RFQ / TENDER

Tender No: HAM 44

Vendor No: 11001386

BOARD LIST
BOARD LIST
TRANSNET FREIGHT RAIL
PROCUREMENT DEPARTMENT
2000

Purchaser : Helena Mauger
Telephone : 011 584 0604
Fax Number: .

Please quote reference:
DD3/6000562873

Deliver to:
Company
TFR Pretoria
Supply Chain Services
34 Carlton Centre
0001 Johannesburg

Closing Date :11.01.2011
Validity Date :15.04.2011
RFQ No :6000562873

1. RETURN OF QUOTATION/S:

1.1 QUOTATION/S MUST BE SUBMITTED PUNCTUALLY AT 10:00 ON THE CLOSING DATE AND LATE QUOTATIONS WILL NOT BE CONSIDERED, AND MUST BE ENCLOSED IN A SEALED ENVELOPE WHICH MUCH HAVE INSCRIBED ON THE OUTSIDE:TENDER NO:HAM 44 TELEMETERS: CLOSING DATE & TIME 11 JANUARY 2011 AT 10:00

1.2 IF POSTED:

SECRETARY (TRANSNET ACQUISITION COUNCIL)
PO BOX 4244
JOHANNESBURG
2000

1.3 IF DELIVERED BY HAND:

SECRETARY (TRANSNET ACQUISITION COUNCIL)
GROUND FLOOR
21 WELLINGTON ROAD
PARKTOWN
2193

2. CONDITIONS:

2.1, ANY PURCHASE ORDER PLACED AS A RESULT OF YOUR QUOTATION WILL BE SUBJECT TO THE STANDARD TERMS AND CONDITIONS OF CONTRACT, FORM US7, (LATEST), GENERAL TENDER CONDITIONS, FORM CSS5 (LATEST) AND CONDITIONS MENTIONED HEREIN.

2.2,TENDERERS MAY OFFER AN EARLIER VALIDITY DATE, BUT THEIR QUOTATION MAY, IN THAT EVENT, BE DISREGARDED FOR THIS REASON.

2.3,TENDERERS ARE REQUIRED TO OFFER ONLY FIRM PRICES.

2.4, BEST DELIVERY TIME MUST BE OFFERED.

2.5,DISCOUNT (TRADE DISCOUNT) CASH DISCOUNT (CONDITONAL DISCOUNT) VALUE ADDED TAX (VAT) MUST BE SHOWN SEPARATELY.

2.6,TRANSNET RESERVES THE RIGHT TO NEGOTIATE PRICES AND COMMERCIAL ASPECTS AFTER THE CLOSING DATE OF THE QUOTATION.

DATE: ..... SIGNATURE OF TENDERER(S): ....

CONTACT PERSON: ..... TEL No: .....

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2.7,DIRECT DELIVERY INTIMATES DELIVERY BEING EFFECTED TO THE ACTUAL POINT OF SUPPLY AND SHOULD THEREFORE INCLUDE ANY TRANSPORTATION MODE DEEMED NECESSARY IN EXECUTING THIS METHOD OF DELIVERY BASIS IN ORDER TO MEET THE REQUIRED DELIVERY DATE.

TAX CLEARANCE CERTIFICATES:
The Regulations in terms of the Public Finance Management Act, 1999: Framework for Supply Chain Management as published in Government Gazette No. 25767 dated 5 December 2003, Clause 9 (1) (d), stipulates that the accounting officer or accounting authority of an institution to which these regulations apply must reject any bid from a supplier who fails to provide written proof from the South African Revenue that the supplier either has no outstanding tax obligations or has made arrangements to meet outstanding tax obligations.
Tenderers will be disqualified if a valid tax clearance certificate or written proof from the South African Revenue Service that supplier has made arrangements to meet outstanding tax obligations is not submitted with the tender.

BROAD BASED BLACK ECONOMIC EMPOWERMENT (BBBEE)

Transnet fully endorses and supports the Government's Broad-based Black Economic Empowerment Programme and it is strongly of the opinion that all South African Business Enterprises have an equal obligation to redress the imbalances of the past.
Transnet will therefore prefer to do business with local business enterprises who share these same values. Transnet will endeavour to do business with local business enterprises that possess a BBBEE "recognition level" of at least a level 5. Transnet urges Tenderers (large enterprises and QSE's - see below) to have themselves accredited by any one of the various Accreditation Agencies available, who do their BBBEE ratings in accordance with the latest Codes (i.e. those promulgated on 9 February 2007) and whose names appear on the present ABVA (Association of BEE Verification Agencies) - "List of Full Members" as displayed on the ABVA website (www.abva.co.za).
Although no agencies have, as yet, been accredited by SANAS (SA National Accreditation System), Transnet will, in the interim, accept rating certificates of tenderers who have been verified by any of the listed agencies.

Enterprises will be rated by such agency based on the following:

1. Large Enterprises (i.e. annual turnover >R35million:
   Rating level based on all seven elements of the BBBEE scorecard.

2. Qualifying Small Enterprises - (QSE) (i.e. annual turnover >R5million but <R35million:
   Rating based on any four elements of the BBBEE scorecard.

NB:

3. Emerging Micro Enterprises - (EME) (i.e. annual turnover <R5m) are exempted from being rated/verified:
   Automatic rating of Level 4 BBBEE irrespective of race of ownership, i.e. 100% BBBEE recognition
   Black ownership >50% or Black Women ownership >30% automatically qualifies as Level 3 BBBEE, i.e. 110% BBBEE recognition
   EME's should provide certified documentary proof of annual turnover (i.e. audited financials) plus proof of Black ownership if Black ownership >50% or Black Women ownership >30% from the EME's Auditor/Accounting Officer.

4. In addition to the above, Tenderers who wish to enter into a Joint Venture or subcontract portions of the contract to BBBEE companies, must state in their tenders the percentage of the total contract value that will be allocated to such BBBEE companies, should they be successful in being awarded any business. A rating certificate in respect of such BBBEE JV-partners and / or sub-contractor/s, as well as a breakdown of the distribution of the aforementioned percentage must also be furnished

In view of the high emphasis which Transnet places on Broad-based Black Economic Empowerment, Transnet will allow certain preference points for BBBEE in the evaluation of all responses. Depending upon the value of the ensuing business award (i.e. below or in excess of R2m), the 80/20 or 90/10 point preference systems will be utilized where BBBEE will count out of 20 or 10 respectively in the evaluation process.

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EACH RESPONDENT IS REQUIRED TO FURNISH PROOF OF THE ABOVE TO TRANSNET. FAILURE TO DO SO WILL RESULT IN A SCORE OF ZERO BEING ALLOCATED FOR BBBEE.

Turnover: Kindly indicate your company's annual turnover for the past year R_____

If annual turnover <R5m, please attach certified confirmation from your Auditor/Accounting Officer
If annual turnover >R5m please attach original or certified copy of accreditation certificate and detailed scorecard by an ABVA accreditation agency (registered as a "Full Member")

PAYMENT TERMS

The following payment terms will apply as from 1 October 2008.
All suppliers will be paid 30 days from receipt of month end statement, i.e. payment term F055.
All CIDB suppliers will be paid 21 days from date of invoice, i.e. payment term F057.

CONDITIONS:
This quotation is subject to the provisions of the Standard Terms and Conditions of Contract, Form US7, (Latest) and the General Tender Conditions, Form CSS5 (Latest) and any other standard or special conditions mentioned and/or embodied in the quotation request.

DATE: ..... SIGNATURE OF TENDERER(S): ....

RFQ / TENDER

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SCHEDULE OF REQUIREMENTS
TENDERERS SHOULD INSERT THEIR PRICE/S UNDER THE APPROPRIATE HEADINGS HEREUNDER.

