

SENSO8 NB-IoT Open Close Sensor API Document

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

- SEN20600-0000
- SEN20600-DRMT
- SEN21600-0000

1. Uplink Data

1.1 Data Reporting

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

- There is a trigger event
- Periodic heartbeat
- Button press

MQTT Topic Format

SENSO8/nbiot/data/<IMEI>

MQTT Message Payload Format – Detect Mode (Default)

```
{
  "ver":protocol_version,
  "msg":msg_seq_no,
  "time":epoch_time,
  "sn":sensor_imei,
  "type":payload_type,
  "state":logic_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_type,
  "debug":debug_info
}
```

MQTT Message Payload Format – Counting Mode

```
{
  "ver":protocol_version,
  "msg":msg_seq_no,
```

```

"time":epoch_time,
"sn":sensor_imei,
"type":payload_type,
"state": 0,
"count": trigger_count,
"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_type,
"debug":debug_info
}

```

MQTT Message Payload Format – Pulse Count Mode (supported by SEN21600-0000)

```

{
  "ver":protocol_version,
  "msg":msg_seq_no,
  "time":epoch_time,
  "sn":sensor_imei,
  "type":payload_type,
  "state": 0,
  "count": pulse_count,
  "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_type,
  "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)
payload_type ⁵	Data payload type, always 6 for open/close sensor
logic_state	0 – Logic Input “0” / Open 1 – Logic Input “1” / Close
trigger_count	Total number of triggers since last heartbeat

pulse_count ⁸	Total number of pulse count (decimal number)
battery	Battery voltage (mV) (invalid when using AC adaptor)
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_type ⁵	0 – trigger event 1 – key press event 2 – heartbeat event 3 – repeated event 4 – key press + heartbeat event 5 – key press + repeated event 6 – heartbeat + repeated event 7 – key press + heartbeat + repeated event
debug_info	Reserved

1.2 Device Configuration Reporting

The sensor uploads the device information (like IMEI, firmware version, etc) and settings (like heartbeat period, digital input mode, etc) on start-up. By default, the sensor also reports these data every 24 hours by default. It is strongly suggested to keep a log of it for keep tracking of the sensor status.

MQTT Topic Format

SENSO8/nbiot/sys/<IMEI>

MQTT Message Payload Format (Firmware Version 1.xx.xxx - Deprecated)

```
{
  "ver": protocol_version,
  "sn": sensor_imei,
  "iccid": sim_iccid,
  "din_type": digital_in_type,
  "din_mode": digital_in_mode,
  "din_invert": digital_in_invert,
  "din_latency": digital_in_latency,
  "din_delay": debounce_delay,
  "din_times": debounce_count,
  "din_deaf": digital_in_deaf,
  "din_on": schedule_on_time,
  "din_off": schedule_off_time,
  "din_days": schedule_off_days,
  "heartbeat": heartbeat_interval,
  "low_batt": low_batt_alert_lvl,
  "batt_pwr_alert": batt_pwr_alert,
```

```
"reg_timeout": registration_timeout,
"en_shutdown": enable_shutdown,
"firmware": firmware_version,
"client_prefix": mqtt_client_id_prefix,
"topic_prefix": mqtt_topic_prefix,
}
```

MQTT Message Payload Format (Firmware Version 2.xx.xxx or above)

```
{
  "ver": protocol_version,
  "sn": sensor_imei,
  "iccid": sim_iccid,
  "din_type": digital_in_type,
  "din_mode": digital_in_mode,
  "din_invert": digital_in_invert,
  "din_latency": digital_in_latency,
  "din_delay": debounce_delay,
  "din_times": debounce_count,
  "din_deaf": digital_in_deaf,
  "din_dly_trigger": delay_trigger,
  "din_schedule": [
    mon_on_time, mon_off_time,
    tue_on_time, tue_off_time,
    wed_on_time, wed_off_time,
    thu_on_time, thu_off_time,
    fri_on_time, fri_off_time,
    sat_on_time, sat_off_time,
    sun_on_time, sun_off_time
  ],
  "heartbeat": heartbeat_interval,
  "low_batt": low_batt_alert_lvl,
  "batt_pwr_alert": batt_pwr_alert,
  "reg_timeout": registration_timeout,
  "band": [band_1, band_2, ..., band_N],
  "repeat": [repeat_times, repeat_interval],
  "report": report_interval,
  "local_port": local_tcp_port,
  "psm": [psm_enable, active_period, TAU_period],
  "en_shutdown": enable_shutdown,
  "firmware": firmware_version,
  "client_prefix": mqtt_client_id_prefix,
  "topic_prefix": mqtt_topic_prefix,
  "stat": statistics,
}
```

MQTT Message Payload Format (Pulse Count Mode Enabled, supported by SEN21600-0000)

