

SENSO8 NB-IoT Ultrasonic Distance Sensor API Document

The API document describes the format of downlink and uplink JSON data for the following models:

- SEN20UD0
- SEN21U00-0000
- SEN21U00-1000

1. Uplink Data

1.1 Data Reporting

The sensor sends a data uplink data report in the following cases:

- Change in occupancy state
- Periodic heartbeat
- Button press

MQTT Topic Format

SENSO8/nbiot/data/<IMEI>

MQTT Message Payload Format

```
{
  "ver": protocol_version,
  "msg": msg_seq_no,
  "time": epoch_time,
  "sn": sensor_imei,
  "type": sensoy_type,
  "dist": sensor_distance,
  "state": occupancy_state,
  "bat": battery,
  "RAT": radio_type,
  "rssi": radio_rssi,
  "rsrp": radio_rsrp,
```

```
"rsrq": radio_rsrq,
"ci": radio_ci,
"tac": radio_tac,
"low_batt": low_batt,
"event": event,
"debug": debug_info
}
```

Field	Description
protocol_version	Protocol version (int)
msg_seq_no	Message sequence number (uint32)
epoch_time	Unix epoch time in ms
sensor_imei	IMEI of the sensor (string)
sensor_type	Sensor type = 13
sensor_distance	Distance detected by sensor (int, mm)
occupancy_state	Occupancy state 0 – vacant (distance > threshold) 1 – occupied (distance <= threshold)
bat	Battery voltage (mV)
radio_type	Radio Type, e.g. LTE, 3G, ...
radio_rssi	Radio RSSI (int)
radio_rsrp	Radio RSRP (int)
radio_rsrq	Radio RSRQ (int)
radio_ci	Radio cell information (8-digit hex string)
radio_tac	Radio tracking area code (4-digit hex string)
low_batt	0 – battery normal; 1- battery low
event	0 – Change in occupancy state 1 – Button Press 2 – Periodic Heartbeat
debug_info	Reserved

1.2 Device Configuration Reporting

The sensor uploads the device information (like IMEI, firmware version, etc) and settings (like data upload period, distance thresholds, etc) when start-up. By default, the sensor also reports its device configuration every 24 hours.