IN THIS REGARD THE TENDERER'S ATTENTION IS DIRECTED TO PARAGRAPH 16 OF FORM CSS5 (LATEST).

NB. TENDERERS OFFERING GOODS FROM IMPORTED SUPPLIES MUST SUBMIT THEIR PRICES ON THE DELIVERY BASIS APPEARING UNDER COLUMN (C) OF THIS SCHEDULE OF REQUIREMENTS.

Item	Qty	Material	Description
00010	50		ORE LIne Telemeter Rear Unit

R.....
Each

Delivery Date: 24.03.2011

FULL DETAILS OF DESCRIPTION
50 Full AAR REAR Telemeters (EoT) for the ORE line. The telemeters are to be in accordance with Specification BBD 5420 version 2,Annexure A to BBB1776 for clarification, Annexure B to BBB1776 Version 3, Annexure-D to BBB1776 version 3, Telemeter requirements dated 3 December2010.Specification BBD 5420 Version 2 dated 29 June 2010, attached.

Compliance to all the SPECIFICATION LISTED ABOVE IS REQUIRED

00020	50		ORE line chargers

R.....
Each

Delivery Date: 24.03.2011

FULL DETAILS OF DESCRIPTION
All equipment to be in accordance with the Specification mentioned in item 1.COMPLIANCE TO ALL THE SPECIFICATIONS LISTED ABOVE IS REQUIRED.

00030	50		Chain & locks

R.....
Each

Delivery Date: 24.03.2011

FULL DETAILS OF DESCRIPTION
All equipment to be in accordance with all the Specifications mentioned in item 1. COMPLIANCE TO SPECIFICATIONS LISTED ABOVE IS REQUIRED.

00040	50		Pipe & Coupler

R.....
Each

Delivery Date: 24.03.2011

DATE: ..... SIGNATURE OF TENDERER(S): ....

RFQ / TENDER

BOARD LIST
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Item	Qty	Material	Description

FULL DETAILS OF DESCRIPTION
All equipment to be in accordance with all the Specification mentioned in item 1. COMPLIANCE TO ALL SPECIFICATIONS LISTED ABOVE IS REQUIRED.

00050 50 Keys & tools

R.....
Each

Delivery Date: 24.03.2011

FULL DETAILS OF DESCRIPTION
All items to be in accordance with all the Specification mentioned in item 1. FULL COMPLIANCE TO SPECIFICTION MENTIONED ABOVE IS REQUIRED.

00080 1 Delivery Charges to Saldanha

R.....
Each

Delivery Date: 24.03.2011

FULL DETAILS OF DESCRIPTION

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3. ADDITIONAL INFORMATION REQUIRED: (WHERE APPLICABLE)

3.1 THE FOLLOWING ADDITIONAL INFORMATION IS REQUIRED:

(A) TRADE DISCOUNT:.....

(B) PRICE/S FIRM: .....

(C) PRICE/S FIRM UNTIL ..... THEREAFTER SUBJECT TO REVIEW.

(D) DELIVERY DATE:

TENDERERS MUST FURNISH THEIR ACTUAL DELIVERY AND MANUFACTURNG PERIOD HEREUNDER NOTWITHSTANDING THE DELIVERY DATES SPECIFIED BY TRANSNET.

THE FOLLOWING MUST ALSO BE FURNISHED IN REGARD TO THE ABOVE:

1. PERIOD REQUIRED TO OBTAIN RAW MATERIAL. ....**(DAYS)**
2. MANUFACTURING PERIOD. ....**(DAYS)**
3. PERIOD TO TRANSPORT MATERIAL TO DESTINATION. ....**(DAYS)**

MATERIAL NO.	1.(PERIOD)	2.(PERIOD)	3.(PERIOD)

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freight rail

TECHNOLOGY MANAGEMENT
ANNEXURE *A* TO SPECIFICATION

SPECIFICATION BBB1776 VERSION 3
EOT PROTOCOL CHANGES AND CLARIFICATION

INTRODUCTION

TFR specification BBB 1776 for End of Train devices (EoT's / "Telemeters") makes use of the Association of American Railroads' standard S-5701 *as basis* for the communication protocols between the front and rear units, *but also* specifies additional and slightly different requirements as necessitated by TFR's unique / local circumstances.
This document therefore serves to define the extra two "GPS" data blocks required by TFR and to clarify minor changes and additions to AAR S5701 protocol details, in an attempt to minimize possible mis-interpretations.

A Message Format: Rear to Front Communication

1. "BASIC" Message Block per AAR S-5701 Para. 3.7.1.

1.1 The AAR message block shall be structured as per the format of AAR S-5701 3.7.1.

1.2 For clarification & confirmation, the fields for this block will be as follows:

Field	Bits	Compliance	Clarification
Bit Sync	69	AAR S-5701 2.3.6.1	Shall always start with a "0" bit, such as: bit 1 <010101 ..... 01010 > bit 69
Frame Sync	11	AAR S-5701 2.3.6.1	Send as specified MSD <01001000111> LSD
Chaining Bit	2	AAR S-5701 2.3.6.2	Send as specified
Device Battery Condition	2	AAR S-5701 2.3.6.3	Send as specified
Message Type	3	AAR S-5701 2.3.6.4	000 = Indicates positive air ***pressure*** 111 = Rear Brake ARM request 101 = Indicates ***vacuum***
Rear Unit Address Code	17	AAR S-5701 2.3.6.5	Send as specified
Rear Brake Pipe Status & Pressure	7	AAR S-5701 2.3.6.6	Unsigned binary integer Air Brakes : 0 to125 psig. Vacuum Brakes : 0 to -99 Kpa

Spare	1	Spare	**Not** to be used without TFR approval
% Battery Charge Used	7	AAR S-5701 3.7.2.3	Send % battery charge depleted. "0000000" = Fully charged (e.g. 12.8V) "1100100" = Fully depleted (e.g. 10.8V) Calculations must be based on 40hour standby.
Valve Circuit Status	1	AAR S-5701 3.7.2.1	To be used for RBA confirmation
Confirmation Indicator	1	AAR S-5701 3.7.2.2	Send as specified
Air Turbine / Generator Equipped	1	AAR S-5701 2.3.6.9	Send as specified *This only indicates "Air Turbine Equipped". Battery condition & -status must be used to determine whether Air Turbine has failed or not.*
Motion Detection	1	AAR S-5701 2.3.6.8	Send as specified
Spare	1	Spare	**Not** to be used without TFR approval
Marker Light Status	1	AAR S-5701 2.3.6.10	Send as specified
Basic Block BCH Code	18	AAR S-5701 2.3.6.11	Send as specified
Trailing Bit	1	AAR S-5701 2.3.6.12	Send as specified
Total Length	**144**		

NOTE: The blocks are sent starting with the Bit Sync and ending with the Trailing Bit, sending LSB first for each field as defined by the AAR.

Battery Status: The accuracy of "% battery charge depleted" which is transmitted, shall be such as to enable the CU to display the "Remaining Battery Hours" to an acceptable accuracy (+/- 10%).

When sent from a Repeater, the Trailing Bit shall be "0".

2. First Additional "GPS Latitude" Data Block per BBB1776:

Field	Bits	Description	Clarification
Bit Sync	69	AAR S-5701 2.3.6.1	Shall always start with a "0" bit such as: bit 1 <010101 ..... 01010> bit 69. The "0" bit shall be sent directly after the AAR block trailing bit.
Frame Sync	16	Use the AAR S-5701 2.3.6.1 frame sync by padding with "**01010**"	MSD > 0100100011**01010** > LSD
Chaining Bit	2	AAR S-5701 2.3.6.2	Send as specified
Manufacturer's Code	2	A 2 Bit Code "00" to identify the manufacturer	"00" = EMS Industries "01" = Inteletrack
Message Format	4	This is a 4 bit message "**0001**" identifying the block	**"0001" = Latitude block** "1000" = Longitude block New values to be approved by TFR.

