Digital Matter
Device Integration over HTTP/HTTPS

v1.5

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www.digitalmatter.com

1 REVISION HISTORY

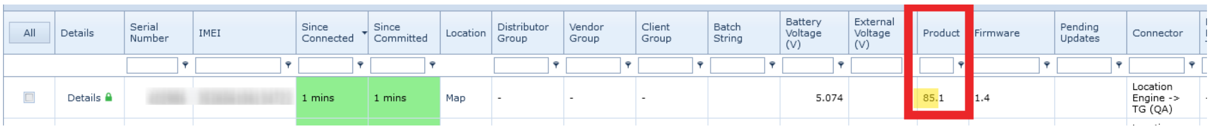
Date	Version	Changes
2021-05-19	1.00	V1
2021-05-20	1.00	Draft edits
2021-05-28	1.00	Status flag edits
2021-06-02	1.00	Setup edits.
2021-08-06	1.00	Added Setup Links
2021-09-22	1.0	Added High-G field
2021-11-04	1.1	Added default analogue mappings Added High G detail and examples Added detail on response
2021-11-13	1.2	Added Source Information fields
2022-01-10	1.3	Added note on closing connection
2022-04-19	1.4	Added Inactivity Indicator on Device Inputs
2022-05-02	1.5	Added BLE Data Fields Added Bit 8 status flag

2 DEVICES

This document relates to the following devices:

Product Name	Product ID Number
Yabby Edge 4G	85
Yabby Edge LoRaWAN (868 and 915 versions)	86
Oyster Edge 4G	92

The product ID for any device type can be found in the "Product" column in the OEM Server Device Grid



3 ARCHITECTURE AND CONCEPTS

Digital Matter (DMT) 'Edge' devices 'scan' for GNSS, WiFi and Cell Tower information.

The resulting 'raw' data is sent to the OEM Device server where the information is processed by DM's *Location Engine* to determine the device location.

This method of positioning uses far less energy than devices which resolve their GNSS position 'on-board'. Additionally the WiFi and Cell Tower information allows for a 'fallback' when GNSS is not available (i.e. indoors or in urban canyons)

The Location Engine makes use of a variety of lookup providers and logic to resolve the most accurate position possible. Filtering is applied with the aim of discarding outliers.
The providers used and filters can be adjusted, see Location Engine Lookup Settings

The location message is then forwarded to a platform that is capable of processing the location information and present this in a usable format for users.

See:

- IoT Asset Tracking on the Edge
- Location Engine - Key Concepts

4 SETUP

The specific endpoint where data is directed is configured via the OEM UI.

See the guide here: Send Cellular Edge Device Data to My Endpoint

5 ADDITIONAL RESOURCES

For further information and documentation, refer to our knowledge base - support.digitalmatter.com.
The knowledge base contains key device-specific information and configuration guides.
Device getting started guides provide default I/O mappings per product.

6 AUTHORIZATION

Supported HTTP Authentication Schemes:

- Basic
- Bearer

7 RESPONSE

The following HTTP response codes are accepted by the Location Engine Forwarder
200, 201, 202, 204
The end server should respond with one of the above upon receiving records, **and then close the connection.**

If a 2XX status code is received, the Location Engine will consider the record(s) as successfully received by the end server, delete it from it's queue, and move to the next.

If this response is not received by the Location Engine – the message queue will be held up **for all devices**

If 2XX is received but the end server leaves the connection open, the Location Engine will timeout and mark the message as failed.

In the event of failed message delivery – the Location Engine will reattempt delivery every 15 minutes.

Messages are sent in a First In, First Out (FIFO) basis – so no new records will be sent during this time as message order is maintained.

The Location Engine will store records for up to **7 days** should the end server not be able to be reached.

NB: In order to ensure the queue is not 'blocked' – the end server should return 2XX to the Location Engine even if a device is not yet configured/enabled on this platform. The data should be accepted and discarded.

8 MESSAGE STRUCTURE

On every POST the records are sent in JSON format below are the fields you can expect in each request. See **Appendix A – Sample JSON** for an example of the post request message in JSON.

