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Dzero Gateway 4X

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- ∓ Hybrid Industrial Gateways
- ∓ Multi Temperature V2 (LoRaWAN, ...)
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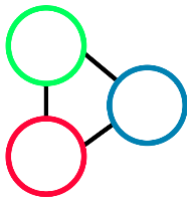


General Information

The Dzero Gateway 4X is a device that can be used to readout modern utility meters with standardized infrared "INFO" interface.

The meter outputs over its infrared "INFO" interface a serial protocol conforming to the [Smart Meter Language Protocol 1.04](#) (SML) or IEC 62056-21 protocol. This interface is intended to be used by end-users and **not** for billing purposes of the electricity supplier.

The read information normally contains the current consumption values of the meter and gets interpreted and forwarded by the Dzero Gateway 4X via a LoRaWAN or Nb-IoT to web based applications interested in further processing this data.



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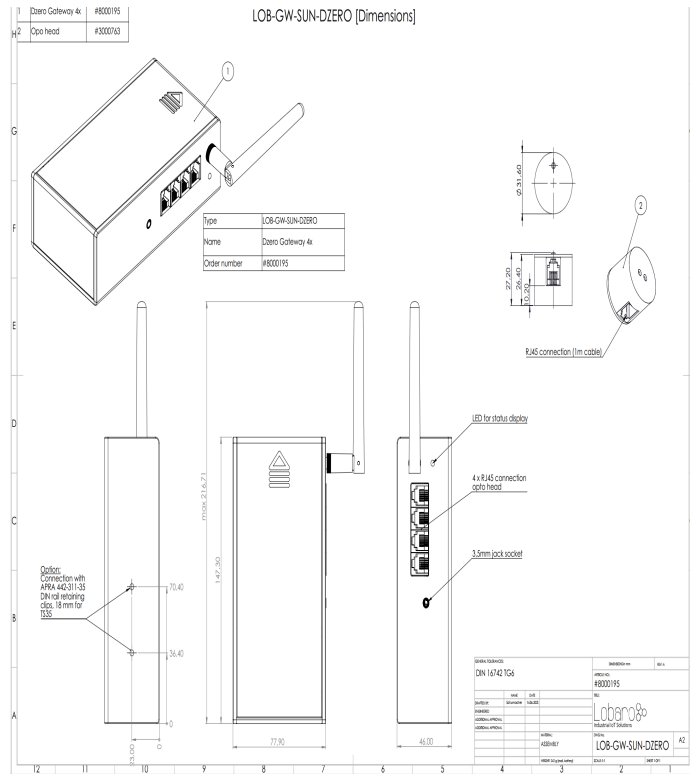
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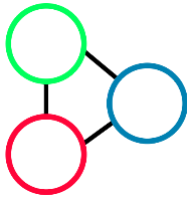
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The Dzero Gateway 4x is a battery powered device and used for remote reading of electricity meters with optical (O) / "IRPC" interface.

DZERO GATEWAY 4X
LOB-GW-SUN-DZERO

OVERVIEW

Version: 15.06.2023

FEATURES

- The device supports the SML protocol and IEC 62056-21 and has a protocol auto-detection.
- Uplink data via NB-IoT mobile radio (LTE bands: 3, 8, 20) or LoRaWAN v1.0.2 (EU-868) or m4Mbus.
- Communication with meters takes place by means of the novel "Lobaro add-on module" ("opto head").
- Up to four electricity meters can be read with only one Dzero Gateway 4x.
- Automatic detection of the amount of connected opto heads.
- Opto head is attached to meter with an integrated magnet.
- One opto head is included, three more can be connected.
- Connection to a TH 35 top-hat rail is given via a top-hat rail holder.
- Interface DO is intended to be used by end users and **not for billing** purposes of the electricity supplier.

APPLICATION

The Dzero Gateway 4X is a battery powered device. It is used for automated LoRaWAN, m4Mbus, NB-IoT or LTE-M remote read out of novel "smart metering" devices via the standardized optical customer interface ("INFO") of the electricity meter.