Latitude (GPS)	32	Floating point number	MSD<XYYYYYYYYTTTTTTTTT TTTTTTTTTTTT>LSD X = 1 bit indicating Sign Y = 8 bit Exponent T = 23 bit Mantissa.
Speed (GPS)	8	Unsigned binary integer	0 to 255 km/h GPS speed e.g. MSD <00110111> LSD = 55km/h
Time (GPS)	8	Unsigned binary Integer	0 to 59 seconds GPS seconds e.g. 0 sec MSD<00000000>LSD to 59 sec MSD<00111011>LSD
CRC	16	16bit CCIT standard	X^16 + X^12 + X^5 + 1 Initial value = FFFFh CRC includes all bits between Frame Sync up to and including Time. Trailing bit excluded
Trailing Bit	1	AAR S-5701 2.3.6.12	
Total Bits	**158**		

NOTE: The blocks are sent starting with the Bit Sync and ending with the Trailing Bit, sending LSB first for each field.

All GPS data such as Latitude, Speed & Time are sent as zeros if there is no GPS fix.

3. Second Additional "GPS Longitude" Data Block per BBB1776:

Field	Bits	Description	Clarification
Bit Sync	69	AAR S-5701 2.3.6.1	Shall always start with a "0" such as: bit 1 <010101 ..... 01010> bit 69. The "0" bit shall be sent directly after the Latitude block trailing bit.
Frame sync	16	Use the AAR S-5701 2.3.6.1 frame sync by padding with "**01010**"	MSD > 0100100011**01010** > LSD
Chaining bit	2	AAR S-5701 2.3.6.2	Send as specified
Manufacture code	2	A 2 bit code "00" to identify the manufacturer	00 = EMS Industries 01 = Inteletrack
Message format	4	This is a 4 bit message "**1000**" identifying the block	MSD<0000>LSD = Latitude block **MSD<1000>LSD = Longitude block** New values to be approved by TFR.
Longitude (GPS)	32	Floating point number	MSD<XYYYYYYYYTTTTTTTTT TTTTTTTTTTTT>LSD X = 1 bit indicating Sign Y = 8 bit Exponent T = 23 bit Mantissa.
Odometer	16	Unsigned binary Integer	0 to 65536 meters since last reset MSD < 0000000000000001 > LSD

Odometer (Cont'd)			1. The Odometer is updated every second by calculating distance from the GPS speed. 2. If the time elapsed is between 1 and 10 seconds, the speed at that moment is multiplied by the seconds elapsed. 3. If the time elapsed is > 10 sec, the latest latitude & longitude coordinates are used to update the Odometer. 4. The Odometer only counts UP. 5. When the speed is zero software must filter out the "jitter" to prevent Odometer counting up / incrementing. 6. The Odometer must overflow to zero. 7. The Odometer must reset when the rear unit is horizontal
CRC	16	16 bit CCIT standard	X^16 + X^12 + X^5 + 1 Initial value = FFFFh CRC includes all bits between Frame Sync up to and including Odometer. Trailing bit excluded
Trailing Bit	1	AAR S-5701 2.3.6.12	Send as specified
Total Bits	**158**		

NOTE: The blocks are sent starting with the Bit Sync and ending with the Trailing Bit, sending LSB first for each field.

All GPS data such as Latitude, Speed & Time are sent as zeros if there is no GPS fix.

The Latitude and Longitude blocks shall always be attached to the AAR block.

B Message Format: Front to Rear Communication

1. The RBA message transmitted by the front (Cab) unit shall be per AAR S-5701 section 3.9, with special reference to paragraphs 3.9.6 & 3.9.7.

2. The Rear Unit must only respond to the Status Update Request (Paragraph 3.9.8.6.1) if AT LEAST ONE of the three 63 bit data blocks is received correctly (error free).

3. The Rear Unit must only execute the Emergency Brake Application (Paragraph 3.9.8.6.2) if AT LEAST ONE of the three 63 bit data blocks is received correctly (error free).

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TECHNOLOGY MANAGEMENT
ANNEXURE *B* TO SPECIFICATION

SPECIFICATION BBB1776 VERSION 3

INTERFACE REQUIREMENTS:

TELEMETER/EoT

and

TRAIN COMMUNICATION SYSTEM (TCS)

(or **EoT "Remote Head"**)

1 Scope

This document specifies the interfacing requirements between the Telemeter / End of Train (EoT) system Cab Units (CU) and the Train Communication System (TCS) when installed in TFR's locomotives.

This interface requirement arises from space limitations in the locomotive cab, thus necessitating the EoT CU to be installed in a suitable nearby location in the locomotive, and all its outputs / indications and controls being available on the display panel of the TCS, with the same "look & feel" as the actual CU.

OR

Alternatively (per clause 3.3.1.4c of specification BBB 1776), the EoT CU must be provided as a "split unit" with a separate compact "remote head" (external display & controls), which is connected to the CU via an Ethernet connection, as detailed in this specification.

*(Certain sections of this document refer more specifically to the interface/display aspects of the TCS, and are indicated by "**$**".)*

2 Applicable documents

BBB 1776 Telemeter / EoT specification
BBC 8282 Train Communication System (TCS) specification
BBC 4204 Triton Data Communication Protocol

3 Requirements

3.1 General Operational Requirements

3.1.1 Telemeter CU

- As soon as power is applied to the CU, it shall be in a "standby mode" so that its Ethernet port is active, and able to accept messages from the TCS / client.
- The CU shall have *at least* the following menu options available:
  - "Comms Test / Status Update"
  - "Acknowledge Current Alarm"
  - "Restart EoT CU"
  - "System / Diagnostics"
  - "Exit"
- The above commands shall be selectable from the TCS / client.
- The Menu shall be activated by pressing either the "UP" or the "DOWN" keys whilst the CU is in its normal state.

3.1.2 TCS / Client

- The TCS shall provide 3 buttons adjacent to each other, close to the default Telemeter / EoT display, to facilitate the 'UP', 'DOWN' and 'Select / Enter' functions.
- A button for selecting and de-selecting the "Pop Up" (Full) Telemeter display.
- An "Emergency" button for selecting the "Emergency Brake Application" option
- An audible alarm output, to facilitate audible alarms as described elsewhere.
- A Red visual indicator, to facilitate visual alarms as described elsewhere.

3.2 Indications ($)

3.2.1 DEFAULT DISPLAY

Under normal conditions, the minimum display on the TCS screen shall comprise

- Pressure (or Vacuum) value in kPa [3 digits]
- "Pressure" (or "Vacuum") and "kPa" indicators [plus "-" for vacuum]
- "Train Status" indication
  ("TRAIN OK" / "CAUTION" / "TRAIN ERROR" / "INACTIVE")

3.2.1.1 ALARM CONDITION

When an alarm is received (see also 3.3.3.2, DGI Frame, Field 4) the entire Default display background area must flash RED on and off, and the "Train Status" indication must be replaced with "ALARM"

3.2.1.2 The above is required in case the "Pop-Up" display below, does not occur for some reason or other.

3.2.2 "POP-UP" DISPLAY (FULL EoT CU DISPLAY)

The display shown below is required on the TCS

- Immediately after any alarm message is received or updated
- When an EoT event occurs which requires response from the train driver
- When requested by the train driver

It may be timed out after 20 seconds (i.e. revert to the Default Display). However, if an alarm condition still exists, an indication on the default display is required. (e.g. by flashing the "Pressure/Vacuum" or "Train Status" indications, or flashing the background, on the default display.)

