



ThingSpace

Global Asset Sensor

Technical Guide

Important – Please Read

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Welcome

The Global Asset Tracker is a compact cellular-based sensor and data logger that attaches to or rides along with valuable assets. The device provides fully configurable real time data and alarms to meet different industry and business needs.

The Global Asset Tracker utilizes the Verizon ThingSpace service to provide:

- Device configuration
- Sensor configuration
- Cloud data storage access

This document describes the interface and data model provided by the device, and is intended for use by developers to integrate the device into their ThingSpace applications.

For details on ThingSpace and background information on the use of data models, characteristics and the MQTT protocol, please refer to the ThingSpace client APIs and device SDK.

Device configuration

The Device Config Characteristic controls the basic high level operating modes of the Critical Asset Sensor.

```
"fields": {
  "opMode": value,
    "ledMode": value,
    "airplaneMode": value,
    "commSynchPeriod": value,
    "bufferMode": value
}
```

Operation mode

The Operation Mode controls the overall behavior of the Critical Asset Sensor.

Value	Description
0	Suspend: Sensor polling is suspended but the cellular radio is on and is connected or trying to connect to ThingSpace.
1 (Default)	Standby: This is the same as Suspend, except the Sensor can be turned to normal power mode with a short press of the mode button.
2	Normal: The Global Asset Tracker is monitoring sensors and reporting data.
3	Low Power: The Sensor is in its lowest power mode. The cellular radio is not active, and the Sensor cannot be controlled from ThingSpace. The sensor can be reactivated to normal mode with a short press of the mode button.

LED mode

The LED mode controls whether the LEDs are active (i.e. powered up) in general operation of the device.

Value	Description
-------	-------------

0	LEDs are Disabled for power save.
1 (default)	LEDs are enabled for a short time as follow: <ul style="list-style-type: none"> • LED will automatically turn off after 5 min from power up. • LED will turn on for 2 min on a short press. <p>Note: This also changes device operational mode in Standby /Low Power to Normal mode.</p>
2	LEDs are enabled

Airplane mode

Value	Description
0 (default)	Airplane detection is disabled
1	Airplane detection is enabled.

Communication sync period

The communication sync period determines how often the sensor tries to establish a connection to the ThingSpace platform. It is specified in minutes.

Buffer mode

The Global Asset Tracker maintains a queue of sensor readings for delivery to ThingSpace. This ensures the sensor does not lose sensor readings, even when out of cellular coverage. If the sensor is out of coverage for an extended period of time, the queue will fill up, and some action has to be taken when a new reading is produced. The buffer mode specifies the action as follows:

Value	Description
0 (Default)	Drops the oldest reading in the queue to make space for the new value.
1	Drops the new reading.

Sensor reporting

The following table shows the parameters available for configuring the time and reporting intervals for each sensor in the device.

Parameter	Values
Operational Mode	0 – Disabled 1 – Normal (Enabled)
Reporting Type	0 – Disabled 1 – One Time 2 – Periodic 3 – Periodic On Change
Monitoring Period	0 – TIME MAX
Reporting Period	0 – TIME MAX
Reporting Offset	0 – Immediate NNNN – relative time YYYY-MM-DDTHH:MM:SSZ

Operational mode

The operational mode controls whether the sensor is enabled or not. When disabled, the sensor is put into its lowest power mode to preserve battery life.

Reporting

To preserve power and maximize battery life, sensors in the EAT module are not continuously active. Each sensor is checked on a fixed period specified using the “monitoring period” parameter in the sensor configuration characteristic.

The Reporting Type and Reporting Period control when sensor readings are sent to the ThingSpace platform.

Reporting Type: Disabled, Value 0

The sensor does not send any reading reports to the ThingSpace portal. This setting is usually used in conjunction with alarms, to set an alarms only monitoring mode for a sensor.

Reporting Type: One Time, Value 1

The sensor will report its value once at the next reporting interval.

Reporting Type: Periodic, Value 2

The sensor will report its reading every X seconds, where X is specified in the reporting period value.

If the reporting period is not a multiple of the monitoring period, readings are sent on the first following monitoring period to the expected time.

