reset Multiplier of 100 results in sync/reset every 6000 s.

The Values element contains the actual measurement data one row/s encoded in CSV format as specified in [RFC 4180]. The first column on each row is a Timestamp followed by HR, RR, SV, HRV, Signal Strength (SS), Status, B2B, B2B', B2B''. Each message will include 5...90 samples defined by Report Interval parameter.

### 3.3 Response

Sensor does not handle response content on data pushes, but rather any HTTP response from the server is ok. HEAD-requests to server root occur at reboots and timestamp reset intervals, and the response to these requests must contain server time in its header (by default, all HTTP responses contain server time). See below for OTA-response content.

### 3.4 Example data

The following example shows BCG measurement with first three values:

```

POST /data/push/ HTTP/1.1
Host: your.cloud.server
Authorization: Basic dXNlcjpwYXNz
Content-Type: application/x-openapi-sidf+xml
Content-Length: 1609

<Data version="1.7" xmlns="urn:wsn-openapi:sidf">
  <Network id="test_network">
    <Node id="test_node">
      <Sensor id="0">
        <Measurement quantity="BioSignal" time="2014-03-07T13:18:04+00:00">
          <Component id="heart rate" unit="bpm" />
          <Component id="respiration rate" unit="rpm"/>
          <Component id="relative stroke volume" unit="µl"/>
          <Component id="heart rate variability" unit="ms"/>
          <Component id="measured signal strength"/>
          <Component id="status"/>
          <Component id="beat-to-beat time" unit="ms"/>
          <Component id="beat-to-beat time -1" unit="ms"/>
          <Component id="beat-to-beat time -2" unit="ms"/>
          <Values tick="sec">
            0,81,11,45,212,1547,1,553,631,0
            1,84,11,37,43,4280,2,611,0,0
            2,83,12,39,41,14280,2,911,0,0
            ...
          </Values>
        </Measurement>
      </Sensor>
    </Node>
  </Network>
</Data>

```

In this example, “2,83,12,39,41,14280,2,911,0,0” means 83 BPM HR-value measured at 2014-03-07T13:18:06+00:00 (2014-03-07T13:18:04+2 seconds).

## 4 Firmware and calibration parameters update

### 4.1 Sync

BSN syncs its FW version details, OTA communication interval and BCG calibration parameters with cloud server after power on/reset and then, by default, every 24 hours. Please note that the BSN has to have a username & password set in the OTA configuration, or OTA communication will not be established.

The request details include following fields:

1. mac (string): Devices MAC address. Acts as unique identifier among devices
2. hardware (string): Used to separate devices that require different firmware based on hardware
3. main\_fw (string): Main firmware version number
4. bcg\_fw (string): BCG firmware version number
5. fs\_fw (string): File system firmware version number
6. dct\_fw (string): Data configuration table firmware version number
7. name (string): Free field to add human readable name to device. Can be left blank
8. pars (string): BCG calibration parameters (Supported in BSN 2.4.15.0 and newer)
9. ota\_period(int): Preferred OTA interval for the device in hours, range 1-24. (Supported in BSN 2.4.17.0 and newer)

Version number format follows X.Y.Z.W, and X is 0-9, Y is 0-99, Z and W is 0-255. Examples: "1.0.0.0", "1.99.0.0", "1.0.0.255".

BCG calibration parameters are in format:

var\_level\_1,var\_level\_2,stroke\_vol,tentative\_stroke\_vol,signal\_range,to\_micro\_g

Variable	Range
var_level_1	1000 - 30000
var_level_2	100 - 10000
stroke_vol	500 - 20000
tentative_stroke_vol	0 - 20000
signal_range	100 - 10000
to_micro_g	2 - 15

Example: "7000,270,5000,0,1500,7"

ota\_period should be returned as integers in hours, with valid range from 1-24. Do note integer format in json response requires no "" symbols in contrast to other settings. Default value is 24, and the device resets to default value on reboots. If none is supplied, device keeps default or previously configured value.