The following parameters which are normally displayed on the EoT CU display, must be displayed in a similar manner, on the TCS display when required:

3.2.2.1 *Primary Display*

- Pressure (or Vacuum) value in kPa [3 digits]
- "Pressure" (or "Vacuum") and "**kPa**" unit indicator [plus "-" for vacuum]
- Remaining Battery Life (hrs) for both CU and RU [2 digits each]
- Symbols for a Battery and "External Power"
- High Visibility Marker (HVM) on RU indicated by (e.g.) an "F" when ON
- RU stationary/stopped or moving indicated by "S" or "M"
- Emergency Valve on RU Closed or Open indicated by "X" or "O"

3.2.2.2 *"Train Status" Display*

- Symbol for a Train as well as "Train OK" / "Caution" / " Train Error"
- Symbol for a Speedometer plus CU & RU speeds in km/h (max 3 digits)
- Distance (between RU & CU at start-up) [m] plus deviation [+/- m]
- ID (of RU) plus actual value [5 digits]
- Time (GPS) [hh:mm]
- Other parameters (Lat, Long, etc - Menu selectable – in the "Status" area)

The above parameters shall be displayed in the following manner:

<table>
<tr><td rowspan="3">587

Pressure kPa</td><td>F</td><td colspan="3">(TrainSymbol) TRAIN OK</td></tr>
<tr><td>S</td><td colspan="3" rowspan="2">CU (Speedo) RU
0 km/h (symbol) 0 km/h</td></tr>
<tr><td>X</td></tr>
<tr><td colspan="2">(Batt)
CU (ExtPwr) (Symbol) RU 40 h</td><td colspan="2">Distance
2215 m (+ 15)</td><td>ID: 12345
16:55</td></tr>
</table>

Illuminated Indicator Lights / LED's

- At least 1 (one) Red LED (or Icon) to visually indicate an Alarm Condition
  - Steady and Flashing display is required when applicable.

3.3 Controls ($)

Push Buttons / Switches

- 3 (three) push buttons:
  - Scroll UP
  - Enter / Select
  - Scroll DOWN
- The push buttons must be located to the *right* of the display as above, in the order mentioned.
- A button for selecting the "Pop Up" (Full) display.
- An "Emergency" button for selecting the "Emergency Brake Application" option (equivalent to the simultaneous pressing of the "UP" & "DOWN" buttons on the CU or "Remote Head").
  Emergency (Rear Brake) Application will be initiated by pressing this button. (Thereafter the message "Emergency Brake?" is displayed, so that if the ENTER button is pressed within 5 seconds, the brake function is activated.)

3.4 Data Communication Interface

3.4.1 Electrical interface:

With TCS or Remote Head:	Ethernet 10/100 Mbit/s TCP/IP	
Connectors:	RJ-45.	
IP address & Port:	192.168.0.**20** : 9760.	(EoT CU)
	192.168.0.**12**	(TCS)
Encoding Format:	ASCII or Binary	

3.4.2 Proposed Configuration

The EoT CU shall be set up as a TCP/IP server listening on port 9760.
As soon as the client (TCS) is connected to the server (EoT CU), it shall send status updates to the client as events occur on the server. It shall be possible for the client to interrogate the server for update information as required, or to evaluate or test the state of the connection. The CU server shall then automatically update the client on any status changes and/or alarm events.

It is important to note that the primary objective of this specification is to ensure provision of the complete control & displays of the actual EoT Cab Unit (CU) front panel remotely from the TCS screen & controls (or "Remote Head"), without duplicating the CU functionality itself.

3.4.3 Messages (Frames)

Messages between server and client shall be as follows:

Three (3) frames from the Telemeter Cab Unit (server) to the TCS or Remote head (client):

- Frame '**A**' (ID A): STATUS Frame (Telemeter Data)
- Frame '**B**' (ID B): DGI (Differential Graphic Information)
- Frame '**C**' (ID C): Acknowledgement of Frame 'X' from TCS (client)

Two (2) frames from the TCS or remote head (client) to the Telemeter Cab unit (server):

- Frame '**X**' (Id X): EVENT Frame
- Frame '**Y**' (ID Y): Acknowledgement of Frame 'A' or 'B' from server.

- Under normal conditions a Status message (Frame 'A') as well as a Differential Graphic Interface (DGI) message (Frame 'B') must be sent by the EoT CU to the TCS each time it receives an update from the RU, whereupon the TCS must update its display, and acknowledge receipt of each of the update messages. Frame 'A' must be sent first and acknowledged, where-after Frame 'B' must be sent.

- If the CU does not receive an update from the RU within 65 seconds as per AAR S-5701, after 66 seconds it must update the TCS / client with its current status.

- Should the TCS not receive an update within 66 seconds, an alarm shall be sounded and a "Data Link" alarm displayed on the screen.

3.4.3.1 Status Frame A (ID A): Server → Client

Frame A is implemented as a comma delimited record (ASCII Frame)

For Example:

**, A, 10123,587, Train OK, Ext Pwr,45,80, 85,2215, Y,-15, 16:45,F,M,X,S 26 07' 36. 8",E027 5' 15.0",S 26 07' 36.8",E027 5' 15.0", 1, 1234,COMMS ALM,5A3C,&, CR, LF.*

Field	Abbreviation	Characters	Description	Example
1	STX	1	Start (Asterisk)	*
2	FRM_ID	1	Frame ID (A)	A
3	RU_ID	5	Matched/Paired Rear Unit ID	10123
4	PRESSURE	3 (Signed)	Brake Pipe Pressure (kPa)	587 or -58 or ERR
5	TR_STATUS	16 (Max)(String)	Train Complete Status	e.g. TRAIN OK
6	CU_PWR	16 (Max)(String)	CU Power Status	Ext Pwr
7	RU_PWR	2	RU Bat Remaining (hrs)	45 or --
8	CU_SPEED	3 (max)	CU Speed (km/h)	80 or --
9	RU _SPEED	3 (max)	RU Speed (km/h)	85 or --

10	DSPLM	4 (max)	CU to RU Displacement (m)	2215 or ----
11	DISPL_STATUS	1	See note 'A' below	P
12	DEVIATION	4 (Signed)	Distance Deviation (+/- m)	-15 or +20 or --
13	TIME	5 (String)	Time @ Cab Unit (hh:mm)	16:45
14	HVM	1	HVM Status (ON, OFF or ?)	**F,O** or blank
15	RU_MOV	1	RU Movement Status	M or S or blank
16	RU_EMV	1	Emergency Valve Status	X or O or blank
17	RU_LAT	16 (Max)(String)	RU Latitude (Deg Min [6 decimals])	S 26° 07,123456' or --
18	RU_LONG	16 (Max)(String)	RU Longitude (Deg Min [6 decimals])	E027° 5,123456' or --
19	CU_LAT	16 (Max)(String)	CU Latitude (Deg Min [6 decimals])	S 26° 07,123456' or --
20	CU_LONG	16 (Max)(String)	CU Longitude (Deg Min [6 decimals])	E027° 5,123456' or ---
21	SPARE	1	For Future Use	-
22	PKT_CNT	3 (max)	Packet Counter (max 255)	0 to 255
23	SPARE	16 (Max)(String)	Possibly for Logging Data	-
24	CRC	4	CCITT CRC16 (Polynomial)	5A3C
25	ETX	3	End	&, CR, LF

Note A

Field 11 (DISPL_STATUS) character is defined as

'**P**' (Pop-Up): Must "pop up" the EoT CU display on the TCS screen, and flash the RED LED/Icon once, when an EoT event occurs which requires train driver response (e.g. "ARM NOW?")