TECHNICAL SPECIFICATIONS

General

Type	LOB-GW-SUN-DZERO
Purchase name	Dzero Gateway 4X
Input Voltage	3.3V to 5V, 3.0V (standard)
Item number	8000165

Cellular NB-IoT / LTE Cat. M1 Modem

LTE SIP	Nordic nRF9160
LTE bands	Standard: B8, B20, B3, B31 MHz - 960 MHz, 1710 MHz - 1785 MHz Other Bands on request 4F1 (Nano SIM) Secure CallP over DTLS (via Lobaro IoT Platform)
SIM card	
Data Upload	

LoRaWAN

Type	Semtech SX1261
LoRaWAN Protocol Version	Class A LoRaWAN 1.0.2 (EU-868)
TX power	± 14 dBm
Activation method	Over-the-air activation (OTAA) Activation by personalization (ABP)
Typical RF range	± 2km
Ideal RF range	± 10km (free line of sight)
Encryption	AES128

Antenna

Ext. type	SMA female connector ± 2 dBi
Internal type	Optional: Multiband PCB monopole (NB-IoT)

Battery


Approved type	SAFT LSH-20
Voltage	3.0V
Other types	On request
Chemistry	Li-SOCl ₂
Capacity	± 13 Ah
Max. Current	± 1.8 A
Weight	± 120 g
Connector	JST XH 2 Pin

Additional I/O

Local configuration port	PC Based initial configuration via USB adapter
LED	RGB Led to signal different operating modes
4 x RJ45	Connection of opto heads with 1m cable
Jack socket, 3,5mm	Connection for folding converter

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DZERO GATEWAY 4X
LOB-GW-SUN-DZERO



TECHNICAL SPECIFICATIONS

Power Supply

Supply Voltage	JST XH 2P Connector
Connection	3.3V - 5V Volt (DC)
Supply Voltage Range	± 2.5W
Max. Power Consumption	± 1.5W
Typical Power Consumption	

Housing

Dimensions	147.3mm (l) x 77.9 mm (b) x 46mm (h)
Material	Polystyrol
Weight	342 g (incl. battery)
Protection class	IP4X
Color	black (RAL 9016)
Opto head	31.6(d) x 27.2(h)

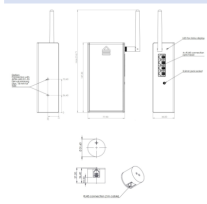
Environment

Operating temp.	-20 °C to 55 °C
Storage temp.	0 °C to 30 °C

Certificates and approvals

- EN 300 220-1 (RF)
- EN 300 220-2 (RF)
- EN 301 908-1 (RF)
- EN 301 908-13 (RF)
- EN 301 490-3 & EN 301 490-32 (EMC)
- EN 62368-1 (Electrical Safety)
- EN 62311:2008 (Electrical Safety)
- IEC 63000 2018 (RoHS)

DIMENSIONAL DRAWINGS



WARRANTY AND GUARANTEE

Warranty and guarantee claims can only be asserted if the device has been used as intended and the technical specifications and applicable technical rules have been observed.

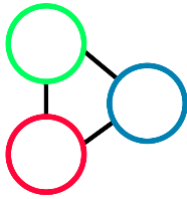
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Warning

Older meters with "infrared pulse" output are **not** compatible to the Dzero Gateway 4X. Please check our list of [compatible meters](#) to



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Hint

Consider using the latest firmware on your hardware

- [See available firmware downloads](#)

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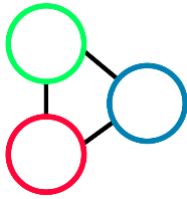
Compatible utility meters

Any meter that adheres to the standard can be read. The following list contains meters that we successfully tested.

Electricity meter	Manufacturer
DTZ541-ZEBA	Holley
LK13 series	Logarex
OpenWay® 3.HZ	iTron
SGM-C4 series	efr
SGM-D series	efr
eHZ-K series	EMH
mMe4.0 series	EMH
ED300 series	EMH
eBZD series	EMH
E320	Landis+Gyr
MT681	ISKRA

Quickstart

1. Connect to the device with the [Lobaro Tool](#) using the [Lobaro Config Adapter](#)
2. Under Configuration click "Reload Config" and change the fields "ReadCron" and "ObisCode" for all connected heads as needed as well as choosing the desired Network Connection by setting the "WAN" followed by clicking on "Write to Device". The RJ12 port near the 3.5 mm jack is port 1, the RJ12 port near the Antenna is port 4.



