Protocol description

Draft Version 1.6

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1 Introduction

This document defines an open and free communications protocol for mobile telecare services, where *Mobile Telecare Devices (Terminals)* need to inter-work with a *Telecare Alarm Center (Center).*

The first version of the protocol was designed to use SMS as a bearer service. The present version maintains the same principles that were used in order to adapt to the limitations of an SMS transport but extends its application to an Internet Protocol (IP) environment.

The following priorities have been taken into account for the design of the protocol:

- Simplicity, in the coding and decoding of frames
- Consistency, in the structure of the coding rules
- Flexibility, in order to accommodate new data types
- Capacity to integrate future services and technologies

Although the definition of the protocol is based on the real requirements of telecare services, the protocol has been designed so it can be adapted to different scenarios and procedures. In other words, the paSOS protocol is designed as a simple tool to enable the exchange of information between the Terminals and the Center, and based on it a variety of mechanisms can be designed to suit the procedures of different Telecare services. Annex 2 illustrates a particular application of the paSOS protocol for a Telecare service, where a subset of all the described options is selected. In order to make interoperability between equipment suppliers easier to achieve, an annex (Annex 5) will be added to this document to define paSOS “profiles”. These so-called “profiles” will correspond to different telecare scenarios (e.g. basic service with user-generated alarms and location, tracking service with geo-fencing etc.). One of the profiles defined will be the one described in detail in annex 2 (Implementation example).

2 Design assumptions

2.1 Mobile Telecare System Elements

A mobile Telecare system is formed by three main elements:

- A **Telecare Alarm Center** which is run by a team of professionals (referred to in this document as “Operators”), using computers, software and communications hardware that enables them to monitor and assist the Telecare Service Users according to predefined procedures. These procedures may also involve resources from third-parties (ambulances, security forces, fire brigade...). The Alarm Center is equipped to receive and generate both messages (referred to in this document as “Frames”), such as alarm messages or location reports, and voice calls. In order to assist the Operators in their work, a Telecare Alarm Center uses specialized software tools such as mapping tools, service support systems and databases.
- The Telecare Users, equipped with **Mobile Telecare Units.** These are GSM or 3G

terminals with specialized functions such as positioning devices, accelerometers, thermometers, RF detectors, and are programmed to interact with a Telecare Alarm Center by means of a Telecare protocol. A mobile telecare unit will have a dedicated SOS button, which will allow the user to send an Alarm. Alarms may also be triggered automatically by the terminal based on measurements, i.e. when a parameter reaches a risk threshold or a combination of parameters indicates a potential risk situation (fall detection, high or low temperature, humidity etc...)

- A **mobile communications network**, providing the underlying communications for the system (voice calls and messages).

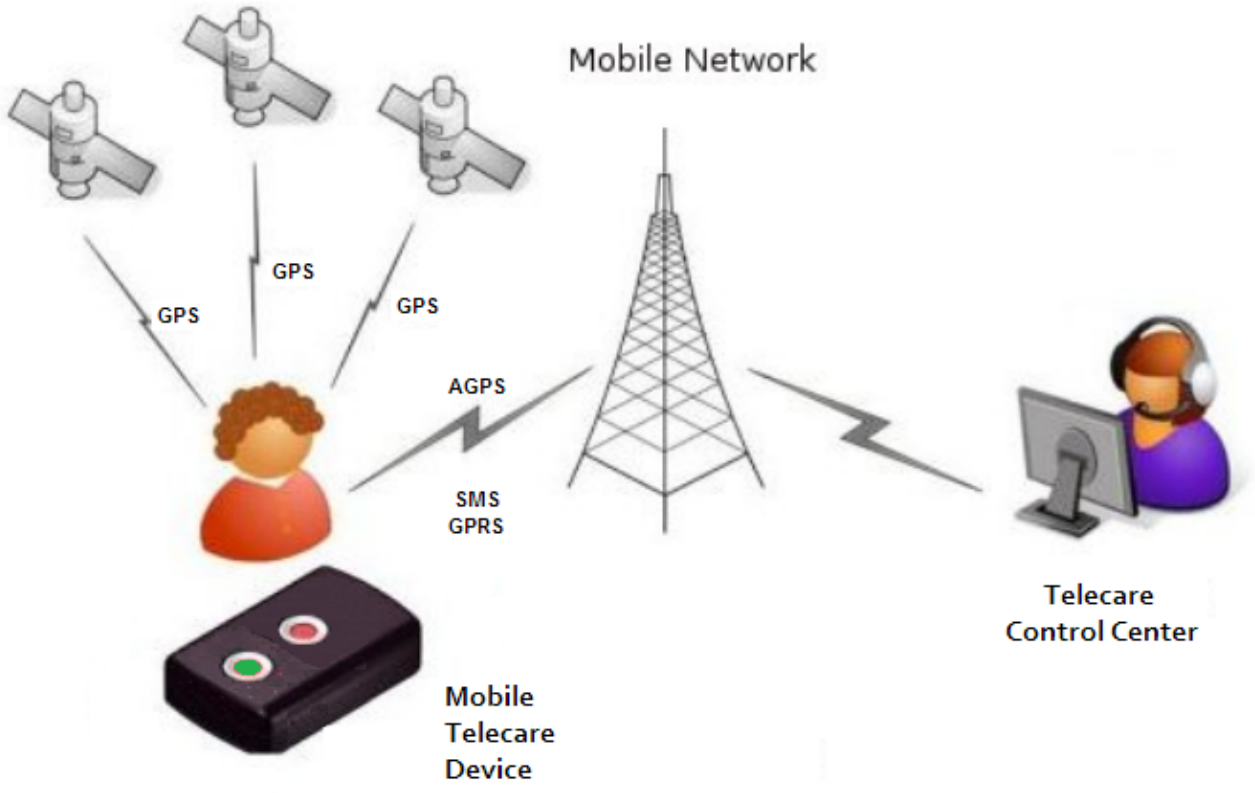


Figure 1. Telecare service network elements

2.2 Alarms

An alarm may be generated by a Telecare User, by pressing an “SOS” button on the Telecare unit, or on a specific device which may be connected to the terminal through a cable, or a radio-link such as Bluetooth. This type of alarm is called a **User Alarm**.

Alarms may also be generated by the Mobile Telecare Unit itself, when it detects through its measurement devices a pattern that is associated with a situation of risk (e.g. fall detection, RF proximity, or the user is moving at a speed that is higher than expected). These alarms that are generated automatically by the terminal based on measurements and the corresponding risk thresholds are referred to in this document as **Device Alarms**.

In both cases, an **Alarm Frame** will be sent via SMS or GPRS to a predefined number or server: The **SMS/GPRS Alarm Center**. The information included in the Alarm Frame, such as the location information and the relevant technical data (e.g. Battery Level) will be thus conveyed to the Alarm Management System of the Alarm Center so that the information is presented to the operators to trigger the emergency procedure. In addition to this, in most cases a (voice) call will be generated from the terminal to a predetermined number: The **Alarm Call Center**. Usually, the operator that will answer the call will be the one that has also access to the Alarm Management System that processes the information of the Alarm Frame.

A third type of frame, the **Technical Alarm** is used to report on circumstances that are related to the performance of the Terminal, such as a low battery level, or to other type of problems related with the communications protocol that may affect the service. In either case these alarms are not directly related to a risk situation for the user.

Regarding protocol problems, these may be related with the interpretation of a frame as a whole, with the frame-type tag or with only one or several data-type tags. In this kind of situation, if the “wrong” frame did not include an acknowledgement request (i.e. it included an outgoing frame ID tag - **&KO** - with a value lower than than 4999, see paragraph 2.6), the receiver of the frame will issue a Technical Alarm with the corresponding failure code (**&PF**ccc) and a received frame ID tag -**&KR** - with the value of the “wrong” frame ID. If the “wrong” frame had no identification tag whatsoever, then the receiver will issue the same Technical Alarm but without any received frame ID tag.

2.3 Position and Tracking

The Telecare Alarm Center may need to know the location of a user (or should we rather say the location of its telecare unit). The protocol establishes two mechanisms for this purpose:

- The use of a **Position Request**. This type of request may be for the current or latest location stored in the terminal or for several locations. It may also be used to request the value of a particular parameter, such as the battery level of the terminal. The Mobile Telecare Unit responds with a **Position Report**, with the requested number of locations or a subset of them if there are no sufficient valid location values and the additional information requested if it is available.

- If the Telecare Alarm Center needs to monitor the consecutive locations of a given terminal for a period of time, it will then send a **Tracking Request**. The Mobile Telecare Unit will then send reports at regular intervals of time, until either a time limit, a maximum number of messages or a given date and time is reached. A variety of modes is supported in order to be able to adapt the protocol to the procedures defined by different service providers. The terminal will then send **Tracking Reports** at the requested time intervals, each report containing one location value, or several location values if this has been defined so previously by a **Tracking Reports Programming** frame.

2.4 Geo-fencing

There are Telecare scenarios where it is necessary to send a report from the terminal when it enters or exits a predefined area. This is programmed by the Telecare Alarm Center with a **Geo-fencing Zone Configuration** frame. A Geo-fencing Zone can either be an Inclusion Zone (and therefore the Terminal sends a Geo-fencing Event Notification when it detects that it is located outside of the zone) or an Exclusion Zone (and then the Terminal sends a Notification if it detects it is located within the zone). Geo-fencing Zones can be defined with a variety of geometric shapes. The Telecare Alarm Center may check the current Geo-fencing configuration of a Terminal by means of a Geo-fencing Zone Information Request, and the Terminal will respond with a Geo-fencing Zone Information Report, indicating the Geo-fencing zone to which the alarm relates and the position where the event has occurred.

2.5 Remote Enquiry

The paSOS's protocol structure, based on tags for each type of data-field allows the Central to modify a parameter or a set of parameters in the Terminal by sending a single type of frame (Remote Parameters Programming -**$RP**-). This frame will indicate which parameters must be programmed with given values by associating a tag to each parameter. Once the parameters have been programmed, the Terminal will send back a Remote Parameters Enquiry (**$RE**) with the programmed values.

The Central can check the current value or values of a parameter or a set of parameters at any time by issuing a Remote Parameters Query frame. The Terminal will reply with a Remote Parameters Enquiry frame with the required parameters and the corresponding values.

Programming and modification of an Access Key:

Note that the Remote Enquiry frame (**$RE**) can be used by the Central to program, modify or suppress the Access Key of a Terminal for the paSOS protocol.

The programming or modification of an Access Key always requires that two Access Key Tags (**&RK**vvvvv...) are received in the Terminal:

- First programming: If no key is set in the Terminal, the first **$RP** message with two identical Access Keys (**&RK**vvvvv...) will program the access key of the Terminal with this Access Key.
- Modification: If the key needs to be changed, the Central will send a Remote Programming (**$RP**) frame with the old key first (**&RK**oooo...) and then the new key (**&RK**nnnn...).
- Suppression: It is performed as a modification, but the second key (new key) is left void. The terminal will then suppress the Access Key.

In all cases, once the programming or the modification of the Access Key has been performed, the Terminal will send back a Remote Parameters Enquiry (**$RE**) with the Access Key tag that has been programmed (with a no value if it has been suppressed).

Activation and de-activation of the Access Key control mechanisms

Once the Access Key has been programmed in a terminal, the Central may want to de-activate the related control mechanisms. To do so, it can send an **$RA** frame to that terminal, with n = 0 for de-activation and n = 1 to activate the control mechanisms. In both cases, it will have to send the Access Key for that terminal.

2.6 Frame Identification, Acknowledgement and Error Handling

The paSOS protocol offers the possibility to identify a frame with an Outgoing Frame Identification - **&KO** -. This identification can be used to request an acknowledgement (when ID is equal or greater than 5000) or just to identify the frame (ID is less than 5000) but not requesting an acknowledgement.

No acknowledgement required:

In the second case – i.e. no acknowledgement requested - if an error occurs, the receiver will then send a Technical Alarm with a Received Frame Identification tag (**&KR**) that has the same value as the previous **&KO** tag, and indicate the failure cause (Tag **&PF**), in order to help tracking the error (as already described in section 2.2).