'**A**' (Alarm): Must "pop up" the CU display on the TCS, Flash (~1Hz) the RED LED/Icon and flash RED the background on Default display, as well as sounding the audible alarm/buzzer for 3 seconds.

'**O**' (OK) (no Alarm): Must flash RED LED/Icon *once* on TCS display, "refresh" default and pop-up display (if active), and cancel any existing alarm/flashing.

3.4.3.2 ***DGI*** *(Differential Graphic Information)*
Frame B (ID B)*(Binary Frame)****: Server → Client***

In this Frame 'B' the data is packaged in multiples of rows (i.e. horizontally).

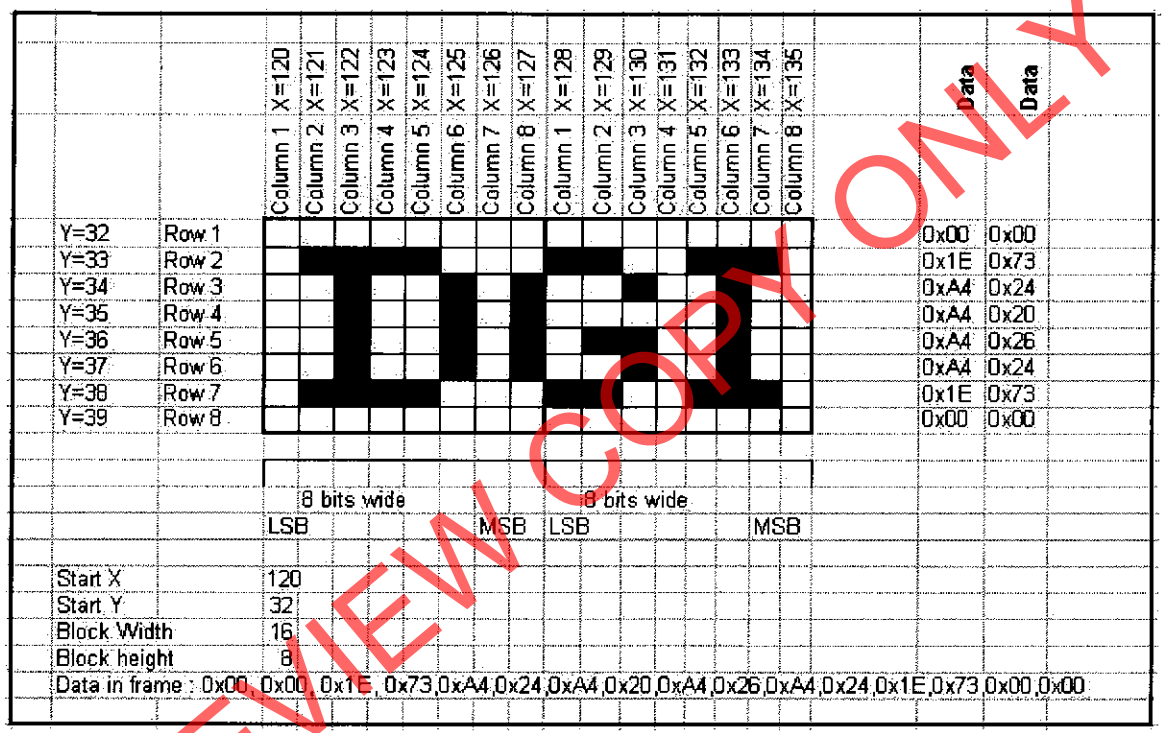
Field	Abbreviation	Bytes	Description	Example
1	STX	1 byte	Start (Asterisk)	*, 0x2A, d:042
2	FRM_ID	1 byte	Frame ID : **B**	B, 0x42, d:066
3	Packet Length	2 bytes	Packet Length Typical : (Block width * (Block Height/8)) + 9	Variable Min 13, Max 1933
4	Output Status	1 byte	Bit 0 : ALARM LED On/Off Bit 1 : Led 2 On/Off Bit 2 : BUZZER On/Off Bit 3 : Flash Led 1 On/Off Bit 4: Flash Led 2 On/Off Bit 5 : Spare Bit 6 : Spare Bit 7: LCD backlight Intensity Bits 0 to 2: 1 = ON and 0 = OFF	LSB : Bit 0 For bit 7, if '1' then display backlight is at max. brightness, & if '0' then display backlight is at standard intensity.
5	Packet Counter PKT_CNT	1 byte	Packet counter Increment from 0 to 255 and overflow to 0 on each packet sent by the EoT CU	0x00 to 0xFF
6	Start X Position	1 byte	In LCD screen pixels Left = 1, max = 240	Top LHS = 1,1
7	Start Y Position	1 byte	In LCD screen pixels Top = 1 , max = 64	Bott. RHS = 240,64
8	Block width	1 byte	In Pixels, max = 240	
9	Block height	1 byte	In Pixels, max = 64	
10	DGI Information	0 to 1920 bytes	Each byte represents 8 pixels on the LCD screen. LSB of byte is Top (or Left) of LCD and MSB is below (or to right of) it. One byte represents 8 columns of data, 1 bit in height. See examples below	
11	CRC	2 bytes	CCITT CRC16 (Polynomial) Standard TFR CRC	Calculated from Field 1 (STX) up to field 10 (DGI information) (inclusive)
12	ETX	3	End	&, CR, LF

Packet length: Minimum 15 bytes if zero DGI is included. (Including *, CR, LF)

The TCS or CU remote display will always acknowledge this frame 'B' received from the EoT CU with the Acknowledge frame 'Y'.

Sample implementation for DGI data for Horizontal data in frame 'B':

Each bit represents 1 pixel on the Telemeter CU LCD screen, or screen buffer.
To display or update the text 'DGI' with an empty space at both sides roughly in the middle of the screen (based on a 240 x 64 bit LCD), the data will appear as follows:



		Column 1 X=120	Column 2 X=121	Column 3 X=122	Column 4 X=123	Column 5 X=124	Column 6 X=125	Column 7 X=126	Column 8 X=127	Column 1 X=128	Column 2 X=129	Column 3 X=130	Column 4 X=131	Column 5 X=132	Column 6 X=133	Column 7 X=134	Column 8 X=135	Data	Data
Y=32	Row 1																	0x00	0x00
Y=33	Row 2																	0x1E	0x73
Y=34	Row 3																	0xA4	0x24
Y=35	Row 4																	0xA4	0x20
Y=36	Row 5																	0xA4	0x26
Y=37	Row 6																	0xA4	0x24
Y=38	Row 7																	0x1E	0x73
Y=39	Row 8																	0x00	0x00
		8 bits wide								8 bits wide									
		LSB						MSB		LSB						MSB			
Start X		120																	
Start Y		32																	
Block Width		16																	
Block height		8																	
Data in frame : 0x00, 0x00, 0x1E, 0x73, 0xA4, 0x24, 0xA4, 0x20, 0xA4, 0x26, 0xA4, 0x24, 0x1E, 0x73, 0x00, 0x00																			

Note that the block width will always be multiples of 8 bits.