Key	Description	Unit	Data Type
date	Date time message	UTC date time	DATETIME
device	Device data JSON object	HttpDevice (see 8.3)	Object
sqn	Sequence number	64-bit	LONG
reason	Log Reason – reason for device logging a position	8-bit (see 10)	BYTE
lat	Latitude	Degrees	DOUBLE
lng	Longitude	Degrees	DOUBLE
posAcc	Position accuracy	Metres	DOUBLE
posInfo	Device position information	HttpPositionInfo (see 8.4)	Object
analogues	Key value pair of device analogue values	HttpAnalogue[] (see 8.5)	Array of Objects
inputs	Digital Inputs Yabby Edge **LoRa**: Bit 0 = In trip (1 = in trip) Bit 4 = Inactivity Timer (if configured)	32-bit	UINT
outputs	Digital Outputs	16-bit	USHORT
status	Device Status Flags Yabby Edge **LoRa**: Bit 0 = In trip (1 = in trip) Yabby Edge **Cellular:** Bit 0 = In Trip (1 = in trip) Bit 1 = Internal battery good [1] (1 = 'good', 0 = 'low') Bit 2 = Battery Critical[1] (1 = 'critical') Bit 3 = Connected to GSM Bit 7 = Recovery Mode[2] (1 = recovery mode active) Bit 8 = No Movement Flag Used by the Location Engine for Combo Scan functionality	16-bit	USHORT

[1] Be sure to see Battery Monitoring for further details
[2] See Recovery Mode for further details.

counters	Key value pair of device information counters	HttpDeviceCounter[] (see 0)	Array of Objects
lora	LoRaWAN specific device information	HttpLoraDetails (see 8.10)	Object
source	Source Information (GNSS, Wifi, Cell ID, Lora)	HTTPSourceInformation (see 8.12)	Object

8.3 HttpDevice

Key	Description	Unit	Data Type
sn	Device serial number (Cellular) / DevEUI (LoRaWAN)		STRING
prod	Product ID Yabby Edge Cellular = 85 Yabby Edge LoRa = 86	8-bit	BYTE
rev	Hardware revision	8-bit	BYTE
fw	Device firmware version		STRING
module	Device module (LoRaWAN only)		STRING
Iccid	ICCID stands for Integrated Circuit Card Identification Number. It is the SIM card's identifier (Cellular Only)	A unique 18-22 digit code	STRING
imei	International Mobile Equipment Identity (IMEI). (Cellular Only)	A unique 15-digit code	STRING

8.4 HttpPositionInfo

Key	Description	Unit	Data Type
GDOP	Geometric Dilution of Precision	Number, lower is better	DOUBLE
HDOP	Horizontal Dilution of Precision	Number, lower is better	DOUBLE
PDOP	Position Dilution of Precision	Number, lower is better	DOUBLE
BSat	Beidou Satellite Count	32-bit	INT
GSat	GPS Satellite Count	32-bit	INT
Src	Position Source	8-bit None = 0 LE-GNSS = 1 LE-Wifi-Premium = 6 CellId7 = 7 LE-Cell-Pro = 8 LE-Wifi-Value = 9	BYTE

8.5 HttpAnalogue

Key	Description	Unit	Data Type
id	Analogue ID	32-bit	INT
val	Analogue Value	32-bit	INT

8.5.1 Default Analogue Mappings

Yabby Edge 4G and Oyster Edge 4G

Analogue	Value	Units
A1	Battery Voltage	mV
A3	Internal Temperature	°C
A4	Cellular Signal Strength	RSRP
A5	Loaded Battery Voltage	mV

8.6 HttpHighG

For further details on configuration and device behaviour, see High-G Events

Key	Description	Unit	Data Type
peak	Peak Force	Number	INT
avg	Average Force	Number	INT
dur	Duration	Number	INT

Units are as follows:

Key	Description	Units
peak	Peak Force	1024 = 1G
avg	Average Force	1024 = 1G
dur	Duration	ms