Acknowledgement mechanism:

A number of request, configuration or programming frames (Basic and Advanced Tracking Request, Tracking Reports Programming, Tracking Deactivation Request, Remote Parameters Programming, Geo-fencing Zone Configuration) from the Central may use a request identifier with an acknowledgement request (**&KO** with value equal to or greater than 5000). After receiving such a message, the terminal will program the required action and, if everything is correct, will reply with a Status Report message containing a Received Frame Identifier (**&KR**) tag with the same identifier and parameter r set to 0 (r = 0 means a positive acknowledgement, i.e. everything is correct). If for some reason the request, configuration or programming cannot be executed, the terminal will reply with a Status Report message containing the Received Frame Identifier tag (**&KR**) with the same identifier and parameter r set to 1 (r = 1 means a negative acknowledgement due to a fatal failure). If the action can be programmed but not exactly as requested (non-fatal failure, e.g. the Central requests a Location Report with the information on battery level – Tag **&PB** - and this information is not available), the Terminal will reply with r = 2 (non-fatal failure) and indicate the failure cause (Tag **&PF**) and the tags that relate to that non-fatal failure.

Note that if the action required by the Central will result in a number of frames sent during a period of time, the reply (Status Report **$SR** frame) will be sent just after checking that everything can be done as requested, not waiting until the action is completed.

Also note that the protocol does not define a complete acknowledgement mechanism. When it comes to implementation, the described mechanism will need to be complemented with a time-out control, and a number of retries after which an error procedure is initiated. But these matters fall out of the scope of this document.

Finally, it is worth mentioning that the definition of this mechanism also allows the Terminal to request an acknowledgement when issuing a Frame (e.g. an Alarm), although this possibility may not be really needed in practice.

The diagram in annex 4 illustrates the different possibilities regarding Error Handling from the receiver point of view.

2.7 Transport Mechanisms

The paSOS protocol is designed for using the Short Message Service (SMS) as a bearer of its frames. The reason for this is that SMS is widely available in nowadays' mobile networks, and its coverage is wider than that of IP-based mobile data services, such as GPRS, EDGE or UMTS. Besides, in many Telecare environments where the exchange of information is limited to infrequent events such as alarms, provisioning and reports, the cost of the messages is not an issue. However, SMS may not be so practical or cost-effective for certain applications where the quantity and frequency of messages is significantly larger, such as location tracking. For these type of applications an IP-based transport service allows the user or the service provider to benefit from tariff schemes that are more economical to transmit such large quantity of data or messages. However, two main issues need to be taken into account:

- In many network environments, IP addresses will not be statically assigned to the terminals, therefore when the Alarm Center needs to send a frame to a given terminal, it may not be able to tell its IP address beforehand.

- If an IP communication is permanently maintained (e.g. with a TCP-IP permanent session), the battery life of the terminal may be limited by excessive power consumption.

These two issues may be overcome in different ways: mobile operators may offer solutions where terminals can be identified from the alarm center with static addresses, and the

transport sessions may be managed in very effective ways to optimize battery life. In order to facilitate interoperability, the proposed solutions try to strike a balance between optimization and simplicity.

A basic assumption of paSOS is that the default transport service is SMS. An IP data service may be used if the Alarm Center specifies so. If problems with the IP data service are found (e.g. lack of coverage), the Terminal and Alarm Center will use SMS as a back-up.

This protocol version only supports IPv4. Currently, this version does not support IPv6. It´s a goal for de next version.

In this moment, we recommend a IP port (9004) for future implementation in telecare units and centrals.

It´s important explain that the TCP implementation is mandatory, leaving UDP as an option in case you want to do finer tracking.

2.7.1 Initial communication between the Alarm Center and the Terminals

SMS is the “default” transport service for paSOS, therefore the communication between the Alarm Center and the Terminals will always begin using SMS. If the system has been designed to use a Data Service, an **$RP** remote programming frame will be sent to the terminals, using an **&RT** data tag to specify that the Data Transport Service must be used, either in both directions or only to send frames to the Alarm Center, and what transport protocol must be used (e.g. UDP[1] or TCP[2]). The same **&RP** frame or another one will be used to send an **&RI** data tag specifying the IP address and Port of the Alarm Center, as well as the Destination Port Number to be used to address the paSOS UDP datagrams or TCP Segments to the Alarm Center.

If the Alarm center needs to indicate to a Terminal that it must stop using the Data service, it will do so by sending an **$RP** frame with an **&RI** data tag with r = 0 (SMS only). If the Terminal is using TCP and receives such a frame, it will terminate the TCP connection and send the next paSOS frame via SMS.

Terminals can be programmed locally using wired systems, working directly without any programming over-the-air.

[1]User Datagram Protocol – RFC 768 (http://tools.ietf.org/html/rfc768)
[2]Transmission Control Protocol – RFC 793(http://tools.ietf.org/html/rfc793)

2.7.2 Messages originated from the Alarm Center to the Terminal(s)

If the data service provided by the Mobile Network Operator does not ensure static IP addresses for the Mobile Terminals, and if there is no active TCP connection between the Alarm Center and the Terminal, a Frame will be sent from the Alarm Center to that Terminal using an SMS. In this case the Terminal will be identified by means of a mobile subscriber number.

If the data service provided by the Mobile Network Operator guarantees static IP addressing for the Mobile Terminals, once the Initial communication between the Alarm Center and a given Terminal has been carried out (via an $RP frame), messages can be sent to this terminal using UDP datagrams or TCP segments. In this case the Terminal will be identified by means of its IP address.

2.7.3 Messages originated from the Terminals to the Alarm Center

If the Terminal is programed for using the IP data service as the preferred transport option (as explained in section 2.7.1) it will send the paSOS frames to the Alarm Center using either UDP datagrams or TCP segments with the Destination Port Number that has been specified by the Alarm Center in the remote programming paSOS Frame (see section 2.7.1.).

The IP address and port for receiver servers (almost one) must be fixed.

2.7.4 Terminal Identifications mechanisms

As mentioned in section 7.2, when SMS is the transport mechanism Terminals can be easily identified by means of the mobile subscriber number. If a data transport service is used, the system may use other ways to identify the Terminal and/or user of the service, either using the &RD tag (IMEI identifier of the terminal), the &RM tag (IMSI identifier of the SIM card) and / or the &IP tag (static IP address of the terminal). Besides, the system may identify the paSOS terminals using the **&RP** tag. This is an ad-hoc identification that may be programmed remotely by the Alarm Center using an **$RP** frame (Remote parameters programming).

The Alarm Center may instruct the terminals to use a certain ID tag (&RP, &RM, &RD) by sending an $RP frame with the &RN tag, indicating which ID parameter is required.

3 paSOS Protocol Proposal

3.1 Format

The proposed format combines frames and data fields of fixed and variable lengths, with the purpose of achieving two goals:

- Flexibility: so as to be able to extend and modify the protocol's applications
- Simplicity: for when it comes to coding the protocol, either in the Mobile Device or in the *Alarm Center*

3.1.1 Special characters

The following set of characters is used as a basis for the structure of the paSOS frames:

- START OF FRAME HEADER: *****
- MULTIPLE MESSAGE: **+** Optional
  - MESSAGE'S INDEX NUMBER **-** Optional
- TAGs
  - FRAME TYPE TAG: **$**
  - DATA TYPE TAG: **&**
- DATA VALUES SEPARATOR: **:**
- CHECKSUM (Reserved for future use): **%** No defined in this version
- END OF FRAME: **#**

Note that these characters can only be used for this purpose (structuring the paSOS frame), and hence cannot be part of any parameter or string of characters within a data-field (such as an access key)

3.1.2 Implementation examples

Example 1: GENERAL IMPLEMENTATION:

*****42**+**2**-**1**$AU**12**&LN**12345**&LT**12345**&PB**50**%**19**#**

Example 2: BASIC IMPLEMENTATION WITHOUT MULTIPLE MESSAGE AND CHECKSUM:

***$AU**12**&LN**12345**&LT**12345**&PB**50#

3.2 Tags

There are two main types of tags:

- *Frame-type Tags* are those that are used to identify the cause or purpose of the frame being sent (it may be either a command, a request, a response, an alarm notification, etc..). They are identified with a "**$**" (dollar) character at the beginning.

- *Data-type Tags* are the those that are used to identify the information fields sent in a frame, (i.e. the information parameters with their associated values). They are identified with a "**&**" (ampersand) character at the beginning.

3.2.1 Frames

In the paSOS protocol, a frame may either be a command, a request, a response an alarm etc... A frame may be conveyed by means of a single SMS or multiple SMSs (Multiple Message).

3.2.1.1 Frame Format overview

General Format:

$TTnn**&PP**uuuu…**&QQ**vvvv…**&RR**wwww...

- The Frame-type tags always begin with the "**$**" (Dollar) character
- **TT** Two (or three in the case of non-standard features, see section 5.1) alphabetic characters identify the type of frame. In future versions of the protocol three or more characters may be used if required, but this initial version limits itself to two characters for standard features for the sake of reducing the length of the frames.
- **nn** Two numerical digits give additional information for certain messages. Although the length of this field is set initially to two numerical digits, it may be increased if required in future versions of the protocol
- **&PP**uuuu… Data fields, with Data-type Tags and their values as described in the corresponding section of this document.

3.2.1.2 Frame-Type Tag Groups

Code	Frame Type					
$Ax	**Alarms and notifications**					
	AU	AD	AT			
$Px	**Position**					
	PR	PE				
$Tx	**Tracking**					
	TR	TX	TE	TP	TS	
$Zx	**Geo-fencing**					
	ZC	ZE	ZN	ZR		
$Rx	**Provisioning and Management**					
	RP	RE	RQ	RA		
$Sx	**Status**					
	SR					

3.2.2 Data fields

General Format:

&VVnn**:**pp**:**.....**:**mmmm….

- The data-type tags of a data field always start with an "**&**" (ampersand) character
- **VV** Two (or three in the case of non-standard features, see section 5.2) alphabetic characters are used to identify the data-type or a parameter. In future versions of the protocol three or more characters may be used if required, but this initial version limits itself to two characters for standard features for the sake of reducing the length of the frames.
- nn**:**… pp**:**mmmm…. Several groups of numerical digits of fixed or variable length. If there are several values they are separated using the "**:**" Character.
- Zero "0" characters, when situated at the leftmost positions and do not alter the value these may be omitted.
- A fixed or a variable length is defined for each particular case of Data Type.
- Examples:
    - **&VV**mmmm…. Data-type tag with a single value field of variable length
    - **&VV**mmm Data-type tag with a single value field of fixed length
    - **&VV**nnn…**:**mmmm…Data-type tag with several value fields of variable length
    - **&VV**nnnnn**:**mmmm…Data-type tag with several value fields of fixed and variable length

3.2.2.1 Data-Type Tag Groups

Code	Type						
&Lx	**Location Data**						
	LT	LN	LA	LV	LB	LM	LD
	LH	LS	LQ	LI	LP	LR	LW
&Dx	**Device Data**						
	DT	DA	DR	DH	DS		
&Px	**Operational Data**						
	PB	PC	PF	PG	PU	PD	
&Rx	**Provisioning and Management Data**						
	RB	RC	RD	RF	RI	RG	RJ
	RK	RL	RM	RN	RP	RS	RT
	RU	RV					
&Kx	**Protocol Data**						
	KO	KR	KT				

3.3 Frame Types ($)

3.3.1 Alarms (A)

3.3.1.1 User Alarm (AU)

- **Direction:** Terminal → Center
- **Frame Format:** **$AU**nn**&PP**uuuu…**&QQ**vvvv…**&RR**wwww…
- **Purpose:** This frame is sent when the user of the terminal presses the alarm button (voluntarily, in general).
- **Data sent: nn:** Alarm's origin
  - **11:** The terminal's SOS button has been pressed
  - **21:** A Radio-linked button has been pressed
  - **31:** A Cable-linked button has been pressed
- **Minimum set of data-tags: &LD, &LH, &LN, &LT**
- **Optional data-tags:** parameters related to the status of the terminal that may be relevant for the processing of the alarm in the Central (e.g. battery level **&PB, &LS** number of satellites)
- **Example:**

*$AU11&LD20160303&LH060654&LN1008052067&LT153052067&PB50#

Interpretation of the example: Alarm where the terminal's button has been pressed, and the location (Date, Time, Longitude, Latitude) and battery information are indicated.

3.3.1.2 Device Alarm (AD)

- **Direction:** Terminal → Center
- **Frame Format:** **$AD**nn**&PP**uuuu…**&QQ**vvvv…**&RR**wwww…
- **Purpose:** This frame is intended for alarms that are generated automatically by the Terminal, based on the values of a sensor or a device and that are related to the security of the user of the terminal.
- **Data sent: nn:** alarm's origin and → associated data
  - **11** Fall detection → &DA Acceleration data
  - **21** Proximity detection → &DR RF data

- **31** Low-Temperature → &DT Temperature data
- **32** High-Temperature → &DT Temperature data

- **Minimum set of data-tags: &LD, &LH, &LN, &LT** plus those that relate to the alarm and the terminal's associated devices

- **Example:**

$AD31**&LD**20160303**&LH**060654**&LN**1008052067**&LT**153052067**&DT**75**#**

Interpretation of the example: Low-Temperature automatic alarm with location information and the temperature measurement.

