

<b>DETAILS:</b>	Controller for “Infostation” Display: communication protocol.
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# **Communication Protocol Controller for “Infostation” Display Review 1.0 Version 1.0**

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Doc. Rev.	Protocol Version	Date	Update Description
1.0	1.0	20/Sep/10	First release

### Controller for “Infostation” Display

**DETAILS:** Controller for "Infostation" Display: communication protocol.

<b>Customer</b>	AESYS
<b>Order #</b>	
<b>Subject</b>	Communication protocol for the management of "Infostation" indicator with cpu NIOS II. They are managed completely by the protocol without VFP configuration file.
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### Controller for "Infostation" Display

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Annex:

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## 1 Introduction

The system consists of a dedicated controller CPU (from now on only "**controller**") managing some equipments, which are *informative signs* (from now on "**Infostation Display**").

The controller knows which Infostation Displays are part of the selected equipment and sends the data using **one channels RS485** and a appropriate communication protocol according to the type of Infostation Displays (not described in this document).

Infostation Displays are labelled as:

**CLOCK:** used to display information about the date and time, typically the controller sends a command for time synchronization and the Infostation Display updates its internal time clock;

**INFO:** used to display generic information, they merely show what the controller sends to them;

**SCROL:** used to display information on text sliding and the controller sends a command and the Infostation Display scrolls the text individually.

Commands described in this document refer to a **single abstract display area**, the controller must map the information to the correct Infostation Display sending a new command with the information appropriately adjusted. In particular, INFO Display are seen as a single unit and the controller determines which is the destination Display according to the graphical coordinates of the text to be written.

There only is **one channel** used by controllers to communicate with the central Master, this channel is used for long distance communication, and it works with several devices (such as GSM, GPRS, LAN).

In this document the word "**EAT**" means Estimated Arrival Time.

The encoding font used is "ISO 8859-1".

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### 1.1 Notes for Infostation Display with character matrix

Infostation Displays may consist of a graphic matrix or a characters matrix, in the latter case the following notes have to be considered:

- in CFE and CFL commands, the Master **MUST SET** "X coordinates" and "Y coordinates" for a character matrix and not for graphics matrix;
- if the equipment has CLOCK Displays, information for the date and time is always sent from Controller to CLOCK Displays, then "Date and time display flag" in CFL command **IS IGNORED** and is automatically set to 'X' ("Date and time not displayed"), otherwise even INFO Displays show the date and time;
- "font" is always "7x5", then parameters in CFE and CFL commands and "Selects the font" effect in "Free text composition" **ARE IGNORED**;
- In "Free text composition" only "Begin/end flashing text" effect is supported.

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## 2 Main communication protocol

All the commands and related data fields are composed exclusively of ASCII characters in order to simplify their coding. Some specific command, example for upload the firmware, use binary data fields.

### 2.1 General description

Regardless of the protocol type used, the message containing the controller information is composed as follows:

**<Command>;<data field 1>;<data field n>;**

Where:

**<Command>**

indicates the message content exchanged between the two devices.

- *Length*: 3 bytes;
- *Values*: from 0x41 to 0x5A

**<data fields>**

are the information exchanged between the two devices. The content of these fields depends on the message type.

- *Length*: variable (possibly 0, maximum 250);
- *Values*: from 0x21 to 0x7E;

*The fields of a command are separated by the character ';'. With the TXS and TXT commands if the text should contains the character ';' you must insert ';;'. The last field must contain a final ';'.*

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## 2.2 Basic binary protocol description

The messages exchanged between the devices that compose the system, have the following structure (fields between square brackets "[ ]" are optional):

**STX <IndH> <IndL> [**<MagicH><MagicL>**] <Command> <Data length> ; <Data field 1> ; <Data field n> ; **ETX <Checksum>****

Where:

### <IndH> <IndL>

The slave device involved in the information exchange (the receiver for the call message, the sender for the reply message) is identified by a code **<Address>** on 14-bits. The 7-bits least significant of **<IndH>** are the 7-bits most significant of **<Address>**, while the 7-bits least significant of **<IndL>** are the 7-bit least significant **<Address>**. The most significant bit of **<IndH>** and **<IndL>** is always high. (set to one).

- *Length:* 1 byte **<IndH>** and 1 byte **<IndL>**;
- *Values:* 0x80 – 0xFF.

Reserved addresses:

- 0x3FFD = broadcast address (without controller response);
- 0x3FFE = always valid address (with controller response);

### [<MagicH> <MagicL>]

These are optional fields. At server side, these fields are used in order to identify at which command refers the response.

In practice, the slave device includes these fields in the response.

The most significant bit of these fields is always high (set to one):

- *Length:* 1 byte **<MagicH>** ed 1 byte **<MagicL>**;
- *Values:* 0x80 – 0xFF.

### <Command>

Displays the contents of the message exchanged between the two devices.

- *Length:* 3 bytes;
- *Values:* from 0x41 to 0x5A.

### <Data length>

Indicates the length in bytes of the **<Data>** field codified in hexadecimal format.