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interface

5. Restart the device by pressing the reset button

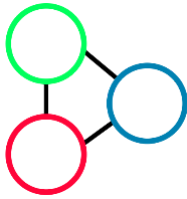
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- [Configuration](#)
 - [Network \(general\)](#)
 - [LoRaWAN](#)
 - [LTE](#)
 - [wMBus \(experimental\)](#)
 - [Operation](#)
- [Payload](#)
 - [Payload Format 1 \(Port 3, with exponent\)](#)
 - [Payload Format 2 \(Port 4, with exponent and timestamp\)](#)
 - [Example packet: 03 00 63 d1 47 80 01 00 01 08 00 ff 03 14 e3 31 ff 00 01 00 01 08 00 FE 08 FF 02 00 00 00 00 00 02 00](#)
 - [Multiple messages](#)
- [Status Message \(Port 64\)](#)
- [Payload \(wMBus\)](#)
- [Reference decoder](#)

Configuration

The configuration is done using [Lobaro Maintenance Tool](#) and the Lobaro USB PC adapter or remote via LoRaWAN downlink (see [LoRaWAN Downlink Config](#)) or LTE.

Network (general)

Name#LoRaWAN-RemoteConfiguration	Description	Default Value
WAN	Radio technology used for connection to backend	lte



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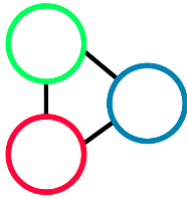
Host		

LoRaWAN

The connection to the LoRaWAN network is defined by multiple configuration parameters. This need to be set according to your LoRaWAN network and the way your device is supposed to be attached to it, or the device will not be able to send any data.

For a detailed introduction into how this values need to be configured, please refer to the chapter [LoRaWAN configuration](#) in our LoRaWAN background article.

Name#LoRaWAN-RemoteConfiguration	Description	Default Value
LostReboot	Days without downlink before reboot (triggers downlinks)	5
DevEUI	DevEUI used to identify the Device	
AppKey	Key used for OTAA (v1.0 and v1.1)	
NwkKey	Key used for OTAA (v1.1 only)	



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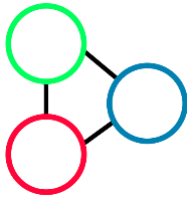
	(called AppEUI in v1.0)	
SF	Spreading Factor	12

LTE

Name#LoRaWAN-RemoteConfiguration	Description	Default Value
Host	Hostname / IP of the Lobaro Platform API	coaps://plat
Operator	Mobile Operator Code (optional)	26201
Band	NB-IoT Band	
APN	Mobile operator APN (optional)	*
PIN	SIM PIN (optional)	
DNS	DNS Server	9.9.9.9,1.1.
UseNbiot		true
UseLtem		true

wMbus (experimental)

Name#LoRaWAN-RemoteConfiguration	Description	Default Value



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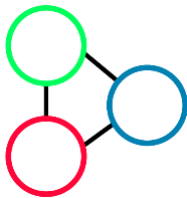
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Operation

Configuration values defining the behaviour of the device.

Name#LoRaWAN-RemoteConfiguration	Description	Default Value
ObisCode1	Comma separated list of ObisCodes to select a subset of the available information on port 1	1-0:1.8.0*255
ObisCode2	Comma separated list of ObisCodes to select a subset of the available information on port 2	1-0:2.8.0*255
ObisCode3	Comma separated list of ObisCodes to select a subset of the available information on port 3	1-0:1.8.0*255
ObisCode4	Comma separated list of ObisCodes to select a subset of the	1-0:2.8.0*255



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PayloadFormat	Format used for data upload (include timestamps or not)	int
ReadCron	Cron expression defining when to read and upload	0 0/15 * * * *
VerboseLogging	Enables additional Debug output	false

See also our [Introduction to Cron expressions](#) and our [Introduction to Obis Codes](#).