3.4.3.3 Acknowledge Frame C (ID C): Server → Client.

Field	Abbreviation	Bytes	Description	Example
1	STX	1 byte	Start (Asterisk)	*, 0x2A, d:042
2	FRM_ID	1 byte	Frame ID : C	C, 0x43, d:067
3	Packet Length	2 bytes	Number of Bytes to follow	This packet has a fixed length to follow of 5 bytes 0x05 (excluding CR, LF)

4	ACKNW	1 byte	0x58: 'X' = Event frame from TCS/Remote head. or Any other future message from TCS/remote head to TCS	
5	Packet Counter PKT_CNT	1 byte	Increment from 0 to 255 and overflow to 0 on each packet sent by the HOT or TCS to the EoT CU	0x00 to 0xFF
6	CRC	2 bytes	CCITT CRC16 (Polynomial) Standard TFR CRC	CRC is calculated from field 1 (STX) up to field 5 (PKT_CNT)
7	ETX	3 bytes	End of Packet.	&, CR, LF

Total Packet length: Always 11 bytes (Including *, CR, LF)

3.4.3.4 EVENT Frame (ID X): Client → Server

Field	Abbreviation	Bytes	Description	Example
1	STX	1 byte	Start (Asterisk)	*, 0x2A, d:042
2	FRM_ID	1 byte	Frame ID : X	X, 0x58, d:088
3	Packet Length	2 bytes	Number of Bytes to follow	This packet has a fixed length to follow of 5 bytes 0x05 (excluding CR, LF)
4	Button Status BT_ST	1 byte	Bit 0 – Up button pressed Bit 1 – Enter/Select button pressed Bit 2 : Down button pressed Bit 3 : Emergency function Bit 4 : Update Request / Query Bit 5 : Spare bit Bit 6 : Spare bit Bit 7 : spare bit Where 1=pressed, 0=not pressed.	0x00 to 0x08
5	Packet Counter PKT_CNT	1 byte	Increment from 0 to 255 & overflow to 0 on each packet sent by the TCS or R/H to the EoT CU.	0x00 to 0xFF
6	CRC	2 bytes	CCITT CRC16 (Polynomial) Standard TFR CRC	CRC is calculated from field 1 (STX) up to field 5 (PKT_CNT) (inclusive)
7	ETX	3 bytes	End of Packet.	&, CR, LF

Total Packet length: Always 11 bytes (Including *, CR, LF)

3.4.3.5 Acknowledge Frame (ID Y): Client → Server

Field	Abbreviation	Bytes	Description	Example
1	STX	1 byte	Start (Asterisk)	*, 0x2A, d:042
2	FRM_ID	1 byte	Frame ID : Y	Y, 0x59, d:089
3	Packet Length	2 bytes	Number of Bytes to follow	This packet has a fixed length to follow of 5 bytes 0x05 (excluding CR, LF)
4	ACKNW	1 byte	0x41 : 'A' = Status frame from CU **or** 0x42 : 'B' – DGI frame from CU **or** Any other future message from CU to TCS	
5	Packet Counter PKT_CNT	1 byte	Increment from 0 to 255 and overflow to 0 on each packet sent by the HOT or TCS to the EoT CU	0x00 to 0xFF
6	CRC	2 bytes	CCITT CRC16 (Polynomial) Standard TFR CRC	CRC is calculated from field 1 (STX) up to field 5 (PKT_CNT) (inclusive)
7	ETX	3 bytes	End of Packet.	&, CR, LF

Total Packet length: Always 11 bytes (Including *, CR, LF)

3.4.3.6 Illustrative Frame Flows

Action	TCS/Remote head (Client)	Data Direction	CU Telemeter (Server)	Note
TCS Starts Up	Connect to CU (server) IP 192.168.0.20:9760	--→		
	Send Event Frame X Field 4.4 Update Request / Query	--→		TCS requests updated screen and status info.
		<---	Send Event ACKNW Frame C, Field 4='X'	CU Acknowledges Event frame X
			Delay....	

	Sequence AB		←--	Send Status Frame 'A'	Send Status information
		Send Acknw Frame 'Y' with Field 4='A'	--→		TCS Ackn's Status Frame 'A'
			←--	Send DGI Frame 'B'	Send DGI information
		Send Acknw Frame 'Y' with Field 4='B'	--→		TCS Ackn's DGI Frame 'B'
Normal operation, All communications OK, Telemeter RU Updates CU twice a minute. With a CU update from RU, the CU updates the Status and DGI frames.					
			←--	Send Status Frame 'A'	Send Status information
		Send Acknw Frame 'Y' with Field 4='A'	--→		TCS Ackn's Status Frame 'A'
			←--	Send DGI Frame 'B'	Send DGI information
		Send Acknw Frame 'Y' with Field 4='B'	--→		TCS Ackn's DGI frame 'B'
Driver presses any Telemeter button on TCS screen. (e.g. Enter/Select button)					
		Send Event Frame X Field 4, bit 1 = 1 (Enter/Select button pressed)	-→		
			<--	Send Event Acknw Frame C, Field4='X'	CU Ackn's Event frame 'X'
If CU display changes OR the Enter button causes a change in data value, sequence AB follows. Else no DGI or Status is sent.					
Driver presses a Telemeter button on TCS screen. (e.g. Enter/Select button) AND there is a communication delay or problem on the data link between the TCS and CU					
		Send Event Frame X Field 4, bit 1 = 1 (Enter/Select button pressed)	-→		
No Acknw is sent: Triton Hub problem					
		Wait 1 Second for Acknw, if not received, send again 2nd time.			
		Send Event Frame X Field 4, bit 1 = 1 (Enter/Select button pressed)			
		Wait 1 Second for Acknw, if not received, Send again 3rd time.			
TCS / Remote Head receives no frames from Telemeter CU for 66 seconds.					
		TCS must display 'Data Link Error.'			

3.4.4 Alarm Messages, Indications & Sounds (As per BBB 1776)

- When an alarm occurs on the EOT system, the CU must immediately send an alarm message to the client via an updated Status Frame (ID **A**) and DGI Frame (ID **B**).
  The TCS / client must then immediately "pop-up" the telemeter screen (per 3.1.3) on its display.

- The Red (LED) indicator must flash and an audible alarm must sound when
  - the brake pipe pressure drops below 400 kPa (or less than –51 kPa for a vacuum train) OR
  - a Train Status alarm occurs ("Caution" or "Train Error")
  - a Comms Alarm is received from the CU
  - the cab- or rear unit battery life drops below 25% or 10 hours of normal operation.

- In the case of a "Train Error" alarm, the audible alarm must latch ON until acknowledged by the train driver.

- Each time a status update is received, the red indicator must flash once, and a short audible beep must be sounded.

3.4.5 Emergency Rear-End Brake Operation

In order to minimize the possibility of accidental / unintended operation, this function shall preferably not be a single button operation. The required operation shall be

1: Press the Emergency button on the TCS

A message "*Emergency Brake?!*" must then be displayed

2: ENTER within 5 seconds.