- *Length:* 4 bytes;
- *Values:* from 0x30 to 0x39 otherwise between 0x41 and 0x46 otherwise "ZZZZ" to not carry out any verification;

### <Data fields>

These are the information exchanged between the two devices. The contents of the fields depends on the message type and each field is separate by the character ';'.

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- *Length*: variable (possibly 0, maximum 4096 bytes – with DLE conversion the maximum number of characters is 8192);
- *Values*: from 0x00 to 0xFF;
- *Note*: to represent the bytes with ASCII values 02h (STX), 03h (ETX), 10h (DLE) is necessary used the DLE character (10h) followed by a character obtained by summing the ASCII code of the character to convert with 40h (ex. STX becomes: "DLE" + ("STX" + 40h) so "DLE" + "B").

### <Checksum>

It is the sum, modulo 65536, for all the characters that compose the message. (STX, <IndH>, <IndL>, [<MagicH><MagicL>], <Commands>, <Length>, <Data>, ETX). The value is obtained thought the ASCII encoding of the hexadecimal value of this sum.

- *Length*: 4 byte;
- *Values*: from 0x30 to 0x39 otherwise between 0x41 and 0x46 otherwise "ZZZZ" to not carry out any verification;

In the following table you can see how are converted the three data types:

IDENTIFIER	CODE	CONVERSION
STX	0x02	0x10 + 0x42 (ASCII 'B')
ETX	0x03	0x10 + 0x43 (ASCII 'C')
DLE	0x10	0x10 + 0x50 (ASCII 'P')

There is a response to each command.

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### 2.2.1 Binary protocol variant

The basic binary protocol was developed with the intent to simplify the work at the application developers. For this reason it was introduced the fields separator (';') and ASCII format data. This is useful in order to control the controller even from a normal terminal.

However, for some special commands this format is not possible, both for the amount of data that would generate and for compatibility reasons towards some additional devices.

In these particular cases, the transport protocol is similar, but the data field will no longer have the fields separator (';') and it will be in binary format (possibly the data must be masked with the DLE character).

**STX <IndH> <IndL> [<MagicH><MagicL>] <Command> <Data length> <Data> ETX <Checksum>**

#### <Data field>

These are the information exchanged between the two devices. The contents of the field depends on the message type.

- *Length*: variable (possibly 0, maximum 4096 bytes – with DLE conversion the maximum number of characters is 8192);
- *Values*: from 0x00 to 0xFF;
- *Note*: to represent the bytes with ASCII values 02h (STX), 03h (ETX), 10h (DLE) is necessary used the DLE character (10h) followed by a character obtained by summing the ASCII code of the character to convert with 40h (ex. STX becomes: "DLE" + ("STX" + 40h) so "DLE" + "B").

All binary commands receive binary responses. Also for the ACK is expected the equivalent binary ACB.

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### COMMANDS

#### 2.3 Call commands (Master -> Slave, Controller)

COMMAND	DESCRIPTION	RECIPIENTS
CDO	Date and time configuration	Controller
CFC	Communication device configuration	Controller
CFG	Basic parameters configuration	Controller
CFI	Communication address configuration	Controller
CFE	EATs Layout configuration	Controller
CFL	Layout configuration for date, time, logo and text	Controller
CFP	EAT configuration	Controller
CLO	Logo configuration	Controller
DAF	End remotely firmware upgrade	Controller
DAT	Send firmware update data packets	Controller
DEF	Default settings	Controller
DFW	Begin remotely firmware upgrade	Controller
DPP	EAT page header deletion	Controller
DPR	Single EAT deletion	Controller
DPA	All EATs deletion	Controller
DPI	Single EAT immediate deletion	Controller
DST	All spot texts deletion	Controller
DSP	Single spot text deletion	Controller
DTA	All free texts deletion	Controller
DTS	Single sliding text deletion	Controller
DSA	All sliding texts deletion	Controller
DTX	Single free text deletion	Controller
GDO	Reading date and time from BSS	Controller
KAL	Keep-Alive	Controller
POL	Request status (polling)	Controller
PRV	EAT activation/update	Controller
PRA	Multiple EATs activation/update	Controller
RES	BSS restart	Controller
TPP	EAT page header activation	Controller
TSP	Spot text activation/update	Controller
TXS	Sliding text activation/update	Controller
TXT	Free text activation/update	Controller
UCM	GPRS/GSM switch	UBGPRS/GMS
UCO	GPRS connection	UBGPRS
UDI	GPRS dial-up	UBGPRS
UPO	GPRS polling	UBGPRS
VER	Firmware version request	Controller
VEM	Wavecom modem version request	Controller
XRE	GPRS reset	UBGPRS
XVE	UBGPRS firmware version request	UBGPRS

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SDY	Set Infostation Display equipment	Controller
GDY	Get Infostation Display equipment	Controller

### 2.4 Response commands (Slave, Controller -> Master)

COMMAND	DESCRIPTION	RECIPIENTS
ACK	Generic positive response	PC
NAK	Negative response due to checksum error	PC
RDA	DAT command response	PC
RDO	GDO command response	PC
RPO	POL command response	PC
RRA	PRA and PRM commands response	PC
RVE	VER command response	PC
RVM	VEM command response	PC
URP	UPO command response	Controller
XRV	XVE command response	Controller
RDY	GDY command response	PC

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### **3 EXCHANGE COMMANDS**

If the slave receives a message with a wrong checksum, it must response to the master with the NAK and discard the received message.

