Cellocator Wireless Communication Protocol - CelloTrack Nano

Proprietary and Confidential

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POINTER TELOCATION LTD. 14 HAMELACHA ST. ROSH HA'AYIN 4809133, ISRAEL • TEL: 972-3-5723111 • FAX: 972-3-5723100 • WWW.POINTER.COM

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Table of Contents

1 Introduction

1.1 About this Document

This document describes the unit wireless communication protocol structure, implemented in Cellocator units. It describes every byte of the inbound/outbound messages, which can be sent/received by the unit over the air.

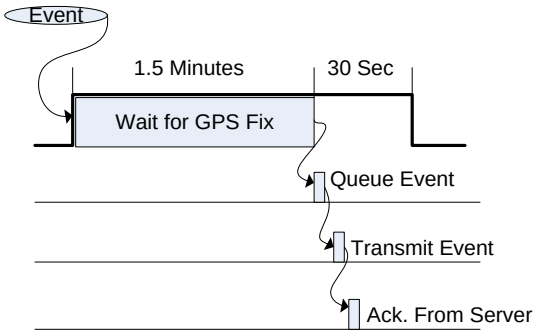
The document comprises of the following main parts:

- Telemetry Channel (outbound messages initiated from the unit towards the server)
- Command Channel (inbound messages initiated from the server towards the unit)
- CSA Channel

Most communication flow scenarios between the unit and the server implement acknowledge from the receiving side to the sending side. Some are done using generic ACK (acknowledge) message, and some are done using other messages dedicated to the specific scenario.

A large portion of the outbound messages from the unit to the server, are initiated by the unit in a response to a certain trigger (e.g. GPIO activation, speed violation, etc.). Those messages are referred as events. The unit supports the following kinds of events:

- **Logged Event:** If the condition for a specific logged event is met, the unit will create an event and store it into its non-volatile memory. The event will be sent to the server only during the GPRS session and will be deleted from the memory of the unit only after reception of acknowledge from the server. Note: Plain events will never be delivered by SMS.
- **Distress Event:** If the condition for a specific distress event is met, the unit will create a series of messages (session). The messages will be sent to the server immediately with the first available communication transport (during GPRS session – over IP, otherwise by SMS). The messages are not stored in the unit memory and if there is no cellular coverage at the moment of sending the message will be lost. Distress events do not require acknowledge from the server.
- **Active Logged Event:** This event is designed to enhance the functionality of legacy logged events. It is important for units such as CelloTrack, which are battery operated and mostly hibernating while periodically communicating with the server. Enabling the Active Logged Event feature changes the behavior of the unit in the following way:
  - During Hibernation
    When a new event is generated, the unit will turn its modem and GPS on, wait for a GPS fix and then queue the event into the event queue. The event will be transmitted to the server, acknowledged by the server and removed from the queue. Active Logged Event turns the unit on from hibernation for up to 2 minutes. If a GPS fix is not detected within 1.5 minutes from the beginning of the session, the event will be queued into the events queue and sent towards the server while giving an extra 30 seconds for the server to acknowledge the event. If a cellular link is not available the unit will be turned off and the message will wait in the queue for later delivery.



-
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- During Live Tracking
  When a new event is generated, and the GPS is off (in CelloTrack units), the unit will turn the GPS on, wait for a fix and then insert the event into the event queue.

Naturally, the wireless protocol has evolved over the years, to answer the growing needs, and old lean message types are gradually replaced by newer message type (Type 11), which has more robust and modular structure, intended to support longer diverse messages. Thus, it is recommended to implement the complete Type 11 on the server side.

1.2 Abbreviations

Abbreviation	Description
ACK	Acknowledge
CAN	Controller Area Network
CCC	Command and Control Center
DB	Database
OTA	Over the Air
PDU	Protocol Description Unit (Common name for data SMS)
PGN	Parameter Group Number
SMS	Short Message Service (GSM)
PTR	Pointer Telocation Ltd.
PSP	Pointer Serial Protocol, normally refers to a Car Alarm System interfacing through this protocol
NVM	Non Volatile Memory
FW	Firmware
HW	Hardware

1.3 References

All the reference documents listed in the following table can be downloaded from the support section of the Pointer Website (www.pointer.com).

#	Reference	Description
1	Cellocator Programming Manual	This document describes the features supported by the Cellocator unit and provides details about the parameters of its configuration.
2	Cellocator Hardware Installation Guides	This document provides all necessary information for a technician who is involved in the installation of Cellocator units. It describes how to install and verify the proper functioning of the unit installation kit elements.
3	Cellocator Serial Communication Protocol	This document describes the serial interface (RS232) protocol

2 Telemetry Channel (Outbound Messages)

2.1 Overview

The telemetry channel comprises several types of messages, as described in the following:

- **Status/location Message (Message Type 0)** – a legacy message, which is sent by default, as a reply to a command or as the message of choice when reporting events or emergency situations.
- **Programming Data (Message Type 3)** – this message is sent as a reply to programming commands, or by request. It contains the new contents of the programmed block, which allows verification of the programming.
- **Modular Message (Message Type 9)** – this legacy modular message is designed to contain different types of data, such as CAN bus sensors, Cell ID, debug data, etc.
- **Modular Message (Message Type 11)** – this modular message type implements an extended modular protocol, intended to replace older message types (0, 3, and 9). It is currently used for CAN bus applications, CelloTrack Nano, CelloTrack-4 family, configuration memory programming and uploading of devices with 8 Kbytes of configuration memory, etc.

2.2 Status/Location Message (Message Type 0)

The message is used for reporting most of the basic unit events. It contains basic status data and location of the unit.

2.2.1 *Message Ingredients*

- Message Header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Unit ID – 4 bytes
  - Communication Control Field – 2 bytes
  - Message Numerator – 1 byte
- Unit Hardware Version – 1 byte
- Unit Firmware Version – 1 byte
- Protocol Version and Unit Functionalities – 1 byte
- Unit Status – 1 byte
- Current GSM Operator – 2 bytes
- Transmission Reason Specific Data – 1 byte
- Transmission Reason – 1 byte
- Unit Mode of Operation – 1 byte
- Unit I/O status – 4 bytes
- Analog Input Values – 4 bytes
- Mileage Counter (Odometer) – 3 bytes
- Multi-Purpose Field – 6 bytes
- Last GPS Fix – 2 bytes
- Service and Status – 1 byte
- Mode 1/2 – 2 bytes
- Number of Satellites Used – 1 byte
- Longitude – 4 bytes
- Latitude – 4 bytes
- Altitude – 4 bytes
- Ground Speed – 4 bytes
- Speed Direction (True Course) – 2 bytes

- Time and Date – 7 bytes
- Error Detection Code – 1 byte

2.2.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"
4	System Code, byte 4 – ASCII "P"
5	Message Type (0)
6	Unit ID
7	
8	
9	
10	Communication Control Field
11	
12	Message Numerator (Anti-Tango™)
13	Unit Hardware Version
14	Unit Firmware Version
15	Protocol Version and Unit Functionalities
16	Unit Status and Current GSM Operator (1st Nibble)
17	Current GSM Operator (2nd and 3rd Nibbles)
18	Transmission Reason Specific Data
19	Transmission Reason
20	Unit Mode of Operation
21	Unit I/O Status 1st byte
22	Unit I/O Status 2nd byte
23	Unit I/O Status 3rd byte
24	Unit I/O Status 4th byte
25	Current GSM Operator (4th and 5th Nibbles)

26	Analog Input 1 Value
27	Analog Input 2 Value
28	Analog Input 3 Value
29	Analog Input 4 Value
30	Mileage Counter (Odometer)
31	
32	
33	Multi-Purpose Field (Driver/Passenger/Group ID, PSP/Keyboard Specific Data, Accelerometer Status, SIM IMSI)
34	
35	
36	
37	
38	
39	Last GPS Fix
40	
41	Service and Status
42	Mode 1
43	Mode 2
44	Number of Satellites Used
45	Longitude
46	
47	
48	
49	Latitude
50	
51	
52	
53	Altitude
54	

55	
56	
57	Ground Speed
58	
59	
60	
61	Speed Direction (True Course)
62	
63	UTC Time – Seconds
64	UTC Time – Minutes
65	UTC Time – Hours
66	UTC Date – Day
67	UTC Date – Month
68	UTC Date – Year (-2000) (e.g. value of 7 = year 2007)
69	
70	Error Detection Code (8-bit additive checksum, excluding system code)

Multiple byte fields are sent Intel style (i.e. least significant bytes sent first).

2.2.3 *Detailed Per-Field Specifications*

2.2.3.1 System Code

System code is a 4-byte value, which identifies the Cellocator system. The field is sent as the ASCII values of the letters "M", "C", "G", "P" (for IP messages) or "M", "C", "G", "S" (for SMS messages), in that order.

2.2.3.2 Message Type

Message type identifies the kind of the message. It allows the receiver to differentiate between different messages types, according to the value sent in this field.

Status/Location messages contain a value of 0 (zero) in the message type field.

2.2.3.3 Unit ID

This field contains a value that is uniquely assigned for every Cellocator unit during the manufacturing process. All messages sent by the same unit contain the same value in the Unit ID field.

2.2.3.4 Communication Control Field

This is a bitmapped field, providing information about the message and the situation in which it was originated.

First byte (10th):

		Multi-Purpose Field (Bytes 33-38) assignment		Message Source	Garmin Connected	Garmin Enabled	Message Initiative
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Second byte (11th):

GSM Hibernation			Firmware Sub-Version				
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Message initiative

0 – Active transmissions (initiated by the unit, based on its logic and decisions)

1 – Passive responses (response to a command or a query message)

Message Source

0 – Direct message (not from memory)[1]

1 – Message from memory (the unit tries to resend the message from the memory, until ACK from the server is received)

Multi-Purpose Field (Bytes 33-38) Assignment

This 2 bits, along with bit 7 in byte 41 of this message (Service and Status), define the data provided in bytes 33-38 of this message according to the following table:

Byte 41	Byte 10		Data in Bytes 33-38
Bit 7	Bit 5	Bit 4	
X	X	X	IMSI (in Wake Up event (TR 202))
1	0	1	CelloTrack Nano Data

Note: The Communication Control Field is sent also in other (than 0) message types. In those message types the Multi-Purpose Field (Bytes 33-38) Assignment indication is a don't care.

Firmware Sub-Version

[1] The only exception is the "Transmission Reason 32 - IP changed/Connection up" message, which always requires ACK from server, even if it was sent as a direct message and not through memory.

This field (5 bits) defines the firmware sub-version of the unit. The number of Cellocator firmware is built from two parts: [Firmware version][Firmware sub-version], where firmware version usually defines the unit family and the sub-version defines the list of supported features.

For example, 30a:

- Version – 30
- Sub-Version – a (1)

Firmware Sub-Version Value (decimal)	Firmware Sub-Version Identifier
0	No identifier
1	a
2	b
3	c
…	…
26	z

GSM Hibernation

0 – Unit is not in GSM hibernation

1 – Unit is in GSM hibernation (message sent during GSM peeking)

2.2.3.5 Message Numerator (Anti-Tango™)

The Message numerator field contains a value that is increased after every self-initiated generation of a message (in cases where an ACK from server was received).

When the unit is reset/powered-up, this value is set to zero. This provides a way to chronologically sort incoming messages from a certain unit, in case an anachronistic communication medium is used.

NOTE: The unit assigns different message numerator sequences for the logged events and for real-time events. In passive transmission (reply to command), the value in this field represents the number from the Command Numerator Field in an incoming command.

2.2.3.6 Unit Hardware Version

This field defines the unit HW (PCB) version and the ID of the modem embedded in it.

The legacy addressing scheme defined 5 bits for HW (PCB) ID and 3 bits for Modem Code. This limited the number of products to 32 products.

For new products (starting from CelloTrack Nano), an alternative backwards compatible approach will be used, in which each unit HW will be uniquely defined by a complete byte (8 bits).

The table for **legacy products**, which will be identified by the **Legacy HW ID** is detailed below:

New HW ID (8 Bits)	Legacy HW ID (5 Bits)	Product Name	Modem Code (3 Bits)	Modem Type
225	1	CR300	7	GE864-QUAD-V2
2	2	CFE	0	No Modem
170	10	CelloTrack 1 Output	5	Enfora 3
235	11	CR300B	7	GE864-QUAD-V2
172	12	CelloTrack	5	Enfora 3
78	14	Cello-IQ GNSS	2	GE910 QUAD V3
18	18	CelloTrack T (2G)	0	Telit GE910 QUAD (V2) (V3)
82	18	CelloTrack T (3G)	2	Telit HE910 NAD
114	18	CelloTrack T (3G)	3	Telit UE910 EUD
19	19	CelloTrackPower T (2G)	0	Telit GE910 QUAD (V2) (V3)
83	19	CelloTrackPower T (3G)	2	Telit HE910 NAD
115	19	CelloTrackPower T (3G)	3	Telit UE910 EUD
20	20	Cello-CANiQ (NA)	0	UE910 NAR
52	20	Cello-CANiQ (EU)	1	UE910 EUR
84	20	Cello-CANiQ (2G)	2	GE910 QUAD V3
183	23	CelloTrack Power	5	Enfora 3
216	24	Cello-F (Telit)	6	Telit GE864, automotive
249	25	Cello-F Cinterion	7	Cinterion BGS3
221	29	CR200	6	Telit GE864, automotive
222	30	CR200B	6	Telit GE864, automotive
223	31	Cello-IQ	6	Telit GE864, automotive

The table for **new products**, which will be identified by the **New HW ID** is detailed below:

New HW ID (8 Bits)	Legacy HW ID (5 Bits)	Product Name	Modem Code (3 Bits)	Modem Type
38	6	Cello-D	1	UE910 NAR
70	6	Cello-D	2	UE910 EUR
136	8	CelloTrack Nano 10 GNSS	4	Cinterion BGS2-W
168	8	CelloTrack Nano 10 3G GNSS	5	Cinterion EHS6A
9	9	Cello-CANiQ CR (NA)	0	UE910 NAR
41	9	Cello-CANiQ CR (EU)	1	UE910 EUR
73	9	Cello-CANiQ CR (2G)	2	GE910 QUAD V3
105	9	Cello-CANiQ CR (2G) – Car Sharing	3	GE910 QUAD V3
169	9	Cello-CANiQ CR (3G) – Car Sharing	5	UE910 NAR
201	9	Cello-CANiQ CR (NA) – Aux	6	UE910 NAR
233	9	Cello-CANiQ CR (EU) – Aux	7	UE910 EUR
43	11	CR300B 3G NA GNSS	1	UE910 NAD
75	11	CR300B 3G EU GNSS	2	UE910 EUD
107	11	CR300B 2G	3	GE910 QUAD V3
139	11	CR300B 2G SIRFV	4	GE910 QUAD V3
77	13	Cello-IQ CR GNSS	2	GE910 QUAD V3
15	15	CelloTrack 10Y	0	Cinterion ELS61-US
47	15	CelloTrack 10Y	1	Cinterion ELS61-USA R2
79	15	CelloTrack 10Y	2	Cinterion ELS61-E
59	27	CelloTrack-LTE	1	Cinterion ELS61-USA R2
91	27	CelloTrack-LTE-Power	2	Cinterion ELS61-USA R2
123	27	CelloTrack-LTE	3	Cinterion ELS61-E
155	27	CelloTrack-LTE-Power	4	Cinterion ELS61-E
187	27	CelloTrack-LTE-Phoenix	5	Cinterion ELS61-USA R2
143	15	CelloTrack Solar	4	Cinterion ELS61-US/USA R2

New HW ID (8 Bits)	Legacy HW ID (5 Bits)	Product Name	Modem Code (3 Bits)	Modem Type
175	15	CelloTrack Solar	5	Cinterion ELS61-E
207	15	CelloTrack Solar Gen2	6	Cinterion ELS61-USA R2
239	15	CelloTrack Solar Gen2	7	Cinterion ELS61-E
116	20	Cello-CANiQ (2G) – Car Sharing	3	GE910 QUAD V3
212	20	Cello-CANiQ CV	6	CE910 Dual V
244	20	Cello-CANiQ CS	7	CE910 Dual S
53	21	PointerCept Base Station	1	No Modem
88	24	Cello-CANiQ India (2G)	2	GE910 QUAD V3
26	26	CelloTrack Nano 20	0	Cinterion BGS2-W
122	26	CelloTrack Nano 20 3G Worldwide	3	Cinterion EHS6A
136	8	CelloTrack Nano 10 2G Worldwide	4	Cinterion BGS2-W
168	8	CelloTrack Nano 10 3G Worldwide	5	Cinterion EHS6A
218	26	CelloTrack Nano 20 LTE-Cat1 NA	6	Cinterion ELS61-USA R2
72	8	CelloTrack Nano 10 LTE-Cat1 NA	2	Cinterion ELS61-USA R2

2.2.3.7 Unit Firmware Version

This field defines the firmware version of the unit. The number of Cellocator firmware is built from two parts: [Firmware version][Firmware sub-version], where firmware version usually defines the unit family and the sub-version defines the list of supported features.

For example, 30a:

- Version – 30
- Sub-Version – a (1)

2.2.3.8 Protocol Version and Unit Functionalities

This is a bitmapped field, providing information about protocol version and other unit functionalities (AR, IQ).

				Protocol Version			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

2.2.3.9 Unit Status and Current GSM Operator (1st Nibble)

This is a bitmapped field, providing information about unit statuses and current GSM operator.

Current GSM Operator (PLMN), 1st nibble					Correct Time	Home/ Roam Network	GPS Comm.
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

GPS Comm.