3.3.1.3 Technical Alarm (AT)

- **Direction:** Terminal → Center
- **Frame Format:** **$AT***nn***&PP**nn**&QQ**mm…
- **Purpose:** This frame is used by the terminal to send alarms that are related to the performance of that Terminal, such as a low battery level. The Technical Alarm may also be used to report a Protocol error, when the frame that has originated the error does not include an acknowledgement. In any case, Technical Alarms are not directly related to a risk situation for the user.
- **Data sent:**
  - ***nn***: event counter (*Optional*)
  - The type of tag that relates to the event that causes the alarm
  - A Terminal Equipment Failure Tag (**&PF**) with the corresponding failure or error code
- **Minimum set of tags:** Those tags that relate to the event for that Terminal

- **Example 1:**
  - ***$AT**2**&LD**20160303**&LH**060654**&LN**1008052067**&LT** 153052067**&PB**05**&PC**999**#**
  - Interpretation of the example: Technical alarm reporting a low battery level whilst the Terminal is connected to the battery charger
- **Example 2:**
  - ***$AT**1**&PF**304**#**
  - Interpretation of the example: Technical alarm reporting that the Alarm Call Center is not reachable.

- **Example 3:**
  - ***$AT**1**&PF**103**#**
  - Interpretation of the example: Technical alarm reporting that a frame which could not be interpreted has been received (Frame Syntax unknown).
- **Example 4:**
  - ***$AT**1**&PF**101**&KR**1134**&DA#**
  - Interpretation of the example: Technical alarm reporting that a frame has been received and has originated an error: the received frame requests the value of a parameter (**&DA**: acceleration that is not supported by the terminal). Error code 101: Data type tag not supported. The **&KR** field indicates the identification of the frame that has originated the error. Note that this identification is lower than 5000, therefore no acknowledgement was requested and this is why the error is reported through a Technical Alarm.

3.3.2 Position (P)

3.3.2.1 Position Request (PR)

- **Direction:** Center → Terminal
- **Frame Format:** **$PR**nn**&VV**
- **Purpose:** This frame allows an Operator at the Center to request manually the location of a terminal.
- **Data Sent:**
  - **nn**: Number of location values requested. If nn is 00, force to send the current position instead the last stored to know if has or not valid position. In this case and no GPS valid FIX, the answer must be &PG
  - **&VV**: Additionally, the value of a particular parameter may be requested
- **Minimum set of tags:** None.
- **Example 1:**
  - ***$PR#** or ***$PR**1**#**
  - Interpretation: Simple request for the latest location value stored in the Terminal
- **Example 2:**
  - ***$PR**5**#**
  - Interpretation: Request for the five last location values stored in the Terminal
- **Example 3:**

- ***$PR3&PB#**
- Interpretation: Request for the three last location values stored in the terminal and a request of the battery status for each of them.

3.3.2.2 Position Response (PE)

- **Direction:** Terminal → Center
- **Frame Format:** **$PE**nn**&PP**uuuu…**&QQ**vvvv…**&RR**wwww…
- **Purpose:** This frame is used by the Terminal to respond to a Location Request from the Center
- **Data Sent:**
  - **nn**: number of location values sent (in case several location values were requested)
  - **Minimum set of tags**: GPS Date (**&LD**), GPS Time(**&LH**), Longitude(**&LN**), Latitude (**&LT**);
  - **Recommended Tags**: **&PB**
- **Example 1**: Single location value request:
  - ***$PE&LD**20160303**&LH**060654**&LN**1008052067**&LT**153052067**&PB**75**#**
  - Interpretation: Location response, with indication of GPS Date, GPS time, Longitude, Latitude and Battery level.
- **Example 2**: Multiple locations – two location values
  - ***$PE2&LD**20160303**&LH**060654**&LN**1008052067**&LT**153052067**&LD20**160303**&LH**060722**&LN**1008052141**&LT** 153052041**#**
  - Interpretation: Location response, two locations reported, no battery information.

3.3.3 Tracking (T)

3.3.3.1 Basic Tracking Activation Request (TR)

- **Direction:** Center → Terminal
- **Frame Format:** **$TR**dd**:**ttt**:**NNNN…
- **Purpose:** This frame is used by an Operator in the Center to program a real-time location Tracking Process of a Terminal
  - The ways (modes) in which a Tracking Process is programmed vary according to the criteria used to end that process
  - There are different options (submodes) to program a Tracking Process depending on the duration of the interval of time between two consecutive messages
  - Several modes and submodes of Tracking may be activated simultaneously in a Terminal
  - When sending a Tracking request for the same mode and submode which

has already been requested, this implies that the operational parameters of this existing process are modified, instead of initiating a new Tracking Process
    - All the basic tracking responses must be sent to a single Center, which is the one that has initiated it or the first Center in the Sequence of Centers
    - Minimum set of Tags: None. Some parameters may be requested depending on the exact application.
- **Data Sent:**
    - **dd:** Tracking mode and submode (see below)
    - **ttt** (0..999): Time interval (in seconds, minutes or hours)
    - **NNNNN or YYYYMMDDHHMMSS**: maximum number of messages (0..99999) or date and time
    - **Mode 1:** dd =**1x** Initiate a Tracking Process until a number of messages is reached
        - **11**sss**:** NNN.. Every sss seconds until NNN… messages are reached
        - **12**mmm**:** NNN.. Every mmm minutes until NNN…messages are reached
        - **13**hhh**:** NNN... Every hhh hours until NNN…messages are reached
    - **Mode 2:** dd= **2x** Initiate a Tracking Process until a given date and time
        - **21**sss**:**YYYYMMDDHHMMSS Every sss seconds until date and time
        - **22**mmm**:**YYYYMMDDHHMMSS Every mmm minutes until date and time
        - **23**hhh:YYYYMMDDHHMMSS Every hhh hours until date and time
    - **Mode 3:** dd = **3x** Initiate a Tracking Process until a given period of time is reached
        - 3**1**sss**:**HHMMSS Every sss seconds until HHMMSS are reached
        - 3**2**mmm**:**HHMMSS Every mmm minutes until HHMMSS are reached
        - 3**3**hhh**:**HHMMSS Every hhh hours until HHMMSS are reached
            - (In this Tracking mode the minutes and seconds (MMSS) are rarely specified, therefore this information can be omitted)
    - **Mode 4:** dd = **4x** Reserved for future use (Days)
    - **Mode 9:** dd = **9x** Initiate an unlimited Tracking Process
        - 9**1**sss Every sss seconds until a Tracking Process deactivation frame is received
        - 9**2**mmm Every mmm minutes until a Tracking Process deactivation frame is received
        - 9**3**hhh Every hhh hours until a Tracking Process deactivation frame is received
- **Optional Data-Tag: &KO** (To identify the frame and, optionally, request an acknowledgement)

- NOTE: In all these messages, the value fields have a variable length, with the exception of the Date-Time fields. Date and Time fields are sorted starting with the most significative values and ending in the least significant values:
  - **Time-only:** HHMMSS
    - HH = HH hours, maximum 99 hours = 4 days and 3 hours (for longer Tracking processes the date and time mode may be used)
    - HHMM = HH hours and MM minutes
    - HHMMSS = HH hours, MM minutes and SS seconds
  - **Date and Time:** YYYYMMDDHHMMSS
    - YYYY = 00:00:00, January 1st , YYYY
    - YYYYMM = 00:00:00, MM 1st, YYYY
    - YYYYMMDD = 00:00:00, MM DDth, YYYY
    - YYYYMMDDHH = HH:00:00, MM DDth, YYYY
    - YYYYMMDDHHMM = HH:MM:00, MM DDth, YYYY
    - YYYYMMDDHHMMSS = HH:MM:SS, MM DDth, YYYY

- **Examples for mode 1:**
  - ***$TR**11:30:20**#*** Initiate Tracking Process. Report Location every 30 seconds until a total of 20 messages are sent
  - ***$TR**12:5:100**#*** Initiate Tracking Process. Report Location every 5 minutes until a total of 100 messages are sent
  - ***$TR**13:2:8**&KO**8002**#*** Initiate Tracking Process. Report Location every 2 hours until a total of eight messages are sent. Upon completion of the programming of the tracking process by the terminal, it will have to reply with a $SR frame with a received frame ID tag with reference id 8002 (and r = 0 if the programming is successful or r = 1 if a problem has been encountered).

- **Examples for mode 2:**
  - ***$TR**31:30:20090516123045**#*** Initiate Tracking Process. Report Location every 30 seconds until 12:30 45s of the 16th of May 2009
  - ***$TR**22:5:2010123112**#*** Initiate Tracking Process. Report Location every 5 minutes until 12:00 00s of the 31st of December 2010
  - ***$TR**23:120:20160228**#*** Initiate Tracking Process. Report Location every 120 hours minutes until 00:00 00s of the 28th of February 2016

- **Examples for mode 3:**
  - ***$TR**31:30:0230**#*** Initiate Tracking Process. Report Location every 30

seconds during a total of two and a half hours (300 messages)

- ***$TR**32**:**5**:**0030**#** Initiate Tracking Process. Report Location every 5 minutes during a total of 30 minutes (6 messages)
- ***$TR**33**:**2**:**99**&KO**5108**#** Initiate Tracking Process. Report Location every 2 hours during a total of 99 hours. Upon completion of the programming of the tracking process by the terminal, it will have to reply with a $SR frame with an received frame ID tag (**&KR**) with reference id 5108 (and r = 0 if the programming is successful, r = 1 if a fatal problem has been encountered or r =2 if the programming is successful but a non-fatal error has occurred).

- **Examples mode 9:**
  - ***$TR**91**:**30**#** Initiate Tracking Process. Report Location every 30 seconds until reception of a Tracking Process deactivation frame
  - ***$TR**92**:**5**#** Initiate Tracking Process. Report Location every 5 minutes until reception of a Tracking Process deactivation frame
  - ***$TR**93**:**2**#** Initiate Tracking Process. Report Location every two hours until reception of a Tracking Process deactivation frame

3.3.3.2 Advanced Tracking Activation Request (TX)

- **Direction:** Center → Terminal
- **Frame Format:** **$TX**i**:**c**:**dd**:**ttt**:**NNNN…
- **Purpose:** This frame is used by an Operator in the Center to program a real-time location Tracking Process of a Terminal
- **Data sent:**
  - **i** (0..9)**:** (tracking process) index reference
  - **c** (0..9): center sequence number
  - **dd:** Tracking mode and submode (see below)
  - **ttt** (0..999): Time interval (in seconds, minutes or hours)
  - **NNNNN or YYYYMMDDHHMMSS**: maximum number of messages (0..99999) or date and time
  - The ways (modes) in which a Tracking Process is programmed vary according to the criteria used to end that process
  - There are different options (submodes) to program a Tracking Process depending on the duration of the interval of time between two consecutive messages
  - Several modes and submodes of Tracking may be activated simultaneously in a Terminal

- The Advanced Tracking Process messages may be sent to one or several Centers simultaneously. Each Center is programmed individually for each Tracking Process, by using the identical frames, with the same *index* **i** but with different *Center Sequence Number* **c**.
- The Advanced Tracking Process processes with identical mode and submode may be requested for the same Center depending on the index **i**.
- When sending a Tracking request for the same mode and sub mode which has already been requested with identical Center Sequence Number and Index, this implies that the operational parameters of this existing process are modified, instead of initiating a new Tracking Process
- The parameters **dd:t:n** behave in the same way as for the basic Tracking.
- All the basic tracking responses must be sent to a single Center, which is the one that has initiated it or the first Center in the sequence of Centers
- Minimum set of Tags: None. Some parameters may be requested depending on the exact application.
- Different messages (requests) may be sent in a single SMS or in separate SMSs

- **Optional Data-Tag: &KO** (To identify the frame and, optionally request an acknowledgement)