Valid response to devices OTA-HTTP POST request updates device details. The device has a 15 second response timeout (2.4.17.0 and newer) during which the response must reach the device or the response is discarded and operation continues with old settings. This 15 second timeout allows for, for example, Intelligent Calibration calculation during response timeout.

The server should check each firmware type separately and return direct link to binary file when newer version is available. The server must ensure only allowed versions

(same or newer XYZ version numbers, W-version number is not checked) are returned. BSN will upgrade if received binary file is a valid firmware. Note that only main\_fw, bcg\_fw and fs\_fw can be updated via OTA. Dct\_fw changes communication configurations, therefore it cannot be updated via OTA.

If the server returns BCG calibration parameters in response message, BSN will update these parameters. After parameter update BCG algorithm will reset. The server must ensure returned parameters are valid.

The server response header must include at least "Content-Type: application/json" and "Transfer-Encoding: chunked".

Example message is shown below:

Request:

```
POST /firmware/device/5C:F8:A1:5F:CC:A2/ HTTP/1.1
Host: your.cloud.server
Authorization: Basic dXNlcjpwYXNz
Accept: application/json
Content-Type: application/json
Content-Length: 130
```

```
{"mac":"5C:F8:A1:5F:CC:A2","hardware":"AAF","main_fw":"2.4.0.0","fs_fw":"1.2.0.0","dct_fw":"2.4.0.0","bcg_fw":"2.0.1.0","name":"","pars":"7000,270,5000,0,1500,7","ota_period":24}
```

Response:

```
HTTP/1.1 200 OK
Server: nginx/1.4.6 (Ubuntu)
Date: Tue, 07 Apr 2015 02:30:07 GMT
Content-Type: application/json
Transfer-Encoding: chunked
Connection: keep-alive
Vary: Accept
X-Frame-Options: SAMEORIGIN
Allow: GET, POST, PUT, PATCH, HEAD, OPTIONS
```

```
71
{"main_fw":"http://your.cloud.server/media/firmwares/TypeAAF_APP_FW_izdeWd.bin","pars":"7000,270,5000,0,1400,7","ota_period":24}
0
```

## 4.2 Check for upgrades

Response contains keys for each firmware that can be upgraded using OTA. In the above response server has newer version only for main firmware.

## 4.3 Download new firmware file

If the server has at least one newer firmware version, BSN downloads binary file and proceeds to update firmware.



For the above example, BSN sends the request as following.

```
GET http://your.cloud.server/media/firmwares/TypeAAF_APP_FW_iajdeWd.bin
```

After successful download, BSN will reboot and program the new FW autonomously, after which an OTA-message is naturally triggered.

#### 4.4 BSN Firmware Upgrade Message

If BSN firmware upgrade is successfully triggered, BSN will log the start upgrade time immediately and send an XML-message containing the start time of upgrade and status "1" to cloud server by the end of the upgrade. During the upgrade no measurement results are sent to the cloud server.

The XML-message template is:

```
<SIDF version="1.7" xmlns="urn:wsn-openapi:sidf">
  <Network id="Network ID">
    <Node id="Node ID">
      <Sensor id="0">
        <Measurement quantity=" BioSignal:firmwareupdate"
          time="Time">
          <Component id="status" unit="">1</Component>
        </Measurement>
      </Sensor>
    </Node>
  </Network>
</SIDF>
```

Firmware update status message is sent as a measurement using data API. Message includes the same HTTP header as described in section 3.1.