Example:

```
“peak”: 4300
“avg”: 2500
“dur”: 350
```

Peak G force = 4300/1024 = 4.199G

Average G Force = 2.441G

Duration = 350ms

High G Logging Behaviour

- As soon as a High G event is detected, it is logged with log reason 46 (High G event)
- The log time is the instant the impact was detected
- No position info (8.4) is sent via the forwarder (as a scan hasn’t been completed at this point)
- If configured, the device will then scan, and upload the result in a separate, subsequent log.
- The server should use this subsequent log to mark the position of the High-G event
- This scan may not return a position (i.e. no satellites or access points found)

8.7 HttpBluetoothTagListTag

Available on the Oyster Edge.

Tag data is sent via an array of objects.

Tag data formats are described in Appendix B – Tag Data Formats

Key	Description	Unit	Data Type
tt	Tag type. See below for types		BYTE
Reason	Log Reason. 0 = Update, 1 = Found, 2 = Lost		BYTE
RSSI	RSSI (received signal strength indicator) in dBm (signed)	dBm	INT8
Data	Tag Data. See below for tag data formats		BASE64 encoded array

8.8 HttpTagPosition

Key	Description	Unit	Data Type
FType	Field Type Always 30 for Tag Individual Data		BYTE
tt	Tag type. See below for types		BYTE
Reason	Log Reason. 0 = Update, 1 = Found, 2 = Lost		BYTE
RSSI	RSSI (received signal strength indicator) in dBm (signed)	dBm	INT8
Data	Tag Data. See below for tag data formats		

8.9 HttpDeviceCounter

For device counter ID values please see 11111 - Device Counters.

Key	Description	Unit	Data Type
id	Analogue ID	32-bit	INT
val	Analogue Value	32-bit	INT

8.10 HttpLoraDetails

Key	Description	Unit	Data Type
dev_id	LoRaWAN Device ID		STRING
app_id	LoRaWAN Application ID		STRING
dev_addr	LoRaWAN Device Address		STRING
gw	LoRaWAN gateway information	HttpLoraGateway[] (see 0)	Array of Objects

8.11 HttpLoraGateway

Key	Description	Unit	Data Type
id	Gateway identifier		STRING
snr	Signal-to-Noise Ratio	Number	DOUBLE
rssi	Received Signal Strength Indication	Number	DOUBLE

8.12 HTTPSourceInformation

In order to receive this data field, Digital Matter support must specifically configure the forwarder to send the HTTP Source information. Contact your support team

This field is the 'raw' GNSS, WiFi and Cell Tower information. The Location Engine already resolves this information into the Latitude/Longitude, so for most users, this field is not needed.

The key use cases for this field are:

- In case of theft. The Location Engine will filter positions it considers 'inaccurate' based on the configured Lookup Settings. Under normal conditions this may be desirable. However if an asset is stolen we may wish to be able to use ANY location result the data will provide us.
- Debugging/Troubleshooting

For most users, it is not expected this field will be required/desired. **There is no need to integrate this field for the majority of users.**

8.12.1 HttpGnssData

Key	Description	Unit	Data Type
gnss	GNSS Source Information	8-bit	BYTE
wifi	Wifi Source Information	HttpWiFiData[](see 8.8.1)	OBJECT
cell	Cell ID Source Information	HttpCellTowerData[](see 8.8.2)	OBJECT
lora	Lora Source Information	HttpLoraGateway[](see 8.8.3)	OBJECT

8.12.2 HttpWiFiData

Key	Description	Unit	Data Type
mac	HttpWifiData MAC address		STRING
channel	HttpWifiData channel	8-bit	BYTE
rssi	HttpWifiData received signal strength indicator(strength)	8-bit	SBYTE

8.12.3 HttpCellTowerData

Key	Description	Unit	Data Type
cid	HttpCellTowerData ID	32-BIT	INT
lac	Location area code	16-bit	USHORT
mcc	Mobile country code	16-bit	USHORT
mnc	Mobile network code	16-bit	USHORT
ta	Timing advance	16-bit	USHORT
towers	HttpCellTowerData towers	HttpNeighbourCellData[](see 8.8.2.1)	OBJECT