Reporting Type: Periodic On Change, Value 3

The sensor will report its reading every X seconds but only if the value has changed from the previous report.

Report Offset

The reporting offset is used to set a starting time for the sensor monitoring to begin.

A 0 value will activate the polling immediately.

A numeric value of 1 to 4 digits can be set which specifies a number of seconds to delay from the time the message is received.

A UTC time can be set which will activate the polling at a fixed start time. Times can be set which are behind the current time, in which case the sensor will calculate when to report next based on the start time specified and the reporting period.

Alarm behavior

All single value sensors (battery, signal strength, pressure, humidity and temperature) implement alarm behavior in the same manner. This behavior is controlled by the following three parameters in the corresponding sensor configuration characteristic.

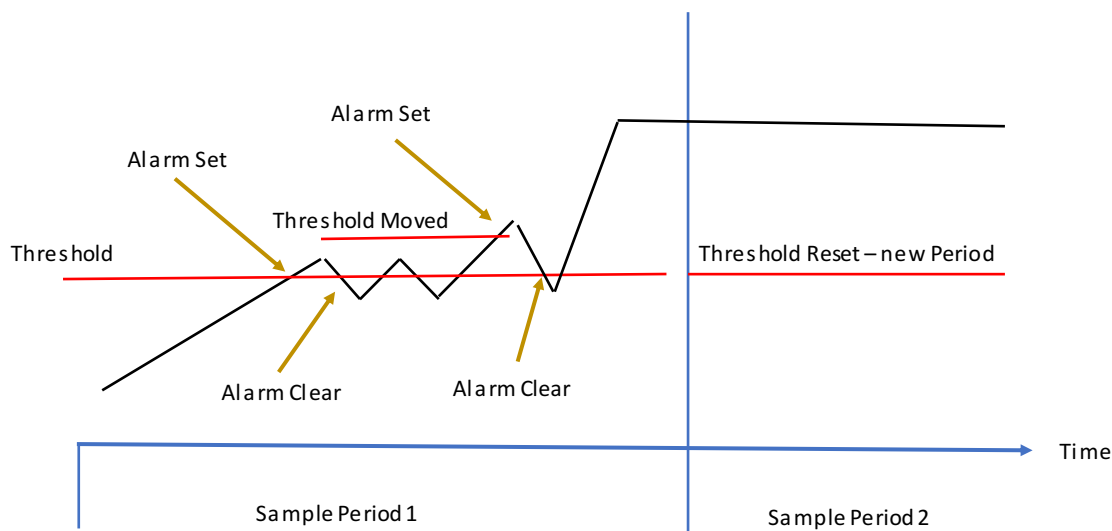
Parameter	Values
Alarm Type	0 - Disabled 1 - Value Change 2 - Exceed Threshold 3 - Below Threshold 4 - Out of Range
Threshold	Varies by sensor
Threshold Range	Varies by sensor

The operation of the different alarm modes is closely tied to the sensor monitoring and reporting periods described in the previous section. In most cases, the alarms are checked each time the sensor value is read, which is specified by the monitoring period. Once an alarm is triggered, a report is immediately sent to the ThingSpace platform.

One problem that can occur with many sensor is an oscillating effect where successive readings fluctuate slightly. This is normally not an issue, but causes a potential problem when the sensor is at the threshold of an alarm. This situation can lead to stream of alarms as the value fluctuates above and below the threshold. To combat this problem, a corrective adjustment, referred to as threshold range, is included for most alarm definitions.

When a sensor reading crosses an alarm threshold, an alarm is triggered, and the threshold is then offset by the corrective adjustment to form a new alarm level for the remainder of the sampling period. If the alarm is cleared it will not re-trigger until the new threshold is crossed. If the original alarm is not cleared and the value crosses the new threshold a new alarm is generated, and the offset re-applied to the active threshold.

This operation is illustrated in the following example:



Disabled – Value 0

Deactivates the alarm for the sensor.

Value Change – Value 1

The alarm will be triggered if the value changes during the reporting period. To prevent random firing due to sensor sensitivity or minor environmental changes, the Threshold value specifies minimum change required to trigger the alarm.