Example message is shown below. BSN node with identifier "B11" under network "u-murata" sends firmware update status message after new firmware file location is received from OTA update.

```

POST /data/push/
Host: your.cloud.server
Authorization: Basic dXNlcjpwYXNz
Content-Type: application/x-openapi-sidf+xml
Content-Length: 265

<SIDF version="1.7" xmlns="urn:wsn-openapi:sidf">
  <Network id="u-murata">
    <Node id="B11">
      <Sensor id="0">
        <Measurement quantity=" BioSignal:firmwareupdate" time="2015-03
          10T12:37:54+00:00">
          <Component id="status" unit="">1</Component>
        </Measurement>
      </Sensor>
    </Node>
  </Network>
</SIDF>

```

## 5 Embedded BCG calibration function

When embedded BSN calibration function is started by a third party, BSN sends the calibration start timestamp and calibration message to cloud. Calibration has two phases and different message contents are used for different phases.

Measurement results are not sent to cloud during the calibration. This message can be used to notify lack of data.

Message template:

```

<SIDF version="1.7" xmlns="urn:wsn-openapi:sidf">
  <Network id="Network ID">
    <Node id="Node ID">
      <Sensor id="0">
        <Measurement quantity=" BioSignal:calibration"
          time="Time">
          <Component id="phase" unit="">{phase
            id}</Component>
        </Measurement>
      </Sensor>
    </Node>
  </Network>
</SIDF>

```

Calibration message is sent as a measurement using data API. Message includes the same HTTP header as described in section 3.1.

Example: BSN node with identifier “B11” under network “u-murata” sends calibration message after calibration phase 1 is started.

```
POST /data/push/  
Host: your.cloud.server  
Authorization: Basic dXNlcjpwYXNz  
Content-Type: application/x-openapi-sidf+xml  
Content-Length: 265  
  
<SIDF version="1.7" xmlns="urn:wsn-openapi:sidf">  
<Network id="u-murata">  
  <Node id="B11">  
    <Sensor id="0">  
      <Measurement quantity=" BioSignal:calibration" time="2015-03  
        10T12:37:54+00:00">  
        <Component id="phase" unit="">1</Component>  
      </Measurement>  
    </Sensor>  
  </Node>  
</Network>  
</SIDF>
```

Example: BSN node with identifier "B11" under network "u-murata" sends calibration message after calibration phase 2 is started.

```
POST /data/push/  
Host: your.cloud.server  
Authorization: Basic dXNlcjpwYXNz  
Content-Type: application/x-openapi-sidf+xml  
Content-Length: 265  
  
<SIDF version="1.7" xmlns="urn:wsn-openapi:sidf">  
<Network id="u-murata">  
  <Node id="B11">  
    <Sensor id="0">  
      <Measurement quantity=" BioSignal:calibration" time="2015-03  
        10T12:37:54+00:00">  
        <Component id="phase" unit="">2</Component>  
      </Measurement>  
    </Sensor>  
  </Node>  
</Network>  
</SIDF>
```

## 6

### References

[1]

[http://www.tkt.cs.tut.fi/research/gwg/downloads/WSN\\_OpenAPI\\_Specification\\_r1.0.pdf](http://www.tkt.cs.tut.fi/research/gwg/downloads/WSN_OpenAPI_Specification_r1.0.pdf)

## 7 Document change control

Rev.	Date	Change Description
1	10-Sep-15	Document moved to new control system and template, section 4.1 changed to BSN checks new OTA update every 24h
2	25-Oct-15	Updated section 4.1 "The server must ensure only allowed versions are returned."
3	7-Apr-16	Added BCG calibration parameters update from cloud. Feature is supported in BSN FW 2.4.15.0 and newer.
4	19-Sep-16 20-Nov-17 1-Feb-18	Added to section 4.1 list of FWs that can be updated via OTA Added comment in section 4 that OTA communication will not be established if no username & password are configured. Added notes on TLS extensions
5	31-May-18	Added configurable OTA-interval feature that was introduced in the newest 2.4.17.0 BSN firmware. Included 15s OTA response timeout, and changes to which firmware version numbers the BCG checks. Clarified server response requirements in section 3.3.

**Signatures:**

**Controlled  
Document  
Approval:**

I approve this document.

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Timestamp