```
{
  "ver": protocol_version,
```

```

"sn": sensor_imei,
"iccid": sim_iccid,
"din_type": digital_in_type,
"din_mode": digital_in_mode,
"din_invert": digital_in_invert,
"din_latency": digital_in_latency,
"din_delay": debounce_delay,
"din_times": debounce_count,
"din_deaf": digital_in_deaf,
"din_dly_trigger": delay_trigger,
"din_schedule": [
    mon_on_time, mon_off_time,
    tue_on_time, tue_off_time,
    wed_on_time, wed_off_time,
    thu_on_time, thu_off_time,
    fri_on_time, fri_off_time,
    sat_on_time, sat_off_time,
    sun_on_time, sun_off_time
],
"heartbeat": heartbeat_interval,
"pulse_cnt": [num_digits, num_decimals, initial_digits, initial_decimals],
"low_batt": low_batt_alert_lvl,
"reg_timeout": registration_timeout,
"band": [band_1, band_2, ..., band_N],
"report": report_interval,
"overwrite": overwrite,
"psm": [psm_enable, active_period, TAU_period],
"en_shutdown": enable_shutdown,
"secure": secure,
"client_prefix": mqtt_client_id_prefix,
"topic_prefix": mqtt_topic_prefix,
"firmware": firmware_version,
"model": model_number,
"stat": statistics,
}

```

Field	Description
protocol_version	Protocol version (int)
sensor_imei	IMEI of the sensor (string)
sim_iccid	ICCID of the SIM card (string)
digital_in_mode	Digital Input Mode 0 – detect mode 1 – counting mode
digital_in_type	Digital Input Trigger Type ² 0 – falling edge trigger 1 – rising edge trigger 2 – rising and falling edge trigger

digital_in_invert	Digital Input Trigger Edge Select ² 0 – select rising edge to enter active state 1 – select falling edge to enter active state
digital_in_latency	Reserved
debounce_delay	Sampling interval for input debounce (ms) ³ Debounce Time = debounce_delay x debounce_count
debounce_count	Number of samples used for deounce (int) ³ Debounce Time = debounce_delay x debounce_count
digital_in_deaf	Timeout for returning to inactive state (sec) ⁴
delay_trigger ⁵	Time duration for a trigger to hold to report event (sec)
schedule_enable ⁶	Enable scheduler 0 – disable 1 – enable
schedule_on_time ⁶	Schedule on time (minutes) counting from 00:00 e.g. 480 = 08:00
schedule_off_time ⁶	Schedule off time (minutes) counting from 00:00 e.g. 1380 = 23:00
schedule_days ⁶	Bitmask for activating schedule on day-of-week (int) Bit 0 – Monday Bit 1 – Tuesday Bit 2 – Wednesday Bit 3 – Thursday Bit 4 – Friday Bit 5 – Saturday Bit 6 – Sunday e.g. 31 will activate the schedule on Monday to Friday e.g. 96 will activate the schedule on Saturday and Sunday
mon_on_time tue_on_time wed_on_time thu_on_time fri_on_time sat_on_time sun_on_time	Scheduled On starting time counting from 00:00 (minutes) ⁵ e.g. 480 means the open/close detection is turned on starting from 08:00. The scheduler starts from 00:00 every data. If Scheduled On time is < 0, the scheduler will not activate the detection for that day. Similarly, if Scheduled Off time is < 0, the scheduler will not deactivate the detection for that day. If both Scheduled On and Off time are < 0 or the Scheduled On and Off time are equal, the schedule is disabled for that day.
mon_off_time tue_off_time wed_off_time thu_off_time fri_off_time sat_off_time sun_off_time	Scheduled Off starting time counting from 00:00 (minutes) ⁵ e.g. 1380 means the open/close detection is turned off starting from 23:00. The scheduler starts from 00:00 every data. If Scheduled On time is < 0, the scheduler will not activate the detection for that day. Similarly, if Scheduled Off time is < 0, the scheduler will not deactivate the detection for that day.

	If both Scheduled On and Off time are < 0 or the Scheduled On and Off time are equal, the schedule is disabled for that day.
heartbeat_interval	Sensor heartbeat period (sec)
num_digits	Max number of digits
num_decimals	Number of decimal places
initial_digits	Initial value of digits
initial_decimals	Initial value of decimals
secure	Reserved
overwrite	Reserved
low_batt_alert_lvl	Battery low alert threshold (mV)
batt_pwr_alert	Reserved
registration_timeout	Mobile network registration timeout (sec)
band_X	NB-IoT frequency band number in use (int) 0 – auto 1 – B1 3 – B3 5 – B5 8 – B8 20 – B20
repeat_times	Reserved
repeat_interval	Reserved
report_interval	Periodic SYS message upload interval (hour) 0 – No periodic SYS message upload X – periodic upload SYS message every X hours
local_tcp_port	0 – TCP local port is assigned by NB-IoT module 1 – TCP local port is assigned by firmware (recommended)
psm_enable ⁷	0 – Disable NB-IoT PSM mode 1 – Enabled NB-IoT PSM mode
active_period	PSM Active Timer (T3324) in seconds
TAU_period	PSM Periodic TAU (T3412) in seconds
enable_shutdown	Reserved
firmware_version	Firmware version (string)
model_number	Model number (string)
client_prefix	MQTT client ID prefix (string)
topic_prefix	MQTT topic prefix (string)
statistics	Reserved

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 is described in Section 2.2 below. **After issuing a downlink configuration command, the device 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 Downlink Data Format

2.2.1 Input Type (NC/NO) Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "din_type": digital_in_type,
  "din_invert": digital_in_invert
}
```