For every commands where it is not required any response, the slave must send an ACK.

There are some functionalities that include a sequence of commands:

- Remotely firmware upgrade:
  - DFW = Begin -> Controller responses with ACK;
  - DAT = Send data packet n. 0 -> Controller responses with RDA;
  - DAT = Send data packet n. x -> Controller responses with RDA;
  - DAF = End -> Controller responses with ACK;

When the Controller must communicate something at the master (for example the request for a voice call), without having received any message it sends spontaneously a STATUS command, or a RPO (if, for instance, is connected via GPRS).

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## 4 Commands details sent by the Master

### 4.1 ASCII commands

#### CFG (basic parameters configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
EATs display time (in seconds)	2 ASCII	0,2 ÷99 0 = disabled EATs	5
Display time for free text and spot messages (in seconds)	2 ASCII	0,2 ÷99 0 = disabled messages	5
Display time of the company page (in seconds)	2 ASCII	0,2 ÷99 0 = disabled business page	2
Receiver EATs deletion time-out (in seconds) <sup>1</sup>	3 ASCII	From 60 to 200 0 = not controlled	60
Receiver texts deletion time-out (in minutes) <sup>2</sup>	2 ASCII	From 1 to 60 0 = uncontrolled	10
Brightness	3 ASCII	From 0 to 255 0 = automatic brightness	0
Text sliding speed (only from TXS commands)	1 ASCII	From 0 to 9 0 = fixed text	4
Spot page mode	1 ASCII	C = every <i>n</i> cycles mode T = every <i>n</i> minutes mode	C
N. of cycles / time (in minutes) spot page	2 ASCII	From 1 to 99 (cycles or minutes) 0 = disabled	0
Disables responses to commands (You can set either P or T or both of them)	2 ASCII	X = responses to all commands P = does not respond to PRV command T = does not respond to TXT, TSP, TXS	
Language	2 ASCII	Allows to select the language of the displayed months: IT = Italian EN = English FR = French ES = Spanish GE = German	IT

<sup>1</sup> When this timeout expires the Controller no longer displays the estimated arrival time (**EAT**).

<sup>2</sup> When this timeout expires the Controller no longer displays text pages. Usually this timeout should be set higher than " *EATs deletion time-out* "; in this way, in case of no communication with the central, the Controller before deletes the EATs (that need to be updated more frequently and that are more important ) and then it erases the free texts in order to display only the company logo.

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### **CFC (communication device configuration)**

<b>Field</b>	<b>Length (bytes) and type</b>	<b>Value range</b>	<b>Default</b>
Number of device to be configured	1 ASCII	From 0 to 1	0
Device Type	1 ASCII	From 0 to 5 <ul style="list-style-type: none"> <li>• 0 = MODEM;</li> <li>• 1 = GSM;</li> <li>• 2 = GPRS;</li> <li>• 3 = WIRELESS;</li> </ul>	0
Device options	3 ASCII	From 0 to 255 The global configuration value is the sum of all single options: <ul style="list-style-type: none"> <li>• 1 = RTS;</li> <li>• 2 = CTS;</li> <li>• 4 = DCD;</li> <li>• 8 = RESET;</li> <li>• 16 = ON;</li> <li>• 32 = SMS;</li> <li>• 64 = quotation marks command AT+CSCA;</li> <li>• 128 = UBICOM;</li> </ul>	0
Device Baud Rate	5 ASCII	From 2400 to 115200	9600
Configuration string	200 ASCII	Every single initialization command is ended with "_" (0x5F). For example: AT&F_ATE0_ (The NULL value is accepted in absence of configuration string)	

With the "CFC" command, only a single communication device is configured at time. So, if there are two devices, it is necessary send two different command changing the value of "Device number" field. Obviously, if there is only a device, it must be configured as the device number 0.

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### **CFI (communication address configuration)**

<b>Field</b>	<b>Length (bytes) and type</b>	<b>Value range</b>	<b>Default</b>
Number of configured communication devices	1 ASCII	From 0 to 2	0
Controller Address	5 ASCII	from 0 to 16127	0
Operative center' public IP	15 ASCII	From 0.0.0.0 to 255.255.255.255	
Operative center' TCP port	5 ASCII	From 0 to 65535	4000
Ubicom status check' polling time (in seconds)	3 ASCII	From 0 to 255	5
GPRS connection timeout	2 ASCII	From 2 to 30	10
GPRS connection modality	1 ASCII	'C' (connect) o 'L' (listen)	C
GPRS APN connection	64 ASCII	ASCII string (NULL permitted)	NULL
GPRS ID connection (username)	64 ASCII	ASCII string (NULL permitted)	NULL
GPRS connection password	20 ASCII	ASCII string (NULL permitted)	NULL

If there is no value for a parameter, you must write "NULL" (where it is permitted).

**Pay attention.** All settings send with this command, become effective only after a Controller restart (also via RES command).