0 – Communication with GPS is available

1 – Communication with GPS is not available

Home/Roam Network

0 – Home network

1 – Roam network

Correct Time

0 – Valid time stamp

1 – Invalid/estimated time stamp

Source of Speed

0 – GPS

1 – Pulse frequency input

Current GSM Operator

The current GSM Operator (PLMN) is represented as a 5 character hexadecimal number. After conversion into decimal it represents the MCC-MNC of a cellular operator (country code + network number). The 5 PLMN nibbles (nibble for each character) are provided in the following places:

Nibble 1	Nibble 2	Nibble 3	Nibble 4	Nibble 5
Byte 16 (4MSbits)	Byte 17		Byte 25	

2.2.3.10 Current GSM Operator (2nd and 3rd Nibbles)

Current GSM Operator (PLMN), 2nd Nibble				Current GSM Operator (PLMN), 3rd Nibble			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

2.2.3.11 Transmission Reason Specific Data

Additional information Related to the transmission reason (specified in byte 19)

Transmission Reason	Transmission Reason Specific Data Description
18 Voice call	0 – Stop incoming voice call 1 – Start incoming voice call 2 – Stop outgoing voice call 3 – Start outgoing voice call
34 Over speed start	0 – Plain 1 – Threshold changed by input
42 Over speed end	0 – Plain 1 – Threshold changed by input
53 Driving stop	0 – Accelerometer based
69 Driving start	0 – Accelerometer based 1 – GPS based (CelloTrack family only)
102 Activation mode change	0 - CelloTrack about to move to Inactive mode 1 - CelloTrack Activated 2 - CelloTrack Activated by wireless command 3 - CelloTrack Activated by wire (serial) command
158 Tamper active	0 – Nano: Removal from cradle 1 – Reserved 2 – Nano and PointerCept(CR300): Tilt tamper
159 Tamper inactive	0 – Nano: Back to cradle 1 – Reserved 2 – Spare

<table>
<tr><th>Transmission Reason</th><th>Transmission Reason Specific Data Description</th></tr>
<tr><td>164
Nano/ CelloTrack 4 event</td><td>0 – Reserved
1 – Impact event
2 – Orientation change event
3 – Man down event
4 – Open package
5 – Close package
6 – Reserved
7 – Reserved
8 – Reserved
9 – Work ID promoted event
10 – MultiSense event (details about this event will be passed on the Multi-Purpose field (bytes 33-38))
11 – Temperature event
12 – Humidity event
13 – Check-in event
14 – Open door/window
15 – Close door/window
16 – Free-fall event
17 - Check-out by timeout event
18 - Check-out by user event</td></tr>
<tr><td>191
Geo hotspot violation</td><td>
<table>
<tr><td>Direction
0 – exit from hot spot
1 – entry to hot spot</td><td colspan="7">The index of the geo-fence</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>200
AHR (Auto Hardware Reset)</td><td>
<table>
<tr><td colspan="4">AHR reason
0 – Modem non responsiveness
1 – Registration problem
2 – GPS AHR</td><td colspan="4">Number of performed AHR attempts</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Transmission Reason</th><th>Transmission Reason Specific Data Description</th></tr>
<tr><td>206
Jamming detection</td><td>
<table>
<tr><td colspan="5">Not used</td><td colspan="2">GSM jamming ignition state
0 – Legacy (Not associated with Ignition state)
Advanced Jamming Mode:
1 – Ignition Off
2 – Ignition On</td><td>GSM jamming state
0 – GSM jamming detection start
1 – GSM jamming detection end</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>207
Radio off mode</td><td>
<table>
<tr><td>Spare</td><td></td><td></td><td></td><td>Airplane Mode</td><td>Early Radio Off Event</td><td>GPS Status
0 – Off
1 – On</td><td>Modem Status
0 – Off
1 – On</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
<table>
<tr><th>(Bit 5)</th><th>(bit 4)</th><th>Airplane Mode
(Bit 3)</th><th>Early Radio Off Event
(Bit 2)</th><th>GPS Status
(Bit 1)</th><th>Modem Status
(Bit 0)</th><th>Description</th></tr>
</table>
</td></tr>
</table>

Transmission Reason	Transmission Reason Specific Data Description						
	0		0	0	0	0	Going to inactive mode
	0	0	0	0	0	1	N/A
	0	0	0	0	1	0	Detection of internal backup battery voltage lower than 3.46V (on any temperature) for longer than 1 second (100 samples) upon sole work from internal backup battery. The unit will switch off the radio 2 seconds after event generation. Once switched off, the modem will be switched back on only upon main power reconnection.
	0	0	0	0	1	1	CelloTrack Nano battery voltage increases above 3.55V for 30 consecutive seconds will resume the unit from radio off state to fully operative. The event is designed to alert the server that the unit has exit the Radio Off state
	0	0	0	1	0	0	N/A

Transmission Reason	Transmission Reason Specific Data Description
	0 0 0 1 0 1 N/A 0 0 0 1 1 0 N/A 0 0 0 1 1 1 N/A 0 0 1 0 0 0 Nano airplane mode 0 0 1 1 0 0 Nano early airplane mode (Stage-1 of recognition)
252 Com location glancing / Offline tracking	0 – Plain Com location glancing 1 – ST (Specific Time) Com location glancing 2 – Nano/CelloTrack 4 improved glancing event
253 Violation of keep in fence	Index of the geo-fence
254 Violation of keep out fence	
255 Violation of waypoint	

2.2.3.12 Transmission Reason

This field contains the reason for the message transmission. Note that this value is valid only for self-initiated active transmissions, i.e. transmissions that the unit generated because of its logics, in contrast to reply transmissions. Reply transmissions contain the last transmission reason that was used.

Transmission Reason Value	Transmission Reason Description

Transmission Reason Value	Transmission Reason Description
4	Emergency (Distress) mode by command
10	Periodic transmission
11	Communication idle
31	Reply to command
32[2]	IP changed/connection up
33	GPS navigation start
34	Over speed start
35	Idle speed start
36	Distance event
38	GPS factory reset (automatic only)
41	GPS navigation end
42	Over speed end
43	Idle speed end
44	Timed event[3]
53	Driving stop
69	Driving start
70	Distress button active
81	Battery low level
82	Charging power disconnected (USB)
84	Halt (movement end)
85	Go (movement start)
88	Battery high level
89	Charging power connected (USB)
102	Activation mode change
158	Tamper Active

[2] Always requires acknowledge from server, even if it was sent as a direct message and not through memory.

[3] In Cello-CANiQ, this event is used also for the 1 second GPS data reporting.

Transmission Reason Value	Transmission Reason Description
159	Tamper inactive
164	Nano event
165	Nano location report in POD mode
166	Orientation Change
190	No Modem zone entry
191	Geo hotspot violation
200	AHR (Auto Hardware Reset)
202	Wake Up event
203	Pre-hibernation event
204	Vector (course) change (curve smoothing event)
206	Jamming detection
207	Radio off mode
208	Header error (self re-flash processing)
247	Finish mode
252	Com location glancing / Offline tracking
253	Violation of keep in fence
254	Violation of keep out fence
255	Violation of waypoint

2.2.3.13 Unit Mode of Operation

The functioning of the unit can be generalized as a finite state machine model, with a few "stages" of operation. The "current stage" is referred to as "unit mode", or "mode of operation", as following:

Unit Mode Value	Unit Mode Description
0x00	Standby Engine On
0x01	Standby Engine Off
0x10	Towed mode (same as Standby Engine On, but with ignition off)

2.2.3.14 Unit I/O Status

The unit is provided with many I/Os (inputs/outputs). Each I/O may be "high" or "low" at a given moment. The I/O status field is a bitmapped representation of the I/Os physical levels. Note that the I/Os that have been configured to be inverted will affect the application but will not be shown in this field, as it only represent the raw physical signals read from the HW.

1st Byte of I/O Status

CelloTrack Nano	Package is open	USB power connected	Movement sensor	Button_1		GP input1 (Power harness)	Button_2	Tamper Switch
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

2nd Byte of I/O Status

CelloTrack Nano								
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

3rd Byte of I/O Status

CelloTrack Nano					GPS Power			-
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

4th Byte of I/O Status

CelloTrack Nano	Charger status							
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

2.2.3.15 Current GSM Operator (4th and 5th Nibbles)

Current GSM Operator (PLMN), 4th Nibble				Current GSM Operator (PLMN), 5th Nibble			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

2.2.3.16 Analog Inputs

The unit may handle up to 4 analog inputs. These inputs are multiplexed and sent as 8 bit samples each.

The allocation of measurements to the bytes of the message is configurable (PL addresses 1620-1623).

For CelloTrack Nano unit:

Field name	Default value	Byte number in the message
1st analog measurement	1 (Battery Voltage)	26
2nd analog measurement	0 (USB input Voltage)	27
3rd analog measurement	2 (NTC)	28
4th analog measurement	8 (Nano_source)	29

Available inputs for mapping:

Measurement source number	Measurement source name	Coefficient	Comment
0	USB input voltage	0.02353	
1	Battery Voltage	0.01647058823	
2	NTC	Temperature conversion formula: T=0.4314x-40; 0≤x≤255 (-40ºC≤T≤70ºC)	
3	Audio in		Infrastructure
4	No source		
5	No source		
6	No source		
7	No source		
8	Nano source after mux	Context dependent: Temperatures: 1[°C] Signed 8 Humidity: 1[%] Pressure: 32[m] with -400m offset Light: 4[lux]	The value is the mux output after selecting the source in PL addresses 2064-2065

2.2.3.17 Mileage Counter (Odometer)

The unit is provided with a distance accumulator feature. The unit counts distance "base units" programmed in the PL.

By synchronizing the accumulator value with the vehicle odometer reading and setting the distance base units to one kilometer/mile, this counter provides the ability to remotely read the vehicle odometer. The programming and synchronizing is only needed once – during the installation.

The mileage counter field contains the current 24-bit value of this accumulator.

2.2.3.18 Multi-Purpose Field (Bytes 33-38)

This field may carry different information as per bits 4, 5 in Communication Control Field (byte 10) and bit 7 in Service and Status (byte 41):

Byte 41	Byte 10		Data in Bytes 33-38
Bit 7	Bit 5	Bit 4	
X	X	X	IMSI (in Wake Up event (TR 202))
1	0	1	CelloTrack 4/Nano Data

IMSI

In case of a Wake Up event (TR 202), the unit reports the 12 first characters of the SIM IMSI converted to hex (Little Endian).

The IMSI number consists of up to 15 numerical characters (0-9). An IMSI consists of a three digit mobile country code (MCC, which is not reported by Cellocator Protocol) and a variable length national mobile station identity (NMSI).

The NMSI consists of two variable length parts: the mobile network code (MNC) and the mobile station identification number (MSIN). A Class 0 IMSI is 15 digits in length. A Class 1 IMSI is less than 15 digits in length.

Example: 425020315229000 (Cellcom IL)

MCC	425	Israel
MNC	02	Cellcom IL
MSIN	0315229000	

The Hex value received in bytes 33-38:

Value (hex)	00	5A	16	0F	03	02
Location	Byte 33	Byte 34	Byte 35	Byte 36	Byte 37	Byte 38

Conversion table:

In wireless protocol (big-endian)	00	5A	16	0F	03	02
HEX values (little-endian)	02	03	0F	16	5A	00

DEC values	02	03	15	22	90	00
NMSI (MNS + MSIN)	020315229000					

CelloTrack 4/Nano Data

IMPORTANT: In messages from the unit, this is the **default** content of the Multi-purpose field, **unless otherwise stated**.

Byte	Description								Containing
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
33	Multi-purpose bytes area management byte: 0x00 = Nano readings 0x01 = Nano event 0x02 = MultiSense event …								0x00 = Nano readings
34	Bits [7÷4]: Slow filtered X Acceleration, limited to +1.75g÷-2g and shrunk to "SINT4 format". (LSB= 0.25g, so 0111 = +1.75g, 1111 = -0.25g etc.)				Bits [3÷0]: Slow filtered Y Acceleration, limited to +1.75g÷-2g and shrunk to "SINT4 format". (LSB= 0.25g, so 0111 = +1.75g, 1111 = -0.25g etc.)				
35	Bits [7÷4]: Slow filtered Z Acceleration, limited to +1.75g÷-2g and shrunk to "SINT4 format". (LSB= 0.25g, so 0111 = +1.75g, 1111 = -0.25g etc.)				Bit [3]: This bit represent "Upright position"=0 or "Laying position"=1 Bit [2]: Not "Upright position" and not "Laying position" Bit [1]: Nano temperature readings are "Invalid / NA"=0 or "Valid"=1. (Due to the fact that it is actively charging or during 30 minutes period after that, the temperature is shifted upwards). Bit [0]: Reserved = 0				
36	ADC raw reading of Ambient Light in 12-bit (LSB), in 0.25								In Nano 10 = 0

	lux units		
37	(Infrastructure) Reserved = 0000	Bits [3÷0]: ADC raw reading of Ambient Light in 12-bit (MSB), in 0.25 lux units	In Nano 10 = 0
38	Average of 2 last Pressure samples, translated to meters above sea-level, UINT8 format, where 400m **below** sea-level is =0 and the value is divided by 32, i.e. 200→6000m.		In Nano 10 = 0

Impact and Free-fall Recognition

Type 0 with TR 164 and STR 1 (Impact event) or STR 16 (Free-fall event) is used.

For this combination of TR and STRs, the default Multi-purpose field will be replaced by the following structure:

Byte	Description	Containing
33	Multi-purpose bytes area management byte: 0x00 = Nano readings 0x01 = Nano event 0x02 = MultiSense event …	0x01= Nano event **or** 0x02 = MultiSense event
34	Source of measurement (single only)	Sources enumeration according to this definition
35	Reserved	0
36	Battery level in %	
37	Last RSSI value (Cellular if Nano, and SR-RF if MultiSense)	SINT8 format in dBm units
38	RMS value = SQRT ($X^2+Y^2+Z^2$)	Shrunk to UINT8: LSB resolution = 32mg

Orientation Change

Type 0 with TR 164 and STR 2 (Orientation change event) is used.

Man Down

Type 0 with TR 164 and STR 3 (Man down event) is used.

Package Open/Close

Type 0 with TR 164 and STR 4 (Open package) or STR 5 (Close package) is used.

For this combination of TR and STRs, the default Multi-purpose field will be replaced by the following structure:

Byte	Description	Containing
33	Multi-purpose bytes area management byte: 0x00 = Nano readings 0x01 = Nano event 0x02 = MultiSense event …	0x01= Nano event
34	Source of measurement (single only)	Sources enumeration according to this definition
35	Reserved	0
36	Battery level in %	
37	Last RSSI value (Cellular if unit, and SR-RF if MultiSense)	SINT8 format in dBm units
38	Light Value	Shrunk to UINT8: LSB resolution = 4 lux

Check-in

Type 0 with TR 164 and STR 13 (Check-in event) is used.

MultiSense Provisioning Event

Type 0 with TR 164 and STR 10 (MultiSense) is used.

For this combination of TR and STR, the default Multi-purpose field will be replaced by the following structure:

Byte	Description	Containing
33	Multi-purpose bytes area management byte: 0x00 = Nano readings 0x01 = Nano event 0x02 = MultiSense event …	0x02 = MultiSense event
34	Source of measurement (single only)	Sources enumeration according to this definition
35	Problem code	0= All OK 1= Lost communication 2= Communication

Byte	Description	Containing
		restored 3= Low bat 4= Low bat restored 5= Dead bat 7= MultiSense Power-up 8= MultiSense Power-down by button
36	Battery level in %	
37	Last RSSI value (SR-RF)	SINT8 format in dBm units
38	Reserved	00

MultiSense Open/Close Package

Type 0 with TR 164 and STR 4 (Open package) or STR 5 (Close package) is used.

For this combination of TR and STR, the default Multi-purpose field will be replaced by the following structure:

Byte	Description	Containing
33	Multi-purpose bytes area management byte: 0x00 = Nano readings 0x01 = Nano event 0x02 = MultiSense event …	0x02 = MultiSense event
34	Source of measurement (single only)	Sources enumeration according to this definition
35	Problem code	0= All OK 1= Lost communication 2= Communication restored 3= Low bat 4= Low bat restored 5= Dead bat 7= MultiSense Power-up 8= MultiSense Power-down by button
36	Battery level in %	

Byte	Description	Containing
37	Last RSSI value (SR-RF)	SINT8 format in dBm units
38	Light level	Shrunk to UINT8: LSB resolution = 2 lux

MultiSense Open/Close Door/Window

Type 0 with TR 164 and STR 14 (Open door/window) or STR 15 (Close door/window) is used.

For this combination of TR and STR, the default Multi-purpose field will be replaced by the following structure:

Byte	Description	Containing
33	Multi-purpose bytes area management byte: 0x00 = Nano readings 0x01 = Nano event 0x02 = MultiSense event …	0x02 = MultiSense event
34	Source of measurement (single only)	Sources enumeration according to this definition
35	Problem code	0= All OK 1= Lost communication 2= Communication restored 3= Low bat 4= Low bat restored 5= Dead bat 7= MultiSense Power-up 8= MultiSense Power-down by button
36	Battery level in %	
37	Last RSSI value (SR-RF)	SINT8 format in dBm units
38	Reserved	00

Temperature/Humidity events

Type 0 with TR 164 and STR 11 (Temperature event) or STR 12 (Humidity event) is used.

For this combination of TR and STR, the default Multi-purpose field will be replaced by the following structure:

Byte	Description	Containing
33	Multi-purpose bytes area management byte: 0x00 = Nano readings 0x01 = Nano event 0x02 = MultiSense event …	0x01= Nano event
34	Source of measurement (single only)	Sources enumeration according to this definition

Byte	Description	Containing
35	Event code	<u>Bits [2..0] – Violation/Alert status:</u> 000 - Within the limits 001 - (Unknown) 010 - Violating (not in alert) a lower TH but alert is not yet declared 011 - Violating (not in alert) a upper TH but alert is not yet declared 100 – Alert for lower TH violation 101 – Alert for upper TH violation 110 – Violating while in alert the lower TH 111 - Violating while in alert the upper TH <u>Bits [3] – Retransmission indication bit</u> This bit indicates (when '0') if the current report is a retransmission or not. 0 – Retransmission 1 – Not retransmission <u>Bits [5..4] – Charging status</u> 00 – Not charging 01 – Charging slow 10 – Charging fast 11 – Charger fault / charger thermal shutdown <u>Bits [6] – 30 min after charging bit</u> 0 – Not during 30 minutes after charging. 1 – During 30 minutes after charging. **<u>Bits [7] – Reserved</u>** = 0

Byte	Description	Containing
36	Battery level in %	
37	Last RSSI value (of Cellular modem)	SINT8 format in dBm units
38	Reserved	0

Alternatively, the following structure is used:

Byte	Description	Containing
33	Multi-purpose bytes area management: 0x00 = Nano readings 0x01 = Nano event 0x02 = MultiSense event …	0x02 = MultiSense event
34	Source of measurement (single only)	Sources enumeration according to this definition
35	Problem code	0= All OK 1= Lost communication 2= Communication restored 3= Low bat 4= Low bat restored 5= Dead bat 7= MultiSense Power-up 8= MultiSense Power-down by button
36	Battery level in %	
37	Last RSSI value (SR-RF)	SINT8 format in dBm units

Byte	Description	Containing
38	Event code	Bits [2..0] – Violation/Alert status: 000 - Within the limits 001 - (Unknown) 010 - Violating (not in alert) a lower TH but alert is not yet declared 011 - Violating (not in alert) a upper TH but alert is not yet declared 100 – Alert for lower TH violation 101 – Alert for upper TH violation 110 – Violating while in alert the lower TH 111 - Violating while in alert the upper TH Bits [3] – Retransmission indication bit This bit indicates (when '0') if the current report is a retransmission or not. 0 – Retransmission 1 – Not retransmission Bits [4..7] – Reserved = 0000

2.2.3.19 Last GPS Fix

This field provides a timestamp when which the GPS was last in navigation mode.

Day of Month					Hours					Minutes					
Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 40								Byte 39							

NOTE: The easiest way to define if the GPS data in the message is valid and updated, or

historical, is to compare between the time of the timestamps and UTC time (see below).

2.2.3.20 Service and Status

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

2.2.3.21 MODE 1 and Mode 2

These fields are generated by the GPS and transparently monitored in the outgoing message from the unit. The fields define the validity of GPS data in the message.

The unit considers the valid fix according to the "Enable Tight GPS PMODE Filter" parameter (address 509, bit 7):

- If "Enable Tight GPS PMODE Filter" is enabled, the unit considers the GPS data as valid only if Mode 1 = 3 or 4 AND Mode 2 = 2
- If "Enable Tight GPS PMODE Filter" is disabled, the unit considers the GPS data as valid only if Mode 1 =2, 3, 4, 5 and 6

2.2.3.22 Number of Satellites Used

Number of satellite measurements used for current position fix. Possible values are 0 to 20 (GNSS modules).

2.2.3.23 Longitude, Latitude

Longitude and latitude coordinates of current position fix. Both coordinates are sent as 32-bit signed integers, representing the coordinates in 10^{-8} radian resolution. Possible values are $-\Pi$ to $+\Pi$ for longitude, or $-\Pi/2$ to $+\Pi/2$ for latitude. The coordinates refer to WGS-84 map datum and ellipsoid.

2.2.3.24 Altitude

Altitude of current position fix. Represented as a 32-bit signed integer, in 10^{-2} meter resolution (altitude is represented in centimeters).

2.2.3.25 Ground Speed

Current speed (absolute value of the vector). Represented as a 32-bit unsigned integer, in 10^{-2} meter/sec resolution (speed is represented in centimeters/sec).

2.2.3.26 Heading/Speed Direction (True Course)

Direction (angle) of the speed vector. Represented as 16-bit unsigned integer, in 10^{-3} radian resolution. Possible values are 0 to 2Π.

2.2.3.27 System Time

Universal coordinated time of the position fix, represented in seconds (0-59), minutes (0-59) and hours (0-23).

Note that the system time and date fields are monitoring system time, based on the internal timer of the unit. The internal timer synchronizes with GPS time when the GPS fix is considered as valid (or always as per configuration flag).

2.2.3.28 System Date

Universal coordinated date of the position fix, represented in days (1-31), months (1-12) and years (1980-2079).

Note that the system time and date fields are monitoring system time, based on the internal timer of the unit. The internal timer synchronizes with GPS time when the GPS fix is considered as valid (or always as per configuration flag).

2.2.3.29 Error Detection Code

The error detection code (checksum) is a last byte of sum of all bytes in a message, excluding the 4 bytes of System Code and the Error Detection Code itself.