LED blinking patterns

The following pattery are explained in the order in which they appear after initial power on / reset of the device.

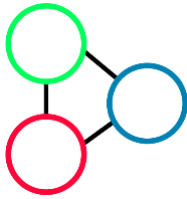
red/green/blue	500 ms each	initial pattern after reset

Payload (LoRaWAN)

Payload

Payload Format 1 (Port 3, with exponent)

This Format is used, when the configuration parameter `PayloadFormat` is set to 1. Please refer to the documentation of Format 2. The only differences are the port and that there is no Unix Timestamp included in the header.



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This Format is used, when the configuration parameter `PayloadFormat` is set to 2 .

Each uploaded LoRaWAN-Message with data is prefixed with a 5 byte Timestamp, indicating when the values were received from the attached meter. This allows for a more precise timing information than using the time of reception, as the upload can be delayed quite heavily due to our random delay feature and potentially due to duty cycle restrictions. The timestamp also makes it easy to reassociate values from multiple uplinks to a single reading, when multiple uplinks must be used to upload all values. If a readout is spilt over multiple uplinks (because of LoRaWAN's length restrictions), every uplink from that reading will have the same timestamp (which is the time of received the values from the meter).

The Timestamp is sent as a [UNIX-Timestamp](#) encoded as a bigendian signed 40-bit number.

"Unit" is not yet implemented and will always be zero. Please be aware that SML relates to SI units whereas IEC can output units like kWh. The output of the device will not be automatically converted to SI units.

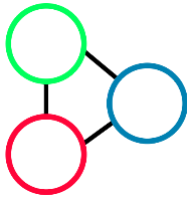
The payload consists of a header and multiple entries, one entry per OBIS code given in the configuration. Each entry follows the following structure:

Header

Head Number	Unix Timestamp
1 byte	5 bytes

Entry

OBISCode (hex)	length of value (n)	value	exponent	unit
6 bytes	1 byte	n bytes, LSB first	1 byte (signed)	1 byte



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FF 02 00 00 00 00 00 00 02 00

Header:

	Head Number	Unix Timestamp
Bytes	03	00 63 d1 47 80
Description	Opto Head connected to Port 3	Wednesday, 25. January 2023 15:15:12

Entry 1:

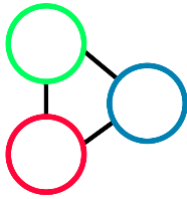
	OBISCode (hex)	length of value (n)	value
Bytes	01 00 01 08 00 FF	03	14 e3 31 (=3269396)
Description	1-0:1.8.0*255	3	326939.6 (3269396*10 ⁻⁶)

Entry 2:

	OBISCode (hex)	length of value (n)	value
Bytes	01 00 01 08 00 FE	08	FF 02 00 00 00 00 00 00 (=767)
Description	1-0:1.8.0*254	8	76700 (767*10 ²)

Multiple messages

The Bridge puts as many values in a single data message as possible (respecting the current Spreading Factor). When it cannot fit all values in a single message, it will send multiple data messages until all values are uploaded. It will never split a single value. Since every value is prefixed with the Obis



Status Message (Port 64)

Example Payload: 45 44 4c 00 00 01 00 00 00 0e 31 00 dc 00

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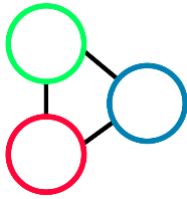
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name	len	type	description	ie
Firmware Identifier	3	String	3 Character FW Identifier	4 -
Firmware Version	3	uint8[3]	Version: <major>. <minor>. <patch>	0 -
Status	1	uint8	RFU - always 0	0
Reboot reason	1	uint8	RFU - always 0	0
Final words	1	uint8	RFU - always 0	0
vBat	2	int16	battery Voltage in mV	0 3 - V
Temperature	2	int16	Internal temperature from controller in 1/10 °C	0 - 2
Custom Status	1	uint8, bitfield	Indicates global errors, i.e. if bit 5 is set no opto head could be found	0 e e is



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powered by the Platform

Payload (wMBus)

See Standard. APPKey will be used as key for encryption.

