TLV FORMAT

Type	Data Mark	Data Type	Length (Bytes)	Read Write	Fixed Unit	
T	0x09	Acc Ax	4	R	G	Acceleration reading on the x axis
	0x0A	Acc Ay	4	R	G	Acceleration reading on the y axis
	0x0B	Acc Az	4	R	G	Acceleration reading on the z axis
	0x0C	Tmp102: Temp	4	R	°C	tmp102 temperature reading
	0x0D	Bme280: Temp	4	R	°C	bme280 temperature reading
	0x0E	Bme280: Hum	4	R	%	bme280 humidity reading
	0x0F	Bme280: hPa	4	R	hPa	pressure reading bme280
	0x16	Meter N.	4	RW	None	meter id
	0x19	Packet Sentence	1	R	None	packet of data
	0x1B	Meter Type	1	R	None	placeholder, variable that is consulted and is the reading of the gpio
	0x1C	Module Time	6	R	None	Year/mounth/day/hour/min/sec UTC
	0x1D	Positive/ negative	1	R	None	00: Positive, east longitude FF: Negative, west longitude
		Longitude	4	R	Deg	Corresponds to degrees, minutes, and seconds in Hex
		Positive/ negative	1	R	None	00: Positive, North latitude FF: Negative, South latitude
		Latitude	4	R	Deg	Corresponds to degrees, minutes, and seconds in Hex
	0x1F	LEDs	1	RW	None	00: LED1 OFF 00: LED1 ON 00: LED2 TOGGLE
	0x22	Error Status Word	1	R	None	error message header

Error Status Word

BIT3~BIT2	BIT1~BIT0
Sensor ID	Error Type

ID	sensor type
0x30	No sensor Error
0x31	Mpu6050
0x32	Tmp102
0x33	Bme280
0x34	GPS

ID	error identifier
0x40	No error
0x41	No Device
0x42	No Data
0x43	Invalid Gps Data

This section shows the ID of the associated sensor and the ID that identifies what type of error it is. At the moment, only errors have been established for the connection of the sensors and the failure to obtain data. More error codes will be added in future work. referring to other parts of the system

1. QUERY STRUCTURE FOR READING REGISTERS

The node query has the following structure

- data format: header+length +Command code+ CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x03	All bytes
Command code	1	0xXX	See TLV format
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

The node's response will have the following structure

- data format: header + packet data + length + register of meter n. + Command code +CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0xXX	All bytes
Meter n.	1	0x16	Header number meter
Meter n. data	4	0xXXXXXXXX	number meter in HEX
Command code	1	0xXX	See TLV format
Data of Command code	n	0xXXXXXXXX	data of the consulted command
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

1.1 query of sensor measurements

data format: header+length +module time+ CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x03	All bytes
Command code	1	0xXX	See TLV format
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

End device response (return) data format

data format: header + packet data + length + meter n. + sensor ID + CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0xXX	All bytes
Meter n.	1	0x16	Header number meter
Meter n. data	4	0xXXXXXXXX	number meter in HEX
Sensor register	1	0xXX	See TLV format
sensor measurement	4	0xXXXXXXXX	measured value in HEX
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

1.2 meter number query

data format: header+length + Command code + CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x03	All bytes
Command code	1	0x16	Meter number register
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

End device response (return) data format

data format: header + packet data + length + meter n. + sensor ID + CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0xXX	All bytes
Meter n.	1	0x16	Meter number register
Meter n. data	4	0xXXXXXXXX	number meter in HEX
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

1.3 date time query

data format: header+length + Command code + CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x03	All bytes
Command code	1	0x1C	Current time register
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

End device response (return) data format

data format: header + packet data + length + meter n. + Curret time register + CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0xXX	All bytes
Meter n.	1	0x16	Header number meter
Meter n. data	4	0xXXXXXXXX	number meter in HEX
Date time	1	0x1C	Current time rister
Date time data	6	0xXXXXXXXXXXX	Year/Month/Date/Hour/Minute/Second in HEX
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

1.4 GNSS query

data format: header+length + Command code + CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x03	All bytes
Command code	1	0x1D	GNSS register
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

End device response (return) data format

data format: header + packet data + length + meter n. GNSS refister + CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0xXX	All bytes
Meter n.	1	0x16	Header number meter
Meter n. data	4	0xXXXXXXXX	number meter in HEX
GNSS data register	1	0x1C	GNSS register
East/west	1	0xXX	00: Positive, east longitude FF: Negative, west longitude
longitude	4	0xXXXXXXXX	Deg/min/sec
North/south	1	0xXX	00: Positive, North latitude FF: Negative, South latitude
latitude	4	0xXXXXXXXX	Deg/min/sec
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

1.5 LEDs query

data format: header+length + Command code + CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x03	All bytes
Command code	1	0x1F	GNSS register
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