Example:
The message:
*4D434750*0006000000081A0202120400000021006230000000 6B00E1000000000000000000E5A100040206614EA303181A57034E12000000000000000001525071403D607*CS*

Calculation of the CS=>

00+06+00+00+00+08+1A+02+02+12+04+00+00+00+21+00+62+30+00+00+00+6B+00+E1+00+00+00+00+00+00+00+00+00+00+E5+A1+00+04+02+06+61+4E+A3+03+18+1A+57+03+4E+12+00+00+00+00+00+00+00+00+15+25+07+14+03+D6+07= 0x749

=>CS=0x49

2.2.4 *Distress (Emergency) Queue Description*

There is a dedicated queue in size of 5 for distress (emergency) messages.

For legacy events with the CelloTrack 4/Nano (which have TR ≠ 164), this decision is made by considering both the TR and STR and if to replace or not.

For CelloTrack 4/Nano events (non-legacy, TR =164), these substitutions are not applied at all. Every Nano emergency event is inserted into the queue and nothing is removed from it.

The CelloTrack 4/Nano emergency events contain the authentic Multi-purpose bytes of the event, so the reported event and sensor data should be relevant to the event.

2.3 Programming Data (Message Type 3)

This message is sent as a reply to programming commands, or by request. It contains the new contents of the programmed block.

NOTE: For configuration spaces larger than 4K (Typically in Cello-IQ and Cello-CANiQ units) it is mandatory to use Type 11 programming command (modules 10, 11).

2.3.1 *Message Ingredients*

- Message header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Unit ID – 4 bytes
  - Communication Control Field – 2 bytes
  - Message Numerator – 1 byte
- Spare – 1 byte
- Block Code – 1 byte
- Block Data – 16 bytes
- Error Detection Code – 1 byte

2.3.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"
4	System Code, byte 4 – ASCII "P"
5	Message Type (3)
6	Unit ID
7	
8	
9	
10	Communication Control Field
11	

12	Message Numerator (Anti-Tango™)
13	Spare
14	Block Code
15-30	Block Data
31	Error Detection Code (8-bit additive checksum, excluding system code)

2.3.3 *Detailed Per-Field Specifications*

2.3.3.1 System Code

Refer to Section 2.2.3.1

2.3.3.2 Message Type

Programming Data messages contain a value of 3 (three) in the message type field.

2.3.3.3 Unit ID

Refer to Section 2.2.3.3

2.3.3.4 Communication Control Field

Refer to Section 2.2.3.4

2.3.3.5 Message Numerator (Anti-Tango™)

Refer to Section 2.2.3.5

2.3.3.6 Block Code

OTA (over the air) parameter programming is done in blocks. The entire parameter memory is partitioned to 16-bytes long blocks. Each of those blocks is identified with a block code. The block code field contains the code of the block whose data is sent in this message (in the block data field).

2.3.3.7 Block Data

Contains the actual data programmed in the specified block of the parameter memory.

2.4 Modular Message (Message Type 9)

The modular data packet is designed to provide different data types in the same message.

2.4.1 *Message Ingredients*

- Message Header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Unit ID – 4 bytes
  - Communication Control Field – 2 bytes
  - Message Numerator – 1 byte
- Packet Control Field – 1 byte
- Message Length – 1 byte
- First Sub-Data Type – 1 byte
- First Sub-Data Length – 1 byte
- First Sub-Data variable length, depends on Data Type
- ……
- Nth Sub-Data Type – 1 byte
- Nth Sub-Data Length – 1 byte
- Nth Sub-Data– variable length, depends on Data Type N
- Error Detection Code – 1 byte

2.4.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"
4	System Code, byte 4 – ASCII "P"
5	Message Type (9)
6	Unit ID
7	
8	

9	
10	Communication Control field
11	
12	Message Numerator
13	Packet Control Field
14	Length (of the modules section - not including the checksum)
15	First Sub-data Type
16	First Sub-data Length
17	First Sub-data The Data
…	…
	Nth Sub-data Type
	Nth Sub-data Length
	Nth Sub-data The Data
Last Byte	Error Detection Code (8-bit additive checksum, excluding system code)

2.4.3 *Detailed Per-Field Specifications*

2.4.3.1 System Code

Refer to Section 2.2.3.1

2.4.3.2 Message Type

Modular messages contain a value of 9 (nine) in the message type field.

2.4.3.3 Unit ID

Refer to Section 2.2.3.3

2.4.3.4 Communication Control Field

Refer to Section 2.2.3.4

2.4.3.5 Message Numerator (Anti-Tango™)

Refer to Section 2.2.3.5

2.4.3.6 Packet Control Field

Direction	Out of space indication	Unused					
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Direction

0 – Data from the unit

1 – Request (unit-bound)

Out of Space Indication

0 – All the requested data present in the message

1 – Some Sub-Data was not returned due to data size

2.4.3.7 Length

That field includes the number of data bytes with their types and lengths. It includes the number of bytes from byte 15 to the byte of the checksum, which is not included.

2.4.4 *Outbound Sub-Data Types Table*

Code (Hex)	Function
0x01	Firmware Platform Manifest
0x04	Time and Location Stamp
0x08	Authentication Table Update
0x09	Neighbor List of the Serving GSM Cell
0x0A	Maintenance Server Platform Manifest
0x0C	3G Cell ID Data
0x0D	Compressed vector change report
0x12	Modular Platform Manifest

2.4.5 *Firmware Platform Manifest*

This sub-data is generated as a reply to Firmware Platform Manifest Request (0x01).

Byte	Description
0	Sub-data type (0x01)
1	Length – 18

Byte	Description
2	Processor family identifier 0x01 – PIC18Fx520/620/720 0x02 – PIC18Fx621/525 0x03 – PIC18Fx527/622/627/722 (x=6/8) 0x04 – ARM Cortex M3 F10x 0x05 – ARM Cortex M3 L15x 0x07 – STM32F101RDT6 0x08 – STM32F103RFT6 0x09 – STM32F429IGH6 0x0A – STM32F103VET7 0x0B – STM32L151VDT6 0x0C - STM32F103VET6
3	Hardware interface and peripherals identifier 0x01 – 40/44 pin micro, peripherals as per family 0x02 – 64 pin micro, peripherals as per family 0x03 – 80 pin micro, peripherals as per family 0x04 – 64 pin STM32F101RCT6 0x05 – 64 pin STM32F103RDT6 0x06 – 64 pin STM32L151RDT6 0x07 – 176 pin micro, peripherals as per family 0x08 – 100 pin STM32F103VET6, peripherals as per family
4-5	Size of program memory (in 1024 bytes units) (LSB)
	Size of program memory (in 1024 bytes units) (MSB)
6-7	Size of volatile memory (Divided by 128 bytes and rounded up/down to closest integer) (LSB)
	Size of volatile memory (Divided by 128 bytes and rounded up/down to closest integer) (MSB)
8-9	Size of internal non-volatile memory (Divided by 128 bytes and rounded up/down to closest integer) (LSB)
	Size of internal non-volatile memory (Divided by 128 bytes and rounded up/down to closest integer) (MSB)
10-11	Size of external non-volatile memory (in 1024 bytes units) (LSB)

Byte	Description
	Size of external non-volatile memory (in 1024 bytes units) (MSB)
12	External non-volatile memory type 0x01 – I2C generic NVM (most EEPROMs). 0x02 – SPI generic NVM. 0x03 – Adesto Rev. E 0x04 – SPI N25Q NVM 0x05 – SPI MX25L6433F
13	Hardware Version See Unit Hardware Version
14-15	Reprogramming facility identifier (first LSB, then MSB) Depends on HW/FW variant
16-17	Script language version (first LSB, then MSB) = (0x0001)
18-19	Current Firmware ID (first LSB, then MSB) A build descriptor of the actual firmware running on the platform, allocated in the time of a formal release. It is a valuable field when a re-flash is considered

2.4.6 *Time and Location Stamp*

This sub-data is generated as a reply to Time and Location Stamp Request (0x04). It is also automatically added to the self-initiated messages generated by the unit.

Byte	Description
0	Sub-data type (0x04)
1	Length – 25

<table>
<tr><td>2</td><td>Location status (flags)
<table>
<tr><td>Time Accuracy

0 – Time is accurate
1 – Time is Inaccurate</td><td>GPS Connection

0 – Connected
1 – Not Connected</td><td colspan="6">Spare</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>3</td><td>Mode 1 (from GPS)</td></tr>
<tr><td>4</td><td>Mode 2 (from GPS)</td></tr>
<tr><td>5</td><td>Number of satellites used (from GPS)</td></tr>
<tr><td>6</td><td rowspan="4">Longitude</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td><td rowspan="4">Latitude</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td><td rowspan="3">Altitude</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td><td rowspan="2">Ground speed</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td><td rowspan="2">Speed direction (true course)</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td><td>UTC time – seconds</td></tr>
<tr><td>22</td><td>UTC time – minutes</td></tr>
<tr><td>23</td><td>UTC time – hours</td></tr>
<tr><td>24</td><td>UTC date – day</td></tr>
</table>

25	UTC date – month
26	UTC date – year Current Year minus 2000 (e.g. value of 7 = year 2007)

2.4.6.1 MODE 1/2 from GPS

Refer to Section 2.2.3.21

2.4.6.2 Number of Satellites Used

Refer to Section 2.2.3.22

2.4.6.3 Longitude, Latitude

Refer to Section 2.2.3.23

2.4.6.4 Altitude

Refer to Section 2.2.3.24

2.4.6.5 Ground Speed

This indicates the current speed (absolute value of the vector). It is represented as a 16-bit unsigned integer, in 10^{-2} meter/sec resolution (speed is represented in centimeters/second).

The source of speed data is either the GPS, the vehicle's CAN bus or frequency metering input as per unit's type, installation and configuration.

The reported value may monitor the immediate value of speed recorded upon generation of the message or the maximum value of speed from last report (as per the configuration). Byte 10, bit 6 of the message is monitoring the actual reported type.

2.4.6.6 Heading/Speed Direction (True Course)

Refer to Section 2.2.3.26

2.4.6.7 UTC Time

Refer to Section 2.2.3.27

2.4.6.8 UTC Date

Refer to Section 2.2.3.28

Input's Numbers Definition

2.4.7 *Authentication Table Update*

This sub-data is generated as a reply to Authentication Table Update Command (0x08).

Byte	Description	
0	Sub-Data Type (0x08)	
1	Length – 9	
2	Spare	
3	Authentication table Index 0	Authentication table Index 1
4	Authentication table Index 2	Authentication table Index 3
5	Authentication table Index 4	Authentication table Index 5
6	Authentication table Index 6	Authentication table Index 7
7	Authentication table Index 8	Authentication table Index 9
8	Authentication table Index 10	Authentication table Index 11
9	Authentication table Index 12	Authentication table Index 13
10	Authentication table Index 14	Authentication table Index 15

2.4.8 *Neighbor list of the Serving GSM Cell*

This sub-data is sent:

- Passively, as a reply to Cell ID Request (0x09).
- Actively, if enabled in unit's configuration, separately for home and roam GSM networks (addresses 201 and 203 respectively, bits 0, 1, 3 and 4).

Byte	Description
0	Sub-Data Type (0x09)
1	Length – 53
2	Spare (0x00)
3	seconds (0-59)
4	minutes (0-59)
5	hours (0-23)

Byte	Description
6	day (1-31)
7	month (1-12)
8	Year (Current Year minus 2000 (e.g. value of 7 = year 2007))
9	Serving Cell BSIC (Base Station Identification Code)
10	Serving Cell LAC (LSB) (Localization Area Code)
11	Serving Cell LAC (MSB) (Localization Area Code)
12	Serving Cell ID (LSB)
13	Serving Cell ID (MSB)
14	Serving Cell Power (Received signal strength in dBm (hex). The sign is not saved, this value is always representing a negative number)
15	Neighbor Cell 1 BSIC
16	Neighbor Cell 1 LAC (LSB)
17	Neighbor Cell 1 LAC (MSB)
18	Neighbor Cell 1 Cell ID (LSB)
19	Neighbor Cell 1 Cell ID (MSB)
20	Neighbor Cell 1 Power
…	…
45	Neighbor Cell 6 BSIC
46	Neighbor Cell 6 LAC (LSB)
47	Neighbor Cell 6 LAC (MSB)
48	Neighbor Cell 6 Cell ID (LSB)
49	Neighbor Cell 6 Cell ID (MSB)

Byte	Description
50	Neighbor Cell 6 Power
	Zero Padding to complete the 55 bytes assigned for single event (if it's a logged event, i.e. sent actively)

2.4.9 *Maintenance Server Platform Manifest*

Periodically (or upon server command) the unit connects to a maintenance server in order to check for the latest firmware and/or programming update. Auto connection to the maintenance server can be enabled upon power up and upon firmware upgrade.

Upon connection the unit generates a sub-data which is described below.

If the unit cannot establish a connection to the maintenance server while the GPRS is available, it uses the dial up retry algorithm defined in the NVM Allocation (Anti-Flooding). If all the retries fail, the unit ceases to try and reconnects to an operational server (instead of entering Anti-Flooding, as it would do while connected to an operational server).

Byte	Description
0	Sub-data type (0x0A)
1	Length – 34
2	Processor family identifier 0x01 – PIC18Fx520/620/720 0x02 – PIC18Fx621/525 0x03 – PIC18Fx527/622/627/722 (x=6/8) 0x04 – ARM Cortex M3 F10x 0x05 – ARM Cortex M3 L15x 0x07 – STM32F101RDT6 0x08 – STM32F103RFT6 0x09 – STM32F429IGH6 0xA – STM32F103VET7 0x0B – STM32L151VDT6 0x0C - STM32F103VET6

Byte	Description
3	Hardware interface and peripherals identifier 0x01 – 40/44 pin micro, peripherals as per family 0x02 – 64 pin micro, peripherals as per family 0x03 – 80 pin micro, peripherals as per family 0x04 – 64 pin STM32F101RCT6 0x05 – 64 pin STM32F103RDT6 0x06 – 64 pin STM32L151RDT6 0x07 – 176 pin micro, peripherals as per family 0x08 – 100 pin STM32F103VET6, peripherals as per family
4-5	Size of program memory (in 1024 bytes units) (LSB)
	Size of program memory (in 1024 bytes units) (MSB)
6-7	Size of volatile memory (Divided by 128 bytes and rounded up/down to closest integer) (LSB)
	Size of volatile memory (Divided by 128 bytes and rounded up/down to closest integer) (MSB)
8-9	Size of internal non-volatile memory (Divided by 128 bytes and rounded up/down to closest integer) (LSB)
	Size of internal non-volatile memory (Divided by 128 bytes and rounded up/down to closest integer) (MSB)
10-11	Size of external non-volatile memory (in 1024 bytes units) (LSB)
	Size of external non-volatile memory (in 1024 bytes units) (MSB)
12	External non-volatile memory type 0x01 – I2C generic NVM (most EEPROMs). 0x02 – SPI generic NVM. 0x03 – Adesto Rev. E 0x04 – SPI N25Q NVM 0x05 – SPI MX25L6433F
13	Hardware Version See: Unit Hardware Version
14-15	Reprogramming facility identifier (LSB)

Byte	Description
	Depends on HW/FW variant
	Reprogramming facility identifier (MSB) Depends on HW/FW variant
16-17	Script language version (LSB) (0x01)
	Script language version (MSB) (0x00)
18-19	Current Firmware ID (LSB) Note that this is in fact not a descriptor of the firmware platform per se, but rather a descriptor of the actual firmware running on the platform. However, it is a valuable field when a re-flash is considered.
	Current Firmware ID (MSB) Note that this is in fact not a descriptor of the firmware platform per se, but rather a descriptor of the actual firmware running on the platform. However, it is a valuable field when a re-flash is considered.
20-21	Current PL ID (LSB) Infrastructure only, currently not supported
	Current PL ID (MSB) Infrastructure only, currently not supported
22-29	International mobile subscriber identity of the SIM (IMSI) Reference to GSM 07.07, 15 chars maximum
30-32	Modem's firmware revision From FW version 33x and later – 0x00 For FW versions older than 33x:
33	Maintenance Configuration

Byte	Description
30	Reserved (0)
31	Modem Revision ID, as presented in the table below
32	Modem Type Extension (Extra byte, additional to the 3MSBits in the hardware byte of message type 0)

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td></td><td>
<table>
<tr><td colspan="6">Spare</td><td>Firmware Upgrade Enabled

0 - Disabled
1 - Enabled</td><td>Programming Enabled

0 - Disabled
1 - Enabled</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>34
35</td><td>Release Candidate Revision ID
Little Endian 16 bit representing the Release Candidate SVN revision:
<table>
<tr><th>Value</th><th>Description</th></tr>
<tr><td>0</td><td>Formal Release</td></tr>
<tr><td>1-65535</td><td>The version is a Release Candidate. The 2 bytes represents the SVN revision number:
Example: If the hex file name is F000_...._RC540.hex the resulted
The binary value representing the decimal RC540 is 0x21C in little Endian.</td></tr>
</table>
</td></tr>
</table>

Modem Revision ID

ID (Dec)	Revision	Modem
0	Unknown	All (Used also in Nano from FW version 34d and on).
1	0.7.6	Enfora II
2	0.7.8	
3,4	reserved	
5	1.0.5	Enfora III
6	6.1.1 (Beta)	
7	1.1.1PKG30	

ID (Dec)	Revision	Modem
8	1.1.1PKG41	
9	D3-1.1.2PKG47	
10	D4-1.1.2PKG47	
11	D10.1.1.2	
12-20	reserved	
21	7.02.002	Telit II
22	7.02.100	
23	7.02.002	Telit III
24	7.02.003	
25	7.02.004	
26	7.03.000	
27	7.03.030 (Automotive)	
28	7.03.002	
29	7.03.032	
30	10.00.033 (Obsolete)	Telit V2
31	10.00.036	
32	10.00.035 (Obsolete)	
33	10.00.016	
34-40	reserved	
41	GLM-4-0610-000	Motorola 24L
42-50	Reserved for Motorola	

ID (Dec)	Revision	Modem
51	01.000	Cinterion BGS3
52	02.000	Nano: Cinterion BGS2-W.Rel2 (Used only up to FW version 34c).
53	03.001_arn00.000.14	Nano: Cinterion EHS5-E (Used only up to FW version 34c).
54	03.001_arn00.000.14	Nano: Cinterion EHS5-US (Used only up to FW version 34c).
55	03.001_arn00.000.14	Nano: Cinterion EHS6A (Used only up to FW version 34c).
56	03.001_arn01.000.08	Nano: Cinterion BGS2-W.Rel3 (Used only up to FW version 34c).
57-70	Reserved for Cinterion	
71	12.00.002	Telit HE910-G (Reserved)
72	12.00.323	Telit HE910-NAD
73	13.00.003	Telit GE910 QUAD (V2)
74	12.00.504	Telit UE910-NAR
75	12.00.404	Telit UE910-EUR
76	10.00.023	Telit GE864 QUAD-V2
77	16.00.303	Telit GE910 QUAD-V3
78	10.00.027	Telit GE864 QUAD-V2

ID (Dec)	Revision	Modem
79	12.00.516	Telit UE910-NAD
80	12.00.416	Telit UE910-EUD
81	10.01.522	Telit GE864 QUAD-V2
82	12.00.506	Telit UE910-NAR (SSL)
83-255	Reserved	

2.4.10 *3G Cell ID Data*[4]

This sub-data is sent:

- Passively, as a reply to Cell ID data request (0x09). In this case the sub-data will be sent using the same communication transport as the request.
- Actively, if enabled in unit configuration, separately for home and roam GSM networks, on address 201 and 203 respectively, bits 0, 1, 3 and 4.