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### CFE (EATs layout configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
X coordinates of the EATs page header	3 ASCII	From 0 to 192	0
Y coordinates of the EATs page header	3 ASCII	From 0 to 128	1
EAT page header font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
EAT page header text	30 ASCII	ASCII string (NULL permitted)	NULL
Number of EATs per page	1 ASCII	From 1 to 16	1
X axis offset between the display of the next EAT	3 ASCII	From 0 to 192	0
Y axis offset between the display of the next EAT	3 ASCII	From 0 to 128	0
X coordinates of the bus route code	3 ASCII	From 0 to 192	0
Y coordinates of the bus route code	3 ASCII	From 0 to 128	1
Bus route code font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Bus route font mode	1 ASCII	N = Normal R = Reverse	N
Number of characters for bus route code	1 ASCII	From 1 to 9	6
X coordinates of the description	3 ASCII	From 0 to 192	0
Y coordinates of the description	3 ASCII	From 0 to 128	9
Description font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Number of characters of description	2 ASCII	From 0 to 40	12
X coordinates of the waiting time	3 ASCII	From 0 to 192	60
Y coordinates of the waiting time	3 ASCII	From 0 to 128	1
Waiting time font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
X coordinates of the Category field	3 ASCII	From 0 to 192	0
Y coordinates of the Category field	3 ASCII	From 0 to 128	0
Category font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Number of characters for Category field	1 ASCII	From 0 to 9	0

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<b>Field</b>	<b>Length (bytes) and type</b>	<b>Value range</b>	<b>Default</b>
X coordinates of the Delay field	3 ASCII	From 0 to 192	0
Y coordinates of the Delay field	3 ASCII	From 0 to 128	0
Delay font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Number of characters for Delay field	1 ASCII	From 0 to 9	0
X coordinates of the Track field	3 ASCII	From 0 to 192	0
Y coordinates of the Track field	3 ASCII	From 0 to 128	0
Track font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Number of characters for Track field	1 ASCII	From 0 to 9	0
X coordinates of the Info field	3 ASCII	From 0 to 192	0
Y coordinates of the Info field	3 ASCII	From 0 to 128	0
Info font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Number of characters for Info field	2 ASCII	From 0 to 20	0

See the previous paragraph "Notes for Infostation Display with character matrix" for some notes on this command.

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### **CFL (layout configuration for: Date, Time, Text and Logo)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Free text font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Date and time display flag	4 ASCII	P = date and time with EAT T = date and time with free text L = date and time with logo S = date and time with spot text I = date and time with EAT header (TPP command) X=Date and time not displayed	PTL
X coordinates of the date	3 ASCII	From 0 to 192	88
Y coordinates of the date	3 ASCII	From 0 to 128	65
X coordinates of the time	3 ASCII	From 0 to 192	131
Y coordinates of the time	3 ASCII	From 0 to 128	65
Data and time font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5
Date format	15 ASCII	ASCII string with: \d = day of the month \m = month number \M = month abbr. \y = year (2 digit) \Y = year (4 digit) \D = day of the week abbr. \ = '\ character	\d \M
Time format	15 ASCII	ASCII string with: \h = time (24h) \H = time(12h) \m = minutes \s = seconds \: = flashing colon \A = show AM or PM \ = '\ character	\h\:\m
X coordinates of the logo	3 ASCII	From 0 to 192	88
Y coordinates of the logo	3 ASCII	From 0 to 128	73
Logo font	6 ASCII	6x5, 7x5, 7x7, 8x5, 8x7, 14x7	7x5

See the previous paragraph "Notes for Infostation Display with character matrix" for some notes on this command.

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Some notes on CFE and CFL command:

- Date and time must be displayed on the same line and they are permitted only in the first or in the last line of the panel. If the selected font is 14x7, two lines will be filled. In every case the lines used to show date and time can not be used for other information
- The sliding text is displayed in the last line, only with the EATs and always with a fixed font (7x5).
- The free text is always showed in a whole page. In case of date and time displayed on the first line, the free text will be automatically showed starting from the second line.
- Font and coordinate of free text and logo can be modified only if in their relative commands (TXT and CLO) are sent some CTRL-W sequence (for the font selection/position).
- The point of coordinate 0,0 is at the top and left of the Infostation Display:



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### CFP (EAT configuration)

<b>Field</b>	<b>Length (bytes) and type</b>	<b>Value range</b>	<b>Default</b>
Maximum deviation between prediction and current time (in minutes)	2 ASCII	From 1 to 30 0 = not controlled	0
Maximal time that can be displayed (in minutes)	3 ASCII	From 0 to 240 0 = all	75
Max. number of EATs pages that can be displayed	3 ASCII	From 1 to 10 0 = all received EATs pages	10
Order	1 ASCII	L = by bus route O = by time T = by track (currently not used)	0
Number of EATs per bus route	1 ASCII	From 0 to 9 0 = all	0
Message waiting time threshold from 2 to 1 (in seconds)	3 ASCII	From 1 to 240	60
Message waiting time threshold from 3 to 2 (in minutes)	2 ASCII	From 1 to 120	60
Waiting time message 1 for a monitored EAT.	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message 2 for a monitored EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message 3 for a monitored EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
Waiting time message for a theoretical EAT	30 ASCII	CTRL-W (0x17) and all visible ASCII characters	
EAT alternation	1 ASCII	From 0 to 9 0 = no alternation	0
Free texts alternation	1 ASCII	From 0 to 9 0 = no alternation	0
Displayed time update threshold (in minutes)	1 ASCII	From 0 to 9	0

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Some notes on CFP command:

- The "Waiting time message" (1,2 and 3) fields contain the arrival time string to visualize. This string can be composed in two parts: the first one with a fixed text and the second one with the arrival time. All over the text it is possible to use the control sequence in order to create a flashing text: **CTRLW 'F'** "this is a flashing text" **CTRLW 'F'**.