3.4.6 Error Checking

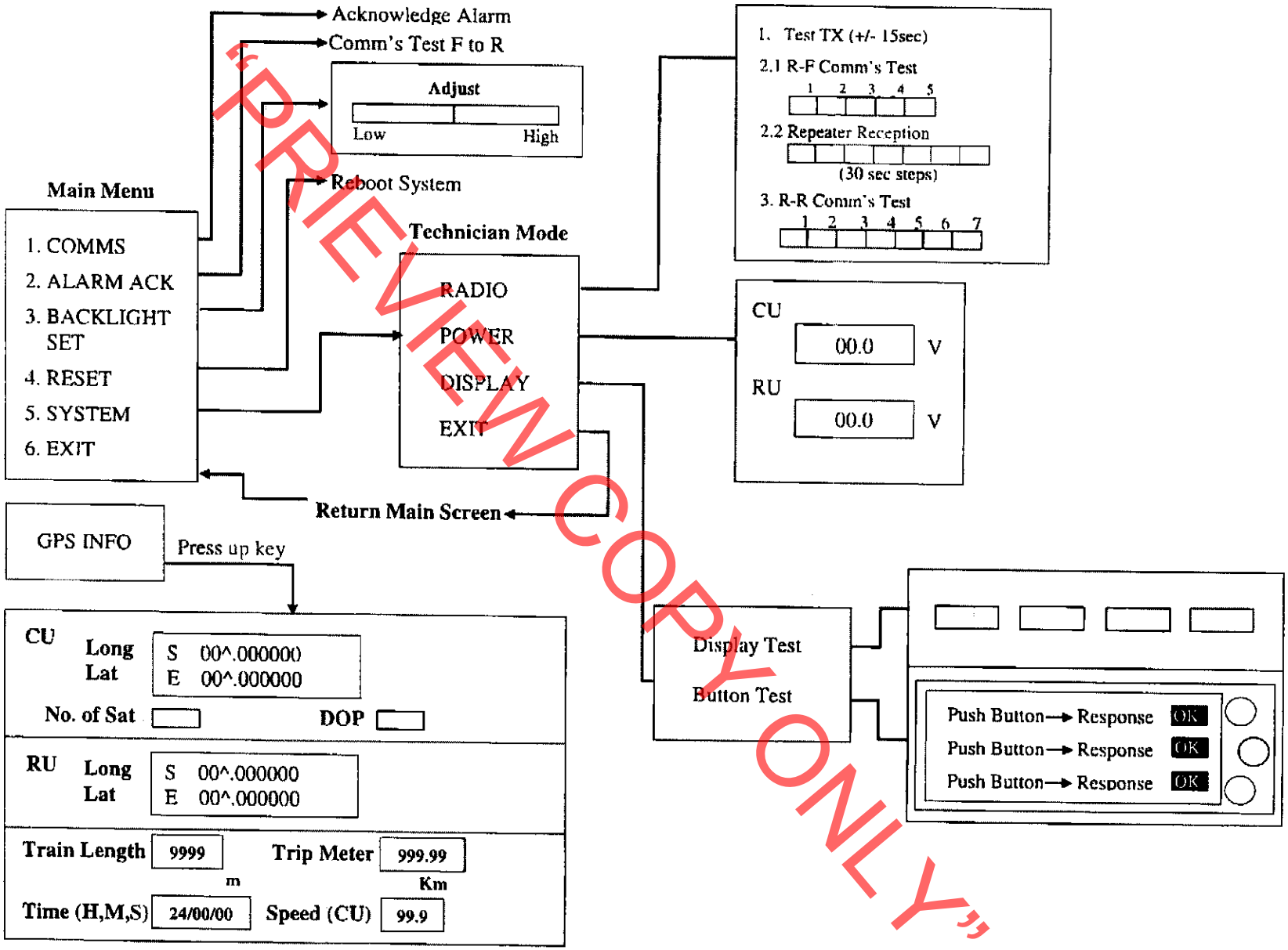
- CRC Error checking is required between the EoT CU and the TCS / remote display, to ensure that trustworthy information is displayed to the train driver.

4 Corrections of Errors by EoT / TCS Suppliers

4.1 Suppliers are welcome to point out any possible errors or omissions in this specification, and clearly propose how these could be corrected, in order to clarify any possible misunderstandings.

5 Acknowledgements

Acknowledgements to both Messrs EMS Industries and Inteletrack for their proposals and constructive inputs into this document.



EOT Menu Structure_April_10

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CAPITAL PROGRAM

Annexure-D to BBB1776 version3

Author: N Breytenbach *Nick Breytenbach*

Date: 15 July 2010

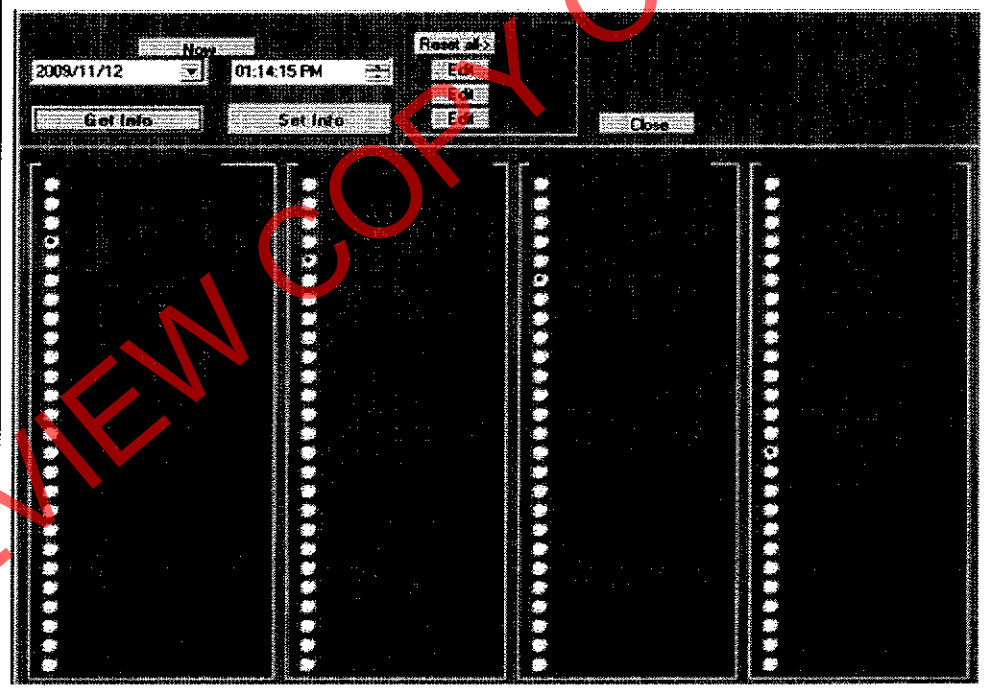
Circulation Restricted To:

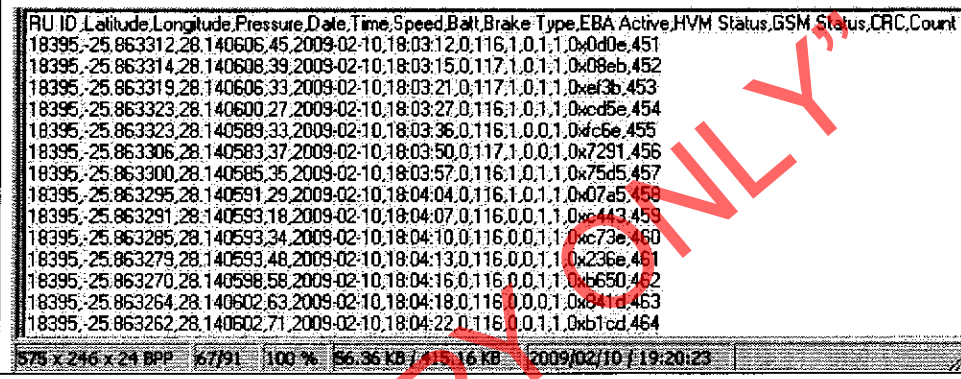
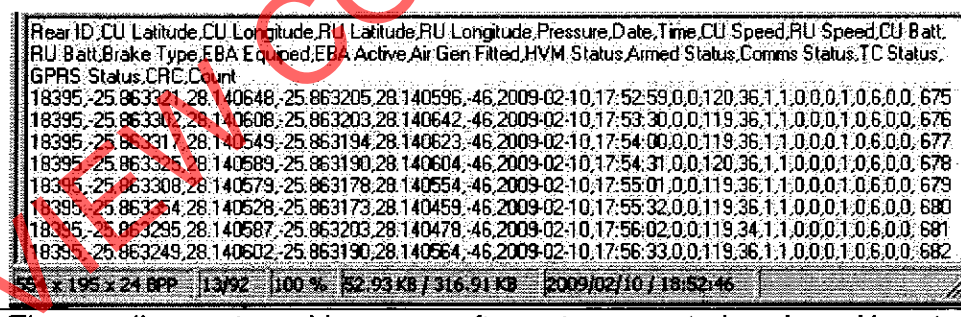
Transnet Freight Rail
Transnet and Relevant Third Parties
Unrestricted