Byte	Description
0	Sub-Data Type (0x0C)
1	Length – 53
2	Spare
3	seconds (0-59)
4	minutes (0-59)
5	hours (0-23)
6	day (1-31)
7	month (1-12)
8	Year (Current Year minus 2000 (e.g. value of 7 = year 2007))
9	MCC (LSB) (Mobile Country Code, Decimal, 200-901)
10	MCC (MSB) (Mobile Country Code, Decimal, 200-901)
11	MNC (LSB) (Mobile Network Code, Decimal, 0-999)

[4] Supported for 3G variants only

Byte	Description
12	MNC (MSB) (Mobile Network Code, Decimal, 0-999)
13	LAC (LSB) (Localization Area Code)
14	LAC (MSB) (Localization Area Code)
15	RSCP (Received Signal Code Power - Energy after processing with gain from coding, which is equivalent to RSSI [RSCP=RSSI+EC/No]; dBm units, (-120)≤RSCP≤(-25))
16	Cell ID (Expanded 3G Cell ID (RNC + Cell ID + possible sector))
17	
18	
19	
20	Power (Received signal strength (hex); the sign is not saved, this value is always representing a negative number; dBm units)
21	AcT (Access Technology) 0 – GSM 2 – UTRAN
22	PSC (LSB) (Primary Scrambling Code, Decimal, 0-65535)
23	PSC (MSB) (Primary Scrambling Code, Decimal, 0-65535)
…	Zero Padding to complete the 55 bytes assigned for single event (if it's a logged event, i.e. sent actively)

2.4.11 *Compressed Vector Change Report*

Note that this sub-data will NEVER be generated as real-time or distress events, only as a logged event.

If a corresponding functionality is enabled by configuration, the compressed vector change data is sent by the unit in the following cases:

- Upon detection of 6th vector change detection occurrence - in this case the system will generate a Message Type-9 containing all 6 vector change detection occurrences.

- Timeout - if at least one vector change event is stored in unit's memory and no other vector changes were generated by the unit during the pre-programmed period, the system will generate Message Type-9 containing all previous vector change detection occurrences.
- Upon Stop - Message Type-9 containing all previous vector change detection occurrences (if any) will be generated immediately upon stop report.
- Upon reset command - the Message Type-9 containing all previous vector change detection occurrences (if any) will be generated.

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td>0</td><td>Sub-Data Type (0x0D)</td></tr>
<tr><td>1</td><td>Length – 53</td></tr>
<tr><td>2</td><td>Number of included vector change detections
<table>
<tr><td colspan="5">Spare</td><td colspan="3">Number of included vector change detections</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>3-6</td><td>Longitude</td><td rowspan="7">Vector Change Detection 1</td></tr>
<tr><td>7-10</td><td>Latitude</td></tr>
<tr><td>11-13</td><td>Odometer</td></tr>
<tr><td>14</td><td>Spare</td></tr>
<tr><td>15</td><td>Course</td></tr>
<tr><td>16</td><td>Speed (km/h)</td></tr>
<tr><td>17-19</td><td>Time</td></tr>
<tr><td>20</td><td>Speed (km/h)</td><td rowspan="4">Vector Change Detection 2</td></tr>
<tr><td>21-22</td><td>Time from vector change (seconds)</td></tr>
<tr><td>23-24</td><td>Delta Longitude (from last vector change)</td></tr>
<tr><td>25-26</td><td>Delta Latitude (from last vector change)</td></tr>
<tr><td>27-33</td><td colspan="2">Vector Change Detection 3</td></tr>
</table>

34-40	Vector Change Detection 4
41-47	Vector Change Detection 5
48-54	Vector Change Detection 6

Each message will contain up to 6 vector change occurrences, while the first one is reported in its full format, and the rest are reported as a delta relative to the last point (see full message format on the next page).

Each vector change detection occurrence (except the first one) consumes 7 bytes containing a data of location change from the last vector change (or from the start event), time from the last event and speed.

The latitude, longitude and time of the first vector detection will be stored in its full format.

True course of the first location is reported as 8-bit unsigned integer. The conversion to degrees is according the equation below:

$$Course\ [degr] = \frac{Received\ value * 360}{255}$$

Possible values are 0 to 2π.

Timestamp of the first Vector change:

Minutes (LSB)		Seconds					
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Hours (LSB)				Minutes (MSB)			
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Spare		Days					Hours
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Delta Longitude and latitude (from last vector change) both are stored as signed integers, in 10^-8 radian resolution. Possible values are -Π to +Π for longitude, or –Π/2 to +Π/2 for latitude.

Time from last vector change is recorded in seconds.

The reported value of speed may monitor the immediate value of speed recorded upon generation of the message or the maximum value of speed from the last report (as per the configuration). Byte 10, bit 6 of the message is monitoring the actual reported type.

If there are less than 6 vector change detections in this message, the unit pads unused bytes of missing occurrences by zeros. The message length will remain constant.

2.4.12 *Modular Platform Manifest*

This sub-data is generated as a reply to Modular Platform Manifest Request (0x12).

Byte	Description
0	Sub-Data Type (0x12)
1	Length – Variable
2	Field 1 – Identifier
3	Field 1 – Length of Payload
4	Field 1 – Payload
…	…
…	Field N – Identifier
…	Field N – Length of Payload
…	Field N – Payload

Fields Definition

Processor Family Identifier

Field ID – 0x0	0x00 – PIC18F6722 0x01 – STM32F101RCT6 0x02 – STM32F103RDT6 0x03 – STM32L151RDT6 0x04 – STM32F101RDT6 0x05 – STM32F103RFT6 0x06 – STM32F429IGH6 0x07 – STM32F103VET7 0x08 – STM32L151VDT6 0x09 - STM32F103VET6

Accelerometer Identifier

Field ID – 0x1	0x00 – MMA7260QT 0x01 – LIS331DL 0x02 – LIS331DLH (12 bit) 0x03 – LIS3DH (16 bit)

Size of Program Memory

Field ID – 0x2 (Kbytes)	Cello, CelloTrack-T: 256 (dec) Cello-IQ, Cello-CANiQ, CelloTrack Nano: 384 (dec) CR400: 512 (dec)

Amount of Non-Volatile Memory Used by Application (e.g. configuration)

Field ID – 0x3 (Bytes)	Default 0 (N.A)

Size of Internal RAM

Field ID – 0x4 (Kbytes)	Cello, CelloTrack-T: 32 (dec) Cello-IQ, Cello-CANiQ, CR400: 64 (dec) CelloTrack Nano: 48 (dec)

Size of External Non-Volatile Memory

Field ID – 0x5 (Kbytes)	Cello, CelloTrack-T, CR400: 512(dec) Cello-IQ, Cello-CANiQ: 8192(dec) CelloTrack Nano: 1024 (dec)

Amount of External Non-Volatile Memory Used by Application (e.g. configuration)

Field ID – 0x6 (Kbytes)	Cello, CelloTrack-T, CelloTrack Nano: 4 Cello-IQ, Cello-CANiQ, CR400: 8

Size of External RAM

Field ID – 0x7 (Bytes)	Default - 0 (N.A)

Current Firmware ID Number

Field ID – 0x8	Same as in Type-0 message

Current Hardware ID Number

Field ID – 0x9	Same as in Type-0 message. See new table here

Modem Type

Field ID – 0xA	Same as in Type-0 message. See new table here (only the 3 modem ID bits, for backwards compatibility)

Modem Firmware Version

Field ID – 0xB	Byte 2: Reserved (sent as zero) Byte 1: • 0, from FW version 33x and later • Per table below, for FW versions older than 33x Byte 0: Reserved (sent as zero)
	from FW version 33x and later: Modem firmware string returned from the Modem (Byte 1)
	…
	Modem firmware string returned from the Modem (Byte n)

Bytes 45-47 of Maintenance Platform Manifest contain the value of modem revision. The modem type is declared in a hardware byte; this field provides an additional definition.

Reserved (sent as zero)	Modem revision ID, as per table below	Reserved (sent as zero)
Byte 2	Byte 1	Byte 0

Modem revision ID: Refer to Modem Version ID

The new Modem firmware reporting mechanism is supported by the following products and FW versions:

- Cello-CAN(IQ) from FW version 33x and later
- CR300/B from FW version 43c and later
- CelloTrack Nano from FW 34d and later

GPS Type

Field ID – 0xC	00 – CEL3535 01 – CEL1500 02 – CEL1500L 03 – CEG-1000 (Internal) 04 – SIRF4 chip (internal) 05 – Glonass (internal) 06 – SIRF4 ROM – NMEA 07 – Telit JF2 (internal) 08 – Telit SE868-V2 (internal) 09 – Telit Modified JF2 (CelloTrack T) 10 – Telit SE868-V3 (internal) 16 – NMEA (CelloTrack T) 17 – ME910C1-WW-GNSS

GPS Firmware

Field ID – 0xD	String as returned by GPS to revision request command

First Activation Date/Time

Field ID – 0xE

Byte	Description
0	Year
1	Month
2	Day
3	Second
4	Minute
5	Hour

Note that byte 0 is transmitted first, then byte 1 etc.
On the display it's shown as d/m/y h:m:s

FW Upgrade Date/Time

Field ID – 0xF

Byte	Description

	0 Year 1 Month 2 Day 3 Second 4 Minute 5 Hour Note that byte 0 is transmitted first, then byte 1 etc. On the display it's shown as d/m/y h:m:s

Last Configuration Change Date/Time

Field ID – 0x10	Byte: Description 0 Year 1 Month 2 Day 3 Second 4 Minute 5 Hour Note that byte 0 is transmitted first, then byte 1 etc. On the display it's shown as d/m/y h:m:s

Firmware File Name

Field ID – 0x11 (up to 120 bytes)	Firmware file name string

System ID (STM ID in case of STM controller)

Field ID – 0x12	12 bytes hexadecimal

Boot Loader ID

Field ID – 0x13	Contains 1 byte indicating Boot Loader's version number

DFD/SD Card Version

Field ID – 0x14

Byte	Description
0	DFD Version Byte 0
1	DFD Version Byte 1
2	DFD Version Byte 2
3	DFD Version Byte 3
4	SD Card Version Byte 0
5	SD Card Version Byte 1
6	SD Card Version Byte 2
7	SD Card Version Byte 3

The SD card version is extracted from a file called ver.txt in the DFD's SD card root directory.

Cello-CANiQ VIN

Field ID – 0x15	VIN – Vehicle Identification Number Null terminated string, Up to 17 Bytes

IMSI/IMEI/MEID

Field ID – 0x16	IMSI – 8 Bytes, decimal IMEI – 8 Bytes, decimal MEID – 8 Bytes, decimal (for CDMA devices)

Nano Sensors

Field ID – 0x18	

Byte	Description
0	0x00 – Compass: ST LIS3MDL 0x01 – Not installed
1	0x00 – Barometer: Freescale MPL3115A2R1
2	0x00 – Accurate temperature sensor: Atmel AT30TS750A
3	0x00 – Touch sense controller: Freescale MPR031-EPR2
4	0x00 – BLE chip: CSR1010
5	BLE stack version
6	CBLE application major version
7	CBLE application minor version
8-13	CBLE MAC address (MSB first)
14-17	CBLE RC# (32-bit)

Size of Internal Non-Volatile Memory

Field ID – 0x1A (Divided by 128 bytes and rounded up/down to closest integer)	Cello, CelloTrack-T, Cello-IQ, Cello-CANiQ, CR300, CR400: 0 (Dec) CelloTrack Nano, CelloTrack-4 family: 96 (Dec) = 12KB

SIM ICCID

Field ID – 0x1C	ASCII String (Up to 20 Bytes)

2.4.13 *Car Sharing 2 Reservation Entry Response*

This sub-data is sent as a reply to Car Sharing 2 Reservation Command message (0x1A) with Read command from server.

Byte	Description
0	Sub-Data Type (0x1A)
1	Length – 53
2	Slot Number
3	Spare
4–9	Driver ID (SCN) Bytes 0-5 of reservation table entry
10-13	Reservation Start time/date Bytes 6-9 of reservation table entry (Number of Seconds from December 31, 1989, 12 am UTC.)
14-48	Spare - Zero Padded

2.4.14 *CDMA Cell ID Data*[5]

This sub-data will be sent:

- Passively, as a response to Cell ID data request (0x09). In this case the packet will be sent using the same communication transport as the request.
- Actively, if enabled in unit's configuration, separately for home and roam GSM networks, on addresses 201 and 203 respectively, bits 3 and 4.

Byte	Description
0	Sub-Data Type (0x1C)
1	Length (0x35)
2	Spare
3	seconds (0-59)
4	minutes (0-59)

[5] Supported for CDMA variants only

Byte	Description
5	hours (0-23)
6	day (1-31)
7	month (1-12)
8	Year (Current Year minus 2000 (e.g. value of 7 = year 2007))
9	SID (LSB) (System ID, Decimal, 0-999)
10	SID (MSB) (System ID, Decimal, 0-999)
11	NID (LSB) (Network ID)
12	NID (MSB) (Network ID)
13	RSSI (Received Signal Strength Index [RSSI=Rx Power + EC/Io]; dBm units)
14	BSID (Base Station ID (Cell ID + possible sector))
15	
16	
17	
…	Zero Padding to complete the 55 bytes assigned for single event (if it's a logged event, i.e. sent actively)

2.5 Modular Message (Message Type 11)

Type 11 was introduced for supporting true modular protocol. The basic structure of the protocol is designed to carry records with predefined structure called modules. The protocol will be used as an extension for Cello fleet protocol. Type 11 supports theoretical message length of up to 65536 bytes, tough the actual rate will be constrained by the HW limitations.

2.5.1 *Message Ingredients*

Type 11 contains the following data (listed in the actual transmitted order):

- Message header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Unit ID – 4 bytes
  - Communication Control Field – 2 bytes
  - Message Numerator – 1 byte
- Packet Control Field – Legacy fleet field
- Message length – 2 bytes
- Spare – 4 bytes
- Payload Modules – User Configuration Depended
- Error Detection Code (checksum) – 1 byte

2.5.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"
4	System Code, byte 4 – ASCII "P"
5	Message Type (11)
6	Unit ID
7	
8	
9	
10	Communication Control Field

11	
12	Message Numerator
13	Packet Control Field
14	Length of the modules section (From byte #16 and not including the last byte of the checksum)
15	
16	= 0x0000
17	Symbolizes outbound message (while in inbound these 2 bytes are allocated to length which is ≠ 0)
18	Spare (sent as 0)
19	
20-28	Module Name 8 - FW_HW ID (Mandatory)
29-50	Module Name 6 - GPS Location Stamp (Mandatory)
51-60	Module Name 7 - Time stamp (Mandatory)
…	
	Other Modules
…	
…	
Last Byte	Error Detection Code (8-bit additive checksum, excluding system code)

2.5.3 *Detailed Per-Field Specifications*

2.5.3.1 System Code

Refer to Section 2.2.3.1

2.5.3.2 Message Type

Modular messages contain a value of 11 (eleven) in the message type field.

2.5.3.3 Unit ID

Refer to Section 2.2.3.3

2.5.3.4 Communication Control Field

Refer to Section 2.2.3.4

2.5.3.5 Command Numerator (Anti-Tango™)

Refer to Section 2.2.3.5

2.5.3.6 Packet Control Field

Direction	Out of space indication	Unused					
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Direction

0 – Data from the unit

1 – Request (unit-bound)

Out of Space Indication

0 – All the requested data is present in the message.

1 – Some Sub-data was not returned due to data size.

2.5.3.7 Length

That field includes the number of data bytes of the modules (with their codes and lengths). It is the number of bytes from byte 16 to the byte of the checksum, which is not included.

2.5.4 *Outbound Type 11 Module Structure*

The general structure of a type 11 module is as follows:

Byte	Description
0	Module Code
1	Length of module – Number of payload bytes
2	
3	Module Payload bytes
.	
.	
n	

2.5.5 *Outbound Type 11 Modules Table*

Code	Description
6	GPS Location Stamp
7	GPS Time Stamp

Code	Description
8	FW ID
9	ACK/NACK
10	Configuration Memory Write Response
11	Configuration Memory Read Response
28	General Status Event
40	Measurement Readings
41	Legacy (Type-0) Encapsulated Message
42	Nano Inherent Sensors
44	MultiSense Additional Information
46	Cell ID 2G/3G/4G
49	Data logger compressed block

2.5.6 *Overview of CelloTrack 4/Nano/Cello with BT Extender Messaging*

When CelloTrack Nano was developed, the goal was to support 3 different kinds of customers:

- Legacy customers, who already have older CelloTrack devices and want the same functionality.
- New customers that want to build everything from scratch.
- Customers that want to combine the legacy devices with the new functionality, or who are in transition between the old and the new worlds.

To achieve this goal, the messages are divided into 2 types:

- Legacy functionality messages (as in the CelloTrack-T): These messages can be passed either by the legacy type-0 and/or "encapsulated type-0 over type-11" as explained below.
- New functionality messages: These can be passed **fully** and natively over the type-11 modular messages, and/or (if configured) over the legacy type-0 system but with only the possible data (sometimes thin or partial data).

All functionality of the events uses Type-0 legacy events and/or the advanced Type-11 messages, all according to the configuration bits per feature.

Each specialized feature has the following 4 bits of configuration:

Type-11		Type-0	
Logged	"Active log event"	Logged	Distress

Bit 3	Bit 2	Bit 1	Bit 0

Type-0 could also be "Active log event" or not, depending on the global (one per system) bit of "Enable Active Events" (in address 0000.0 of the PL).

This enables the user to select between the following options:

Type-11 options:

- 0= Disable
- 1= "Active Log Event"
- 2= Logged

Type-0 options:

- 0= Disable (the global "Active log event" bit will be ignored)
- 1= Distress (the global "Active log event" bit will be ignored)
- 2= Logged
- 3= Logged & Distress (not a recommended setting if the "Active log event" bit is set, as it will cause the sending of 2 messages per event).

The log memory supports both types simultaneously, as a continuous and united space.

After developing the BT extender for Cello units, which now can communicate with MultiSense devices, Cello units also use this messaging logics (Type 11 only) for some MultiSense events.

NOTE: When "Active log event" is used, the unit turns on the GNSS and waits for a fix (up to 90 seconds). If a fix is achieved, both the GPS stamp and time stamps of the event are overridden.

2.5.7 *General Definitions and Data Structures in CelloTrack 4/Nano/Cello with BT Extender*

The CelloTrack 4/Nano and Cello with BT extender design is based on the following data structures:

Description	Source of measurement 0x00÷0x0F – MultiSense unit (according to place in the PL, whether occupied/enabled or not) 0xFB – BT Extender 0xFC – Guest MultiSense (not in the list) 0xFD – High accuracy or specialized sensors of the CelloTrack Nano 20 (for example: Accurate temperature sensor, pressure sensor, etc.) 0xFE – MCU internal (temperature only) 0xFF – Reserved

Bit	7	6	5	4	3	2	1	0

Description	Temperature measured [0..7]							
Units, valid range	0.1ºC in signed (in SINT16 format), -500÷1000 = -50÷100 ºC (The measurement is accurate in the -40÷80 ºC range)							
Bit	7	6	5	4	3	2	1	0

Description	Temperature measured [12]=sign bit only	Reserved			Temperature measured [8..11]			
Units, valid range					0.1ºC in signed (in SINT16 format)			
Bit	7	6	5	4	3	2	1	0

2.5.8 *CelloTrack 4/Nano Extra Take Locations Messages*

The CelloTrack 4/Nano may take GNSS locations an extra configurable times a day and logs them internally as Type-0 with a specific reason, and/or type-11 with the same message but encapsulated, all depending on the configuration bits in PL address 603, bits 0-1.

2.5.9 *GPS Location Stamp*

Byte	Description
0	Module 6 - GPS Location Stamp
1	Length of module - 19
2	
3	HDOP
4	Mode 1 (from GPS)
5	Mode 2 (from GPS)
6	Number of satellites used (from GPS)
7	Longitude
8	
9	

10	
11	Latitude
12	
13	
14	
15	Altitude
16	
17	
18	
19	Ground speed (km/h)
20	Speed direction (true course)
21	

Refer to Sections 2.2.3.21 until 2.2.3.26 for more details about fields' data formats.