Reference decoder

This is a decoder written in JavaScript that can be used to parse the device's messages.

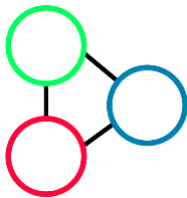
```
function readName(bytes, i) {
    return bytes.slice(i, i + 6);
}

function readValue(len, bytes, i) {
    if (len <= 0) {
        return [];
    }
    return bytes.slice(i, i + len);
}

function toHexString(byteArray) {
    var s = '';
    byteArray.forEach(function (byte) {
        s += ('0' + (byte & 0xFF).toString(16));
    });
    return s;
}

function parse_sint16(bytes, idx) {
    bytes = bytes.slice(idx || 0);
    var t = bytes[0] << 8 | bytes[1] << 0;
    if( (t & 1<<15) > 0){ // temp is negative
        t = ((~t)& 0xffff)+1; // invert 16 bits
        t=t*-1;
    }
    return t;
}

function parse_uint16(bytes, idx) {
    bytes = bytes.slice(idx || 0);
    var t = bytes[0] << 8 | bytes[1] << 0;
    return t;
}
```



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```
function signed(val, bits) {
    if ((val & 1 << (bits - 1)) > 0) { // invert
        var mask = Math.pow(2, bits) - 1;
        val = (~val & mask) + 1; // invert
        val = val * -1;
    }
    return val;
}

function uint40_BE(bytes, idx) {
    bytes = bytes.slice(idx || 0);
    return bytes[0] << 32 |
        bytes[1] << 24 | bytes[2] << 16 |
        bytes[3] << 8;
}

function uint16_BE(bytes, idx) {
    bytes = bytes.slice(idx || 0);
    return bytes[0] << 8 | bytes[1] << 0;
}

function int40_BE(bytes, idx) {return signed(uint40_BE(bytes, idx), 40);}
function int16_BE(bytes, idx) {return signed(uint16_BE(bytes, idx), 16);}
function int8(bytes, idx) {return signed(uint8_BE(bytes, idx), 8);}

function toNumber(bytes) {
    var res = 0;

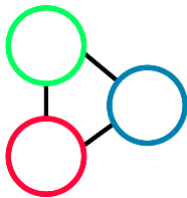
    for (var i = bytes.length-1; i >= 0 ; i--) {
        res *= 256;
        res += bytes[i];
    }

    return res;
}

function readVersion(bytes) {
    if (bytes.length<3) {
        return null;
    }
    return "v" + bytes[0] + "." + bytes[1] + "." + bytes[2];
}

function decodeStatus(bytes) {
    var decoded = {
        "version":readVersion(bytes),
        "flags": bytes[3],
        "vBat": uint16_BE(bytes, 4) / 1000,
        "temp": int16_BE(bytes, 6) / 10,
    };

    if (Device) {
        Device.setProperty("version", decoded.version);
    }
}
```



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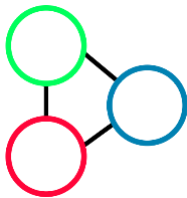
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```
}  
  
    return decoded;  
}  
  
function decodeSmlValuesV1(bytes) {  
    var decoded = {  
        values: [],  
    };  
  
    if (bytes.length === 1) {  
        // No Data! Read error?  
        return decoded;  
    }  
  
    var pos = 0;  
    while (pos < bytes.length) {  
        var name = readName(bytes, pos);  
        pos += 6;  
        var len = bytes[pos];  
        pos += 1;  
        var value = readValue(len, bytes, pos);  
        pos += len;  
  
        var val = {  
            nameHex: toHexString(name),  
            len: len,  
            value: toNumber(value),  
            valueHex: toHexString(value)  
        };  
  
        decoded.values.push(val);  
    }  
  
    return decoded;  
}  
  
function decodeSmlValuesV2(bytes) {  
    var decoded = {  
        values: [],  
    };  
  
    if (bytes.length === 1) {  
        // No Data! Read error?  
        return decoded;  
    }  
  
    var pos = 0;  
    var headNo = bytes[0];
```