8.12.3.1 HttpNeighbourData

Key	Description	Unit	Data Type
earfcn	Absolute radio frequency channel number	16-bit	USHORT
pcid	Personal Computer ID	16-bit	USHORT
rsrp	HttpNeighbourData reference signal received power(power received from signal)	16-bit	SHORT
rsrq	HttpNeighbourData reference signal received quality	8-bit	SBYTE
dt	Data Traffic	32-bit	INT

8.12.4 HttpLoraGateway

Key	Description	Unit	Data Type
id	HttpLoraGateway ID		STRING
snr	Signal-to-Noise Ratio	Number	DOUBLE
rssi	HttpLoraGateway received signal strength indicator(strength)	Number	DOUBLE

9 Versioning

The existing data layout will be maintained, but fields may have new data values added to the end.

10 Log Reasons

Log reasons are used to determine why the logging algorithm decided that a record should be recorded. The full list of log reasons can be found in the document DMT Log Reasons.

Log reasons relevant to the Yabby Edge Cellular are shown below.

Reason Value	Description
1	Start of trip
2	End of trip
3	Elapsed time
9	Digital Input Changed
11	Heartbeat / Status
36	Recovery Mode On
37	Recovery Mode Off
42	Device Counters
46	High-G Event

Relevant to the Yabby Edge LoRaWAN are:

Reason Value	Description
3	Elapsed time
11	Heartbeat / Status

Additional log reasons may be added in future for new devices / events.

11 Device Counters

Not all counters are captured by each device. Counters are only sent periodically and not with each upload.

Counter Id	Use	Units
0	Internal Battery Voltage	1 mV
1	Internal Battery	0.01 %
2	Est. Battery Capacity Used	10 mAh
3	Maximum Temperature	0.01 C°
4	Initial Internal Battery Voltage	1 mV
5	Average Successful GPS Fix Time	1 s per fix
6	Average Failed GPS Fix Time	1 s per failed fix
7	Average GPS Freshen Time	1 s per freshen attempt
8	Average Wakeups Per Trip	1 wakeup per trip
128	Successful Uploads	1 upload
129	Successful Upload Time	1 s
130	Failed Uploads	1 upload
131	Failed Upload Time	1 s
132	Successful GPS Fixes	1 fix
133	Successful GPS Fix Time	1 s
134	Failed GPS Fixes	1 fix
135	Failed GPS Fix Time	1 s
136	GPS Freshen Attempts	1 attempt
137	GPS Freshen Time	1 s
138	Accelerometer Wakeups	1 wakeup
139	Trips	1 trip
140	GPS Fixes Due to ‘Upload on Jostle’	1 fix
141	Uploads Due to ‘Upload on Jostle’	1 upload
142	Uptime	1 s
143	Tx Count	1 tx
144	Rx Count	1 rx
145	Successful Wi-Fi Scans	1
146	Failed Wi-Fi Scans	1

12 Other Notes

12.3 No Lat/Long Returned: No position found

In some cases, the location lookup may not return a position. Either due to the result not meeting the configured accuracy requirements, or insufficient satellite/access point/cell tower data being passed to the Location Engine.

In this event, the record sent via the forwarder will contain no ***lat*** or ***long*** information. The end server should accommodate this.