2.5.10 *GPS Time Stamp*

Byte	Description
0	Module 7 – GPS Time Stamp
1	Length of module - 7
2	
3	Validity of time / GPS Fix (valid - 1 /invalid - 0)
4	System time – seconds
5	System time – minutes
6	System time – hours
7	System date – day
8	System date – month
9	System date – year (-2000)

2.5.11 *Firmware ID*

Byte	Description

0	Module 8 - FW ID
1	Length of module - 6
2	
3	Bits 0-3: Active cellular technology 0 – Unknown 1 – Reserved 2 – 2G 3 – 3G 4 – 4G (LTE CAT-1) 5 - LTE CAT-M1 6 - LTE NB1-IoT 7-15 - Reserved Bits 4-5: Hub kind 0 – Cellocator hub 1 – Android based hub 2 – iOS based hub 3 - Reserved Bits 6-7: Spare
4	Type 11 Protocol ID (=1)
5	FW Version ID (example: 33)
6	FW Sub-Version ID (example: 1 for a)
7	HW ID (example: 20)
8	Spare

2.5.12 *ACK/NACK*

Byte	Description
0	Module 9 – ACK/NACK
1	Length of module – 3
2	
3	0 - ACK 1 - NACK

4	NACK Code (decimal) 0 - General NACK
5	Spare

2.5.13 *Configuration Memory Write Response*

Byte	Description
0	Module 10 – Configuration Memory Write Response
1	Length of module – Variable
2	
3	Numerator
4	
5	Number of instances ACK
6	Instance 1 action status 0 - OK 1 - Write Error
7	Instance 2 action status 0 - OK 1 - Write Error
	…

2.5.14 *Configuration Memory Read Response*

Byte	Description
0	Module 11 – Configuration Memory Read Response
1	Length of module – Variable
2	

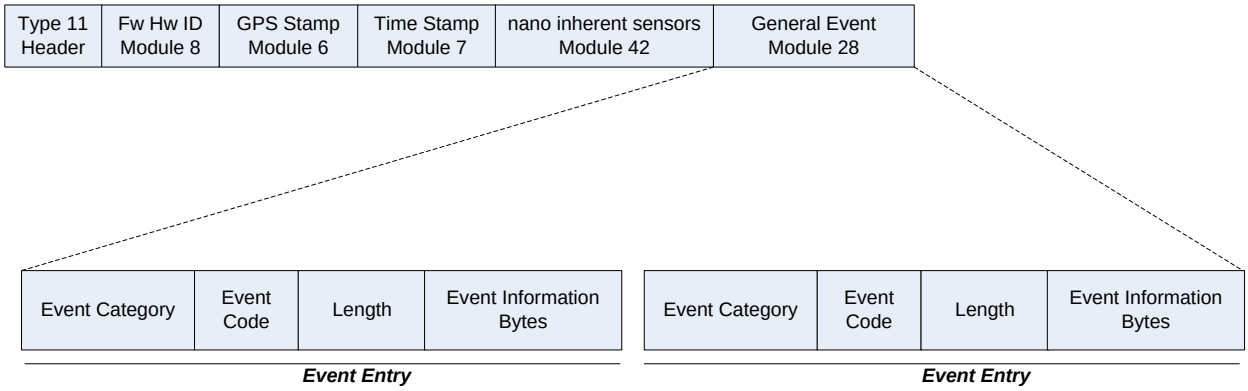
3	Numerator	
4		
5	Number of Instances	
6	Memory type – 0	
7	Memory entry unit type 0 – Bit 1 – Byte 2 – Word (16 bits) 3 – Double Word (32 bits) (Only Byte entry unit type is currently supported)	Instance 1
8	Address in the configuration memory space	
9		
10		
11		
12	Number of Entries	
13		
…	Data Payload	
…	…	Instance 2
…	…	
…	…	

2.5.15 *General Event Report*

2.5.15.1 Message and module structure

This module includes system events and notifications. The Module structure has dedicated event fields which will identify the event type and the attached information fields. The module can support multiple concatenated events structures.

The message is built as follows:



Modules 8, 6, 7 and 42 are mandatory fields, and always come first in this exact order, everything else (module 28 is just an example here) comes after these.

Module 28 below describes the general format of a "General Event". The module can carry multiple entries of "General Event structures". Each "General Event Entry" includes Event Category, Event code, Event data length in bytes and event related data bytes.

Byte	Description
0	Module 28 - General Status Event
1	Length of module – Variable
2	
3	Number of entries
4-5	1st Event Category
6-7	1st Event Code
8	1st Event related data length (bytes)
9	1st Event Related info bytes …
…	2nd Event Category
…	…

2.5.15.2 Event Category Table

Event Category	Description
0	Cello
1	CelloTrack Nano
2	Cello BT Extender
3	CelloTrack Gen 4

Event Category	Description
4	Cello Gen 4

2.5.15.3 Event codes table

Event Category	Event Code	Description
1	1	Impact
1	2	Orientation change
1	3	Man down
1,2,3,4	4	Package Open/Close
1,2,3,4	7	MultiSense Provisioning
1	8	MultiSense Added
1	9	MultiSense Removed
1,3,4	10	Work-ID/Activation
1	11	Check-in
1, 3, 4	13	Guest MultiSense raw data
1,2,3,4	15	MultiSense Door/Window Open/Close
1	16	Free Fall
1, 3, 4	17	Tag mode MultiSense raw data
1	18	Sudden pressure change
1	19	Check-out by timeout event
1	20	Check-out by user event
1	21	No MultiSense received
1, 3, 4	23	MultiSense button pressed

2.5.15.4 Events description

Impact and Free-fall Recognition

Type-0 and/or this Type-11 module is used:

Byte	Description

0	Module 28 - General Status Event
1	Length of module – 11
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) / 2 (BT Extender) / 3 (CelloTrack 4)
5	Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6	Event Code
7	1 – Impact 16 – Free-fall
8	Length – 5
9	Source of measurement According to this definition
10	Impact/ Free-fall acceleration RMS value
11	32-bit value of ($X^2+Y^2+Z^2$), where each of the axis is in 250μg units.
12	(Example: X=2g=8000, Y=3g=12000, Z=8g=32000 → RMS=$8000^2+12000^2+32000^2$ = 1232000000=0x496ED400)
13	

Orientation Change

Type-0 and/or this Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 7
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano)
5	Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6	Event Code – 2 (Orientation Change)
7	
8	Length – 1
9	Spare

Man Down

Type-0 and/or this Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 7
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
5	
6	Event Code – 3 (Man Down)
7	
8	Length – 1
9	Spare

Package Open/Close

Type-0 and/or this Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 10
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) / 2 (BT Extender) / 3 (CelloTrack 4) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
5	
6	Event Code – 4 (Package Open/Close)
7	
8	Length – 4
9	Source of measurement According to this definition
10	Open/Close 0 – Close

	1 – Open
11	Filtered current light value (lux units, 0.25 lux resolution)
12	

MultiSense Package Open/Close

Type-0 and/or a type-11 event (Event Code – 4 (Package Open/Close), identical to Package Open/Close event) is used.

MultiSense Provisioning

Type-0 and/or this Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 33
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) / 2 (BT Extender) / 3 (CelloTrack 4) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
5	
6	Event Code – 7 (MultiSense Provisioning)
7	
8	Length – 27
9	Source of measurement According to this definition
10	Problem code 0 – All OK 1 – Lost communication 2 – Communication restored 3 – Low bat 4 – Low bat restored 5 – Dead bat 6 – Dead bat restored 7 – MultiSense Power-up 8 – MultiSense Power-down by button
11	Battery level (%)

<table>
<tr><td>12</td><td colspan="2">Last RSSI value (SR-RF)
(Signed, dBm units, NA value = 0x80 = -128dBm)</td></tr>
<tr><td>13</td><td>System time – seconds</td><td rowspan="6">Time of last communication from the specific MultiSense</td></tr>
<tr><td>14</td><td>System time – minutes</td></tr>
<tr><td>15</td><td>System time – hours</td></tr>
<tr><td>16</td><td>System date – day</td></tr>
<tr><td>17</td><td>System date – month</td></tr>
<tr><td>18</td><td>System date – year (-2000)</td></tr>
<tr><td>19</td><td colspan="2">MultiSense FW version – Minor Version</td></tr>
<tr><td>20</td><td colspan="2">MultiSense FW version – Major Version</td></tr>
<tr><td>21</td><td colspan="2">BOM mask (indicate which fields below are relevant)
<table>
<tr><td>Spare</td><td>Temp. sensor enable</td><td>Humidity sensor enable</td><td>Magnetic sensor enable</td><td>Light sensor enable</td><td>Accel. sensor enable</td><td colspan="2">Spare</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>22</td><td colspan="2">Enabled sensors mask (indicate which fields below are relevant)
<table>
<tr><td>Data Logger</td><td>Temp. sensor enable</td><td>Humidity sensor enable</td><td>Magnetic sensor enable</td><td>Light sensor enable</td><td>Accel. sensor enable</td><td>TX On Violation only</td><td>Prevent pushbutton power down</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>23
24</td><td colspan="2">Last measured temperature
(Signed, 0.1°C resolution)</td></tr>
<tr><td>25
26</td><td colspan="2">Last measured humidity
(0.1% resolution)</td></tr>
<tr><td>27
28</td><td colspan="2">Last measured light level
(0.5 lux resolution)</td></tr>
<tr><td>29
30</td><td colspan="2">Last measured X acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>31
32</td><td colspan="2">Last measured Y acceleration
(Signed, 250µg resolution)</td></tr>
</table>

<table>
<tr><td>33</td><td colspan="8">Last measured Z acceleration</td></tr>
<tr><td>34</td><td colspan="8">(Signed, 250µg resolution)</td></tr>
<tr><td>35</td><td colspan="8"><table>
<tr><td>Acc. Self test result

0=Fail
1=Pass</td><td colspan="5">Spare</td><td>Package State

0 – Close
1 – Open</td><td>Magnetic Sensor State

0 – Magnet Not Present
1 – Magnet Present</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
</table>

MultiSense Added Event

After MultiSense unit(s) are being paired with the Nano, this event is created.

This Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 16
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano)
5	Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6	Event Code – 8 (MultiSense Added)
7	
8	Length – 10
9	Source of measurement According to this definition
10	MAC address of added MultiSense
11	48 bit MAC address (MSB first)
12	
13	
14	

15	
16	HW-TYPE of added MultiSense According to BOM mask
17	Battery level (%)
18	Last RSSI value (SR-RF) (Signed, dBm units)

MultiSense Removed Event

After MultiSense unit(s) are being unpaired with the Nano, this event is created.

This Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 16
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
5	
6	Event Code – 9 (MultiSense Removed)
7	
8	Length – 10
9	Source of measurement According to this definition (0xFF = All)
10	MAC address of added MultiSense 48 bit MAC address (MSB first)
11	
12	
13	
14	
15	
16	HW-TYPE of added MultiSense According to BOM mask
17	Battery level (%)

18	Last RSSI value (SR-RF) (Signed, dBm units)

Work-ID/Activation Event

The unit promotes a "Work ID" counter on every power turn-on operation by the user. This 32-bit counter is initialized as 0 on the production line.

The promoting of this counter is also a logged event and it is sent to the server.

In this way, the user can relate a specific ID to a certain shipment/task/operation/period.

Type-0 with Transmission-reason = 164 (Nano) and Specific-reason = 9 (Work ID promoted event) is used. Note that the counter itself is not passed over type-0 at all.

And/or this Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 10
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) / 3 (CelloTrack 4)
5	Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6	Event Code – 10 (Work-ID/Activation)
7	
8	Length – 4
9	Work-ID (32 bit)
10	
11	
12	

Check-in

Type-0 and/or this Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 10
2	

3	Number of entries
4 5	Bits 0-14: Event Category – 1 (Nano) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6 7	Event Code – 11 (Check-in)
8	Length – 4
9 10 11 12	Spare

Guest MultiSense raw data

For reporting a guest MultiSense transmission (if this mode is enabled), the following Type-11 module is used:

Byte	Description	
0	Module 28 - General Status Event	
1 2	Length of module – 40	
3	Number of entries	
4 5	Bits 0-14: Event Category – 1 (Nano) / 3 (CelloTrack 4) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)	
6 7	Event Code – 13 (Guest MultiSense raw data)	
8	Length – 34	
9	Source of measurement 0xFC according to definition	
10	RSSI (Signed, dBm units)	Raw advertisement ("0x81") message Note:
11 12 13	MAC Address	

<table>
<tr><td>14</td><td rowspan="3"></td><td rowspan="25">Battery level and RSSI fields will be the values received in message "0x83".</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td><td>Group-ID</td></tr>
<tr><td>18</td><td rowspan="2">Battery Level
(mV units)</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td><td>Enabled Sensors Mask
<table>
<tr><td>Data Logger</td><td>Temp. sensor enable</td><td>Humidity sensor enable</td><td>Magnetic sensor enable</td><td>Light sensor enable</td><td>Accel. sensor enable</td><td>TX On Violation only</td><td>Prevent pushbutton power down</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>21</td><td>BOM Mask
<table>
<tr><td>Spare</td><td>Temp. sensor enable</td><td>Humidity sensor enable</td><td>Magnetic sensor enable</td><td>Light sensor enable</td><td>Accel. sensor enable</td><td colspan="2">Spare</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>22</td><td>TX Reason
0x00 - Reserved
0x01 - Relaxed timer
0x02 - Violation timer
0x03 - Power up
0x04 - Power down (by button)
0x05 - Proximity
0x06 - Push button
0x07 – Magnetic sensor changed state
0x08 - ACC Impact
0x09 - ACC Free-fall
0x0A - Package state changed
0x0B - Shut down due to dead-bat
0x0C÷0xFF - Reserved</td></tr>
<tr><td>23</td><td>MultiSense Major FW Version</td></tr>
<tr><td>24</td><td>MultiSense Minor FW Version</td></tr>
</table>

<table>
<tr><td>25</td><td>
<table>
<tr><td colspan="6">Spare</td><td>Sensor data stream scrambled</td><td>Connection Password Scrambled</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td><td rowspan="13">Raw sensors reading stream ("0x83") message
(unscrambled)</td></tr>
<tr><td>26
27</td><td>Temperature
(Signed, 0.1ºC resolution)</td></tr>
<tr><td>28
29</td><td>Humidity
(0.1% resolution)</td></tr>
<tr><td>30
31</td><td>Light Level
(0.5 lux resolution)</td></tr>
<tr><td>32</td><td>
<table>
<tr><td>Acc. Self test result

0=Fail
1=Pass</td><td colspan="5">Spare</td><td>Package State

0 – Close
1 – Open</td><td>Magnetic Sensor State

0 – Magnet Not Present
1 – Magnet Present</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>33
34</td><td>Last measured X acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>35
36</td><td>Last measured Y acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>37
38</td><td>Last measured Z acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>39
40</td><td>Battery Level
(mV units)</td></tr>
</table>

41	<table><tr><td>Spare</td><td>Humidity Alert 0 – No Alert 1 – Alert</td><td>Humidity Violation 0 – Not Violating 1 - Violating</td><td>Humidity TH 0 – Lower 1 – Upper</td><td>Spare</td><td>Temp Alert 0 – No Alert 1 – Alert</td><td>Temp Violation 0 – Not Violating 1 - Violating</td><td>Temp TH 0 – Lower 1 - Upper</td></tr><tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr></table>	
42	RSSI (Signed, dBm units)	

Notes:

- Regardless of the mask all the data is passed. But, if a sensor disabled, its data value has no meaning.
- If from some reason any unsigned field (such as Humidity or light) value cannot be reported, the value that will symbolize a non-reading will be 0xFFFF.
- If from some reason any signed field (such as Temperature or XYZ) value cannot be reported, the value that will symbolize a non-reading will be 0x8000.

MultiSense Door/Window Open/Close

Type-0 and/or this Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 10
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) / 2 (BT Extender) / 3 (CelloTrack 4)
5	Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6	Event Code – 15 (Door/Window Open/Close)
7	

8	Length – 4
9	Source of measurement According to this definition
10	Open/Close 0 – Close 1 – Open
11	Spare
12	Spare

Tag Mode MultiSense raw data

For reporting a guest MultiSense transmission in Tag mode (if this mode is enabled), the following type-11 message is used:

Byte	Description	
0	Module 28 - General Status Event	
1	Length of module – 23	
2		
3	Number of entries	
4	Bits 0-14: Event Category – 1 (Nano) / 3 (CelloTrack 4)	
5	Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)	
6	Event Code – 17 (Tag mode MultiSense raw data)	
7		
8	Length – 17	
9	Source of measurement 0xFC according to definition	
10	RSSI (Signed, dBm units)	Raw advertisement ("0x81") message Note: Battery level and RSSI fields will be the
11	MAC Address	
12		

<table>
<tr><td>13</td><td rowspan="4"></td><td rowspan="5">values received in message "0x83".</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td><td>Group-ID</td></tr>
<tr><td>18</td><td rowspan="2">Bits 0-13: Battery Level (mV units)
Bit 14: Reserved
Bit 15: Battery type (0=3.0V, 1=3.6V)</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td><td>Enabled Sensors Mask
<table>
<tr><td>Data Logger</td><td>Temp. sensor enable</td><td>Humidity sensor enable</td><td>Magnetic sensor enable</td><td>Light sensor enable</td><td>Accel. sensor enable</td><td>TX On Violation only</td><td>Prevent pushbutton power down</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td><td></td></tr>
<tr><td>21</td><td>BOM Mask
<table>
<tr><td>Spare</td><td>Temp. sensor enable</td><td>Humidity sensor enable</td><td>Magnetic sensor enable</td><td>Light sensor enable</td><td>Accel. sensor enable</td><td colspan="2">Spare</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td><td></td></tr>
<tr><td>22</td><td>TX Reason
0x00 - Reserved
0x01 - Relaxed timer
0x02 - Violation timer
0x03 - Power up
0x04 - Power down (by button)
0x05 - Proximity
0x06 - Push button
0x07 – Magnetic sensor changed state
0x08 - ACC Impact
0x09 - ACC Free-fall
0x0A - Package state changed
0x0B - Shut down due to dead-bat
0x0C÷0xEF - Reserved
0xF0÷0xF7 - Motion detected, where 3 LSB are the "Time since last movement" as in the table:
<table>
<tr><td>0</td><td>Moving now</td></tr>
</table></td><td></td></tr>
</table>

	<table><tr><td>1</td><td>Last movement was < 15 Sec ago</td></tr><tr><td>2</td><td>Last movement was >15 Sec and <=30 Sec ago</td></tr><tr><td>3</td><td>Last movement was >30 Sec and <=60 Sec ago</td></tr><tr><td>4</td><td>Last movement was >60 Sec and <=120 Sec ago</td></tr><tr><td>5</td><td>Last movement was >120 Sec and <=300 Sec ago</td></tr><tr><td>6</td><td>Last movement was >300 Sec and <=900 Sec ago</td></tr><tr><td>7</td><td>Last movement was >900 Sec and <=3600 Sec ago</td></tr></table> 0xF8÷0xFF - Reserved	
23	MultiSense Major FW Version	
24	MultiSense Minor FW Version	
25	<table><tr><td colspan="3">Zone #</td><td colspan="3">Spare</td><td>Sensor data stream scrambled</td><td>Connection Password Scrambled</td></tr><tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr></table>	

Sudden Pressure Change

This feature can identify moving of the unit few meters upwards or downwards in a short time, typically going from floor to floor or other logistic scenarios.

Type-0 and/or this Type-11 module is used:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 11
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano)
5	Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6	Event Code – 18 (Sudden Pressure Change)
7	
8	Length – 5
9	Source of measurement 0xFD according to definition
10	Difference between the last stable altitude and current filtered one

11	(signed, 0.1m resolution)
12	
13	

Check-out by timeout event

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 10
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
5	
6	Event Code – 19 (Check-out by timeout)
7	
8	Length – 4
9	Spare
10	
11	
12	

Check-out by user event

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 10
2	
3	Number of entries
4	Bits 0-14: Event Category – 1 (Nano) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
5	
6	Event Code – 20 (Check-out by user)
7	

8	Length – 4
9	Spare
10	
11	
12	

To request the status of a certain MultiSense (or Nano/BT Extender), the following Type 11 command should be used:

Byte	Description
0	Module 32 - General Command
1	Length of module – 6
2	
3	Number of Command entries sent by this module – 1
4	Command ID – 259 (Nano/Cello with BT Extender: send status of the designated source)
5	
6	Length of entry data – 2
7	Source of measurement According to this definition
8	Spare

If the source is one of the MultiSense units, the answer to this command is the "MultiSense provisioning message" as shown above.