- **Example 1:**
  - ***$TX**000:01:11:30:20**&KO**7108**#** + ***$TX**0:3:11:30:20**&KO**7109**#**
    - Initiate Tracking Process with index number 0. Report Location every 30 seconds until a total of 20 messages are sent simultaneously to the Centers 1 and 3 (please see the alternative use of non-significant «zero» digits). Upon completion of the programming of each tracking process by the terminal, it will have to reply with a $SR frame with an received frame tag (**&KR**) with reference id 7108 for the first request and 7109 for the second request (and r = 0 if the programming is successful or r = 1 if a problem has been encountered).
- **Example 2:**
  - ***$TX**0:1:11:30:20**#** + ***$TX**00:3:11:30:40**#**
    - Initiate Tracking Process with index number 0. Report Location every 30 seconds until a total of 20 messages are sent to Center 1 and a total of 40 messages to Centre3
- **Example 3:**
  - ***$TX**000:01:11:030:20**#** + ***$TX**0:3:31:1:40**#**
    - Initiate Tracking Process with index number 0. Report Location every

30 seconds until a total of 20 messages are sent to Center 1 and every hour until a total of 40 messages to Centre3

3.3.3.3 Tracking Response (TE)

- **Direction:** Terminal → Center
- **Frame Format:** **$TE**n**&PP**uuuu…**&QQ**vvvv…**:**n-1**&PP**uuuu…
- **Purpose:** This frame is used to send the Location Reports that relate to a real-time Tracking Process programmed by the Operator.
- **Data sent:**
  - **n:** This field identifies the number of locations sent in the frame (when multiple locations are being sent).
    - If it is omitted or if its value is **1**, it means that a single location is being sent within this SMS.
    - **0:** In case a time-out has been programmed with **$TP** this value indicates that it has not been possible to identify any valid location during the related tracking interval. The minimum set of tags will be omitted, but can send others as &PB.
  - **Minimum set of tags**: GPS Date, GPS Time, Longitude, Latitude (&LD,&LH, &LN, &LT)
  - **Recommended set of tags**: Number of satellites, bearing, speed, battery power, charger, GSM RSSI (&LS, &LB, &LV, &PB, &PC, &RG), and other parameters that are compatible with the protocol and that are defined by the Equipment Supplier. IMEI (&RD) if GPRS is used for continuous tracking.
  - Note the usage of the "**:**" special character as a Separator for multiple positions within a frame
  - **n-1:** (next) location index
  - Recommended set of Tags: **&PB**

- **Example 1**: Report of a single location within an SMS
  - ***$TE&LD**20160303**&LH**060654**&LN**1008052067**&LT**153052067 **&PB**50**#**
  - Report of a single location, with indication of date, hour, Longitude, Latitude, e and Battery level. .

- **Example 2:** Frame with three Location Reports within a single SMS. The number of locations that have to be sent in a single SMS depend on the configuration of the Terminal. In this example, the separator "**:**" indicates that a new set of location parameters (Location Report) is being sent. After the $TE frame-type tag the

number of Location Reports is indicated, and this index is decreased at the start of each new location (countdown) that follows the previous one chronologically.

- ***$TE**3**&LD**20160303**&LH**060654**&LN**1008052067**&LT**153052067**:**2**&LD20**160303**&LH**060722**&LN**1008052141**&LT**153052041**:**1**&LD20**160303**&LH**060828**&LN**1008052354**&LT**153051364**#**

3.3.3.4 Tracking Reports Programming (TP)

- **Direction:** Center → Terminal
- **Frame Format:** **$TP**n**:**mmm…
- **Purpose:** Program the number of Location Reports to be sent in a single SMS. Program also a maximum lapse of time (time-out) for the terminal to gather the amount of valid location values when multiple locations are configured for a single SMS. In case this Time-out is reached, a message is sent with less location values, to avoid an excessive delay if there are value acquisition problems.
- **Data sent:**
  - **n:** Number of Location Reports to be sent in each SMS (with a maximum of 3). In this case, the Terminal waits until it has the required number of valid Location Values before sending a complete SMS.
  - **mmm…:** Time-out (in minutes). Maximum time to wait to gather the required number of Location Values. If it is reached before gathering **n** Location Values, a message is sent with the available Location Values.
  - Minimum set of tags: None
- **Optional Data-Tag: &KO**nnnn (To identify the frame and, optionally, request an acknowledgement)

- **Example 1:**
  - ***$TP**3**:**30**#**
  - **Interpretation:** send 3 location reports per SMS, wait for up to a maximum of 30 minutes to gather the location information required.

- **Example 2:**
  - ***$TP**2**:**180**&KO**9112**#**
  - **Interpretation:** send 2 location reports per SMS, wait for up to a maximum

of 180 minutes to gather the location information required. Upon completion of the Tracking Reports programming, the Terminal will have to reply with a $SR frame with a received frame ID tag (**&KR**) with reference id 9112 (and r = 0 if the programming is successful or r = 1 if a problem has been encountered).

3.3.3.5 Tracking Deactivation Request (TS)

- **Direction:** Center → Terminal
- **Frame Format:** **$TS**x0
- **Purpose:** This frame is used by an Operator in the Center to cancel a real-time location Tracking Process of a Terminal
    - The deactivation for a given Tracking Mode affects all the Tracking Processes for that mode, regardless of the submode that is being used.

- **Data Sent:**
    - Deactivate all the Tracking Processes for all modes
    - **10** Deactivate all the mode 1 Tracking Processes (number of messages)
    - **20** Deactivate all the mode 2 Tracking Processes (date and time)
    - **30** Deactivate all the mode 3 Tracking Processes (duration)
    - **90** Deactivate all the mode 9 Tracking Processes (until deactivation frame is received)
- **Optional Data-Tag: &KO** (To identify the frame and, optionally, request an acknowledgement)

- **Example mode 0:**
    - ***$TS**00**#**
    - Deactivation of all the Tracking Processes for all modes
- **Example mode 1:**
    - ***$TS**10**#**
    - Deactivation of all the mode 1 Tracking Processes (activated until a number of messages is reached)

- **Example mode 2:**
  - ***$TS**20**#**
  - Deactivation of all the mode 2 Tracking Processes (activated until a given date and time)
- **Example mode 3:**
  - ***$TS**30**#**
  - Deactivation of all the mode 3 Tracking Processes (activated for a given duration)
- **Example mode 9:**
  - ***$TS**90**&KO**8682**#**
  - Deactivation of all the mode 9 Tracking Processes (activated until reception of a deactivation frame). Upon completion of the Tracking deactivation, the Terminal will have to reply with a $SR frame with a received frame ID tag (**&OR**) with reference id 8682 (and r = 0 if the programming is successful or r = 1 if a problem has been found).

3.3.4 Geo-fencing Zone Control (Z)

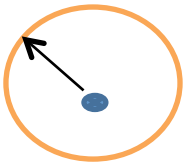
3.3.4.1 Geo-fencing Zone Configuration (ZC)

- **Direction:** Center → Terminal
- **Frame Format:** **$ZC**id:xyz**&LN**vvvv**&LT**uuuu**&LR**xxxx**&LW**yyyyy**…**
- **Purpose:** This frame is used to activate or deactivate Inclusion or Exclusion Zones in a Terminal. Depending on the capabilities and design of each Terminal, it is possible to activate one or several Zones with different geometric figures. Each frame contains a single Zone definition.
- **Data sent:**
  - **id** Zone Identifier (composed of numerical digits of variable length) identifies the defined zone in the system, beginning for 1. 0 means all zones defined.
  - **xyz:**
    - **x:** Type of action on the Zone
      - 1 Activate the Geo-fencing Zone “id”
      - 0 Deactivate the Geo-fencing Zone “id”
    - **y:** Type of restrictions on the Zone. *Note that this field is not used for deactivation (as deactivation is done by using x=0). This value is useful if is necessary optical or acoustical notification to the user, no for alarm management.*
      - 0 Exclusion Zone: The Terminal is in DANGER status when it detects it is located within the Zone. Else is in SAFE status in

this zone.
- 1 Inclusion Zone: The Terminal is in DANGER when it detects it is located out of the Zone. Else is in SAFE status in this zone.

▪ **z:** Type of geometric shape (value only valid for definition)
- 1=Circular, 2=Linear 3=Triangular 4=Rectangular 9= Polygonal

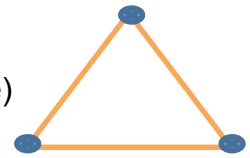
- **Data-field Tags**
  - Depending on the geometry of the shape, additional *data-type tags* (data fields) may need to be sent
  - If some of the data fields required for the type of geometric shape are missing, an error frame is generated (Parameter out of range or wrong format - error code 107)
  - **&LN, &LT, &LR, &LW** tags are used as indicated below:



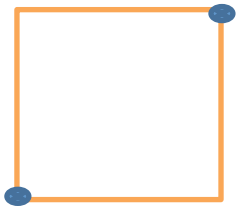
▪ Type 1 Zone (Circular)
- **&LN, &LT** Coordinates of the Center of the circle (Longitude, Latitude)
- **&LR** Radius of the circle (in meters)

▪ Type 2 Zone (Linear, useful to cover roads when the first point is the end point in the previous zone)
- **&LN, &LT, &LN, &LT** Coordinates in sequence (Longitude, Latitude) of the two end points of the line segment (the order of the two points can be swapped).
- **&LW** Width of the linear zone (in meters)

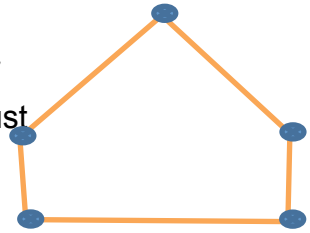
▪ Type 3 Zone (Triangular)
- **&LN, &LT, &LN, &LT, &LN, &LT** Coordinates in sequence (Longitude, Latitude) of the corners of the triangle (the order of the three points can be changed)



▪ Type 4 Zone (Rectangular)
- **&LN, &LT, &LN, &LT** Coordinates in sequence (Longitude, Latitude) of two of the corners on a diagonal of the rectangle (the order of the two points can be swapped).



▪ Type 9 Zone (Polygonal)
- **&LN, &LT, &LN, &LT, &LN, &LT**... Coordinates (Longitude, Latitude) of each of the vertices of the polygon. These points must form the perimeter of a convex set and the sequence of points (their coordinates) in the frame must follow a clock-wise order.



- **Optional Data-Tag: &KO**nnnn (To identify the frame and, optionally, request an

acknowledgement)

- **Examples of Geo-fencing Zone Activation**

- **Example 1**
  - ***$ZC**1**:**101**&LN**2003mmnnnn**&LT**142mmnnnn**&LR**500**#**
  - Activation of a Circular Exclusion Zone with Identification number 1, the coordinates of the Center (&LN and &LT) and a radius of 500 meters (&LR)

- **Example 2**
  - ***$ZC**34**:**112**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn **&LT**142mmnnnn**&LW**30**&KO**7682**#**
  - Activation of a Linear Inclusion Zone with Identification number 34, the coordinates of the two end points of the line segment (&LN and &LT twice) and a width of 30 meters. Upon completion of the Geo-fencing activation, the Terminal will have to reply with a $SR frame with a received frame ID tag (**&KR**) with reference id 7682 (and r = 0 if the programming is successful or r = 1 if a fatal problem has been found).

- **Example 3**
  - ***$ZC**8**:**113**&LN**2003mmnnnn**&LT142mmnnnn&LN**2003mmnnnn **&LT**142mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn**#**
  - Activation of a Triangular Inclusion Zone with Identification number 8, and the coordinates of the three vertices (three times &LN and &LT).

- **Example 4**
  - ***$ZC**45**:**1040**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn**&LT**142mmnnnn**#**
  - Activation of a Rectangular Exclusion Zone with Identification number 45, and the coordinates of two corners on a diagonal of the rectangle.

- **Example 5**
  - ***$ZC**678**:**109**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn**&LT**142mmnnnn**&KO**8655**#**
  - Activation of a Polygonal Exclusion Zone, with Identification number 678 and the coordinates of the vertices of the polygon. Upon completion of the Geo-fencing activation, the Terminal will have to reply with a $SR frame with a received frame ID tag (**&KR**) with reference id 8655 (and r = 0 if the programming is successful or r = 1 if a fatal problem has been found).

- **Examples of Geo-fencing Zone update and deactivation**
- ***$ZC**0**:**0**#** Deactivation of all zones
- ***$ZC**0**:**1**#** Reactivation of all zones
- ***$ZC**3**:**0**#** Deactivation of zone 3
- ***$ZC**5**:**1**#** Reactivation of zone 5
- ***$ZC**8**:**11**#** Changes zone 8 to inclusion zone and convert to active

All zones operation is highly recommended the use ACK to verify the zone is set correctly in the terminal.