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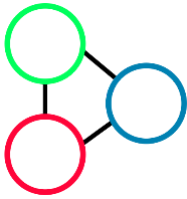


```
var name = readName(bytes, pos);
pos += 6;
var len = bytes[pos];
pos += 1;
var value = readValue(len, bytes, pos);
pos += len;
if (len > 0) {
    var exponent = int8(bytes, pos);
    pos += 1;
}
if (len > 0) {
    var unit = int8(bytes, pos);
    pos += 1;
}
var val;
if (len > 0) {
    val = {
        obiscode: name[0] + "-" + name[1],
        //len: len,
        value: toNumber(value) * Math.pow(10, exponent),
        unit: toNumber(unit),
        //valueHex: toHexString(value)
    }
} else {
    val = {
        obiscode: name[0] + "-" + name[1],
        //len: len,
        value: toNumber(value),
        unit: toNumber(unit),
        //valueHex: toHexString(value)
    }
}
decoded.values.push(val);
}
return decoded;
}

function decodeSmlValuesV3(bytes) {
    var decoded = {
        values: [],
    };

    if (bytes.length === 1) {
        // No Data! Read error?
        return decoded;
    }

    var pos = 0;
```

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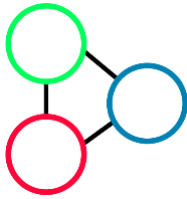
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```
decoded.time = int40_BE(bytes, 1) * 1000000000;
pos+=5;
```

```
while (pos < bytes.length) {
    var name = readName(bytes, pos);
    pos += 6;
    var len = bytes[pos];
    pos += 1;
    var value = readValue(len, bytes, pos);
    pos += len;
    if (len > 0) {
        var exponent = int8(bytes, pos);
        pos += 1;
    }
    if (len > 0) {
        var unit = int8(bytes, pos);
        pos += 1;
    }
    var val;
    if (len > 0) {
        val = {
            obiscode: name[0] + "-" + name[1],
            //nameHex: toHexString(name),
            //len: len,
            value: toNumber(value) * Math.pow(10, exponent),
            //valueHex: toHexString(value),
            unit: toNumber(unit),
        }
    }
    else {
        val = {
            obiscode: name[0] + "-" + name[1],
            //len: len,
            value: toNumber(value),
            //valueHex: toHexString(value),
            unit: toNumber(unit),
        }
    }
    decoded.values.push(val);
}
return decoded;
}
```

```
function decode_status_code(code) {
    switch (code) {
        case 0:
            return "OK";
    }
}
```



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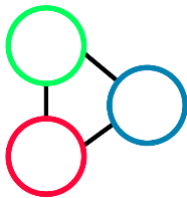
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```
}  
  
function decode_reboot_reason(code) {  
    // STM reboot code from our HAL:  
    switch (code) {  
        case 1:  
            return "LOW_POWER_RESET";  
        case 2:  
            return "WINDOW_WATCHDOG_RESET";  
        case 3:  
            return "INDEPENDENT_WATCHDOG_RESET";  
        case 4:  
            return "SOFTWARE_RESET";  
        case 5:  
            return "POWER_ON_RESET";  
        case 6:  
            return "EXTERNAL_RESET_PIN_RESET";  
        case 7:  
            return "OBL_RESET";  
        default:  
            return "UNKNOWN";  
    }  
}
```

```
function DecoderPort64(bytes) {  
    // legacy format, firmware 4.x  
    // Decode an uplink message from a buffer  
    // (array) of bytes to an object of fields  
    var firmware = String.fromCharCode.apply  
    var version = readVersion(bytes, 3);  
    var status_code = bytes[6];  
    var status_text = decode_status_code(status_code);  
    var reboot_code = bytes[7];  
    var reboot_reason = decode_reboot_reason(reboot_code);  
    var final_code = bytes[8];  
    var vcc = (parse_uint16(bytes, 9) / 1000);  
    var temp = (parse_sint16(bytes, 11) / 10);  
    var error_state = bytes[13];
```

```
    Device.setProperty("firmware", firmware);  
    Device.setProperty("version", version);  
    Device.setProperty("status_code", status_code);  
    Device.setProperty("status_text", status_text);  
    Device.setProperty("reboot_code", reboot_code);  
    Device.setProperty("reboot_reason", reboot_reason);  
    Device.setProperty("final_code", final_code);  
    Device.setProperty("error_state", error_state);  
    Device.setProperty("temperature", temp);  
    Device.setProperty("voltage", vcc);
```