Using the following keys you can select one of the different ways to view the arrival time:

- "\h" shows the absolute arrival time in the format HH:MM
- "\m" shows the missing minutes at the arrival time in the format MM;
- "\#" shows two squares that alternatively flashing (useful to indicate when the bus is coming)
- About the parameters "EATs alternation" and "Free texts alternation", you must know that, if you use the EATs-free texts alternation will not be displayed any sliding text sent through the TXS command (sliding text displayed with the EATs). Instead the sliding texts present in the free text pages (sent with the TXT command) still remain displayed;
- The "Threshold for updating the indicated time" parameter is used only when the new waiting time is greater than the current one. Otherwise (i.e. when it anticipates the estimation) the update is always displayed. We emphasize that this only affects the displayed data.

For example, assume that the threshold is set to 3 minutes and a EAT is 5 minutes. An update to 7 minutes keeps displayed "5 minutes" to 3 minutes before going to see 4 minutes, because the real time expectation is equal to 7 minutes.

### CLO (Logo configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Logo	2048 ASCII	CTRL-W (0x17) and all visible ASCII characters

### CDO (Date and time configuration)

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Date	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Time	6 ASCII	In the format 'hhmss' (all the characters are mandatory)

### Controller for "Infostation" Display

**DETAILS:** Controller for “Infostation” Display: communication protocol.

### **PRV (EAT activation/update) MAX 100**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Estimated Arrival Time ID	8 ASCII hex	
Validity time (in minutes)	4 ASCII	From 0 to 1439 (24 hours) If the value is set to 0, the BSS considers a EAT valid for 15 seconds.
Bus route code	X ASCII	As configured
Description	X ASCII	As configured and NULL
Estimated absolute time of vehicle arrival	6 ASCII	In the format ‘hhmmss’ (all the characters are mandatory)
Waiting hours	2 ASCII	From 0 to 23
Waiting minutes	2 ASCII	From 0 to 59
Waiting seconds	2 ASCII	From 0 to 59
Estimation flag monitored / theoretical / cancel	1 ASCII	T = theoretical M = monitored C = cancel
Bus route code displayed flag	1 ASCII	S = yes N = no
Category	X ASCII	As configured and NULL
Delay	X ASCII	As configured and NULL
Track	X ASCII	As configured and NULL
Information	X ASCII	As configured and NULL

Before accepting the insertion or update of a EAT the Controller performs a consistency check between

the absolute arrival time predicted, the waiting time predicted and the message arrival time.

A EAT is discarded if the following test is true:

$$\begin{aligned}
 &(\text{current\_time} + \text{waiting\_time\_predicted} - \text{estimated\_absolute\_time\_of\_vehicle\_arrival}) \\
 &> \text{Maximum\_deviation\_parameter}
 \end{aligned}$$

When the predicted bus arrival time expires, the deletion of a EAT can happen for two reasons:

- Based on the validity time set by the operative center;
- Through the “single EAT deletion” command (DPR).

### Controller for “Infostation” Display

**DETAILS:** Controller for “Infostation” Display: communication protocol.

### **PRA (Multiple EATs activation/update/deletion) MAX 100**

<b>Field</b>	<b>Length (bytes) and type</b>	<b>Value range</b>
Number of EATs contained in this message	3 ASCII	From 1 to 100
Data buffer composed by $n$ records, each of which composed by the following fields:	Variable up to 1300 Bytes	
Estimated Arrival Time ID	8 ASCII Hex	
Validity time (in minutes)	4 ASCII	From 0 to 1439 (24 hours) If the value is set to 0, the Controller considers a EAT valid for 15 seconds.
Bus route code	X ASCII	As configured
Description	X ASCII	As configured and NULL
Estimated absolute time of vehicle arrival	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Waiting hours	2 ASCII	From 0 to 23
Waiting minutes	2 ASCII	From 0 to 59
Waiting seconds	2 ASCII	From 0 to 59
Estimation flag monitored/theoretical/cancel	1 ASCII	T = theoretical M = monitored C = cancel
Bus route code displayed flag	1 ASCII	S = yes N = no
Category	X ASCII	As configured and NULL
Delay	X ASCII	As configured and NULL
Track	X ASCII	As configured and NULL
Information	X ASCII	As configured and NULL

For arrival times checking you can apply the same considerations already made for PRV command.