2.2.2 Digital Input Mode Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "din_mode": digital_in_mode
}
```

2.2.3 Digital Input Debounce Time Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "din_delay": debounce_delay,
  "din_times": debounce_count
}
```


}

2.2.4 Digital Input Timeout Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "din_deaf": digital_in_deaf
}
```

2.2.5 Heartbeat Period Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "heartbeat": heartbeat_interval
}
```

2.2.6 Scheduler Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format (Firmware Version 1.xx.xxx - Deprecated)

```
{
  "sn": sensor_imei,
  "din_in_enable": schedule_enable,
  "din_on": schedule_on_time,
  "din_off": schedule_off_time,
  "din_days": schedule_days
}
```

MQTT Message Payload Format (Firmware Version 2.xx.xxx or above)

```
{
  "sn": sensor_imei,
  "din_schedule": [
    mon_on_time, mon_off_time,
    tue_on_time, tue_off_time,

```

```
wed_on_time, wed_off_time,
thu_on_time, thu_off_time,
fri_on_time, fri_off_time,
sat_on_time, sat_off_time,
sun_on_time, sun_off_time
]
}
```

2.2.7 Delay Trigger Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "din_dly_trigger": delay_trigger
}
```

2.2.8 Periodic SYS Message Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

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

2.2.9 Pulse Count Configuration

MQTT Topic Format

SENSO8/nbiot/ctrl/<IMEI>

MQTT Message Payload Format