Appendix A – Sample JSON – Yabby Edge LoRaWAN


```
{
  "date": "2021-04-20T11:10:03.702659861Z",
  "device": {
    "sn": "0016C001F000ABEC",
    "prod": 0.2,
    "rev": 0.3,
    "fw": "1.1",
    "module": "LR 34.3.3",
    "iccid": "89610180000000000000",
    "imei": "354043000000000"
  },
  "sqn": 347263802,
  "reason": 3,
  "lat": 1.1,
  "lng": 2.2,
  "posAcc": 30.1,
  "posInfo": {
    "HDOP": 0.1,
    "PDOP": 0.2,
    "GDOP": 0.3,
    "BSat": 1,
    "GSat": 2,
    "Src": 2
  },
  "analogues": [
    {
      "id": 1,
      "val": 300
    },
    {
      "id": 2,
      "val": 500
    }
  ],
  "inputs": 5001,
  "outputs": 0,
  "status": 17,
  "source": {
    "wifi": [
      {
        "mac": "80:2A:A8:8A:FF:4A",
        "channel": 1,
        "rssi": -37
      },
      {
        "mac": "1C:3B:F3:7F:BF:D8",
        "channel": 11,
        "rssi": -85
      },
      {
        "mac": "BC:0F:9A:73:C1:9E",
        "channel": 12,
        "rssi": -90
      },
      {
        "mac": "74:83:C2:DC:28:1C",
```

```
        "channel": 11,
        "rssi": -57
      }
    ],
    "cell": [
      {
        "cid": 33116449,
        "lac": 40000,
        "mcc": 655,
        "mnc": 1,
        "ta": 0,
        "towers": [
          {
            "earfcn": 3609,
            "pcid": 175,
            "rsrp": -71,
            "rsrq": -7,
            "dt": 0
          }
        ]
      }
    ],
    "lora": [
      {
        "id": "dm-sentrius",
        "snr": 10,
        "rssi": -36
      }
    ],
    "gnss": "JVBERi0xLjQKJeLjz9MKNSAwIG9iago8"
  },
  "counters": [
    {
      "id": 11,
      "val": 43
    },
    {
      "id": 23,
      "val": 8800
    }
  ],
  "lora": {
    "dev_id": "yabby-abec",
    "app_id": "digital-matter",
    "dev_addr": "260B567A",
    "gw": [
      {
        "id": "dm-sentrius",
        "snr": 10,
        "rssi": -36
      }
    ]
  }
}
```

Appendix B – Tag Data Formats

DM Guppy – Tag Type 0

Total Length = 7 Bytes

Offset	Data Type	Length	Description	Unit
0	UINT32	4	Tag Serial Number	
4	INT8	1	Tx Power	0.1 dBm
5	BYTE	1	Battery Voltage	x 50mV
6	INT8	1	Internal Temperature	°C

Apple iBeacon – Tag Type 1

Total Length = 21 Bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[16]	16	UUID (big endian)	
16	UINT16	2	Major ID	
18	UINT16	2	Minor ID	
20	INT8	1	Calibrated Tx Power	dBm @ 1m*

* See specifications at https://developer.apple.com/ibeacon/ for information on Tx power calibration method.

Eddystone – Tag Type 2

Total Length = 17 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[10]	10	Namespace ID (big endian)	
10	BYTE[6]	6	Namespace ID (big endian)	
16	INT8	1	Tx Power	dBm @ 0m

Ingics iBS01 Basic – Tag Type 3

Total Length = 9 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	UINT16	2	Battery Voltage	X 10mV
8	BYTE	1	Tag Flags*	bitfield

* See tag specifications at https://www.ingics.com/

Ingics iBS01 Temperature/Humidity – Tag Type 4

Total Length = 20 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	UINT16	2	Battery Voltage	X 10mV
8	BYTE	1	Tag Flags*	bitfield
9	INT16	2	Temperature	0.01 °C
11	BYTE	1	Relative Humidity	%

* See tag specifications at https://www.ingics.com/

DM SensorNode Bluetooth – Tag Type 5

Total Length = 20 bytes

Offset	Data Type	Length	Description	Unit
0	UINT32	4	Tag Serial Number	
4	INT8	1	Tx Power	0.1dBm
5	BYTE	1	Battery Voltage	X 50 mV
6	INT8	1	Internal Temperature	°C
7	INT16	2	Probe 1 Temperature	0.01 °C
9	INT16	2	Probe 2 Temperature	0.01 °C
11	INT16	2	Temp/RH Sensor Temperature	0.01 °C
13	BYTE	1	Temp/RH Sensor - Humidity	%
14.0	BYTE : 1	1 bit	Digital Input 1 State	
14.1	BYTE : 1	1 bit	Digital Input 2 State	
14.2	BYTE : 6	6 bits	Reserved (set to 0)	
15	UINT16	2	Analogue Input 1 Value	mV
17	UINT16	2	Analogue Input 2 Value	mV
19	BYTE	1	Reserved (set to 0)	