3.3.4.2 Geo-fencing Zone Information Request (ZR)

- **Direction:** Center → Terminal
- **Frame Format:** **$ZR:**id:id**…**
- **Purpose:** Request the Geo-fencing Zone data that have been programmed in the Terminal.
- **Example1:**
  - ***$ZR#**
  - Send the data programmed for all zones.
- **Example2:**
  - ***$ZR:**1:3**#**
  - Send the data programmed for zones 1 and 3.

3.3.4.3 Geo-fencing Zone Information Report (ZE)

- **Direction:** Terminal → Center
- **Frame Format:** **$ZE**id:xyz**&LN**vvvv**&LT**uuuu**&LR**xxxx**&LW**yyyy…
- **Purpose:** Report on the data of the Geo-fencing Zones programmed in the Terminal.
- **Data sent**:
  - **id** : Zone identificator
  - **xyz:** (as for $ZC)
  - **x:** Status type for the zone
    - 1 Active Geo-fencing Zone
    - 0 Inactive Geo-fencing Zone
  - **y:** Type of restrictions on the Zone
    - 0 Exclusion Zone
    - 1 Inclusion Zone
  - **z:** Type of geometry of the zone
    - 1=Circular, 2=Linear 3=Triangular 4=Rectangular 9= Polygonal

- **Data-field tags**: same as for **&ZC** (geo-fencing zone configuration).

- **Example 1:**
  - ***$ZE**1:101**&LN**2003mmnnnn**&LT**142mmnnnn**&LR**500**#**
  - Report of an active Circular Exclusion Zone with Identification number 1, the coordinates of the Center (**&LN** and **&LT**) and a radius of 500 meters (**&LR**).

- **Example 2:**
  - ***$ZE**34:012**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn **&LT**142mmnnnn**&LW**30**#**
  - Report of an inactive Linear Inclusion Zone with Identification number 34, the coordinates of the two end points of the line segment (**&LN** and **&LT** twice) and a width of 30 meters.

- **Example 3:**
  - ***$ZE**8**:**113**&LN**2003mmnnnn**&LT**142mmnnnn**&LN**2003mmnnnn **&LT**142mmnnnn **&LT**142mmnnnn**&LN**2003mmnnnn**#**
  - Report of an active Triangular Inclusion Zone with Identification number 8, and the coordinates of the three vertices (three times **&LN** and **&LT**).

- **Example 4:**
  - ***$ZE**45**:**004**&LN**2003mmnnnn**&LT142**mmnnnn**&LN**2003mmnnnn **&LT142**mmnnnn**#**
  - Report of a inactive Rectangular Exclusion Zone with Identification number 45, and the coordinates of two corners on a diagonal of the rectangle.

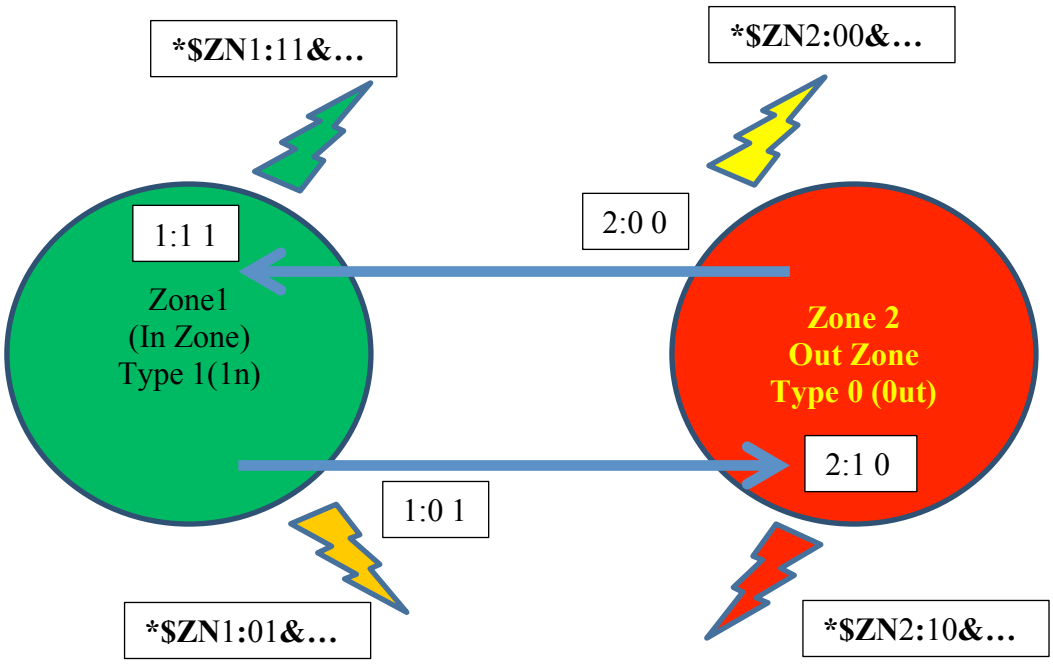
3.3.4.4 Geo-fencing Zone Event Notification (ZN)

- **Direction:** Terminal → Center
- **Frame Format:**
  $ZNid**:**xy**&LD**yyyymmdd**LH**hhmmss**&LN**odddmmnnnn**&LT**hddmmnnnn…#

- **Purpose:** Report the details of an event related to a Geo-fencing Zone: The identification information of the geo-fencing zone to which the event is related and the location details (location coordinates and time) of the position where the geo-fencing zone event has occurred.
- **Minimum set of tags**: GPS Date, GPS Time, Longitude, Latitude (&LD,&LH, &LN, &LT)
- **Recommended set of tags**: Number of satellites, bearing, speed, battery power, charger, GSM RSSI (&LS, &LB, &LV, &PB, &PC, &RG), and other parameters that are compatible with the protocol and that are defined by the Equipment Supplier. IMEI (&RD) if GPRS is used for continuous tracking.
- The terminal will send only ONE alarm event when its status changes, goes in and goes out in any zone type.
- **Data sent**:
  - **id** Geo-fencing zone Id
  - **xy**
    - **x, Type of event related to the zone**
      - 1 Entry (inside the zone)

        - 0 Exit (out of the zone)
    - **y, Type of restriction for the zone**
        - 0 Exclusion Zone
        - 1 Inclusion Zone
    - Note that if **x=y** it means the user is en safe condition, else he/she is in dangerous condition.

- **Example:**
    - ***$ZN**110**:**1**&LD**160303**&LH**060654**&LN**1008052067**&LT**153052067**#**
        - Entry Event into a Circular Exclusion Zone with Identification number 1, and the time and coordinates of the point of the event.
    - ***$ZN**201**:**34**&LD20**160303**&LH**060654**&LN**1008052067**&LT**153052067**&PB**50#
        - Exit Event from a Linear Inclusion Zone with Identification number 34, and the time and coordinates of the point of the event, plus the information on the battery level of the terminal (50% in this case).



3.3.5 Remote Provisioning (R)

3.3.5.1 Remote Parameters Programming (RP)

- **Direction:** Center → Terminal
- **Frame Format:** **$RP**nn**&PP**qq:vvvv…:rr**&SS**nn**:**wwww…
- **Purpose:** Remote "over-the-air" programming of the operational parameters in the Terminal.
- **Data sent:**
  - **nn:** Number of parameters to be programmed [1 to 99]
  - **&PP:** Tags of the parameters to be programmed with index reference **qq and** with the corresponding values to be sent to the Terminal **vvvv** separated by colons "**:**".
- Note that the Terminal may use an access key. If the key needs to be changed, the Central will send the old key first and then the new key (see examples 3 and 4)
- **Minimum set of tags**: Those that correspond to the parameters to be programmed
- **Optional Data-Tag: &KO** (To identify the frame and, optionally, request an acknowledgement)

- **Example 1:**

***$RP**02**&RV**1**:**911234567**&RS**1**:**601234567**&KO**8655**#**

Example interpretation: Programming of the first phone number for the Call Center and the first phone number for the SMS Center. Upon completion of the parameters programming, the Terminal will have to reply with a $SR frame with a received frame ID tag (**&KR**)with reference id 8655 (and r = 0 if the programming is successful or r = 1 if a problem has been found).

- **Example 2:**

***$RP**01**&RK**Z23456**#**

Example interpretation: Programming of the access key of the terminal for the paSOS protocol with value Z23456. The Terminal did not have an access key previously.

- **Example 3:**

***$RP**01**&RK**Z23456**&RK#**

Example interpretation: re-programming of the access key of the terminal for the paSOS protocol with an empty value. The old access key was Z23456. After executing this request, there will be no access key. This may be helpful when migrating an installed base of user Terminals from a Telecare Service Provider to a different one (The new service provider will program a new access key when it takes over the system).

- **Example 4:**

  ***$RP**01**&RK**Z23456**&RK**010122**#**

  Example interpretation: re-programming of the access key of the terminal for the paSOS protocol. The old access key is Z23456. After executing this request (if the old access key is correct), the new access key will be 010122.

3.3.5.2 Remote Parameters Query (RQ)

- **Direction:** Center → Terminal
- **Frame Format:** **$RQ**nn**&PP**qq**&RR**ss **…**
- **Purpose:** Remote Query of the operational parameter's values of the terminal.
- **Data sent:**
  - **nn:** Number of parameters to be queried: [01 to 99]
  - **&PP** Tags of the parameters to be queried and index number qq
- **Minimum set of tags**: Those that correspond to the parameters to be queried
- **Optional Data-Tag: &KO** (To identify the frame and, optionally, request an acknowledgement)
- **Example:**
  - ***$RQ**04**&RV**1**&RS**1**&RV**2**&RS**2**#**
  - **Interpretation o the example:** Query of the value of the phone numbers for the two first Call Centers and the two first SMS Centers

3.3.5.3 Remote Parameters Report (RE)

- **Direction:** Terminal → Center
- **Frame Format:** **$RE**nn**&PP**qq:vvvv…:rr**&SS**nn**:**wwww…

- **Purpose:** Reply to a Remote Information Query, or confirmation of the parameters that have been programmed in the terminal when it results from a former Remote Provisioning Request.
- **Data-fields:**
  - **nn:** Number of parameters requested in the corresponding Remote Provisioning Request or in the Remote Information Query: [1 to 99]
  - **&PP** Tags of the parameters to be programmed with index reference **qq,** and with the corresponding values to be sent to the Terminal **vvvv…** separated by colons "**:**"
- **Minimum set of tags**: Those that correspond to the parameters that have been programmed or queried
- **Example:**
  - ***$RE**02**&RV**1**:**911234567**&RS**1**:**601234567**#**
  - Interpretation: Data Programmed of the first phone number for the Call Center and the first phone number for the SMS Center

3.3.5.4 Access Key Control Mechanisms Activation or de-activation (RA)

- **Direction:** Center → Terminal
- **Frame Format:** **$RA**n**&RK**vvvvv...
- **Purpose:** Gives the Central the possibility to activate or de-activate the Access Key control mechanisms (once an Access Key is programmed in the terminal).
- **Data-fields:**
  - **n:** Type of request
    - 0: de-activation of the Access Key control mechanisms
    - 1: activation of the Access Key control mechanism
  - **&RK**vvvvv... Access Key of the Terminal
- **Example 1:**
  - ***$RK**0**&RV**01234567**#**
  - Interpretation: Deactivate the Access Key control mechanisms in the terminal. The Access Key is 01234567.
- **Example 2:**
  - ***$RK**1**&RV**01234567**#**
  - Interpretation: Activate the Access Key control mechanisms in the terminal. The Access Key is 01234567.