### Controller for “Infostation” Display

**DETAILS:** Controller for "Infostation" Display: communication protocol.***DPR (Single EAT deletion)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Estimated Arrival Time ID	8 ASCII hex	

This command deletes the EAT from the BSS memory. If the EATs page is displaying at this moment, the EAT continues to be showed. It will be completely removed only at the next display cycle.

***DPI (Single EAT immediate deletion)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Estimated Arrival Time ID	8 ASCII hex	

This command deletes the EAT from the Controller memory (as the previous DPR command) and also from the display cycle if there are the following condition:

- Are not active any sliding texts with EAT (TXS command);
- The EAT in question is not present in the page currently displayed;
- If you're currently viewing the EAT page header and the EAT is not the only there;

***DPA (All EATs deletion)***

No data fields

**DETAILS:** Controller for "Infostation" Display: communication protocol.

### **TXT (Free text activation/update) MAX 20**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII Hex	
Activation date <sup>3</sup>	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Activation time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Deactivation date	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Deactivation time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Text <sup>4</sup>	1650 ASCII	CTRL-W (0x17) and all visible ASCII characters
Concatenated message ID. (0 = none concatenated message) <sup>5</sup>	8 ASCII Hex	

### **DTX (Single free text deletion)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	

### **DTA (All free texts deletion)**

No data fields

<sup>3</sup> If the initial date is equal to the final date and the initial time is equal to the final time, the text is always valid.

<sup>4</sup> If you need to compose the text with the control characters CTRLW (for example to insert a sliding line) is always required that the text start with the CTRLW even though the first part does not need any particular effects.

If the text begins with CTRLW, the formatting (next line alignment) must be done manually in the text itself (otherwise the automatic formatting only manage a single character, not whole words).

<sup>5</sup> The concatenated message ID must be contiguous and in ascending order.

<b>DETAILS:</b>	Controller for "Infostation" Display: communication protocol.
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**TSP (Spot text activation/update) MAX 5**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII Hex	
Text <sup>6</sup>	X ASCII	As configured
Concatenated message ID. (0 = none concatenated message) <sup>7</sup>	8 ASCII Hex	

**DSP (Single spot text deletion)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	

**DST (All spot texts deletion)**

No data fields

**TPP (EAT page header activation)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Text <sup>6</sup>	1650 ASCII	As configured

**DPP (EAT page header deletion)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	

<sup>6</sup> If you need to compose the text with the control characters CTRLW (for example to insert a sliding line) is always required that the text start with the CTRLW even though the first part does not need any particular effects.

If the text begins with CTRLW, the formatting (next line alignment) must be done manually in the text itself (otherwise the automatic formatting only manage a single characters, not whole words).

<sup>7</sup> The concatenated message ID must be contiguous and in ascending order.

**DETAILS:** Controller for "Infostation" Display: communication protocol.

### ***TXS (Sliding text activation/update) MAX 50***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	
Activation date <sup>8</sup>	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Activation time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Deactivation date	6 ASCII	In the format 'ddmmyy' (all the characters are mandatory)
Deactivation time	6 ASCII	In the format 'hhmmss' (all the characters are mandatory)
Text	100 ASCII	

If, after the activation of a sliding message, the sliding speed is changed, the message remains at the speed defined at the time of its activation.

**Pay attention.** This command does not function if the alternation free text-EATs page is enabled (See parameters and notes of CFP command).

### ***DTS (Single sliding text deletion)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Message ID	8 ASCII hex	

The TXS and DTS commands are available only if the layout provides the bottom line sliding and if it does not use the free text-EATs page alternation.

### ***DSA (All sliding texts deletion)***

No data fields

<sup>8</sup> If the initial date is equal to the final date and the initial time is equal to the final time, the text is always valid.

<b>DETAILS:</b> Controller for "Infostation" Display: communication protocol.
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***POL (Request status (polling))***

No data fields. BSS polling.

***KAL (Keep-alive)***

No data fields. When this message is received, the "received message timeout" BSS side is reset.

***RES (Reset)***

No data fields. This message causes the BSS restart.

***DEF (Default)***

No data fields. The receiving of this command forces the default configuration data. It also deletes all data (EAT, sliding and free texts) and restart the CPU.

***VER (Firmware version)***

No data fields. It requests the firmware version.

***VEM (Wavecom modem version)***

No data fields. It requests the Wavecom modem version.

***GDO (Reading date and time from BSS)***

No data fields. It requests current date and current time.

**DETAILS:** Controller for “Infostation” Display: communication protocol.

## ***SDY (Set Infostation Display equipment)***

<b><u>Field</u></b>	<b><u>Length (bytes) and type</u></b>	<b><u>Value range</u></b>	<b><u>Default</u></b>
Equipment Code	1 ASCII	0	0

### ***Equipment Code 0:***

- |   |
|---|
| <ul style="list-style-type: none"> <li>• 2 Displays type INFO: 5 rows of 24 characters, protocol 'E', address 'A' and 'B';</li> </ul> |
| <ul style="list-style-type: none"> <li>• 1 Display type CLOCK: 1 rows of 5 characters, protocol 'E', address 'C';</li> </ul>          |

### ***Equipment Code 1:***

- |   |
|---|
| <ul style="list-style-type: none"> <li>• 2 Displays type INFO: 8 rows of 24 characters, protocol 'E', address 'A' and 'B';</li> </ul> |
| <ul style="list-style-type: none"> <li>• 1 Display type CLOCK: 1 rows of 5 characters, protocol 'E', address 'C';</li> </ul>          |

In Equipment Code 0 an 1, Infostation Displays all consist of a **characters matrix** and all use the **Protocol 'E'** for communication with Controller. This means the notes already mentioned in paragraph “Notes for Infostation Display with character matrix”.