Eddystone TLM Frame – Tag Type 6

Total Length = 19 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	BYTE[13]	13	Telemetry frame data	X 10mV

* (Excludes Frame Type Byte) See specification at:
https://github.com/google/eddystone/blob/master/eddystone-tlm/tlm-plain.md

Technoton ES7 Fuel Sensor – Tag Type 7

Total Length = 21 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	UINT32	4	Frequency	0.001Hz
10	BYTE	1	Temperature	°C + 50°C
11	UINT16	2	Lateral Acceleration	0.01m/s^2 + 320m/s^2
13	UINT16	2	Longitudinal Acceleration	0.01m/s^2 + 320m/s^2
15	UINT16	2	Vertical Acceleration	0.01m/s^2 + 320m/s^2
17	UINT32	4	Malfunction Mask*	bitfield

* See specification at: https://www.jv-technoton.com/

Geobox Ble TPMS Sensor – Tag Type 8

Total Length = 10 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE	1	Tyre number	
1	BYTE[]	4	Sensor ID	
5	BYTE	1	Flags*	Bit 0: Alert Bit 1: Status 0 Bit 2: Status 1 Bits 3-5: Wake mode Bit 6: Aerated
6	UINT16	2	Pressure	2.5kPa
8	BYTE	1	Temperature	°C + 50°C
9	BYTE	1	Battery Voltage	- Value < 0x3A: Fault - Value = 0xFF: Fault - Else: Voltage (V) = 1.8 + (value-0x3A)*0.01

* See specification at: http://www.cubautoparts.com/

Escort Ble Fuel Sensor – Tag Type 9

Total Length = 10 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	UINT16	2	Level	Arbitrary unit between 0-1024/4096
8	BYTE	1	Battery Voltage	0.1V
9	BYTE	1	Temperature	°C

Ingics iBS04 Tag – Tag Type 10

Total Length = 11 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	UINT16	2	Battery Voltage	X 10mV
8	BYTE	1	Tag Flags	Bit 0: Button Bit 1: Moving Bit 2: Hall Effect
9	BYTE	1	User Data 0	
10	BYTE	1	User Data 1	

See tag specifications at https://www.ingics.com/

ELA MAG – Tag Type 11

Total Length = 24 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	CHAR[15]	15	Tag name (ASCII)	
21	UINT16	2	Magnet Count	
23	BYTE	1	Flags	Bit 0: Magnet Present

ELA MOV – Tag Type 12

Total Length = 24 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	CHAR[15]	15	Tag name (ASCII)	
21	UINT16	2	Movement Count	
23	BYTE	1	Flags	Bit 0: Moving

ELA ANG – Tag Type 13

Total Length = 27 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	CHAR[15]	15	Tag name (ASCII)	
21	INT16	2	X Axis Acceleration	mG
23	INT16	2	Y Axis Acceleration	mG
25	INT16	2	Z Axis Acceleration	mG

ELA ID – Tag Type 14

Total Length = 27 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	CHAR[15]	15	Tag name (ASCII)	
21	BYTE[6]	6	Manufacturer ID	

ELA T – Tag Type 15

Total Length = 23 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	CHAR[15]	15	Tag name (ASCII)	
21	INT16	2	Temperature	0.01 °C

ELA RHT – Tag Type 16

Total Length = 24 bytes

Offset	Data Type	Length	Description	Unit
0	BYTE[6]	6	MAC Address (little endian)	
6	CHAR[15]	15	Tag name (ASCII)	
21	BYTE	1	Relative Humidity	%
22	INT16	2	Temperature	0.01 °C

Generic Tag – Tag Type 255

Total Length = N bytes

Offset	Data Type	Length	Description	Unit
0	UINT16	2	Generic Tag Type	
2	BYTE[6]	6	MAC Address (little endian)	
8	BYTE	1	Length of Data	
8	BYTE[]	N	Data	