3.3.6 Status Report

3.3.6.1 Status Report (SR)

- **Direction:** Terminal → Center
- **Frame Format:** **$SR**r**&PP**qq:vvvv…
- **Purpose:** This frame is used to reply to a programming or configuration request that has been received with the Received Frame ID (**&KR**) tag.
- **Data-fields:**
  - **r:**
    - 0: Positive acknowledgement
    - 1: Negative acknowledgement/ fatal error
    - 2: Positive acknowledgement with errors (non-fatal)
  - **&PP** Received Frame Identity Tag (**&KR**nnnn), and tags related to the programming request or, in case of failure to the cause of the failure (**&PF**ccc).
- **Minimum set of tags**: Acknowledgement Tag. If r = 1 or r = 2, it is highly recommended to report on the cause of the error with a Terminal Equipment Failure (**&PF**) tag and the corresponding error code(s).
- **Example 1:**
  - ***$SR**0**&KR**8557
  - Interpretation: The request with the associated received frame ID tag with id number 8557 has been performed correctly (r = 0).
- **Example 2:**
  - ***$SR**1**&KR**8003**&PF**104
  - Interpretation: The request with the associated received frame ID Tag with id number 8003 could not be performed correctly (r = 1). Additionally, the Terminal reports on a failure with code number 104 (i.e. Frame Type Tag not supported).
- **Example 3:**
  - ***$SR**2**&KR**9133**&PF**301**&PB**
  - Interpretation: The request with the associated received frame ID Tag with id number 9133 could be performed but with non-fatal errors (r = 2). Additionally, the Terminal reports on a failure with code number 301 (Function not supported), and sends back the **&PB** (battery level) tag, that is the requested information that can not be reported because the terminal does not measure the battery level (although it could interpret the data-type Tag)

3.4 Data Types (&)

3.4.1 Location Data (L)

3.4.1.1 Latitude (LT)

- **Field Format:** **&LT**hddmmnnnn
  - This data-field has a fixed length
- **Purpose:** Value of the Latitude of the location of a positioning device, measured from the equator.
- **Information sent:** Latitude in sexagesimal degrees (from 0º to 90º) in NMEA format.
- **Data sent:**
  - hddmmnnnn hemisphere/degrees/minutes/ten-thousandths minutes in decimal x 10^4
- **Relation to NMEA:**

GLL *Geographic Position Latitude Longitude*				
Parameter	**Name**	**Value range**	**Units**	**NMEA position**
h	N/S Indicator	1 – 2	1=North, 2=Souh	2nd value
dd	Latitude hex degrees	00 – 90	degrees	1st value, dígits 1-3
mm	Latitude hex INT min	00 – 59	minutes	1st value before the decimal point digits 4-5
nnnn	Latitude hex dec.min	0000 – 9999	ten-thousandths.min	1st value after the decimal point digits 6-9

GGA *Global Positioning System Fixed Data*				
Parameter	**Name**	**Value range**	**Units**	**NMEA position**
h	N/S Indicator	1 – 2	1=North, 2=South	3rd value
dd	Latitude hex degrees	00 – 90	degrees	2nd value
mm	Latitude hex INT min	00 – 59	minutes	2nd value before the decimal point
nnnn	Latitude hex dec.min	0000 – 9999	ten-thousandths.min	2nd value after the decimal point

RMC *Recommended Minimum Specific GNSS Data*				
Parameter	**Name**	**Value range**	**Units**	**NMEA position**
h	N/S Indicator	1 – 2	1=North, 2=South	4th value
dd	Latitude hex degrees	00 – 90	degrees	3rd value
mm	Latitude hex INT min	00 – 59	minutes	3rd value before the decimal point
nnnn	Latitude hex dec.min	0000 – 9999	ten-thousandths.min	3rd value after the decimal point

3.4.1.2 Longitude (LN)

- **Field Format:** **&LN**odddmmnnnn
  - This data field has a fixed length
- **Purpose:** Value of the longitude of the location of a positioning device, measured from the Greenwich Meridian.
- **Information sent:** Longitude in sexagesimal degrees (from 0º to 180º) in NMEA format.
- **Data sent:**
  - **odddmmmnnnn:** orientation (direction)-degrees-minutes in decimal x 10^4

- **Relation to NMEA:**

GLL *Geographic Position Latitude Longitude*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
o	E/W Indicator	1 – 2	1=East,2=West	4th value
ddd	Longitude hex degrees	000 – 179	degrees	3rd value digits 1-3
mm	Longitude hex INT min	00 – 59	minutes	3rd value before the decimal point digits 4-5
nnnn	Longitude hex dec.min	0000 – 9999	ten-thousandths.min	3rd value after the decimal point digits 6-9

GGA *Global Positioning System Fixed Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
o	E/W Indicator	1 – 2	1=East,2=West	5th value
ddd	Longitude hex degrees	000 – 179	degrees	4th value, digits 1-3
mm	Longitude hex INT min	00 – 59	minutes	4th value before the decimal point digits 4-5
nnnn	Longitude hex dec.min	0000 – 9999	ten-thousandths.min	4th value after the decimal point digits 6-9

RMC *Recommended Minimum Specific GNSS Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
o	E/W Indicator	1 – 2	1=East,2=West	6th value
ddd	Longitude hex degrees	000 – 179	degrees	5th value, digits 1-3
mm	Longitude hex INT min	00 – 59	minutes	5th value before the decimal point digits 4-5
nnnn	Longitude hex dec.min	0000 – 9999	ten-thousandths.min	5th value after the decimal point digits 6-9

3.4.1.3 Altitude (LA)

- **Field Format:** **&LA**mmmmn
  - This data field has a fixed length
- **Purpose:** Value of the height of the location of a positioning device, measured from the sea level.
- **Information sent:** Altitude, in meters from 0000 to 9999 meters in NMEA format.
- **Data sent:**
  - **mmmmn** (see description above)

- **Relation to NMEA:**

GGA *Global Positioning System Fixed Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
mmmm	MSL Altitude	0000 – 9999	meters	9th value before the decimal point
n	MSL Altitude	0 – 9	dm	9th value after the decimal point x 10

3.4.1.4 Speed (LV)

- **Field Format:** **&LV**vvv
  - This data field has a fixed length
- **Purpose:** Value of the speed of a positioning device relative to the ground.
- **Information sent:** Speed in km/h (This protocol does not foresee the support of other units out of the International System of Units -SI- Should values in non SI units be obtained from the NMEA this will have to be converted to SI).
- **Data sent:**
  - **vvv: Example 1:** km/h (see description above)

- **Relation to NMEA:**

RMC *Recommended Minimum Specific GNSS Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
vv…	Speed Over Ground		Knots	7th value

VTG *Course Over Ground and Ground Speed*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
vv…	Speed Over Ground		Knots	5th value
vv…	Speed Over Ground		ISO (km/h)	7th value

3.4.1.5 True Course (LB)

- **Field Format:** **&LB**dddnn
  - This data-field has a fixed length
- **Purpose:** Value of the True Course of a positioning device relative to the Geographic North Pole.
- **Information sent:** Course in degrees relative to the True North, multiplied by 100 and without decimal fraction.
- **Data sent:**
  - ddd: degrees (0..359)
- nn: hundredths of degrees

- **Relation to NMEA:**

VTG *Course Over Ground and Ground Speed*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
ddd	Course		Degree	1st value before the decimal point
nn	Course		Hundredths of degree x 100	1st value after the decimal point

RMC *Recommended Minimum Specific GNSS Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
ddd	Course Over Ground		Degree	8th value before the decimal point
nn	Course Over Ground		Hundredths of degree x 100	8th value after the decimal point

3.4.1.6 Magnetic Course (LM)

- **Field Format:** **&LM**dddnn
  - This parameter has a fixed length
- **Purpose:** Value of the true course of a positioning device relative to the Magnetic North Pole (variable magnetic declination).
- **Information sent:** Course in degrees relative to the Magnetic North Pole, multiplied by 100 and without decimal fraction.
- **Data sent:**
  - ddd: degrees (0..359)
  - nn: thousandths of degree (see the description above)

- **Relation to NMEA:**

VTG *Course Over Ground and Ground Speed*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
ddd	Course		Degree	3rd value before the decimal point
nn	Course		Hundredths of degree x 100	3rd value after the decimal point

3.4.1.7 GPS Location Date (LD)

- **Field Format:** **&LD**yyyymmdd
  - This data-field has a fixed length
- **Purpose:** For positioning devices, date of a GPS location value.
- **Information sent:** Value of the date of a valid location acquisition
- **Data sent:**

- **yyyymmdd** Year (0001-9999), Month (01-12), Day (01-31)
- **Relation to NMEA:**

RMC *Recommended Minimum Specific GNSS Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
dd	Day	01 - 31	Days	9th value, digits 1-2
mm	Month	01 – 12	Months	9th value, digits 3-4
yyyy	Year	0001-9999	Years	9th value, digits 5-6

3.4.1.8 GPS location time (LH)

- **Field Format:** **&LH**hhmmss
  - This field has a fixed length
- **Purpose:** GPS date of a positioning device
- **Information sent:** UTC time of a valid GPS location value.
- **Data sent:**
  - hhmmss hours (00-24) minutes (00-59) seconds (00-59)
  - Format: The seconds value format is the NMEA one.

- **Relation to NMEA:**

GGA *Global Positioning System Fixed Data*				
RMC *Recommended Minimum Specific GNSS Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
Hh	Hour	00 - 23	Hours	1st value, digits 1-2
mm	Minutes	00 – 59	Minutes	1st value before the decimal point digits 3-4
ss	Seconds	00 – 59	Seconds	1st value before the decimal point digits 5-6

GLL *Geographic Position Latitude Longitude*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
hh	Hour	00 - 23	Hours	5th value, digits 1-2
mm	Minutes	00 – 59	Minutes	5th value before the decimal point, digits 3-4
ss	Seconds	00 – 59	Seconds	5th value before the decimal point, digits 5-6

ZDA *SiRF Timing Message*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
hh	Hour	00 - 23	Hours	1st value, digits 1-2
mm	Minutes	00 – 59	Minutes	2nd value, digits 3-4
ss	Seconds	00 – 59	Seconds	3rd valor, digits 5-6

3.4.1.9 Number of satellites (LS)

- **Field Format:** **&LS**vv:uu
  - This field has a fixed length
- **Purpose:** Number of satellites detected from a positioning device (in view) and number of satellites that are used for the calculation of a position (FIX).
- **Information sent:** Number of satellites
- **Data sent:**
  - **vv:** (01-99) number of satellites in view (**00:** No satellites detected)
  - **uu:** (01-99) number of satellites used for the position calculation (FIX)
- **Relation to NMEA:**

GSV *GNSS Satellites in View*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
vv	Satellites in view	00 - 12	-	3rd value, digits 1-2

GGA *Global Positioning System Fixed Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
uu	Satellites Used	00 - 12	-	7th value, digits 1-2

3.4.1.10 Quality of the Location Calculation (LQ)

- **Field Format:** **&LQ**s**:**f**:**p:q**:**m
  - This parameter has a fixed length
- **Purpose:** Quality of the calculation of a location of a positioning device.
- **Information sent:** Several indicators may be sent: FIX, automatic selection, manual selection, and calculation mode.
  - **s**: status (0: no information, 1: valid data, 2: non valid data)
  - **m**: mode (0: no information, 1: autonomous, 2: DGPS, 3: DR)
  - **f:** position fix indicator (0: No FIX or invalid FIX, 1: FIX GPS SPS mode, 2 : valid FIX differential GPS mode, 3-5 Not supported)
  - **p**: mode 1 (0: No information, 1: M = Manual – 2D or 3D manually selected, 2: A = 2D or 3D automatic selection)
  - **q:** mode 2 (0: No information, 1 = No FIX availability, 2 = 2D (<4 SVs used), 3 = 3D (>3 SVs used)

- **Relation to NMEA:**

GLL *Geographic Position Latitude Longitude*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
s	Status	0 - 2	0 No information 1 – A = Valid Data 2 – V = Non-valid Data	6th value, digit 1
m	Mode *(Only for NMEA v3.00)*	0 - 2	0 No information 1 – A = Autonomous 2 – D = DGPS 3 – E = DR	7th value, digit 1

RMC *Recommended Minimum Specific GNSS Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
s	Status	0 - 2	0 No information 1 – A = Valid Data 2 – V = Non-valid Data	2nd value, digit 1

m	Mode *(Only for NMEA v3.00)*	0 - 2	0 No information 1 – A = Autonomous 2 – D = DGPS 3 – E = DR	11th value, digit 1

GGA *Global Positioning System Fixed Data*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
f	Position Fix Indicator	0 - 6	0 – No FIX or invalid FIX 1 – valid FIX GPS SPS mode 2 - valid FIX differential GPS mode 3-5 Not supported 6 – valid FIX Dead Reck mode.	6th value, digit 1

GSA *GNSS DOP and Active Satellites*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
p	Mode 1	0 - 2	0 No information 1 – M = Manual – 2D or 3D manually selected 2 – A = 2D Automatic – 2D/3D automatic selection	1st value, digit 1
q	Mode 2	0 - 3	0 No information 1 – 1 = No FIX availability 2 – 2 = 2D (<4 SVs used) 2 – 3 = 3D (>3 SVs used)	2º valor, digit 1