If the source is BT extender (0xFB), the answer to this command is the "BT Extender provisioning message" as shown above.

If the source is Nano (0xFD), the answer will be a type-11 message with module name 42 as payload, as described here.

No MultiSense received

When configured, if no MultiSense from the same Group-ID is received for more than the configured time, this message will be sent repeatedly every configured time:

Byte	Description
0	Module 28 - General Status Event
1	Length of module – 14
2	

3	Number of entries
4 5	Bits 0-14: Event Category – 1 (Nano) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6 7	Event Code - 21 (No MultiSense received)
8	Length – 8
9	Source of Event - 0xFD (Nano self)
10 11 12 13	Time elapsed from last reception [Seconds]
14 15 16	Spare

MultiSense button pressed event

When configured, every press on a paired MultiSense pushbutton (short press), will create this event:

Byte	Description
0	Module 28 - General Status Event
1 2	Length of module – 11
3	Number of entries -1
4 5	Bits 0-14: Event Category – 1 (Nano) / 3 (CelloTrack 4) Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)
6 7	Event Code – 23 (MultiSense button pressed)

8	Length – 4
9	Source of measurement According to this definition
10	Reserved
11	
12	
13	

2.5.16 *Measurement Readings*

This module is used to report on data-logger temperatures and humidity samples, as well as for temperatures and humidity TH crossing events.

Type-0 and/or this Type-11 module is used:

Temperature Measurement

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td>0</td><td>Module 40 – Measurement Readings</td></tr>
<tr><td>1</td><td rowspan="2">Length of module – Variable</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="2">Bits 0-14: Event Category – 1 (Nano) / 3 (CelloTrack 4)
Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="2">Event Code – 1 (Temperature measurements)</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td>Metadata Length – 13</td></tr>
<tr><td>8</td><td>Metadata TX Reason
<table>
<tr><td colspan="5">Spare</td><td colspan="3">TX Reason

0 – Normal
1 – Start Charging
2 – Requested by Command</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>9</td><td>Metadata:
<table>
<tr><td>Source of violation/ alert

0-Temp.
1-Humidity</td><td>30 min after charging indication

0 – Not during 30 minutes after charging*
1 – During 30 minutes after charging</td><td colspan="2">Charging Status

0 – Not charging*
1 – Charging slow
2 – Charging fast
3 – Charger Fault/Charger thermal shutdown</td><td>Retransmission indication

0 – Retransmission
1 – Not retransmission</td><td colspan="3">Violation/Alert status

0 – Within the limits
1 – (Unknown)
2 – Violating (not in alert) a lower TH but alert is not yet declared
3 – Violating (not in alert) a upper TH but alert is not yet declared
4 – Alert for lower TH violation
5 – Alert for upper TH violation
6 – Violating while in alert the lower TH
7 – Violating while in alert the upper TH</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
* This will be the sent value if the source is a MultiSense</td></tr>
<tr><td>10</td><td colspan="2">Metadata Source
According to this definition</td></tr>
<tr><td>11</td><td>First sample timestamp – seconds</td><td rowspan="6">First sample timestamp</td></tr>
<tr><td>12</td><td>First sample timestamp – minutes</td></tr>
<tr><td>13</td><td>First sample timestamp – hours</td></tr>
<tr><td>14</td><td>First sample timestamp – day</td></tr>
<tr><td>15</td><td>First sample timestamp – month</td></tr>
<tr><td>16</td><td>First sample timestamp – year (-2000)</td></tr>
<tr><td>17</td><td rowspan="2" colspan="2">Metadata Sampling rate (Seconds)</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td><td colspan="2">Metadata Upper threshold (Signed, 1ºC Resolution)</td></tr>
<tr><td>20</td><td colspan="2">Metadata Lower threshold (Signed, 1ºC Resolution)</td></tr>
</table>

21	Sample (payload entry) size – 3
22	Number of samples in the payload
23 24	Temperature reading 1 (Signed, 0.1ºC Resolution, according to this definition)
25	Delay from previous sample (in "Metadata Sampling rate" units)
26 27	Temperature reading 2 (Signed, 0.1ºC Resolution, according to this definition)
28	Delay from previous sample (in "Metadata Sampling rate" units)
…	…

Humidity Measurement

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td>0</td><td>Module 40 – Measurement Readings</td></tr>
<tr><td>1
2</td><td>Length of module – Variable</td></tr>
<tr><td>3
4</td><td>Bits 0-14: Event Category – 1 (Nano) / 3 (CelloTrack 4)
Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes)</td></tr>
<tr><td>5
6</td><td>Event Code – 2 (Humidity measurements)</td></tr>
<tr><td>7</td><td>Metadata Length – 13</td></tr>
<tr><td>8</td><td>Metadata TX Reason
<table>
<tr><td colspan="5">Spare</td><td colspan="3">TX Reason

0 – Normal
1 – Start Charging
2 – Requested by Command</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>9</td><td>Metadata:
<table>
<tr><td>Source of violation/ alert

0-Temp.
1- Humidity</td><td>30 min after charging indication

0 – Not during 30 minutes after charging*
1 – During 30 minutes after charging</td><td colspan="2">Charging Status

0 – Not charging*
1 – Charging slow
2 – Charging fast
3 – Charger Fault/Charger thermal shutdown</td><td>Retransmission indication

0 – Retransmission
1 – Not retransmission</td><td colspan="3">Violation/Alert status

0 – Within the limits
1 – (Unknown)
2 – Violating (not in alert) a lower TH but alert is not yet declared
3 – Violating (not in alert) a upper TH but alert is not yet declared
4 – Alert for lower TH violation
5 – Alert for upper TH violation
6 – Violating while in alert the lower TH
7 – Violating while in alert the upper TH</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
* This will be the sent value if the source is a MultiSense</td></tr>
<tr><td>10</td><td colspan="2">Metadata Source
According to this definition</td></tr>
<tr><td>11</td><td>First sample timestamp – seconds</td><td rowspan="6">First sample timestamp</td></tr>
<tr><td>12</td><td>First sample timestamp – minutes</td></tr>
<tr><td>13</td><td>First sample timestamp – hours</td></tr>
<tr><td>14</td><td>First sample timestamp – day</td></tr>
<tr><td>15</td><td>First sample timestamp – month</td></tr>
<tr><td>16</td><td>First sample timestamp – year (-2000)</td></tr>
<tr><td>17</td><td rowspan="2" colspan="2">Metadata Sampling rate (Seconds)</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td><td colspan="2">Metadata Upper threshold (Unsigned, 1% Resolution)</td></tr>
<tr><td>20</td><td colspan="2">Metadata Lower threshold (Unsigned, 1% Resolution)</td></tr>
<tr><td>21</td><td colspan="2">Sample (payload entry) size – 3</td></tr>
<tr><td>22</td><td colspan="2">Number of samples in the payload</td></tr>
</table>

23 24	Humidity reading 1 (Unsigned, 0.1% Resolution)
25	Delay from previous sample (in "Metadata Sampling rate" units)
26 27	Humidity reading 2 (Unsigned, 0.1% Resolution)
28	Delay from previous sample (in "Metadata Sampling rate" units)
…	…

2.5.17 *Legacy (Type-0) Encapsulated Message*

This packet is used whenever a legacy message is configured in the configuration bytes at addresses 540÷603 (also configurable via the Nano editor in the 3rd tab) to send a Type-11 message (and it does not have a native type-11 message, i.e. TR=164).

Byte	Description
0	Module 41 – Legacy (Type-0) Encapsulated Message
1 2	Length of module – 26
3	Message type – (a value of 0 for status/location message)
4	Inbound/Outbound – 1 (Outbound)
5	Spare
6	Spare
7	Spare
8	Protocol Version Identifier
9	Unit status + Current GSM Operator (1st nibble)
10	Current GSM Operator (2nd and 3rd nibble)
11	Transmission Reason Specific Data
12	Transmission reason
13	Unit's mode of operation
14	Unit's I/O status 1st byte
15	Unit's I/O status 2nd byte
16	Unit's I/O status 3rd byte
17	Unit's I/O status 4th byte

18	Current GSM Operator (4th and 5th nibble)
19	Analog input 1 value
20	Analog input 2 value
21	Analog input 3 value
22	Analog input 4 value
23	Mileage counter
24	
25	
26	Last GPS Fix
27	
28	Location status (from unit)

2.5.18 *Nano inherent sensors*

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td>0</td><td>Module 42 – Nano Inherent Sensors</td></tr>
<tr><td>1</td><td rowspan="2">Length of module – 15</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="2">X acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="2">Y acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td rowspan="2">Z acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td><td>ADC raw reading of Ambient Light (0.25 lux resolution)
<table>
<tr><td colspan="8">Ambient Light Reading (LSB)</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
(In Nano 10 - 0)</td></tr>
</table>

<table>
<tr><td>10</td><td>ADC raw reading of Ambient Light (0.25 lux resolution)
<table>
<tr><td colspan="4">Spare</td><td colspan="4">Ambient Light Reading (MSB)</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
(In Nano 10 - 0)</td></tr>
<tr><td>11
12</td><td>Average of 2 last Air pressure samples, translated to altitude above sea-level
(Unsigned, 0.1m resolution, 400m below sea-level = 0)
(In Nano 10 = 0)</td></tr>
<tr><td>13
14</td><td>Current temperature from the most accurate available source (MCU internal in Nano 10, and the accurate temperature sensor in Nano 20)
(Signed, 0.1ºC resolution)</td></tr>
<tr><td>15</td><td>
<table>
<tr><td>Position
0 – Upright
1 – Laying</td><td>Position
0 – Upright or laying position
1 – Not upright or laying position</td><td>Temperature Readings Validity
0 – Invalid / NA
1 – Valid</td><td colspan="5">Spare</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>16</td><td>Nano battery level (%)</td></tr>
<tr><td>17</td><td>RSSI (of cellular modem)
(Signed, dBm)</td></tr>
</table>

IMPORTANT: X, Y and Z acceleration values are according to the following axis system:

2.5.19 *MultiSense Additional Information*

Supported from Nano FW version 34f and later, and from Cello FW version 35g and later (supporting BT extender), there is an option to add this module as prefix to any paired MultiSense related message in Type-11, that is, before modules 28 and 40 transmissions with source = 0÷15.

Byte	Description
0	Module 44 – MultiSense Additional Information
1	Length of module – 31
2	
3	MultiSense MAC address (Full 6 bytes address)
4	
5	
6	
7	
8	
9	Battery level (%)
10	Last RSSI (BLE) (Signed, dBm)

<table>
<tr><td>11</td><td>System time – seconds</td><td rowspan="6">Time of last communication from the specific MultiSense</td></tr>
<tr><td>12</td><td>System time – minutes</td></tr>
<tr><td>13</td><td>System time – hours</td></tr>
<tr><td>14</td><td>System date – day</td></tr>
<tr><td>15</td><td>System date – month</td></tr>
<tr><td>16</td><td>System date – year (-2000)</td></tr>
<tr><td>17</td><td colspan="2">MultiSense Minor FW Version</td></tr>
<tr><td>18</td><td colspan="2">MultiSense Major FW Version</td></tr>
<tr><td>19</td><td colspan="2">BOM mask (indicate which fields below are relevant)
<table>
<tr><td>Spare</td><td>Temp. sensor enable</td><td>Humidity sensor enable</td><td>Magnetic sensor enable</td><td>Light sensor enable</td><td>Accel. sensor enable</td><td colspan="2">Spare</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>20</td><td colspan="2">Enabled sensors mask (indicate which fields below are relevant)
<table>
<tr><td>Data Logger</td><td>Temp. sensor enable</td><td>Humidity sensor enable</td><td>Magnetic sensor enable</td><td>Light sensor enable</td><td>Accel. sensor enable</td><td>TX On Violation only</td><td>Prevent pushbutton power down</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>21</td><td colspan="2" rowspan="2">Last measured temperature
(Signed, 0.1°C resolution)</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td><td colspan="2" rowspan="2">Last measured humidity
(0.1% resolution)</td></tr>
<tr><td>24</td></tr>
<tr><td>25</td><td colspan="2" rowspan="2">Last measured light level
(0.5 lux resolution)</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td><td colspan="2" rowspan="2">Last measured X acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>28</td></tr>
<tr><td>29</td><td colspan="2" rowspan="2">Last measured Y acceleration
(Signed, 250µg resolution)</td></tr>
<tr><td>30</td></tr>
<tr><td>31</td><td colspan="2">Last measured Z acceleration</td></tr>
</table>

<table>
<tr><td>32</td><td>(Signed, 250µg resolution)</td></tr>
<tr><td>33</td><td>
<table>
<tr><td>Accelerometer Self-Test Result
0 – Fail
1 – Pass</td><td colspan="5">Spare</td><td>Package State
0 – Close
1 - Open</td><td>Magnetic Sensor State
0 – Magnet Not Present
1 – Magnet Present</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
</table>

2.5.20 *2G/3G/4G Cell-ID*

This module is sent when the modem is attached/camping on a cellular network.

The size of this module is **dynamic**, according to the "Neighbors count" field, which can be 0-6, where the "Neighbors count" field will always appear in the module.

This message will be sent:

1. Passively, as a reply to Cell ID module request (Type-11, Module-29). In this case the sub-data will be sent using the same communication transport as the request.
2. Actively, if enabled in unit's configuration, separately for home and roam GSM networks, on addresses 201 and 203 respectively, bits 0, 1, 3 and 4.

(2G/3G terminology is in cyan)

Byte	Description
0	Module 46 - 2G/3G/4G Cell-ID
1	Length (0x1B-0x87)
2	
3	Spare
4	seconds (0-59) (Modem enquiry timestamp)
5	minutes (0-59) (Modem enquiry timestamp)
6	hours (0-23) (Modem enquiry timestamp)
7	day (1-31) (Modem enquiry timestamp)
8	month (1-12) (Modem enquiry timestamp)

9	Year (Current Year minus 2000 (e.g. value of 7 = year 2007)) (Modem enquiry timestamp)
10	Serving Cell MCC (LSB) (Decimal, 0-65535)
11	Serving Cell MCC (MSB) (Decimal, 0-65535)
12	Serving Cell MNC (LSB) (Decimal, 0-65535)
13	Serving Cell MNC (MSB) (Decimal, 0-65535)
14	Serving Cell LAC / TAC (LSB) (Tracking Area Code)
15	Serving Cell LAC / TAC (MSB) (Tracking Area Code)
16	Serving Cell Global Cell ID (LSB) (Decimal, 0-16777216)
17	Serving Cell Global Cell ID (Decimal, 0-16777216)
18	Serving Cell Global Cell ID (Decimal, 0-16777216)
19	Serving Cell Global Cell ID (Decimal, 0-16777216)
20	Serving Cell Global Cell ID (Decimal, 0-16777216)
21	Serving Cell Global Cell ID (Decimal, 0-16777216)
22	Serving Cell Global Cell ID (MSB) (Decimal, 0-16777216)
23	Serving Cell PSC / Physical Cell ID (LSB) (Decimal, 0-65535) (not supported in 2G networks)
24	Serving Cell PSC / Physical Cell ID (MSB) (Decimal, 0-65535) (not supported in 2G networks)
25	Serving Cell RSRP (Reference Signal Received Power [dBm], the sign is not saved as this value is always representing a negative number) (in modem EHS6-A:BCCH or dBm, in modem BGS2-W:RxLev)
26	Serving Cell ACT (Access Technology: 2G=0, 3G=2, 4G=7)
27	Serving Cell Spare
28	Serving Cell Spare
29	Neighbors count (0-6)
30	Neighbor Cell 1 MCC (LSB) (Decimal, 0-65535)
31	Neighbor Cell 1 MCC (MSB) (Decimal, 0-65535)
32	Neighbor Cell 1 MNC (LSB) (Decimal, 0-65535)
33	Neighbor Cell 1 MNC (MSB) (Decimal, 0-65535)
34	Neighbor Cell 1 LAC / TAC (LSB) (Tracking Area Code)
35	Neighbor Cell 1 LAC / TAC (MSB) (Tracking Area Code)

36	Neighbor Cell 1 Global Cell ID (LSB) (Decimal, 0-16777216)
37	Neighbor Cell 1 Global Cell ID (Decimal, 0-16777216)
38	Neighbor Cell 1 Global Cell ID (Decimal, 0-16777216)
39	Neighbor Cell 1 Global Cell ID (Decimal, 0-16777216)
40	Neighbor Cell 1 Global Cell ID (Decimal, 0-16777216)
41	Neighbor Cell 1 Global Cell ID (Decimal, 0-16777216)
42	Neighbor Cell 1 Global Cell ID (MSB) (Decimal, 0-16777216)
43	Neighbor Cell 1 PSC / Physical Cell ID (LSB) (Decimal, 0-65535) (not supported in 2G networks)
44	Neighbor Cell 1 PSC / Physical Cell ID (MSB) (Decimal, 0-65535) (not supported in 2G networks)
45	Neighbor Cell 1 RSRP (Reference Signal Received Power [dBm], the sign is not saved as this value is always representing a negative number) (in modem EHS6-A:BCCH or dBm, in modem BGS2-W:RxLev)
46	Neighbor Cell 1 ACT (Access Technology, 2G=0, 3G=2, 4G=7)
47	Neighbor Cell 1 Spare
…	…
120	Neighbor Cell 6 MCC (LSB) (Decimal, 0-65535)
121	Neighbor Cell 6 MCC (MSB) (Decimal, 0-65535)
122	Neighbor Cell 6 MNC (LSB) (Decimal, 0-65535)
123	Neighbor Cell 6 MNC (MSB) (Decimal, 0-65535)
124	Neighbor Cell 6 LAC / TAC (LSB) (Tracking Area Code)
125	Neighbor Cell 6 LAC / TAC (MSB) (Tracking Area Code)
126	Neighbor Cell 6 Global Cell ID (LSB) (Decimal, 0-16777216)
127	Neighbor Cell 6 Global Cell ID (Decimal, 0-16777216)
128	Neighbor Cell 6 Global Cell ID (Decimal, 0-16777216)
129	Neighbor Cell 6 Global Cell ID (Decimal, 0-16777216)
130	Neighbor Cell 6 Global Cell ID (Decimal, 0-16777216)
131	Neighbor Cell 6 Global Cell ID (Decimal, 0-16777216)
132	Neighbor Cell 6 Global Cell ID (MSB) (Decimal, 0-16777216)
133	Neighbor Cell 6 PSC / Physical Cell ID (LSB) (Decimal, 0-65535) (not supported in 2G networks)

134	Neighbor Cell 6 PSC / Physical Cell ID (MSB) (Decimal, 0-65535) (not supported in 2G networks)
135	Neighbor Cell 6 RSRP (Reference Signal Received Power [dBm], the sign is not saved as this value is always representing a negative number) (in modem EHS6-A:BCCH or dBm, in modem BGS2-W:RxLev)
136	Neighbor Cell 6 ACT (Access Technology, 2G=0, 3G=2, 4G=7)
137	Neighbor Cell 6 Spare

2.5.21 *Data logger compressed block*

For MultiSense Data-logger raw compressed block, this module will be used:

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td>0</td><td>Module 49 – Data logger compressed block</td></tr>
<tr><td>1</td><td rowspan="2">Length of module – Variable</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td rowspan="2">Bits 0-14: Event Category – 1 (Nano) / 3 (CelloTrack-4)
Bit 15: Sourced from MultiSense Data-logger (0=No, 1=Yes, Always 1 in this module)</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="2">Event Code - 0</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td>Metadata Length – 13</td></tr>
<tr><td>8</td><td>Metadata TX Reason
<table>
<tr><td colspan="5">Spare</td><td colspan="3">TX Reason

0 – Normal
1 – Start Charging
2 – Requested by Command</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>9</td><td colspan="8">Metadata:</td></tr>
<tr><td></td><td>Spare</td><td>30 min after charging indication

0 – Not during 30 minutes after charging*
1 – During 30 minutes after charging</td><td colspan="2">Charging Status

0 – Not charging*
1 – Charging slow
2 – Charging fast
3 – Charger Fault/Charger thermal shutdown</td><td colspan="4">Reserved</td></tr>
<tr><td></td><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
<tr><td></td><td colspan="8"></td></tr>
<tr><td>10</td><td colspan="8">Metadata Source (MS index/number in the system 0-0xF)</td></tr>
<tr><td>11</td><td colspan="5">Base timestamp – seconds</td><td colspan="3" rowspan="6">Base timestamp, of the moment of start reading the blocks (correlates to the relative timestamp below)</td></tr>
<tr><td>12</td><td colspan="5">Base timestamp – minutes</td></tr>
<tr><td>13</td><td colspan="5">Base timestamp – hours</td></tr>
<tr><td>14</td><td colspan="5">Base timestamp – day</td></tr>
<tr><td>15</td><td colspan="5">Base timestamp – month</td></tr>
<tr><td>16</td><td colspan="5">Base timestamp – year (-2000)</td></tr>
<tr><td>17</td><td colspan="8" rowspan="4">Relative timestamp (from MS battery insertion)– 32-bit counter in 65536uS units</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td></tr>
<tr><td>21</td><td colspan="8">Payload entry (packet) size = 16</td></tr>
<tr><td>22</td><td colspan="8">Number of packets in the compressed block</td></tr>
<tr><td>23</td><td colspan="8">Compressed block</td></tr>
<tr><td>24</td><td colspan="8">Compressed block</td></tr>
<tr><td>25</td><td colspan="8">Compressed block</td></tr>
<tr><td>…</td><td colspan="8">…</td></tr>
</table>

Where this is the internal structure of the log block itself:

- Every packet is 16 bytes long.