Temperature example:

Threshold = 2

Reading at start of monitoring period = 30 degrees C.

The alarm will trigger if the temperature moves outside of the range 28 – 32 degrees during the monitoring period.

The Alarm is reset at the start of each reporting period.

Exceed Threshold – Value 2

The alarm will be triggered if the value moves above the value specified in Threshold during the reporting period.

Once the alarm has fired the upper threshold will be adjusted by the amount specified in Threshold Range.

Below Threshold – Value 3

The alarm will be triggered if the value moves below the value specified in Threshold during the reporting period.

Once the alarm has fired the lower threshold will be adjusted by the amount specified in Threshold Range.

Out of RANGE – Value 4

The out of range alarm is triggered if the sensor reading moves outside of a specified range. In this mode Threshold specifies the lower boundary of the range and Threshold Range specifies the upper boundary.

Sensor specifications

Battery

Property	Description
Description	Provides an indication of the remaining battery life.
Units	Percentage %
Range	0 - 100
Value	The value is reported as a whole number

Temperature

Property	Description
Description	Measure the ambient air temperature around the device.
Units	Degrees Celsius
Range	-40 to 85.
Value	The value is reported as a whole number

Atmospheric pressure

Property	Description
Description	Measure the air pressure around the device.
Units	Hectopascal – hPa
Range	300 – 1100
Value	The value is reported as a whole number

Humidity

Property	Description
Description	Measure the relative air humidity around the device
Units	% Relative Humidity
Range	0 - 100
Value	The value is reported as a whole number.

Ambient light

Property	Description
Description	Measure the ambient light around the device.
Units	LUX
Range	1 to 64,000
Value	The value is reported as a whole number.

For reference some common lux levels are:

- 0.05 – 0.36 – full moon on clear night
- 3.4 – defined value for official twilight under a clear sky
- 400 – sunrise and sunset on a clear day
- 1000 – overcast day
- 10K – 25K – full daylight in indirect sun
- 32K – 100K – direct sunlight

Signal strength

Property	Description
----------	-------------

Description	Measures the signal strength of the cellular signal.
Units	Decibel milliwatts dBm
Range	-130 to 0
Value	The value is reported as a negative whole number

Orientation

Property	Description
Description	Measures the angular orientation of the device relative to horizontal. Orientation is provided for the x and y axis. This is also commonly referred to as pitch(X) and roll (Y).
Units	Degrees
Range	0 – 360
Value	The value is reported as a whole number of degrees

Accelerometer

Property	Description
Description	Measure the current acceleration acting on each axis of the device.
Units	Multiple of gravitation force – g
Range	+ - 2G
Value	The value is reported as a floating-point number.

MQTT message formats

This section contains descriptions of the message protocol used to exchange information with the Critical Asset Sensor. There are two broad categories of messages exchanged between the sensor and the MQTT ThingSpace broker.

Commands

Commands to configure the device or request data values are sent to the device by publishing a specific message format to the topic: **ThingSpaceSDK/{imei}/TSServerPublishCommand**, where {imei} is the imei number of the target sensor. The Global Asset Tracker supports two command variants as follows:

The set command is used to write one or more settings to the Global Asset Tracker configuration table. The basic structure of the content body is:

```
{
  "characteristicsName": "",
  "commandUUID": "",
  "unitCommand": "set",
  "value": {}
}
```

The get command is used to read sensor readings, or settings from the EAT configuration table. The basic structure of the content body is:

```
{
  "characteristicsName": "",
  "commandUUID": "",
  "unitCommand": "get",
}
```

The parameters in the command object are as follows:

Parameter	Description
characteristicsName	Specifies the name of the characteristic to which the command applies.
commandUUID	This is a unique command identifier that the caller provides. The Global Asset Tracker does not interpret this value.

unitCommand	“get” or “set”
value	Applicable to the set command, and contains the characteristic values to update.