3.4.1.11 Satellite information (LI)

- **Field Format:** **&LI**cc:nneeaaass:nneeaaass:nneeaaass…
  - This parameter has a variable length
- **Purpose:** Satellite identification and positioning information sent in 9 digits groups for each satellite in view.
- **Information sent:**
  - **00:** No satellites detected
  - **cc:** Number of satellites whose information is being sent
  - **nn:** Satellite identification
  - **ee:** elevation,
  - **aaa:** azimuth,
  - **ss:** Signal strength (SNR)

- **Relation to NMEA:**

GSV *GNSS Satellites in View*				
Parameter	**Name**	**Val. range**	**Units**	**NMEA position**
nn	Satellite ID	01 - 32	-	4^{th} , 8^{th} , 12^{th}, 16^{th} value. PRN identifier
ee	Elevation	00 - 90	Degrees	5^{th}, 9^{th},13^{th}, 17^{th} value
aaa	Azimuth	00 - 359	Degrees	6^{th}, 10^{th}, 14^{th}, 18^{th} value
ss	SNR (C/No)	00 - 99	dBHz	7^{th}, 11^{th}, 15^{th}, 19^{th} value

3.4.1.12 GPS Location Precision Dilution (LP)

- **Field Format:** **&LP**nnpphhvv
  - This parameter has a fixed length
- **Purpose:** GPS Location precision dilution for positioning devices
- **Information sent:** Pseudo-random Number ID PRN, Position dilution of precision PDOP, Horizontal dilution of precision HDOP, Vertical dilution of precision VDOP.
- **Data sent:**
  - **00**: No data
  - **nn**: (01-99): PRN identifier
  - **pp**: (01-99): DOP Position
  - **hh**: Horizontal DOP
  - **vv**: Vertical DOP
- **Relation to NMEA:**
- GSA Dilution of precision:

○ nn	01 – 99	3rd, 7th, 11th, 15th value	PRN identifier
○ pp	01 – 99	4th, 8th, 12th, 16th value	DOP position
○ hh	00 – 99	5th, 9th, 13th, 17th value	Horizontal DOP
○ vv	00 – 99	6th, 10th, 14th, 18th value	Vertical DOP

3.4.1.13 Circular Geo-fencing Zone Radius (LR)

- **Field Format:** **&LR**rrrr
  - This parameter has a fixed length
- **Purpose:** Radius of a circular Geo-fencing zone for a positioning device.
- **Information sent:** Radius in meters
- **Data sent:**
  - **rrrr**: Radius in meters in Hex (from 1 to 65535)
- **Relation to NMEA:**
- N/A

3.4.1.14 Linear Geo-fencing Zone Width (LW)

- **Field Format:** **&LW**wwww
  - This parameter has a fixed length
- **Purpose:** Width of a Linear Geo-fencing Zone for a positioning device
- **Information sent:** Width in meters across the line segment that defines the Geo-fencing Zone.
- **Data sent:**
  - **wwww**: Width in meters in Hex from 1 to 65535.

3.4.2 Device data (D)

3.4.2.1 Temperature (DT)

- **Field Format:** **&DT**cc
  - This parameter has a fixed length
- **Purpose:** This tag is intended for devices that have sensors to measure the room temperature or the user's body temperature.
- **Information sent:** Temperature in Celsius degrees.
- **Data sent:**
  - **cc:**
  - Temperature below threshold (for bi-metal sensors)

- 01-98 Value of the temperature measurement in Celsius degrees +20 (range: from -19 to 78 ºC) for sensors such as NTC.
- 99 Temperature above threshold (for bi-metal measuring devices)

3.4.2.2 Acceleration (DA)

- **Field Format:** **&DA**cc
  - This parameter has a fixed length
- **Purpose:** This tag is intended for sensors that measure the acceleration or deceleration of the equipment in one or several directions to detect potential falls or hits, movements that can be interpreted as movement or position changes (e.g. from a vertical to a horizontal position).
- **Information sent:** Positive or negative acceleration level relative to g = 9,81 m/s^2.
- **Data sent:**
  - **cc:**
  - Below threshold (not quantified)
    - 01-98 Value of acceleration where 50 = 0 x g ; 01 = - 3 x g ; 98 = + 3 x g
    - 99 Above threshold (not quantified)

3.4.2.3 RF signal strength (DR)

- **Field Format**: **&DR**cc
  - This parameter has a fixed length
- **Purpose:** This tag is intended for devices that can measure the proximity of an RF beacon, either RF-PMR, 802.15.1-4 or another unidirectional or bidirectional RF system.
- **Information sent:** RF level measured by the receiver (related to the distance between the receiver and the beacon)
- **Data sent:**
  - **cc:**
    - 00 No RF detected
    - 01-98 RF Signal strength
    - 99 RF detected but not quantified.

3.4.2.4 Humidity (DH)

- **Field Format**: **&DH**cc
  - This parameter has a fixed length
- **Purpose:** This tag is intended for devices that measure humidity
- **Information sent:** Percentage of relative humidity as measured by the device. For devices based on open/closed contact, water detected.
- **Data sent:**
  - **cc:**
    - 00 No humidity detected
    - 01-98 Percentage of relative humidity (values above 98% are indicated as 98%)
    - 99 Humidity detected, but not quantified.

3.4.2.5 Sound pressure level (DS)

- **Field Format**: **&DS**cc
  - This parameter has a fixed length
- **Purpose:** This tag is intended f or devices that measure the level of sound.
- **Information sent:** Sound pressure level as measured by the device, or detection of a sound pressure level above a threshold defined for intrusion detection systems, activity control systems (usage of appliances, movements) or systems to control the users' quality of life
- **Data sent**
  - **cc:**
    - 00 Sound pressure below the defined threshold
    - 01-98 Value of the Sound Pressure measurement in dBA (values above 98 dBA are indicated as 98).
    - 99 Sound pressure above the defined threshold.

3.4.3 Terminal Equipment Operational Data (P)

3.4.3.1 Battery Level (PB)

- **Field Format:** **&PB**cc
  - This parameter has a fixed length
- **Purpose:** This tag is used by the Terminal Equipment to inform on the battery charge level. This is required to give a proper level of protection to the user, to advise him or her on the actions that may be required, and evaluate the kind of procedures to follow in case of emergency.
- **Information sent:** Percentage of the battery charge.

- **Data sent:**
  - **cc:**
    - 00 Battery low – not quantified
    - 01-98 Either the percentage (%) of battery charge or a set of values that are associated with a list of discrete battery states
    - 99 Battery full charged – not quantified

3.4.3.2 Battery charger (PC)

- **Field Format:** **&PC**ccc
  - This parameter has a fixed length
- **Purpose:** This tag is used by the Terminal Equipment to indicate whether the battery charger is connected. This is needed in case the battery level is low to help the Central evaluate whether the Terminal Equipment may run out of battery, leaving the user unprotected.
- **Information sent:** Voltage of the battery charger (when connected to the terminal)
- **Data sent:**
  - **cc:**
    - 000 Terminal Equipment not connected to the battery charger
    - 01-998 Optional: Voltage of the battery charger x 10,

      (Example 5,1 V = 051; 13,8 V = 138)

    - 999 Terminal Equipment connected to the battery charger

3.4.3.3 Terminal Equipment Failure (PF)

- **Field Format:** **&PF**ccc
  - This parameter has a fixed length
- **Purpose:** This tag is used by the Terminal Equipment to indicate to the Center that it has detected one or several failures. The list of failure causes and the corresponding codes is defined in annex 3.
- **ccc:** Failure code (3 digits decimal)
  - 000: Undefined failure
  - 001 – 900: Standard Failure codes
  - 901 - 999: Vendor-specific/Non-standard failure codes

3.4.3.4 Positioning System's Failure (PG)

- **Field Format:** **&PG**ccc:*hhh*
  - This parameter has a variable length
- **Purpose:** This tag is used by the Terminal Equipment to indicate to the Center that it has detected one or several failures in the Positioning System. The coding of the list of failures is defined by each Equipment Supplier.
- **Data sent:**
  - **ccc:hhh**
    - 000: Undefined failure
    - ccc: Failure code
    - 999:hhh No RF signal detected from any satellite for *hhh* hours (optional).

3.4.3.5 Power Up (PU)

- **Field Format:** **&PU**cc
  - This parameter has a fixed length
- **Purpose:** This tag is used by the Terminal Equipment to indicate to the Center that it is going to be disconnected manually or automatically.
- **Data sent:**
  - **cc**

- 00:Undefined power up
- 01:Manual power up pushing the “ON” button in terminal
- 02:Automatic power up using a built-in timer
- 03:Automatic power up connecting to a power charger
- 04:Automatic power up using an alarm trigger device

3.4.3.6 Power Down (PD)

- **Field Format:** **&PD**cc:yyyymmddhhmmss
  - This parameter has a fixed length
- **Purpose:** This tag is used by the Terminal Equipment to indicate to the Center that it is going to be disconnected manually or automatically.
- **Data sent:**
  - **cc**
    - 00:Undefined power down
    - 01:Manual power down pushing the “OFF” button in terminal
    - 02:Automatic power down using a built-in timer
    - 03:Automatic power down due low battery condition
    - 04:Automatic power down using an remote trigger device
    - 05:Automatic power down for security reasons
    - 06:Automatic power down for relevant failure detected

  yyyymmddhhmmss (Optional): Date-time when the event happened

3.4.4 Terminal Equipment Provisioning Data (R)

3.4.4.1 Alarm Call Center (RV)

- **Field Format: &RVcc:nnnn…:h**
  - This parameter has a variable length
- **Purpose:**
  - This number is used by the Terminal Equipment to place a voice call in case of alarm, or more generally when a voice connection to the Alarm Center is required
  - The Terminal Equipment places calls to the phone numbers in sequence (from 01 to 99), until the call is answered by one of the Alarm Centers.
  - It is possible to include an additional function whereby the Terminal Equipment checks that the reply to the call has been performed by a true Alarm Center and not by a regular telephone.
- **Data sent:**
  - cc Alarm Center Sequence Number, (from 01 to 99)
  - nnnn… Phone number (including prefixes) – up to 16 digits

Optional, else=0

h: 0: The phone number can't auto answer the unit;

1: Auto answer (the terminal answer automatically to the incoming call).

3.4.4.2 SMS Alarm Center (RS)

- **Field Format: &RScc:nnnn…:s:p**
  - This parameter has a variable length
- **Purpose:**
  - This subscriber phone number is used by the Terminal Equipment to send SMSs in case of alarm, or more generally when there is a need to report on the state of the Terminal Equipment to the Alarm Center
  - The Terminal Equipment sends the SMSs to the same Alarm Center as for the voice calls. If an Alarm Center has several phone numbers for voice calls, its corresponding RS has the same phone number for SMS reception.
- **Data sent:**
  - cc SMS Center Sequence Number, (from 01 to 99)
  - nnnn… Phone number (including prefixes) – up to 16 digits

Optional, else=0

- *s:* 0: The phone number can send SMS to unit

  1: The incoming SMS will be deleted and no showed to the user

- *p:* 0: The phone number can send programming to unit

  1: The incoming SMS can't program any parameter in the terminal

3.4.4.3 Personal phone book number (RB)

- **Field Format: &RBccc:nnnn…:a:h:s:p**
  - This parameter has a variable length
- **Purpose:**
  - This number is used by the Terminal Equipment to place a voice call in case to a personal phone number.
  - It can be used in an internal phone book and define the auto-answer function in incoming calls
- **Data sent**
  - ss ccc: Phone Book Sequence Number, (from 001 to 999)
  - nnnn… Phone number (including prefixes) – up to 16 digits

Optional, else=0

- *a*: 0: The phone number can be accepted as incoming call; 1 rejected.
- *h*: 0: The phone number can't auto answer the unit; 1 auto answer.
- *s*: 0: The phone number can send SMS to unit; 1 rejected
- *p*: 0: The phone number can't send programming to unit; 1 accepted

- **Examples:**

  &RB001:911234567 same to **&RB**001:911234567:*0:0:0:0*

  Number programmed in phonebook position 1 (normal functions)

  &RB001:911234567:*0:1* same to **&RB**001:911234567:*0:1:0:0*

  Number programmed in phonebook position 1 with auto-answer and incoming call capability

&RB001:911234567:*0:1:0:1*

Number programmed in phonebook position 1 with auto-answer, incoming call capability, incoming SMS accepted and programming (max functions)

&RB001:911234567 same to **&RB**001:911234567:*1:0:1:0*

Number programmed in phonebook position 1 only for outgoing call (minimal functions)

3.4.4.4 User identificator (RU)

- **Field Format:** **&RUnnnnnn…**
  - This parameter has a variable length
- **Purpose:**This value is used by the Terminal Equipment to show in the screen or at demand, the identificator of the unit, code, name, etc. for use en multi-users services as residences, etc. Also it can be used in any enquiry command if it requested by the center.
- **Data sent:**

  nnnn… Alphanumeric values up to 16 digits

3.4.4.5 Access Key (RK)

- **Field Format:** **&RK**vvvvvvvv…
  - This parameter has a variable length
- **Purpose:**This key (password) may be required by the Central or the Terminal to validate frames (Queries, Alarms, Requests...). Note that the paSOS protocol does not define the contents or the management of the access key. The access key will be defined by the Telecare Service Provider. It may be generated and updated from the Alarm Center Management System, but as long as the reserved characters of the paSOS protocol are not used, any method will be compatible with it.
- **Data sent:**

  vvvvvvvv...: Alphanumeric key.