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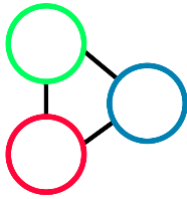


```
"version": version,
"status_code": status_code,
"status_text": status_text,
"reboot_code": reboot_code,
"reboot_reason": reboot_reason,
"final_code": final_code,
"temperature": temp,
"voltage": vcc,
"error_state": error_state
};
}

function Decoder(bytes, port) {
  // Decode an uplink message from a buffer
  // (array) of bytes to an object of fields
  switch (port) {
    case 1:
      return decodeStatus(bytes);
    case 2:
      return decodeSmlValuesV1(bytes);
    case 3:
      return decodeSmlValuesV2(bytes);
    case 4:
      return decodeSmlValuesV3(bytes);
    case 64:
      return DecoderPort64(bytes);
  }
}

function NB_ParseDeviceQuery(input) {
  for (var key in input.d) {
    var v = input.d[key];
    switch (key) {
      case "temperature":
        v = v / 10.0;
        break;
      case "vbat":
        v = v / 1000.0;
        //NB_SetBatteryStatus(v)
        break;
    }
    Device.setProperty("device." + key, v);
  }
  return null;
}

function NB_ParseConfigQuery(input) {
  for (var key in input.d) {
    Device.setConfig(key, input.d[key]);
  }
}
```



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```
function ParseV2(input) {
  var decoded = {
    values: [],
  };

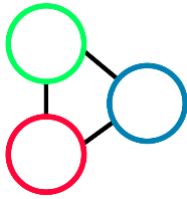
  decoded.headNo = input.d.head;
  decoded.time = new Date(input.d.timestamp);

  //return toNumber(parseBase64(input.d.batch));
  //decoded.payload = input.d;
  var val;

  if ((input.d.batch) && (input.d.batch.length))
    for( i = 0; i<input.d.batch.length; i++)
      val = {
        obiscode: input.d.batch[i].obiscode,
        value: input.d.batch[i].value * 1000,
        //valueHex: toHexString(input.d.batch[i].value),
        unit: toNumber(input.d.batch[i].unit);
      }
      decoded.values.push(val);
    }
  }
  return decoded;
}

function NB_ParseStatusQuery(input) {
  for (var key in input.d) {
    var v = input.d[key];
    switch (key) {
      case "temperature":
        v = v / 10.0;
        break;
      case "vbat":
        v = v / 1000.0;
        //NB_SetBatteryStatus(v)
        continue;
    }
    Device.setProperty("device." + key, v);
  }
  return null;
}

function ParseNBiot(input) {
  var query = input.q || "data";
  var res = null;
}
```



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```
        break;
    case "config":
        res = NB_ParseConfigQuery(input);
        break;
    case "data":
        res = ParseV2(input);
        break;
    case "status":
        res = NB_ParseStatusQuery(input);
        break;

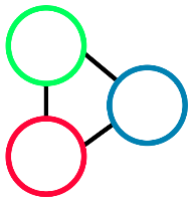
    default:
        throw new Error("Unknown message");
}

if (res != null) {
    res.addr = input.i;
    res.fCnt = input.n;
}
return res;
}

// Wrapper for Lobaro Platform
function Parse(input) {
    // Decode an incoming message to an object
    var b = bytes(atob(input.data));

    // NB-IoT
    if (input.d) {
        return ParseNBiot(input)
    }

    // LoRaWAN
    return Decoder(b, input.fPort);
}
```



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