The Global Asset Tracker will respond to commands by publishing a completion message to the topic: **ThingSpaceSDK/{commandUUID}/UNITCmdResponse**

With the following JSON message content.

```
{
  "commandUUID": "",
  "payload": {},
  "statusCode": "",
  "statusMsg": "",
  "unitCommand": ""
}
```

The parameters in the response are as follows:

Parameter	Description
commandUUID	This is a unique command identifier that the caller provides. The Global Asset Tracker does not interpret this value.
unitCommand	“get” or “set”
statusCode	200: MQTT_CMD_STATUS_OK 202: MQTT_CMD_STATUS_ACCEPTED 204: MQTT_CMD_STATUS_NO_CONTENT 400: MQTT_CMD_STATUS_BAD_REQUEST 401: MQTT_CMD_STATUS_UNAUTHORIZED 403: MQTT_CMD_STATUS_FORBIDDEN 404: MQTT_CMD_STATUS_NOT_FOUND 406: MQTT_CMD_STATUS_NOT_ACCEPTABLE 409: MQTT_CMD_STATUS_CONFLICT

	416: MQTT_CMD_STATUS_RANGE_NOT_SATISFIABLE 423: MQTT_CMD_STATUS_RANGE_LOCKED
statusMsg	A text representation of the status code.
payload	Present if unitCommand is “get”. Contains the data requested by the command.

Command UUID

Since the command UUID is returned in the topic from the device, and enables listeners to match responses to requests, it is important that this string is generally unique. A good technique to ensure this is to use randomly generated UUIDs as suggested by the name, but it should be noted the Global Asset Tracker make no inference as to the format or meaning of this value. It is strictly copied, without modification, from the request packet, to the response topic and data.

Sensor reports and alarms

The Global Asset Tracker publishes data to the MQTT broker by publishing to the topic **ThingSpaceSDK/{imei}/UNITOnBoard** using the following general format.

```
{
  "lastUpdated": "2017-11-20T01:47:25Z",
  "sensor": {
    "characteristics": [{
      "characteristicsName": "",
      "currentValue": ,
      "measurementUnit": "",
      "parameterType": "",
      "readLevel": ""
    }],
    "name": "cHe_AssetSensor"
  },
  "unitMacId": "{imei}",
```

```
"unitName": "VZW_LH_UNIT_01"
}
```

Parameter	Description
lastUpdate	Contains the time of the sensor reading or alarm in the format YYYY-MM-DDTHH:MM:SSZ for example. 2017-11-20T01:47:25Z. Note all times are reported as UTC, hence an empty offset following the trailing Z.
sensor: {"characteristics"}	Contains an array of characteristic values.
sensor: {"name"}	Contains the name of device type / data model.
unitMacId	Contains the imei number of the device.
unitName	Contains the name of the sensor. Defaults to VZW_LH_UNIT_01.

Each entry in the characteristics array contains the following fields.

Parameter	Description
characteristicsName	Contains the name of the characteristic.
currentValue	Current value varies depending on the type of the characteristic. Single value types are returned as strings containing the value. Complex values are returned as objects.
measurementUnit	Describes the units of the sensor value, for example, Celsius, Percentage, hPa etc.
parameterType	Contains the type of the characteristic.
readLevel	Identifies if the characteristic is Read Only (R), Read Write (RW) or Write only (W)

MQTT message examples

Configuring a sensor

The following sample shows how to configure the temperature sensor, to read and report every 60 seconds. The format is basically identical for configuring the remaining sensors.

Request

Topic: ThingSpaceSDK/{imei}/TSServerPublishCommand

Data:

```
{
  "characteristicsName": "deviceConfig",
  "commandUUID": "864508030027392_jk9pkx7u",
  "unitCommand": "Set",
  "value": {"temperature": {
    "monitorPeriod": 60,
    "opMode": 1,
    "reportOffset": 0,
    "reportPeriod": 60,
    "reportType": 2
  }}
}
```

Response

Topic: ThingSpaceSDK/864508030027392_mi8chtms/UNITCmdResponse

Data:

```
{
  "commandUUID": "864508030027392_mi8chtms",
  "statusCode": 200,
  "statusMsg": "OK",
  "unitCommand": "Set"
}
```

Retrieve the value of a characteristic (GET)

This example illustrates how to retrieve the current value of the temperature sensor.