- Each module-49 can contain up to 16 packets, 16 bytes each.
- Every block of 256 bytes (16 packets of 16 bytes each) always starts with a packet that has full timestamp in its 1st Quadruple, then long forms of temp and humidity (if enabled), then pace info and battery info.

Basic packet structure:

Byte #	Desciption
1	Header
2	
3	1st Quadruple
4	
5	
6	
7	2nd Quadruple
8	
9	
10	
11	3rd Quadruple
12	
13	
14	
15	4th Word
16	

0	1	2	3	4	5	6	7	8
Empty	Long timestamp	Long Temp	Short Temp	Short Temp	Short Humidity	Info	Event	Acc. Data (X,Y)
			Short Temp	Short Humidity	Short Humidity			
		Long Humidity	Short Temp	Short Temp	Short Humidity			
			Short Temp	Short Humidity	Short Humidity			

0	1	2	3	4	5	6	7	8
Empty			Short Temp	Short Temp	Short Humidity	Battery info		Acc. Data (Z)
			Short Temp	Short Humid	Short Humidity			

Header parsing:

Bit	7	6	5	4	3	2	1	0
Description of **Byte #1** of the packet	**2nd Quadruple** 0-Empty 1-Long Timestamp 2-Long Temp sample [0.1°C] + Long Humidity sample [0.1%] 3-Quad Short Temp samples [0.1°C] 4-Mixed: Short Temp + Short Humidity + Short Temp + Short Humidity 5-Quad Short Humidity samples [0.1%] 6-Info 7-Event 8-Event Data (X,Y) [250ug] 9-15 - Reserved				**1st Quadruple** 0-Empty 1-Long Timestamp 2-Long Temp sample [0.1°C] + Long Humidity sample [0.1%] 3-Quad Short Temp samples [0.1°C] 4-Mixed: Short Temp + Short Humidity + Short Temp + Short Humidity 5-Quad Short Humidity samples [0.1%] 6-Info 7-Event 8-Event Data (X,Y) [250ug] 9-15 - Reserved			

Bit	7	6	5	4	3	2	1	0

Description of **Byte #2** of the packet	**4th Word** 0-Empty 1-Not used 2-Not used 3-Dual Short Temp samples [0.1°C] 4-Mixed: Short Temp + Short Humidity 5-Dual Short Humidity samples [0.1%] 6-Battery info [1mV] 7-Reserved 8-Event Data (Z) [250ug] 9-15 - Reserved	**3rd Quadruple** 0-Empty 1-Long Timestamp 2-Long Temp sample [0.1°C] + Long Humidity sample [0.1%] 3-Quad Short Temp samples [0.1°C] 4-Mixed: Short Temp + Short Humidity + Short Temp + Short Humidity 5-Quad Short Humidity samples [0.1%] 6-Info 7-Event 8-Event Data (X,Y) [250ug] 9-15 - Reserved

First packet of the block structure:

<table>
<tr><th>Byte #</th><th colspan="2">Description</th></tr>
<tr><td>1</td><td colspan="2" rowspan="2">Header=1,6,2,6</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td colspan="2" rowspan="4">Timestamp</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td colspan="2">Bits 0-4: Info:
0= Reserved
1= Reserved
2= Pace info
3-31 = Reserved

Bits 5-7: Reserved</td></tr>
<tr><td>8</td><td colspan="2" rowspan="2">In case Info=2:
LSB of Current sampling rate [Seconds] (raw value not including multiplier)</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td><td>Bits 6-7:
Timers multiplier (from MS 4v68)
0 = x1 (no multiplier)
1 = x60
2-3 = Reserved</td><td>Bits 0-5: MSB of Current sampling rate [Seconds] (raw value not including multiplier)</td></tr>
<tr><td>11</td><td colspan="2" rowspan="2">Long Temp</td></tr>
<tr><td>12</td></tr>
<tr><td>13</td><td colspan="2" rowspan="2">Long Humidity</td></tr>
<tr><td>14</td></tr>
</table>

15	Bits 0-13: Battery info bit 14: Reserved bit 15: Battery type (0=3.0V, 1=3.6V)
16	

Typical event packet structure:

Byte #	Description	
1	Header=1,7,0,6	
2		
3	Timestamp	
4		
5		
6		
7	Event:	Tx-reason
8		TH states
9		Light [LSB]
10		Light [MSB]
11	Empty	
12		
13		
14		
15	Bits 0-13: Battery info bit 14: Reserved bit 15: Battery type (0=3.0V, 1=3.6V)	
16		

Typical impact/FF event packet structure:

Byte #	Description	
1	Header=1,7,8,8	
2		
3	Timestamp	
4		
5		
6		
7	Event:	Tx-reason
8		TH states
9		Light [LSB]
10		Light [MSB]
11	Event data: X	
12		
13	Event data: Y	
14		
15	Event data: Z	
16		

Typical samples packet Temp+Humidity (when both enabled):

Byte #	Description
1	Header=4,4,4,4
2	
3	Short Temp
4	Short Humidity
5	Short Temp
6	Short Humidity
7	Short Temp
8	Short Humidity
9	Short Temp
10	Short Humidity
11	Short Temp
12	Short Humidity
13	Short Temp
14	Short Humidity
15	Short Temp
16	Short Humidity

Typical samples packet Temp (when only Temperature exists/enabled):

Byte #	Description
1	Header=3,3,3,3
2	
3	Short Temp
4	Short Temp
5	Short Temp
6	Short Temp
7	Short Temp
8	Short Temp
9	Short Temp
10	Short Temp
11	Short Temp
12	Short Temp
13	Short Temp
14	Short Temp
15	Short Temp
16	Short Temp

Data type = 0: Empty

Entire record size = 4 bytes in quadruples 1-3 or 2 bytes in the 4th word.

Empty = all zeros.

Data type = 1: Long Timestamp

Entire record size = 4 bytes.

The 4 MSB out of 6 bytes of internal timestamp.

This timestamp represents values in resolution of **65536uS (0.065536 Sec)**. So it total of 32 bits it can count up to ~9 years.

Data type = 2: Long Temp sample + Long Humidity sample

Entire record size = 2 x 2 bytes.

2 Bytes in SINT16, Bits 0-14: The signed temperature in 0.1°C units, where Bit15 is the sign bit (Where =0x8000= **N/A, no sample**).

2 Bytes in UINT16, Bits 0-15: The unsigned humidity in 0.1% units (Where =0xFFFF= **N/A, no sample**).

Quadruples Data type = 3: Quad Short Temp samples

Entire record size = 4 x 1 byte.

Each byte: Signed delta from previous sample, where Bit7 is the sign bit.

Can represent values from -127 (=0x81= -12.7°C) to +127 (=0x7F= +12.7°C). (Value of 128=0x80= **N/A, no sample**)

The delta limitation dictates that it can be used only if the current sample is within the -12.7 to +12.7C from previous one.

Word Data type = 3: Dual Short Temp samples

Entire record size = 2 x 1 byte.

Each byte: Signed delta from previous sample, where Bit7 is the sign bit.

Can represent values from -127 (=0x81= -12.7°C) to +127 (=0x7F= +12.7°C). (Value of 128=0x80= **N/A, no sample**)

The delta limitation dictates that it can be used only if the current sample is within the -12.7 to +12.7C from previous one.

Data type = 4: Mixed: Short Temp + Short Humidity + Short Temp + Short Humidity

Entire record size = 4 x 1 byte.

1st and 3rd bytes: Signed delta from previous sample, where Bit7 is the sign bit.

Can represent values from -127 (=0x81= -12.7°C) to +127 (=0x7F= +12.7°C). (Value of 128=0x80= **N/A, no sample**)

2nd and 4th bytes: Signed delta from previous sample, where Bit7 is the sign bit.

Can represent values from -127 (=0x81= -12.7%) to +127 (=0x7F= +12.7%). (Value of 128=0x80= **N/A, no sample**)

Of course the timestamp and the time ticks relates to each pair of samples (assuming each pair of Temp+humidity samples where sampled and stored simultaneously).

Quadruples Data type = 5: Quad Short Humidity samples

Entire record size = 4 x 1 byte.

Each byte: Signed delta from previous sample, where Bit7 is the sign bit.

Can represent values from -127 (=0x81= -12.7%) to +127 (=0x7F= +12.7%). (Value of 128=0x80= **N/A, no sample**)

Word Data type = 5: Dual Short Humidity samples

Entire record size = 2 x 1 byte.

Each byte: Signed delta from previous sample, where Bit7 is the sign bit.

Can represent values from -127 (=0x81= -12.7%) to +127 (=0x7F= +12.7%). (Value of 128=0x80= **N/A, no sample**)

Quadruples Data type = 6: Info

Entire record size = 4 bytes

1st Byte, Bits 0-4: Header type:

0=Reserved

1=Reserved

2=Change in pace / Pace info (2nd byte till 4th byte = sampling rate in Seconds units)

3=Reserved

Word Data type = 6: Battery info

Entire record size = 2 bytes

UINT14, Bits 0-13: The unsigned battery voltage in 1mV units (Where =0xFFFF= N/A, no sample).

Bit 14: Reserved

Bit 15: Battery type (0=3.0V, 1=3.6V)

Data type = 7: Event

1st Byte: Bits 0-4: Tx-Reason:

0x03 - Power up

0x04 - Power down (by button)

0x06 - Push button

0x07 - Magnetic sensor changed state

0x08 - ACC Impact

0x09 - ACC Free-fall

0x0A - Package state changed

0x0B - Shut down due to dead-bat

0x12 - Started logger uploading

2nd byte: TH states:

Bit0 is TempTH:

0=Lower

1=Upper

Bit1 is TempViolation:

0=Not violating

1=Violating

Bit2 is TempAlert:

0=No alert

1=Alert

Bit3 is the state of the magnetic sensor (hall-effect).

1= magnet is present

Bit4 is HumidityTH:

0=Lower

1=Upper

Bit5 is HumidityViolation:

0=Not violating

1=Violating

Bit6 is HumidityAlert:

0=No alert

1=Alert

Bit7 is package state per the MultiSense decision (light sensor based).

0=Close

1=Open

3rd and 4th bytes: Light level in 0.5 lux units

Quadruples Data type = 8: Impact/FF Event

Entire record size = 2 x 2 bytes.

First word: Signed value (SINT16) of X axis acceleration in 250ug units.

Second word: Signed value (SINT16) of Y axis acceleration in 250ug units.

Word Data type = 8: Impact/FF Event

Entire record size = 2 bytes.

Signed value (SINT16) of Z axis acceleration in 250ug units.

3 Command Channel (Inbound Messages)

3.1 Overview

The command channel comprises several types of messages, as described in the following:

- **Generic Command (Message Type 0)** – some commands are sent using this legacy message. This message is always replied with a legacy status/location message from the target unit (if the command is received successfully).
- **Programming Command (Message Type 1)** – this message provides OTA programming capabilities, and is always replied to with a programming data message from the target unit, when received correctly.
- **Generic Acknowledge Message (Message Type 4)** – this message is sent by the server to verify reception of outbound status/location, telemetry or transparent data messages.
- **Modular Message Request (Message Type 9)** – this legacy modular message is designed to request the unit to send types of data, defined in Modular Message packet like CAN bus sensors, Cell ID, debug data, etc.
- **Self Re-flash Chunks (Message Type 10)** – this message forwards firmware file data chunks for the self-re-flash process of the unit. The Self re-flash process description is outside of the scope of the current document.
- **Modular Message Request (Message Type 11)** – this modular message type implements an extended modular protocol, intended to replace older message types (0, 1, and 9). It is used to request the unit to send many types of data in a modular message packet, like CAN bus applications, CelloTrack Nano, etc.

3.2 Generic Command (Message Type 0)

The generic command message is the main command interface to the unit.

3.2.1 *Message Ingredients*

- Message header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Unit ID – 4 bytes
  - Command Numerator – 1 byte
  - Authentication Code – 4 bytes
- Command Code – 1 byte (repeated twice)
- 1st Command Data Field – 1 byte (repeated twice)
- 2nd Command Data Field – 1 byte (repeated twice)
- Command Specific Data Field – 4 bytes
- Error Detection Code – 1 byte

3.2.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"
4	System Code, byte 4 – ASCII "P"
5	Message Type (0)
6	Unit ID
7	
8	
9	
10	Command Numerator
11	Authentication Code
12	
13	
14	

15	Command Code
16	Command Code (repetition)
17	1st Command Data Field
18	1st Command Data Field (repetition)
19	2nd Command Data Field
20	2nd Command Data Field (repetition)
21	Command Specific Data Field
22	
23	
24	
25	Error Detection Code (8-bit additive checksum, excluding system code)

3.2.3 *Detailed Per-Field Specifications*

3.2.3.1 System Code

The same system code constant that is sent on every message – ASCII "M", "C", "G", "P" or "M", "C", "G", "S", in this order.

3.2.3.2 Message Type

Message type identifies the kind of the message. It allows the receiver to differentiate between different messages types, according to the value sent in this field.

Generic command messages contain a value of 0 (zero) in the message type field.

3.2.3.3 Unit ID

This field contains the unique unit ID of the target unit. The unit ignores all received commands that do not contain the appropriate unit ID number.

3.2.3.4 Command Numerator Field

This field should contain the number of the command. This number appears in the "Message numerator" field in the unit reply message, enabling the user to easily distinguish between acknowledged commands and un-acknowledged ones.

3.2.3.5 Authentication Code

This field contains a 4 byte unique authentication code, which is verified by the unit, in order to provide protection against unapproved command attempts (from FW 27p and up). For example: an attempt to change the traffic destination IP by unauthorized personnel.

If the code is not verified as authentic – the unit will not perform/acknowledge the command.

The feature should be switched on in the unit configuration (refer to Programming Manual for more details).The feature is switched off by default.

The 4 bytes authentication code is generated as a function of two variables:

- Unit ID
- 8 bytes Authentication Table, stored in the NVM of the unit and concurrently in the Communication Center application (refer to Modular Message Definition for modification instructions to this table).

The OTA Authentication table modification will be only accepted by the unit if the Command Authentication feature is **DISABLED**.

The following are default values of the Authentication table:

Index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value	2	15	7	9	12	1	4	6	8	3	11	14	0	5	10	13

3.2.3.6 Command Code

As the generic command message is relevant for all kinds of commands, it is necessary to specify the actual command that is desired. Therefore, each different command assigns a unique command code, which is used in the command code field, to specify the command to be executed.

3.2.3.7 Command Data Fields (1st and 2nd)

The command data fields contain further information, which is needed by some of the commands.

3.2.3.8 Command Specific Data Field

The command specific data field contains additional information, which is needed by some of the commands.

The available commands and corresponding data fields are detailed below:

Command Code (Hex)	Description
0x00	Immediate status request
0x02	Unit state change Data field value: 0x00: Go to Standby 0x01: Go to Emergency mode This command sets the unit to start transmitting emergency messages

Command Code (Hex)	Description
	according to the command configuration. The command is sent with two parameters, the interval between each emergency transmission and how many transmissions to send to the operator. If the number of transmissions chosen is 0, the unit sends the emergency transmission constantly. If the time between transmissions is set to 0, the unit sends the emergency transmission according to the pre-programmed definition of the Distress Mode in the NVM. The emergency command is meant to emulate the action of a driver pressing on the emergency button. It uses the same mechanism. If an emergency command is sent and the driver simultaneously presses on the emergency button, the emergency function that the driver initiated stops the command sent by the operator and starts its own emergency session. Here is an example of the emergency command sent to a unit: Number of distress transmissions = 2 Time between distress transmissions Events = 5sec 4D 43 47 50 00 4B 01 00 00 1C 6E DF DD DD 02 02 01 01 00 00 02 05 00 00 7C 0x02: Reset The following fields will be reset: The "Garmin Enabled", "Garmin Connected" and GSM hibernation indication bit flags, Message numerator, Unit's status, Current GSM operator report, Unit's mode of operation, I/O, Analog inputs, Driver ID /PSP Specific Data/Accelerometer Status, Last GPS Fix, Number of satellites, Longitude, Latitude, Altitude, Speed, Course, System time, System date. The modem will be re-initialized, the GPRS connection restored. The RAM buffer used for data forwarding will be reset. Configuration parameters will be reloaded from Configuration memory. Command Specific Data field: don't care
0x04	Disable Active Transmissions. This command will control the corresponding bit in the unit's configuration (address 6, bit 1) and immediately stop or restore active transmissions generated by the end unit. The existing GPRS session will be disconnected upon "disable command" or restored upon "Enable command". Data field: 0 – Disable active transmissions 1 – Enable active transmissions Command Specific Data field: don't care

Command Code (Hex)	Description
0x05	Tracking control command (based on time events). Data field: zero to stop tracking, non-zero sets the resolution of time events and immediately implements it. Refer to Programming Manual for values. Command Specific Data field: don't care
0x0D	Erase tracking Log from NVM memory Data field: don't care
0x0E	Reset GPS receiver Data field: Zero for standard reset (by On/Off pin) 1st = 0x5A 2nd =0xA5 For Factory GPS reset command. Note, that the unit can (configurable) perform GPS reset automatically in the following cases: • Standard reset (by On/Off pin) on ignition off. • If the GPS is communicating, but not navigating and MODE1=0, MODE2=16 for 10 minutes the unit performs a factory GPS reset. • If the GPS is not communicating, or communicating but not navigating and MODE1≠0, MODE2≠16 for 15 minutes the unit performs standard GPS reset. • If same condition as in item 3 remains true for the next 15 minutes the unit performs a factory GPS reset.
0x10	Force GPS energizing (Not supported by Cello family) The command allows maintaining GPS activated, regardless of hibernation logic. **Warning:** Note that only GPS is affected by this command! If GPS is forced active, there is no way to send a command to revert the GPS back to automatic behavior while communication is down (due to the hibernation mask or due to shutdown of the modem as a result of the full hibernation). 1st + 2nd command data fields: • A value of 1 (one) to force energizing of GPS. • A value of 0 (zero) for automatic GPS behavior (according to normal logic).
0x12	Connect to server (from FW28 and up) 0 – Main server

Command Code (Hex)	Description
	1 – Secondary server (provisioning) 2 – Maintenance Server
0x19	Nano wakeup and status request (Infrastructure) Data field: don't care

3.3 Programming Command (Message Type 1)

The programming command message allows to configure the unit.

NOTE: For configuration spaces larger than 4K (Typically in Cello-IQ and Cello-CANiQ units) it is mandatory to use Type 11 programming command (modules 10, 11).