**DETAILS:** Controller for "Infostation" Display: communication protocol.

### ***GDY (Get Infostation Display equipment)***

Lists all Infostation Displays of the current equipment.

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>	<u>Default</u>
Equipment Code	1 ASCII	0	0
Data for each external display in equipment:	Variable ASCII		
Type	1 ASCII	Function of display: <ul style="list-style-type: none"> <li>• 0 = INFO (array of characters for generic information visualization)</li> <li>• 1 = CLOCK (one row for clock visualization)</li> <li>• 2 = SCOR (one row for scrolling visualization)</li> </ul>	
Protocol	1 ASCII	Communication protocol: <ul style="list-style-type: none"> <li>• 0 = Protocol 'E'</li> </ul>	0
Address	1 ASCII	From 'A' to 'Y' (Protocol 'E')	'A'
Number character for row	3 ASCII		
Number of row	1 ASCII		
Communication result (*1)	1 ASCII	<ul style="list-style-type: none"> <li>• 0 = WAIT one response</li> <li>• 1 = OK, positive response</li> <li>• 2 = NAK, negative response</li> <li>• 3 = NO response, timeout</li> </ul>	
Bright (*1)	2 ASCII	From 0 to 16 (Protocol 'E')	0
Firmware version (*1)	Variable ASCII	Es. "D1L14A"	

(\*1) This field changes in according to the outcome of transmission between the NIOS CPU and external displays.

### Controller for "Infostation" Display

**DETAILS:** Controller for “Infostation” Display: communication protocol.

### Binary commands

These are the commands that do not involving the “;” character as fields separator (See [section 2.2.1](#)).

#### **DFW (Begin remotely firmware upgrade)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Flag	1 Binary	Bit = 0 forces the deletion of the RAM (with battery buffer);

#### **DAT (Send firmware update data packets)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Packet number	1 Binary	0 - 255 circular
Data buffer	Variable Binary	0 - 255

#### **DAF (End remotely firmware upgrade)**

No data fields. After this command, the BSS restarts with the new firmware.

#### **UCO (GPRS connection)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Mode	1 alphanumeric ASCII	C = connect L = listen
IP address	4 binary	Big-endian format (H-L)
TCP port	2 binary	Big-endian format (H-L)
TCP source port	2 binary	Big-endian format (H-L) 0 = the value is chosen by the device

### Controller for “Infostation” Display

**DETAILS:** Controller for "Infostation" Display: communication protocol.

### ***UDI (GPRS dial-up)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
APN	Variable (max. 64) alphanumeric ASCII	With null terminator.
ID	Variable (max. 64) alphanumeric ASCII	With null terminator.
Password	Variable (max. 20) alphanumeric ASCII	With null terminator.

### ***UCM (GPRS/GSM switch)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Device	1 Binary	0 = GPRS (UBICOM) 1 = GSM (MODEM)

### ***UPO (GPRS polling)***

No data fields.

### ***XRE (GPRS reset)***

No data fields.

### ***XVE (UBGPRS firmware version request)***

No data fields.

Controller for "Infostation" Display

<b>DETAILS:</b>	Controller for "Infostation" Display: communication protocol.
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## 5 Responses details sent by the BSS

### 5.1 ASCII responses

#### **RPO (Polling response)**

<b>Field</b>	<b>Length (bytes) and type</b>	<b>Value range</b>
Controller address	5 ASCII	From 0 to 16127
Status	4 ASCII Hex	From 8049 to 804C
Temperature (°C)	3 ASCII Hex	From -20 to 100 -99 = probe error

The possible values for the STATUS data field are the following (the values are represented in hexadecimal format):

- 8049 = everything OK;
- 804A = system reboot;
- 804B = default loaded (with the specific command, or in case of data loss);
- 804C = request for a voice call;

Every status change is communicated only at the next status request.

**DETAILS:** Controller for "Infostation" Display: communication protocol.

### ***RVE (VER command response)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Firmware code	6 alphanumeric ASCII	
Firmware description	variable alphanumeric ASCII	

### ***RVM (VEM command response)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
ATI3	variable alphanumeric ASCII	
AT+WHWV	variable alphanumeric ASCII	
AT+WSSW	variable alphanumeric ASCII	

### ***ACK (Generic positive response)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Control	3 ASCII	0 = OK 1 = Unrecognized command 2 = Syntax error 3 = Data field not valid 4 = Length error 5 = Unexpected command 6 = Flash memory error 7 = EAT not deleted because it does not exist 8 = EAT does not added because it has been deleted by ShortRange 9 = maximum number of EATs/texts exceeded 10 = EAT does not added due to the failure of the time checking

### Controller for "Infostation" Display

**DETAILS:** Controller for “Infostation” Display: communication protocol.

### **NAK (Negative response due to checksum error)**

No data fields.