Request

Topic: ThingSpaceSDK/{imei}/TSServerPublishCommand

Data:

```
{
  "characteristicsName": "temperature",
  "commandUUID": "864508030027392_ljtgytcg",
  "unitCommand": "Get"
}
```

Response

Topic: ThingSpaceSDK/864508030027392_ljtgytcg/UNITCmdResponse

Data:

```
{
  "commandUUID": "864508030027392_ljtgytcg",
  "payload": {"temperature": "28"},
  "statusCode": 200,
  "statusMsg": "OK",
  "unitCommand": "Get"
}
```

Retrieving the configuration characteristic

This example illustrates the message exchange to retrieve the full device configuration.

Request

Topic: ThingSpaceSDK/{imei}/TSServerPublishCommand

Data:

```
{
  "characteristicsName": "deviceConfig",
```

```
"commandUUID": "864508030027392_283fz6ia",
"unitCommand": "Get"
}
```

Response

Topic: ThingSpaceSDK/864508030027392_283fz6ia/UNITCmdResponse

Data:

```
{
  "commandUUID": "864508030027392_283fz6ia",
  "payload": {"deviceConfig": {
    "accelerometer": {
      "monitorPeriod": "0",
      "opMode": "0",
      "range": "0",
      "reportOffset": "0",
      "reportPeriod": "0",
      "reportType": "0"
    },
    "acclAlarm": {
      "alarmType": "0",
      "threshold": "0",
      "thresholdRange": "0"
    },
    "battAlarm": {
      "alarmType": "0",
      "threshold": "0",
      "thresholdRange": "0"
    },
    "battery": {
      "monitorPeriod": "0",
      "opMode": "0",

```

```
        "reportOffset": "0",
        "reportPeriod": "0",
        "reportType": "0"
    },
    "device": {
        "airplaneMode": "false",
        "bufferMode": "0",
        "commSynchPeriod": "60",
        "ledMode": "true",
        "opMode": "2"
    },
    "gyro": {
        "monitorPeriod": "0",
        "opMode": "0",
        "reportOffset": "0",
        "reportPeriod": "0",
        "reportType": "0"
    },
    "gyroAlarm": {
        "alarmType": "0",
        "threshold": "0",
        "thresholdRange": "0"
    },
    "humiAlarm": {
        "alarmType": "0",
        "threshold": "0",
        "thresholdRange": "0"
    },
    "humidity": {
        "monitorPeriod": "0",
```

```
        "opMode": "0",
        "reportOffset": "0",
        "reportPeriod": "0",
        "reportType": "0"
    },
    "light": {
        "monitorPeriod": "30",
        "opMode": "1",
        "reportOffset": "0",
        "reportPeriod": "30",
        "reportType": "2"
    },
    "liteAlarm": {
        "alarmType": "0",
        "threshold": "0",
        "thresholdRange": "0"
    },
    "locAlarm": {
        "alarmType": "0",
        "threshold": "0",
        "thresholdRange": "0"
    },
    "location": {
        "monitorPeriod": "30",
        "opMode": "1",
        "reportOffset": "0",
        "reportPeriod": "30",
        "reportType": "2"
    },
    "presAlarm": {
```

```
        "alarmType": "0",
        "threshold": "0.0",
        "thresholdRange": "0.0"
    },
    "pressure": {
        "monitorPeriod": "0",
        "opMode": "0",
        "reportOffset": "0",
        "reportPeriod": "0",
        "reportType": "0"
    },
    "rfSignal": {
        "monitorPeriod": "0",
        "opMode": "0",
        "reportOffset": "0",
        "reportPeriod": "0",
        "reportType": "0"
    },
    "rssiAlarm": {
        "alarmType": "0",
        "threshold": "0",
        "thresholdRange": "0"
    },
    "tempAlarm": {
        "alarmType": "0",
        "threshold": "40",
        "thresholdRange": "40"
    },
    "temperature": {
        "monitorPeriod": "60",
```

```
        "opMode": "1",
        "reportOffset": "0",
        "reportPeriod": "60",
        "reportType": "2"
    },
    "wifi": {
        "monitorPeriod": "0",
        "opMode": "0",
        "reportOffset": "0",
        "reportPeriod": "0",
        "reportType": "0"
    }
},
"statusCode": 200,
"statusMsg": "OK",
"unitCommand": "Get"
}
```