MQTT Topic Format

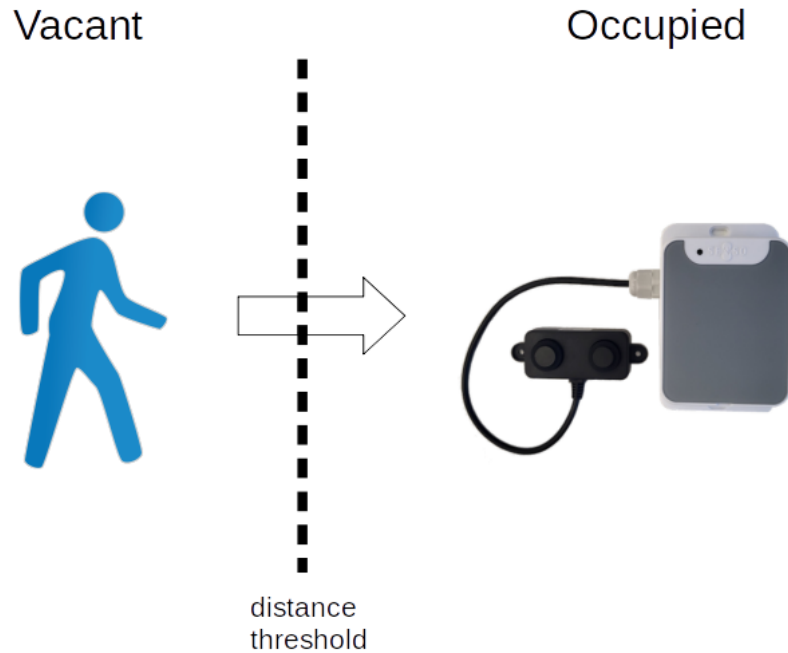
SENSO8/nbiot/sys/<IMEI>

MQTT Message Payload Format

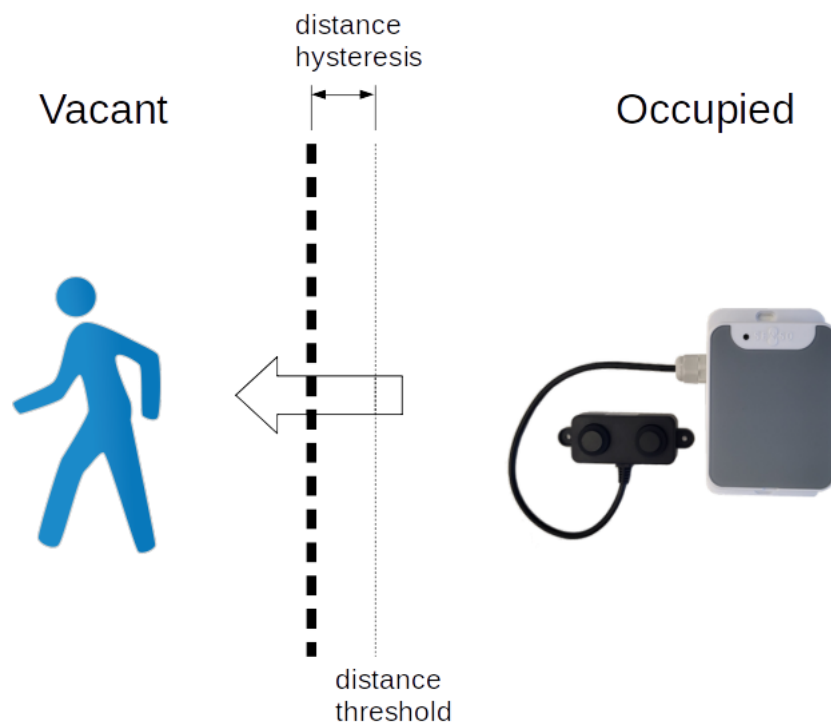
```
{
  "ver": protocol_version,
  "sn": sensor_imei,
  "iccid": sim_iccid,
  "sampling": [sampling_batt, sampling_ac],
  "upload": [upload_batt, upload_ac],
  "dist_th": [distance_threshold, distance_hysteresis, 0],
  "low_batt": low_batt_alert_lvl,
  "batt_pwr_alert": batt_alert_en,
  "reg_timeout": registration_timeout,
  "band": [freq_band, freq_band, ...],
  "lfreq": lock_freq,
  "report": report_interval,
  "overwrite": overwrite,
  "local_port": 0,
  "psm": psm_info,
  "en_shutdown": enable_shutdown,
  "secure": security_level,
  "client_prefix": client_id_prefix,
  "topic_prefix": topic_prefix,
  "firmware": fw_version,
  "model": model_name,
  "stat": stat_info,
}
```

Field	Description
protocol_version	Protocol version (int)
sensor_imei	IMEI of the sensor (string)
sim_iccid	ICCID of the SIM card (string)
sampling_batt	Data sampling period when running on battery (sec)

sampling_ac	Reserved
upload_batt	Data upload period when running on battery (sec)
upload_ac	Reserved
distance_threshold	Distance threshold for occupancy (mm)
distance_hysteresis	Hysteresis for distance threshold (mm)
low_batt_alert_lvl	Battery low alert threshold (mV)
batt_alert_en	Reserved, always 1
registration_timeout	Mobile network registration timeout (sec)
freq_band	NB IoT frequency band supported (int) 0 for automatic band selection or any combinations of 1, 3, 5, 8 and 20
lock_freq	Reserved
report_interval	Periodic SYS message upload interval (hour) 0 – No periodic SYS message upload X – Periodic upload SYS message every X hours
overwrite	Reserved
psm_info	Reserved
enable_shutdown	0 – disable long press button shutdown 1 – enable long press button shutdown
security_level	Reserved
client_prefix	MQTT client prefix (string)
topic_prefix	MQTT topic prefix (string) (apply to data, sys, ctrl topics)
fw_version	Firmware version
model_name	Sensor model name, SEN20600-A010
stat_info	Reserved



Occupancy state change distance (= distance threshold) when subject is **moving toward** to the sensor



Occupancy state change distance (= distance threshold + hysteresis) when subject is **moving away** from the sensor

2. Downlink Data

The downlink data is used for updating the sensor settings online. It is published to the sensor via the MQTT broker. The format of the downlink commands will be described in Section 2.2 below. **After issuing a downlink configuration command, the sensor will publish a Device Configuration Report (SYS message) acknowledging the command and showing the latest device configuration.**

2.1 MQTT Settings

The sensor is using MQTT persistent connection to receive downlink commands.

In order to support downlink command, the **MQTT broker** needs to support **MQTT 3.1.1**. And the following setting is required for MQTT client posting downlink data to SENSO8 sensor.

- Publish QoS = 1
- Retain Flag = False

2.2 Download Data Format

2.2.1 Distance Threshold Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "dist_th": [distance_threshold, distance_hysteresis, 0]
}
```

2.2.2 Data Sampling Period Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
```

```
"sampling": [sampling_batt, sampling_ac],
}
```

2.2.3 Data Upload Period Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "upload": [upload_batt, upload_ac]
}
```

2.2.4 SYS Message upload period Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "report": report_interval
}
```

Field	Description	Type	Default
sensor_imei	IMEI of the sensor (string)	string	
distance_threshold	Distance threshold for occupancy (mm)	number	150 mm
distance_hysteresis	Hysteresis for distance threshold (mm)	number	50 mm
sampling_batt	Data sampling period when running on battery (sec) (min: 60 sec)	number	900 sec
sampling_ac	Data sampling period when running on AC adaptor (sec) (min: 60 sec)	number	900 sec
upload_batt	Data upload period when running on battery (sec) (min: 180, max: 43200)	number	3600 sec

upload_ac	Data upload period when running on AC adaptor (sec) (min: 180, max: 43200)	number	3600 sec
report_interval	Periodic SYS message upload interval (hours)	number	24

3. Revision History

Revision	Date	Description
1.0	May 2023	Initial Release.
1.1	Aug 2023	Update the diagram and explanation for distance threshold.
1.2	May 2024	Added SEN21U00 to the supported models.