End device response (return) data format

data format: header + packet data + length + meter n. GNSS refister + CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0xXX	All bytes
Meter n.	1	0x16	Header number meter
Meter n. data	4	0xXXXXXXXX	number meter in HEX
LEDs register	1	0x1F	LEDs register
Data LEDs	1	0xXX	00: LED1 OFF 00: LED1 ON 00: LED2 TOGGLE
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

2. QUERY STRUCTURE FOR WRITING REGISTERS

The node query has the following structure

- data format: header+length +Command code+ data to write + CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x0X	All bytes
Command code	1	0xXX	See TLV format
Data to write	n	0xXX	See TLV format
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

The node's response will have the following structure

- data format: header + packet data + length + register of meter n. + number meter + Command code + data writing +CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0xXX	All bytes
Meter n.	1	0x16	Header number meter
Meter n. data	4	0xXXXXXXXX	number meter in HEX
Command code	1	0xXX	See TLV format
written data	n	0xXXXXXXXX	written data
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

2.1 LEDs status change

data format: header+length +Command code+ data to write + CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x0X	All bytes
Command code	1	0x1F	See TLV format
Data to write	1	0xXX	See TLV format
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

The node's response will have the following structure

data format: header + packet data + length + register of meter n. + Command code +CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0x08	All bytes
Meter n.	1	0x16	Header number meter
Meter n. data	4	0xXXXXXXXX	number meter in HEX
LEDs registers	1	0x1F	See TLV format
LEDs status	1	0xXX	0X00: LED1 off 0x01 ： LED1 on 0x02 ： LED2 toggle
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

2.2 Meter no. change

data format: header+length +Command code+ data to write + CRC16

name	byte	Data	Description
Frame header	1	0x24	header indicating that it is a message sent to the node
length	1	0x07	All bytes
Command code	1	0x16	See TLV format
Data to write	4	0xXXXXXXXX	See TLV format
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

The node's response will have the following structure

data format: header + packet data + length + register of meter n. + number meter +CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	packet of data
length	1	0x07	All bytes
Meter n.	1	0x16	Header number meter

Meter n. data	4	0xXXXXXXXX	number meter in HEX
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

3. QUERY STRUCTURE FOR STATUS ERROR

3.1 query of error

data format: header+length+command code+ CRC16

name	byte	Data	Description
Frame header	1	0x24	
length	1	0x03	All bytes
Command code	1	0x22	See Error Status
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

End device response (return) data format

data format: header + packet data + length + meter n. + erros status + CRC16

name	byte	Data	Description
Frame header	1	0x26	header indicating that it is a message sent by the node
Packet data	1	0x19	Packet data
length	1	0x1A	All bytes
Meter n.	1	0x16	Header number meter
Meter n. data	4	0xXXXXXXXX	number meter in HEX
Error status	1	0x22	Erros status code
Error device id	1	0xXX	See Error Status Word
Error type	1	0xXX	
CRC16	2	0xXXXX	Low bytes at the front, high bytes at the back

4. EXAMPLE:

4.1 260966DA – acceleration query on the x axis

Answer:

2419101612345678094AC2223443XXXX

- 24: Header
- 1910: packet sentence + length 10 (decimal 16)
- 1612345678: meter no. Dec 12345678 - hex, 305419896
- 094AC2: lectura aceleración eje x
- 223443: error status – 34 GPS – 43 invalid gps data.
- XXXX: CRC16

4.2 2622799A- error query

Answer:

24190F16161234567822314 1B8XXXX

- 24: Header
- 190F: packet sentence + length 0F (decimal 15)
- 1612345678: meter no. Dec 12345678 - hex, 305419896
- 223141: error status – 31 MPU6050 – 41 no device
- XXXX: CRC16

4.3 261CA91B – date time query

Answer:

2419121612345678121C170B150E0B00XXXX

- 24: Header
- 1912: packet sentence + length 12 (18 decimal)
- 1612345678: meter no. Dec 12345678 - hex, 305419896
- 1C170B150E0B00 which is 14:11:00 on Nov 21, 2023
    - 17: year: which is correspond to decimal 23, which is 2023
    - 0B month: which is correspond to decimal 11
    - 15:day: which is correspond to decimal 21
- XXXX: CRC16

4.4 261D69DA – GNSS query

Answer:

241912161234567812 1C170B150E0B00XXXX

- 24: Header
- 1912: packet sentence + length 12 (18 decimal)
- 1612345678: meter no. Dec 12345678 - hex, 305419896
- 1DFF143209060063330258
  - FF: Negative, west longitude
  - 14320906: decimal 20° 50’ 09.06’’
  - 00: Positive, North latitude
  - 63330258: decimal 99° 51’ 02.88’’
- XXXX: CRC16

4.5 261F0169DA – LEDs status change

Answer:

2419121612345678 1F01XXXX

- 24: Header
- 190C: packet sentence + length 0C (12 decimal)
- 1612345678: meter no. Dec 12345678 - hex, 305419896
- 1F01
  - 01: LED 1 - ON
- XXXX: CRC16