3.3.1 *Message Ingredients*

- Message header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Unit ID – 4 bytes
  - Command Numerator – 1 byte
  - Authentication Code – 4 bytes
- Block Code – 1 byte
- Programming Masking Bitmap – 2 bytes
- Block Data – 16 bytes
- Error Detection Code – 1 byte

3.3.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"
4	System Code, byte 4 – ASCII "P"
5	Message Type (1)
6	Unit ID
7	
8	
9	
10	Command Numerator
11	Authentication Code
12	

13	
14	
15	Block Code
16	Programming Masking Bitmap
17	<table><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td colspan="8">Byte 17</td><td colspan="8">Byte 16</td></tr></table>
18-33	Block Data
34	Error Detection Code (8-bit additive checksum, excluding system code)

3.3.3 *Detailed Per-Field Specifications*

3.3.3.1 System Code

Refer to Section 3.2.3.1

3.3.3.2 Message Type

Programming Command messages contain a value of 1 (one) in the message type field.

3.3.3.3 Unit ID

Refer to section 3.3.3.33.2.3.3

3.3.3.4 Command Numerator Field

Refer to section 3.2.3.4

3.3.3.5 Authentication Code

Refer to section 3.2.3.5

3.3.3.6 Block Code

OTA (over the air) parameter programming is done in blocks. The entire NVM parameter memory is partitioned to 16-bytes long blocks. Each of those blocks is uniquely identified with a block code. The block code field contains the code of the block whose data is sent in this message (in the block data field).

3.3.3.7 Programming Masking Bitmap

The bitmap allows programming of only part of the parameters in a block, while leaving the other parameters with their previous values.

Each bit in the 16-bit value represents a byte in the parameters memory block. A value of "1" in a certain bit enables programming to the corresponding byte in the parameters memory, where a value of "0" prohibits programming of that byte.

3.3.3.8 Block Data

Contains the actual data programmed in the specified block of the parameter memory.

3.4 Generic Acknowledge Message (Message Type 4)

The generic acknowledge message is an inbound message sent by server to verify reception of outbound Status/Location (Type 0), Data Forwarding (Type 7, 8) and Modular (Type 9) messages.

3.4.1 *Message Ingredients*

- Message header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Unit ID – 4 bytes
  - Command Numerator – 1 byte
  - Authentication Code – 4 bytes
- Action Code – 1 byte
- Main Acknowledge Number – 2 bytes (1 reserved)
- Secondary Acknowledge Number – 2 bytes (reserved)
- Compressed Date – 2 bytes
- Compressed Time – 2 bytes
- Spare – 2 bytes
- Error Detection Code – 1 byte

3.4.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"
4	System Code, byte 4 – ASCII "P"
5	Message Type (4)
6	Unit ID
7	
8	
9	
10	Command Numerator
11	Authentication Code

<table>
<tr><td>12</td><td rowspan="3"></td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td><td>Action Code (sent as zero)</td></tr>
<tr><td>16</td><td>Main Acknowledge Number – LSB</td></tr>
<tr><td>17</td><td>Reserved for Main Acknowledge Number – MSB (sent as zeros)</td></tr>
<tr><td>18</td><td>Reserved for Secondary Acknowledge Number – LSB (sent as zeros)</td></tr>
<tr><td>19</td><td>Reserved for Secondary Acknowledge Number – MSB (sent as zeros)</td></tr>
<tr><td>20</td><td>Reserved for future use (sent as zeros)</td></tr>
<tr><td>21</td><td rowspan="2">Compressed Date
<table>
<tr><td colspan="5">Day</td><td colspan="4">Month</td><td colspan="7">Year (-2000)</td></tr>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="8">Byte 22</td><td colspan="8">Byte 21</td></tr>
</table></td></tr>
<tr><td>22</td></tr>
<tr><td>23</td><td rowspan="3">Compressed Time
<table>
<tr><td colspan="7">Spare (sent as 128)</td><td colspan="9">Seconds</td><td colspan="6">Minutes</td><td colspan="6">Hours</td></tr>
<tr><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="8">Byte 25</td><td colspan="8">Byte 24</td><td colspan="8">Byte 23</td></tr>
</table></td></tr>
<tr><td>24</td></tr>
<tr><td>25</td></tr>
<tr><td>26</td><td rowspan="2">Spare</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td><td>Error Detection Code (8-bit additive checksum, excluding system code)</td></tr>
</table>

3.4.3 *Detailed Per-Field Specifications*

3.4.3.1 System Code

Refer to Section 3.2.3.1

3.4.3.2 Message Type

Generic Acknowledge messages contain a value of 4 (four) in the message type field.

3.4.3.3 Unit ID

Refer to section 3.2.3.3

3.4.3.4 Command Numerator Field

Refer to section 3.2.3.4

3.4.3.5 Authentication Code

Refer to section 3.2.3.5

3.4.3.6 Action Code

Sent as zero.

3.4.3.7 Main Acknowledge Number

This field contains the Message Numerator filed of the acknowledged outbound message.

3.4.3.8 Secondary Acknowledge Number

Currently not used and sent as zero.

3.5 Modular Message Request (Message Type 9)

The modular data packet request is designed to provide different data types in the same packet.

3.5.1 *Message Ingredients*

- Message header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Unit ID – 4 bytes
  - Command Numerator – 1 byte
- Authentication Code – 4 bytes
- Packet Control Field – 1 byte
- Message Length – 1 byte
- First Sub-Data Type – 1 byte
- First Sub-Data Length – 1 byte
- First Sub-Data variable length, depends on Data Type
- ……
- Nth Sub-Data Type – 1 byte
- Nth Sub-Data Length – 1 byte
- Nth Sub-Data– variable length, depends on Data Type N
- Error Detection Code – 1 byte

3.5.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"
4	System Code, byte 4 – ASCII "P"
5	Message Type (9)
6	Unit ID (total 32 bits)
7	
8	

9	
10	Command Numerator
11	Authentication Code
12	
13	
14	
15	Packet Control Field
16	Length (of the modules section - not including the checksum)
17	First Sub-data Type
18	First Sub-data Length
19	First Sub-data Data
…	…
	Nth Sub-data Type
	Nth Sub-data Length
	Nth Sub-data Data
Last Byte	Error Detection Code (8-bit additive checksum, excluding system code)

3.5.3 *Detailed Per-Field Specifications*

3.5.3.1 System Code

Refer to Section 3.2.3.1

3.5.3.2 Message Type

Modular message requests contain a value of 9 (nine) in the message type field.

3.5.3.3 Unit ID

Refer to Section 3.2.3.3

3.5.3.4 Command Numerator (Anti-Tango™)

Refer to Section 3.2.3.4

3.5.3.5 Authentication Code

Refer to Section 3.2.3.5

3.5.3.6 Packet Control Field

Direction	Out of space indication	Unused					
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Direction

0 – Data from the unit

1 – Request (unit-bound)

Out of Space Indication

0 – All the requested data is present in the message.

1 – Some Sub-data was not returned due to data size.

3.5.3.7 Length

That field includes the number of data bytes of the modules (with their types and lengths). It is the number of bytes from byte 17 to the byte of the checksum, which is not included.

3.5.4 *Inbound Sub-Data Types Table*

Code (Hex)	Function
0x01	Firmware Platform Manifest Request
0x04	Time and Location Stamp Request
0x08	Authentication Table Update Command
0x09	Cell ID Request
0x12	Modular Platform Manifest Request

3.5.5 *Firmware Platform Manifest Request*

This sub-data serves as a Firmware Manifest Request. The unit responds to this sub-data with Firmware Platform Manifest sub-data (0x01).

Byte	Description
0	Sub-Data Type (0x01)
1	Length – 0

3.5.6 *Time and Location Stamp Request*

This sub-data serves as a Time and Location Stamp Request. The unit responds to this sub-data with Time and Location Stamp sub-data (0x04).

Byte	Description
0	Sub-Data Type (0x04)
1	Length – 0

3.5.7 *Authentication Table Update Command*

The system provides protection against unapproved command attempts. For example, it provides protection against an attempt to change traffic destination IP by an unauthorized person. Every incoming message to the unit (such as command, acknowledge and so on) is provided a unique code, which is verified by the unit. If the code is not verified as authentic, the unit does not perform / acknowledge the command.

If Command Authentication is enabled in the unit's programming, the unit checks a valid 4-byte authentication code in bytes 11-14 of every inbound message. An inbound message with an invalid authentication code is declined by the unit. The unit does not respond to such a command and does not perform it. The 4 bytes authentication code in bytes 11-14 is generated as a function of two variables:

- Unit’s ID
- 8 bytes Authentication Table, stored in the NVM of the unit and concurrently in the Communication Center application

---

NOTE: The OTA Authentication table modification will be accepted by the unit only if the Command Authentication feature is DISABLED in the unit's programming.

The default values of the Authentication Table (8 bytes, 16 nibbles) are as follows:

Index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value	2	15	7	9	12	1	4	6	8	3	11	14	0	5	10	13

Note: The values in the authentication table must be different.

This sub-data is sent to the unit in order to access an Authentication Table values OTA (read, write or modify).

Byte	Description
0	Sub-Data Type (0x08)

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td>1</td><td colspan="2">Length – 10</td></tr>
<tr><td>2</td><td colspan="2">Action Byte
<table>
<tr><td colspan="6">Spare</td><td colspan="2">Read/Write
0 - Read Authentication table from NVM
1 – Write Authentication table to NVM</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>3</td><td colspan="2">Spare</td></tr>
<tr><td>4</td><td>Authentication table Index 0</td><td>Authentication table Index 1</td></tr>
<tr><td>5</td><td>Authentication table Index 2</td><td>Authentication table Index 3</td></tr>
<tr><td>6</td><td>Authentication table Index 4</td><td>Authentication table Index 5</td></tr>
<tr><td>7</td><td>Authentication table Index 6</td><td>Authentication table Index 7</td></tr>
<tr><td>8</td><td>Authentication table Index 8</td><td>Authentication table Index 9</td></tr>
<tr><td>9</td><td>Authentication table Index 10</td><td>Authentication table Index 11</td></tr>
<tr><td>10</td><td>Authentication table Index 12</td><td>Authentication table Index 13</td></tr>
<tr><td>11</td><td>Authentication table Index 14</td><td>Authentication table Index 15</td></tr>
</table>

NOTE: Reset is required in order to apply OTA Authentication table modification.

3.5.8 *Cell ID Request*

This sub-data causes the unit to generate a Type-9 outbound message, containing the last known Cell ID related information (updated every 60 seconds). The generated message will vary according to unit Modem: 2G – sub-data 0x09, 3G – 0x0C, CDMA – 0x1C, 4G – 0x1D.

Byte	Description

Byte	Description
0	Sub-Data Type (0x09)
1	Length – 2
2	Cell ID Request (0x09)
3	Spare

3.5.9 *Modular Platform Manifest Request*

This command causes the unit to generate an OTA Modular Platform Manifest message. The message will contain the data fields as per the specification in the command.

Data part: The data part of this packet has a size of 6 bytes. Each byte contains a bitmask as described below. Setting bit to "1" causes the unit to add a corresponding field to the Modular Platform Manifest.

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td>0</td><td>Sub-Data Type (0x12)</td></tr>
<tr><td>1</td><td>Length – 6</td></tr>
<tr><td>2</td><td>Bit Map 0
<table>
<tr><td>Size of external RAM</td><td>Amount of ext. non-volatile memory used by application (e.g. configuration)</td><td>Size of external non-volatile memory</td><td>Size of internal RAM</td><td>Amount of non-volatile memory used by application (e.g. configuration)</td><td>Size of Program memory</td><td>Accelerometer identifier</td><td>Processor identifier</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table></td></tr>
<tr><td>3</td><td>Bit Map 1</td></tr>
</table>

<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td></td><td>
<table>
<tr><td>FW Upgrade Date/Time</td><td>First Activation Date/Time</td><td>GPS firmware</td><td>GPS Type</td><td>Modem firmware</td><td>Modem type</td><td>Current Hardware ID number</td><td>Current Firmware ID number</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>Bit Map 2
<table>
<tr><td>Originating FW ID</td><td>IMSI/IMEI/MEID</td><td>Cello-CANiQ VIN (Vehicle ID)</td><td>DFD/SD card version</td><td>Boot loader ID</td><td>System ID (STM ID in case of STM controller)</td><td>Firmware name (string)</td><td>Last Configuration Change Date/Time</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>5</td><td>Bit Map 3
<table>
<tr><td>Maintenance Configuration</td><td>Modem Firmware Sub Version</td><td>PIN#8 HW Selected Function</td><td>SIM ICCID</td><td>BT Extender Identification</td><td>Size of internal non-volatile memory request</td><td>Version Information</td><td>Nano sensors</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>6</td><td>Bit Map 4
<table>
<tr><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>Reserved</td><td>CSR BT Module Identification</td><td>Battery Fuel Gauge Identification</td><td>Silicon Labs 4632 receiver version</td><td>BT version number</td></tr>
<tr><td>Bit 7</td><td>Bit 6</td><td>Bit 5</td><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Bit 1</td><td>Bit 0</td></tr>
</table>
</td></tr>
<tr><td>7</td><td>Bit Map 5</td></tr>
</table>

Byte	Description							
	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Note: Reserved bits will be sent as 0.

3.6 Modular Message Request (Message Type 11)

Type 11 was introduced for supporting true modular protocol. The basic structure of the protocol is designed to carry records with predefined structure called modules. The protocol will be used as an extension for Cello fleet protocol. Type 11 supports theoretical message length of up to 65536 bytes, tough the actual rate will be constrained by the HW limitations.

3.6.1 *Message Ingredients*

- Message header
  - System Code – 4 bytes
  - Message Type – 1 byte
  - Destination Unit ID – 4 bytes
  - Command Numerator – 1 byte
- Authentication Code – 4 bytes
- Packet Control Field – Legacy fleet field
- Message length – 2 bytes
- spare – 4 bytes
- Payload Modules – User Configuration Depended
- Error Detection Code – 1 byte

3.6.2 *Byte-Aligned Table*

Byte	Description
1	System Code, byte 1 – ASCII "M"
2	System Code, byte 2 – ASCII "C"
3	System Code, byte 3 – ASCII "G"

4	System Code, byte 4 – ASCII "P"
5	Message Type (11)
6	Unit ID
7	
8	
9	
10	Command Numerator (When transmitting ACK/NACK packet, it carries the numerator of the original message)
11	Authentication Code
12	
13	
14	
15	Packet Control Field
16	Length (of the modules section - not including the checksum). Must be ≠ 0 (to symbolize inbound message), meaning that there should not be a message without any modules.
17	
18	Spare (sent as 0)
19	
20	
21	
22	Modules
…	…
…	…
Last Byte	Error Detection Code (8-bit additive checksum, excluding system code)

3.6.3 *Detailed Per-Field Specifications*

3.6.3.1 System Code

Refer to Section 3.2.3.1

3.6.3.2 Message Type

Modular message requests contain a value of 11 (eleven) in the message type field.

3.6.3.3 Unit ID

Refer to Section 3.2.3.3

3.6.3.4 Command Numerator (Anti-Tango™)

Refer to Section 3.2.3.4

3.6.3.5 Authentication Code

Refer to Section 3.2.3.5

3.6.3.6 Packet Control Field

Direction	Out of space indication	Unused					
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Direction

0 – Data from the unit

1 – Request (unit-bound)

Out of Space Indication

0 – All the requested data is present in the message.

1 – Some Sub-data was not returned due to data size.

3.6.3.7 Length

That field includes the number of data bytes of the modules (with their codes and lengths). It is the number of bytes from byte 18 to the byte of the checksum, which is not included.

3.6.4 *Inbound Type 11 Module Structure*

The general structure of a type 11 module is as follows:

Byte	Description
0	Module Code
1	Length of module (16 bits) – Number of payload bytes
2	
3	Module Payload bytes
.	

.	
n	

3.6.5 *Inbound Type 11 Modules Table*

Code	Description
9	ACK (from server)
10	Configuration Memory Write
11	Configuration Memory Block Request
29	General Module Query
32	General Command

3.6.6 *ACK/NACK*

Byte	Description
0	Module 9 – ACK/NACK
1	Length of module – 3
2	
3	0 - ACK
4	Spare
5	Spare

3.6.7 *Configuration Memory Write*

Byte	Description
0	Module 10 - Configuration Memory Write
1	Length of module – Variable
2	
3	Numerator
4	
5	Number of instances (**=1**, Currently only 1 instance is supported)
6	Memory type – 0

7	Memory entry unit type 0 – Bit 1 – Byte 2 – Word (16 bits) 3 – Double Word (32 bits) (Only Byte entry unit type is currently supported)	Instance 1
8	Address in the configuration memory space	
9		
10		
11		
12	Number of Entries	
13		
…	Data payload (according to the entry size and the number of entries defined above)	
…	…	Instance 2
…	…	
…	…	

3.6.8 *Configuration Memory Read Request*

Byte	Description	
0	Module 11 - Configuration Memory Read Request	
1	Length of module – Variable	
2		
3	Numerator	
4		
5	Number of instances (**=1**, Currently only 1 instance is supported)	
6	Memory type – 0	
7	Memory entry unit type 0 – Bit 1 – Byte	Instance 1

	2 – Word (16 bits) 3 – Double Word (32 bits) (Only Byte entry unit type is currently supported)	
8	Address in the configuration memory space	
9		
10		
11		
12	Number of Entries	
13		
…	…	Instance 2
…	…	
…	…	

3.6.9 *General Module Query*

This command will be sent by the server to request a set of outbound modules to be returned to the server. The module describes a list of module IDs. The addressed unit will respond with a type 11 message carrying the requested modules content arranged in the same order of the request.

Byte	Description
0	Module 29 – General Module Query
1	Length of module – Variable
2	
3	Number of requested Modules
4	First requested module ID
5	Second requested module ID
…	…

3.6.10 *General Command*

This module enables the server to command the unit to perform multiple actions while specifying the action code and optional data bytes attached to the command. The general format of the module is shown below. The unit will send Acknowledge (outbound type 11 module 9) upon receiving this module.

Byte	Description

0	Module 32 – General Command	
1	Length of module – Variable	
2		
3	Number of Command entries	
4	Command ID	Command Entry 1
5		
…	Command data bytes	
…	Command ID	Command Entry 2
…		
…	Command data bytes	
…	…	

Commands Types Description:

Command ID	Description	Number of Attached data bytes	Expected unit response
1	Reset Unit	0	One ACK for all the command request
257	Nano: send cyclic buffer of designated source	1+n*5 (n=1 in case of single or all)	Cyclic buffer
258	Nano: send current value of Work ID	1	Work ID
259	Nano/Cello with BT Extender: send status of the designated source	1	Status of the designated source
261	User indication beeps	4	Beeps pattern change

Nano: Send Cyclic Buffer of Designated Source

Byte	Description
0	Module 32 – General Command
1	Length of module – 1+n*5

2	
3	Number of Command entries – n (1 in case of single or all)
4	Command ID – 257 (Send Cyclic Buffer of Designated Source)
5	
6	Length of Entry Data – 2
7	Sensor Type 0 – Reserved 1 – Temperature 2 – Humidity
8	Source of measurement According to this definition
…	…

Nano: Send Current Value of Work ID

Byte	Description
0	Module 32 – General Command
1	Length of module – 6
2	
3	Number of Command entries – 1
4	Command ID – 258 (Send Current Value of Work ID)
5	
6	Length of Entry Data – 2
7	Source of measurement 0xFD according to definition
8	Spare

Nano: User indication beeps command

Byte	Description
0	Module 32 – General Command
1	Length of module – 8
2	

3	Number of Command entries – 1
4	Command ID – **261** (User indication beeps)
5	
6	Length of Entry Data – 4
7	Beeps pattern selection: 0 - OFF, shut down all beeps 1 - Activate beeps in pattern #1
8	Spare
9	
10	

A normal type-11 ACK shall be returned from the unit in reaction to this command.

Patterns:

Pattern #0 of beeps is defined as shut down all user indication beeps (silence).

Pattern #1 of beeps is defined as: Dual beeps of 300mS ON, 300mS OFF, 300mS ON, then 2 Seconds OFF and repeat.