```
{
  "sn": sensor_imei,
  "pulse_cnt": [num_digits, num_decimals, initial_digits, initial_decimals]
}
```

Field	Description	Type	Default
digital_input_mode	Digital Input Mode ¹ 0 – detect mode	number	0

	1 – counting mode		
digital_input_type	Digital Input Trigger Type ² 0 – falling edge trigger 1 – rising edge trigger 2 – rising and falling edge trigger	number	2
digital_input_invert	Digital Input Trigger Edge Select ² 0 – select rising edge to enter active state 1 – select falling edge to enter active state	number	1
debounce_delay	Sampling interval for input debounce (ms) ³ Debounce Time = debounce_delay x debounce_count	number	10 ms
debounce_count	Number of samples used for deounce (int) ³ Debounce Time = debounce_delay x debounce_count	number	5
digital_in_deaf	Timeout for returning to inactive state (sec) ⁴	number	30 s
delay_trigger ⁵	Time duration for a trigger to hold to report event (sec)		
heartbeat_interval	Sensor heartbeat period (sec) (min: 180, max: 43200) (counting mode only)	number	3600 s
schedule_enable ⁶	Enable scheduler 0 – disable 1 – enable	number	0
schedule_on_time ⁶	Schedule on time (minutes) counting from 00:00 e.g. 480 = 08:00	number	0
schedule_off_time ⁶	Schedule off time (minutes) counting from 00:00 e.g. 1380 = 23:00	number	0
schedule_days ⁶	Bitmask for activating schedule on day-of-week (int) Bit 0 – Monday Bit 1 – Tuesday Bit 2 – Wednesday Bit 3 – Thursday Bit 4 – Friday Bit 5 – Saturday Bit 6 – Sunday e.g. 31 (0x1F) will activate the schedule on Mon to Fri e.g. 96 (0x60) will activate the schedule on Sat and Sun	number	0
mon_on_time tue_on_time wed_on_time thu_on_time fri_on_time sat_on_time sun_on_time	Scheduled On starting time counting from 00:00 (minutes). ⁵ e.g. 480 means the dry-contact input detection is turned on from 08:00.	number	0
mon_off_time tue_off_time wed_off_time thu_off_time	Scheduled Off starting time counting from 00:00 (minutes). ⁵ e.g. 1380 means the dry-contact input detection is turned off from 23:00.	number	0

fri_off_time sat_off_time sun_off_time			
report_interval	Periodic SYS message upload interval (hours)	number	24
num_digits	Max number of digits (1-9)	number	6
num_decimals	Number of decimal places (0-4)	number	3
initial_digits	Initial value of digits	number	0
initial_decimals	Initial value of decimals	number	0

Note:

1. Detect mode reports every trigger.
Counter mode reports the total number of triggers within the heartbeat period. No report on individual trigger.
2. digital_input_type and digital_input_invert settings are determined by the type (NC/NO) of device connected to the open/close input and the user application.

		Use case Example	digital_in_type	digital_in_invert
	NC (Single Trigger)	Button	0	1
	NO (Single Trigger)	Button	1	0
	NC (Double Trigger)	PIR, door magnetic	2	1
	NO (Double Trigger)	PIR, door magnetic	2	0

3. The input has a debouncing mechanism to avoid force trigger. After the input is triggered, it is counted as a valid input only if the logic level is stable for the debounce time.
4. Deaf period timeout is to avoid repeated alert. The logic state returns on normal when there is no trigger after timeout.
5. Applicable to firmware version 3.xx.xxx or above.
6. Depreciated. Only applicable to firmware version 1.xx.xxx only.
7. PSM mode requires network operator support. If network operator does not support PSM mode, do not enable this option.
8. The number of digitals and number of decimal places are configurable. The decimal number will roll back to 0 when the count is larger than maximum value based on the configuration. For example, if the maximum number of digits is 4 and the number of decimal places is 3, the count will look like 1023.456. And it will roll back to 0 after reaching 9999.999.

3. Revision History

Revision	Date	Description
1.0	Mar 2020	Initial Release.
1.1	Jul 2020	Added new JSON data keys on firmware version 2.01.000.
1.2	Apr 2022	Update new features for firmware version 3.xx.xxx
1.3	May 2024	Added SEN21600 to supported models.
1.4	Nov 2024	Added payload of pulse count mode.