### **RRA (PRA commands response) MAX 100**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Number of EATs	3 ASCII	From 1 to 100
Data buffer composed by $n$ records, each of which composed by the following fields:	Variable up to 300 Byte	
Estimated Arrival Time ID	8 ASCII Hex	
Result (if this value is different from 0, the EAT is not added)	1 ASCII	See the ACK coding

### **RDO (GDO command response)**

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Date	6 ASCII	In the format ‘ddmmyy’ (all the characters are mandatory)
Time	6 ASCII	In the format ‘hhmmss’ (all the characters are mandatory)

Controller for “Infostation” Display

**DETAILS:** Controller for “Infostation” Display: communication protocol.

Binary responses

These are the responses that do not involving the “;” character as fields separator (See [section 2.2.1](#)).

### ***ACB (Generic positive binary response)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Control	1 Binary	0 = OK 1 = Unrecognized command 2 = Syntax error 3 = Data field not valid 4 = Length error

### ***RDA (DAT command response)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Packet number	1 Binary	0 – 255 circular
Control	1 Binary	0 = OK 1 = Numbering error 2 = Data error 3 = Memory error

### ***URP (UPO command response)***

<u>Field</u>	<u>Length (bytes) and type</u>	<u>Value range</u>
Connection status	1 Binary	0 = link not present 1 = dial-up 2 = available link 3 = listening 4 = connecting 5 = connected 128 = no carrier bit 6 = ring

Controller for “Infostation” Display

**DETAILS:** Controller for “Infostation” Display: communication protocol.

***XRV (XVE command response)***

<b><u>Field</u></b>	<b><u>Length (bytes) and type</u></b>	<b><u>Value range</u></b>
Firmware code	6 alphanumeric ASCII	
Firmware description	variable alphanumeric ASCII	

**Controller for “Infostation” Display**

<b>DETAILS:</b>	Controller for "Infostation" Display: communication protocol.
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## 6 Free text composition

The free text buffer is composed by all the characters that can be visualized on the BSS.

Some display effects can be applied to the text by inserting the sequences described in the table below:

SEQUENCE	EFFECT
CTRL_W + 'N' + F + C	<u>Selects the F font and uses C as inter-column space</u> F = '0' ⇒ Font 7x5 F = '1' ⇒ Font 6x5 F = '2' ⇒ Font 7x7 F = '3' ⇒ Font 14x7 F = '4' ⇒ Font 8x5 F = '5' ⇒ Font 8x7 C should be between '0' and '9'
CTRL_W + 0 + XX + YY	Sets the text position XX – X coordinate (2 hexadecimal characters) YY – Y coordinate (2 hexadecimal characters)
CTRL_W + 'E'	<u>Begin/end expanded text</u>
CTRL_W + 'F'	<u>Begin/end flashing text</u>
CTRL_W + 'C'	<u>Begin/end compacted (proportional) text</u>
CTRL_W + 'V' + 00 + 00	<u>Begin sliding text</u> V = sliding speed (0=min / 9=max) Pay attention: the sliding text is displayed only in the last line of 8 pixels in height, then you can not use the font 14x7

CTRL\_W = 17 hexadecimal

In the following table there are some examples of how the decimal coordinates are converted into hexadecimal ASCII format (upper case letters)

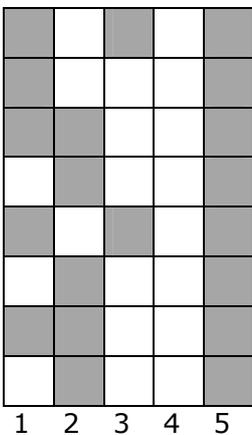
X and Y (decimal)	X and Y (hexadecimal)	X and Y (hexadecimal ASCII)
0, 0	0x00, 0x00	0x30 0x30 0x30 0x30
5, 3	0x05, 0x03	0x30 0x35 0x30 0x33
25, 19	0x13, 0x0D	0x31 0x33 0x30 0x44

### Controller for "Infostation" Display

<b>DETAILS:</b> Controller for "Infostation" Display: communication protocol.
---

## 7 Graphical page composition

Inside a graphical area, each pixel can be either switched on or off. The display can be described as composed by several line each of which is 8 pixels in height. The status of these 8 pixels is controlled by a single byte (the MSB is the higher pixel and the LSB is the lowest one). This byte is then encoded with 2 hexadecimal byte. For example:



The first column is controlled with the sequence 11101010 (1=on, 0=off). The relative hexadecimal value is EA, that is the correct encoding for this column.

Column 1 → 1110 1010 → "EA"

Column 2 → 0011 0111 → "37"

Column 3 → 1000 1000 → "88"

Column 4 → 0000 0000 → "00"

Column 5 → 1111 1111 → "FF"

To display the example image, the complete buffer to send is

```
CTRL_W 'G' 'E' 'A' '3' '7' '8' '8' '0' '0' 'F' 'F' CTRL_W 'G'
```