3.4.4.6 Mobile Station Integrated Services Digital Network MSISDN (RJ)

- **Field Format:** **&RJaaaaaaaaaaaa….**
  - This parameter has a variable length (máx 15 digits)
- **Purpose:**Certain applications may require the MSISDN of the Simcard
- **Data sent:**
  - aaaaaaaaaaaa….: MSISDN number

3.4.4.7 Universal Integrated Circuit Card ICC (RG)

- **Field Format:** **&RGaabbccddddeffffffg**
  - This parameter has a variable length (máx 19 digits including checksum)
- **Purpose:**Certain applications may require the ICC of the Simcard
- **Data sent:**

  aabbccddddeffffffg: ICC number

  - aa : Telecom Id
  - bb : Country
  - cc : Network code
  - dddd : Month-Year of manufacturing
  - ee : Switch configuration code
  - ffffff :SIM number
  - g : Checksum

3.4.4.8 International Mobile Equipment Identity IMEI (RD)

- **Field Format:** **&RDaabbbbbbccccccd or**

  &RDaabbbbbbccccccee

  - This parameter has a variable length (15 or 16 digits)
- **Purpose:**Certain applications may require the IMEI of the Terminal
- **Data sent:**

  - aabbbbbbccccccd: Mobile Terminal IMEI – 15 digits
  - aabbbbbbccccccdee: Mobile Terminal IMEI – 16 digits

3.4.4.9 International Mobile Subscriber Identity – IMSI (RM)

- **Field Format: &RMccc:nnn:sssssssss**
  - This parameter has a variable length (16 digits)
- **Purpose:**Certain applications may use the IMSI as a way to identify the user/terminal
- **Data sent**

  - The IMSI is defined in ITU-T rec. E.212[3]**:**
    - ccc: Mobile Country Code
    - nnn: Mobile Network Code
    - sssssssss: Mobile Subscription Identification Number

3.4.4.10 Transport Media and Protocol (RT)

- **Field Format: &RTm:p**
  - This parameter has a fixed length
- **Purpose:**This data tag is used by the Alarm Center to specify to a Terminal whether it may use the IP data transport service or stick to SMS as the only valid transport option
- **Data sent:**

  - m:
    - 0: use SMS only
    - 1: use the Data transport service in both directions, but only when in the Domestic Network
    - 2: use the Data transport service in both directions, Roaming is allowed
    - 3: use the Data transport service to send frames to the Alarm Center, but only when in the Domestic Network. Receive frames via SMS
    - 4: use the Data transport service to send frames to the Alarm Center, Roaming is allowed. Receive frames via SMS.
  - p:
    - 1: UDP
    - 2: 0: SMS
    - TCP

[3]http://www.itu.int/rec/T-REC-E.212-200805-I

3.4.4.11 paSOS Terminal Identification (RP)

- **Field Format: &RPiiiii....**
  - This parameter has a variable length
- **Purpose:**This data tag can be used by the Alarm Center to identify a Telecare Unit. Its structure can be defined freely.
- **Data sent:**

  iiiii....: Telecare Unit ID (alphanumeric)

3.4.4.12 Identification Parameter (RN)

- **Field Format: &RNi**
  - This parameter has a fixed length
- **Purpose:**This data tag is used by the Alarm Center to indicate to a Terminal that it must (or must not) use a given ID tag in its frames
- **Data sent:**

  - i: Data type required
    - 0: no ID data tag required
    - 1: &RP paSOS ID required
    - 2: &RM IMSI required
    - 3: &RD IMEI required

3.4.4.13 Alarm Center IP Address (RI)

- **Field Format: &RI**cc:aaabbbcccddd:ppppp
  - This parameter has a fixed length
- **Purpose:**This data tag is used by the Alarm Center to specify its IP address and the port number that the Terminal must use to send frames (with UDP datagrams or TCP segments)
- **Data sent:**

  - cc: Alarm Center Sequence number
  - aaabbbcccddd: IP address (in decimal)
  - ppppp: Port number (in decimal)

3.4.4.14 Terminal public IP (RL)

- **Field Format:** **&RL**aaabbbcccddd:ppppp
  - This parameter has a fixed length
- **Purpose:**This data tag is used by the terminal to specify its own IP address and the port number to be connected externally (with UDP datagrams or TCP segments)
- **Data sent:**

  - aaabbbcccddd: IP address in (in decimal)
  - ppppp: Port number (in decimal)

3.4.4.15 Terminal IPv4 address

- **Field Format:** **&IPnnn.nnn.nnn.nnn**
  - This parameter has a variable length
- **Purpose:**
  - This data tag is used by the terminal to identify the IP address of the interface that it uses to communicate with the Alarm Center.
  - This parameter may be used to identify the user in situations when the terminal get static IP address from the operator.
- **Data sent:**

  nnn.nnn.nnn.nnn: IP address (String) – (ej. 192.168.010.25)

3.4.4.16 Terminal Firmware (RF)

- **Field Format:** **&RFvvvvvvvv:dddddd**
  - This parameter has a variable length
- **Purpose:**This data tag is used by the Alarm Center to know the terminal firmware version
- **Data received:**

  - vvvvvvvv: Version of firmware

  Optional:

  - dddddd: yyyymmmddd Date of firmware

3.4.4.17 Operational control (RC)

- **Field Format: &RCcc:a**
  - This parameter has a fixed length
- **Purpose:**This tag is used by the center to activate / deactivate specific services in the terminal and execute operational control actions.
- **Data sent:**

cc:
Operational control group

- 00: Reset to factory defaults values
- 01: Restart the device
- 02: Disconnect the device (shutdown), can be re-activated by user
- 03: Set in blind mode (no screen, lights, sounds, speaker)
- 04: Set in deaf mode (no sounds, speaker)
- 08 Block the unit (disable all user control) can't be re-activated by user
- 09 Set the device in normal mode (no blind and deaf)

Services control group

- 21 Power control notifications
- 22 Power save mode
- 30 GPS operation
- 31 Location services
- 32 Geofencing services

a:

- Deactivate
- Activate

3.4.5 Protocol Data (K)

3.4.5.1 Outgoing Frame ID – Acknowledgement indication (KO)

- **Field Format: &KOnnnn**
  - This parameter has a fixed length
- **Purpose:**This Field is used to identify the frame that is being sent. This may be useful for two purposes:

- **nnnn** =< 4999: In case the sender does not request an acknowledgement (Outgoing Frame ID equal to or less than 4999), but an error occurs, the receiver can then indicate the error with a Technical Alarm -**$AT**- frame and include the Received Frame ID (**&KR**)- with the same parameter value (nnnn) as the **&KO** of the frame which caused the error and 2.

- **nnnn** >= 5000: In case the sender requests an acknowledgement (Outgoing Frame ID -nnnn- equal to or greater than 5000) the Status Report message will include a Received Framed ID -**&KR**- with the same parameter (nnnn) value as the **&KO** tag of the frame that requested the acknowledgement. The same tag will be used for the reply (a Status Report -$SR – frame with parameter r set to 0 for positive acknowledgement, r set to 1 for negative acknowledgement, or r set to 2 for a positive acknowledgement with a non-fatal error.

- **Data sent:**

  - **nnnn**: (0000..9999): Outgoing Frame ID
  - **nnnn** =< 4999: acknowledgement is not requested
  - **nnnn** >= 5000: an acknowledgement is requested

3.4.5.2 Received Frame ID (KR)

- **Field Format: &KRnnnn**
  - This parameter has a fixed length
- **Purpose:**This Field is used in a Technical Alarm (**$AT**) frame or a Status Report (**$SR**) frame to identify the received frame to which it refers. To do so, the value of the received frame ID (**&KR**) is set to the same value as the outgoing frame ID of the received frame (**&KO**)
- **Data sent:**

  nnnn: (0000..9999): Received Frame ID

3.4.5.3 Frame Sender's Time Stamp (KT)

- **Field Format: &KTmmddhhmmss**
  - This parameter has a fixed length
- **Purpose:**If required, the sender of a frame (either the Central or the Terminal) may include this data-field to inform about the date and time at which the frame has been sent (according to its own date and time information). This information may be useful to debug/track problems in the applications or the network.
- **Data sent:**

mmddhhmmss: Month-day-hour-minutes-seconds – UTC (Coordinated Universal Time)

4 Non-standard features

Service providers may want to use features that have not yet been included in the latest version of the paSOS protocol. In order to allow for new features without losing compatibility with the rest of the functionalities, equipment suppliers may make use of “proprietary” Tags that follow a pattern that avoids conflicting with future versions of the protocol.

Two ranges have been defined with this goal:

4.1 Non-standard frame-type tags

Non-standard frame-type tags will have to use the following general format:

$XTTnn**&PP**uuuu…**&QQ**vvvv…**&RR**wwww...

i.e. The tag will use 3 characters instead of 2, and the first character will always be X.

4.2 Non-standard data-type tags

Non-standard frame-type tags will have to use the following general format:

&XVVnn**:**pp**:**.....**:**mmmm….

i.e. The tag will use 3 characters instead of 2, and the first character will always be X.

4.3 Non-standard features and compliance

Note that no compatibility is guaranteed between different providers for this type of “proprietary” frames or data-type tags. i.e. two different providers may want to use the same tag with different purposes. To ensure compatibility, a provider may ask for a particular feature to be included in the next version of the standard. Note that once a feature is defined as part of the paSOS protocol, it must be implemented in the standard way to comply with paSOS.

5 Document versions

Date	Version	Editor	Subject	Description
20/09/10	0.0	Fernando Pina	Draft version	First draft submitted for discussion to the TWG in September 2010
11/11/10	0.3	Ricard Rodrigo	Final Draft	Final Draft with comments and corrections from GTT members up until October 11th, 2010
19/11/10	0.4	Ricard Rodrigo	Final Draft with corrections	Final Drafts with comments and corrections after the second TWG meeting on November 11th, 2010
27/12/10	'1.0	Ricard Rodrigo	First Version	First version. Includes corrections received from GTT members on the final draft.
16/05/11	'1.1	Ricard Rodrigo	Draft version	First draft of the version with IP transport
14/10/11	1.2	Fernando Pina	Draft version with new proposals	Minor corrections: format and examples New tags: &RB, &RU, RF, RC, PU, PD, RB Modified tags: $TE, $ZC, $ZE, $ZN, RV, RS, PB, PC, PF, PG
03/11/11	1.3	Fernando Pina	Draft version revision	Minor corrections: format and drawings. Changed TELEASSISTANCE to TELECARE Added tags RJ and RL and modified RI
04/11/11	1.4	Diego San Segundo	Draft version revision	Minor corrections: format and drawings. Modified Data Types (Protocol Data): &O -> &K
07/11/11	1.5	Juan Noguera	Draft version revision	Minor corrections: format and drawings. Added tags of HTTP protocol, and Annex A
14/11/11	1.6	Diego San	Draft version	Minor corrections: format and

		Segundo	revision	drawings. Added comments

A. Annex A – http as transport protocol

a. Introduction

This Annex specifies the procedure to send messages from handset to server using the HTTP protocol.

The terminal must be provisioned with the URL of the server. The provisioning procedure is outside the scope of this version of the specification.

b. Initial communication between alarm center and terminal

For PaSoS procedure that is initiated by the server (e.g. PR or TR), the initial communication from server to client should be done via SMS. The use of other PUSH options available to some mobile OSes is ffs.

c. Messages originated from terminal to alarm center

Messages from terminals to alarm center must be sent using the HTTP POST method with the pasos message encoded as “text/plain” (raw data).

d. Terminal identification

The description, in Section 2.7.4, of terminal identification for data connections applies.