Sensor report

The following is an example of a temperature sensor report:

Topic: ThingSpaceSDK/{imei}/UNITOnBoard

Data:

```
{
  "lastUpdated": "2017-11-20T01:47:25Z",
  "sensor": {
    "characteristics": [{
      "characteristicsName": "temperature",
      "currentValue": "30",
      "measurementUnit": "Celcius",
      "parameterType": "Number",
```

```
        "readLevel": "R"
    }],
    "name": "cHe_AssetSensor"
},
"unitMacId": "864508030027392",
"unitName": "VZW_LH_UNIT_01"
}
```


Characteristic description

The following pseudo JSON illustrates the complete characteristic table for the Critical Asset Sensor.

```
"location": {
    "latitude":
    "longitude":
    "altitude":
    "accuracy":
},
"temperature":
"humidity":
"light":
"pressure":
"battery":
"orientation":
"acceleration":
"signalStrength":
"deviceConfig": {
"location": {
    "opMode":
    "reportType":
    "reportPeriod":
    "reportOffset":
    "monitorPeriod":
},
"temperature": {
    "opMode":
    "reportType":
    "reportPeriod":
    "reportOffset":
    "monitorPeriod":
```

```
},
"humidity": {
    "opMode":
    "reportType":
    "reportPeriod":
    "reportOffset":
    "monitorPeriod":
},
"pressure": {
    "opMode":
    "reportType":
    "reportPeriod":
    "reportOffset":
    "monitorPeriod":
},
"light": {
    "opMode":
    "reportType":
    "reportPeriod":
    "reportOffset":
    "monitorPeriod":
},
"battery": {
    "opMode":
    "reportType":
    "reportPeriod":
    "reportOffset":
    "monitorPeriod":
},
"accelerometer": {
```

```
        "opMode":
        "reportType":
        "reportPeriod":
        "reportOffset":
        "monitorPeriod":
    },
    "rfSignal": {
        "opMode":
        "reportType":
        "reportPeriod":
        "reportOffset":
        "monitorPeriod":
    },
    "device": {
        "opMode":
        "ledMode":
        "airplaneMode":
        "commSynchPeriod":
        "bufferMode":
    },
    "tempAlarm": {
        "alarmType":
        "threshold":
        "thresholdRange":
    },
    "humiAlarm": {
        "alarmType":
        "threshold":
        "thresholdRange":
    },
    "presAlarm": {
```

```
        "alarmType":
        "threshold":
        "thresholdRange":
    },
    "liteAlarm": {
        "alarmType":
        "threshold":
        "thresholdRange":
    },
    "battAlarm": {
        "alarmType":
        "threshold":
        "thresholdRange":
    },
    "acclAlarm": {
        "alarmType":
        "threshold":
        "thresholdRange":
    },
    "gyroAlarm": {
        "alarmType":
        "threshold":
        "thresholdRange":
        "axisBit":
    },
    "rssiAlarm": {
        "alarmType":
        "threshold":
        "thresholdRange":
    }
}
```

```
},
"deviceAlarm": {
  "temperature": {
    "alarmType":
    "threshold":
    "thresholdRange":
    "sensorReading":
  },
  "humidity": {
    "alarmType":
    "threshold":
    "thresholdRange":
    "sensorReading":
  },
  "pressure": {
    "alarmType":
    "threshold":
    "thresholdRange":
    "sensorReading":
  },
  "light": {
    "alarmType":
    "threshold":
    "thresholdRange":
    "sensorReading":
  },
  "battery": {
    "alarmType":
    "threshold":
    "thresholdRange":
    "sensorReading":
  },
}
```

```
"accelerometer": {
    "alarmType":
    "threshold":
    "thresholdRange":
},
"gyro": {
    "alarmType":
    "threshold":
    "thresholdRange":
    "tiltX":
    "tiltY":
},
"rfSignal": {
    "alarmType":
    "threshold":
    "thresholdRange":
    "sensorReading":
},
"drop":
"vibration":
"motionDetected":
"lowBattery":
},
```