CONTENT

1. SCOPE.

This serve as additional information to **BBB1776 Version 3.**

Function	Information
1. ICASA approval radio	The supplier must submit the ICASA approval certificate for his radio before TFR will accept any deliveries.
2. Setting the parameters.	All parameter settings in the CAB and REAR unit must be via the serial port in standard AT commands or with supplier specific software.
3. Service record rear unit.	The service date and time and fault code are generated as follows. The first code = R. ➢ The supplier can supply software to easy the code generation and updating the REAR unit or. ➢ An AT command set can be used which must be documented clearly in the documentation. ➢ The service date and time and three fault codes must be stored and retrieved at any time. ➢ This information is send via the GPRS. 
4. REAR GPS & GPRS indication.	The supplier must implement a display method to determine at any time if the REAR GPS has satellite lock and if the GPRS successfully send data to the server.
5. REAR matching status.	It is desirable that the REAR unit indicated when matched to the CAB unit and if the Valve is ARMED. Suppliers must look into methods to provide such information.
6. Rear brake valve in Vacuum mode.	No arming and no brake valve activation must be possible in Vacuum mode.
7. Disable of CAB units.	The CAB unit must shut down after 30 "COMMS FAIL" tries. The CAB unit will disable the RBA "ARMING" and stop RF transmission. To re-activate, a new CAB unit start up sequence must be initiated.

8. TCS Interface software.	Must be standard in all CAB units. See **Annexure-B**
9. Interface to remote head.	Must be standard in all CAB units. See **Annexure-B**
10. Manual switched of off REAR unit	The REAR button must be hold in for at least 30 sec before the unit switched off.
11. Logging of REAR unit data.	Typical data logged. The supplier must provide an AT command set where by the REAR unit must output the data in a comma delimiter file format via the serial port. At least 5 days of info must be stored. 
12. Logging of CAB unit data.	Typical data logged. The supplier must provide an AT command set where by the CAB unit must output the data in a comma delimiter file format via the serial port. At least 5 days of info must be stored. 
13. Fix repeater GPRS connection.	The supplier must provide server software to connect, decode and insert the message information in an Oracle database. TFR only define the table. The server software must support at least the following. 1. Changing the repeater server IP remotely. 2. Accommodate and changing two APN names on the repeater remotely 3. Changing the repeater port connection remotely. 4. Request and repeater update remotely. 5. Revert back to the previous settings if remote changes fail. The proposed table look like this which will be finalised with the successful tenderer. **Datetime**: Reporting date & time **Charging**: Are the unit charging **UnitSerNo**: Unit serial number. **Vswr**: Unit vswr status **Longitude**: GPS Longitude

	Latitude: GPS latitude **RearRepIDI**: Rear idi of unit repeated. **Direction**: Was it a front to back or rear to front repeating Triggers: 1. When request remote update. 2. Send one message when any Eot enters the repeater area and trigger a repeater function. 3. When the charging fails. 4. Once every hour. Notes: The unit can send back the last repeated IDI if another EoT was not causing the trigger. TFR only define the table structure. The supplier must implement a suitable and reliable protocol using the least data over the air via his server software with above functions. The server must support up to 100 connections and run on Window XP.
14. Accelerometer. (For RFI)	The fine tuning of the accelerometer alarm levels will be determined by experiment. 1. Ruff handling:(Kpa=0 & Tilt = horizontal. ➢ Drop > 500mm (Scale 01h-ffh with 500mm level at 80h) ➢ Or what ever the supplier recommend as practical and save for his equipment. ➢ Measure any of the three axes. 2. On the Buffer:(Kpa > 50 or Kpa > -10 & Tilt = upright. Moving >) ➢ Vertical : With a vertical variation of 1-50mm over 1.5m distance. (scale 01h – ffh with 50mm at AAh) ➢ Side ways: With a sideway variation of 1-100mm over 3m distance. (scale 01h – ffh with 100mm at AAh) ➢ Horizontal front to back: None

End of document.

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TECHNOLOGY MANAGEMENT

SPECIFICATION

TELEMETER / END-OF-TRAIN (EoT) EQUIPMENT FOR AIR- AND VACUUM BRAKE TRAINS

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Circulation restricted to: Transnet Freight Rail (Technical & Operations)
Relevant third parties

1. SCOPE

1.1 Identification

Telemeter / End-of-Train (EoT) equipment for use on Spoornet's air- and vacuum-braked trains.

1.2 System Overview

The primary function of the telemeter equipment is to

- automatically monitor and display to the train driver, train brake-pipe vacuum or air-pressure at the last vehicle, and to raise an alarm as soon as the reading moves beyond specific levels, in order to enhance safe train handling & operation.

However, additional functionality, such as Emergency Brake Application from the rear of the train, an indication of "Train Complete", automatic logging of performance & alarms, etc, is also required.

1.3 Document Overview

This document defines Transnet Freight Rail's requirements for telemeter equipment (per 1.2 above) on air- and vacuum-brake trains. Additional functionality required (e.g. Emergency Rear-End Braking, Train Status function, etc) is also specified, as well as optional extra functionality (e.g. GPS tracking via GPRS, Repeater function), which is/are to be requested for the specific tender.

2. APPLICABLE DOCUMENTS

The following specifications, standards and drawings of the exact issue form a part of this specification to the extent shown herein. In the event of conflict between this and the relevant document, the contents of this specification shall be considered a superseding requirement.

2.1 Transnet Documents

CSE-1159-001 CAT E48	Standard specification for documentation for signals equipment.
CSE-1154-001 CAT E48	Environmental specification of Transnet Freight Rail railway signalling systems.
BBB0947 (Latest issue)	General Ergonomic Guideline for the Design of Visual Display Man – Machine – Interfaces

2.2 External Documents

Association of American Railroads: Standard S-5701. (Latest issue)	AAR Manual of Standards & Recommended Practices: Railway Electronics: END-OF-TRAIN COMMUNICATIONS (Reaffirmed: 1994; Reprinted: 2000; Revised: 2002, 2007)
Cenelec EN 50121-3-2	Railway Applications: Electromagnetic compatibility, Rolling stock apparatus.
Cenelec EN50155	Railway Applications: Electronic equipment used on Rolling Stock

2.3 Compliance

Certain requirements (e.g. the requirement for a standard "air interface protocol" per AAR Standard S-5701, Emergency Brake Application from the Rear) are *mandatory*, whilst others are *optional* (e.g. GPS Tracking via GPRS), or *desirable* (e.g. 4.2.4: antenna condition). Consequently, *tenderers are required to provide a detailed clause-by-clause Statement of Compliance*, and *preference will be given to offers which comply to the greatest degree with these requirements*.

3. REQUIREMENTS

3.1 System

3.1.1 A system is required to automatically and continuously monitor brake-pipe pressure or vacuum levels measured at the brake pipe of the last vehicle on a train, and to provide the train driver with accurate readings on a regular basis. The system must automatically alert the driver when the pressure (or vacuum) levels move outside the limits as specified elsewhere, and also in case of low battery power and/or other alarms or telemetry system failure of any nature. The basic system is to be composed of two units: A Master- or Rear Unit (RU/EoT) mounted on the rear buffer of the last wagon of a train, and a Display- or Cab Unit (CU/HoT) mounted in the train driver's locomotive cab.

3.1.2 Additional functionalities are also required: Some *mandatory* (e.g. Emergency Brake Application from the Rear Wagon, a "Train Status" function [requiring GPS in the CU and RU], Rear End Illuminated Marker / Beacon, Logging of Performance & Alarms), some *optional* (e.g. a Repeater Function, GPS Tracking via GPRS, etc).

Further details will be provided in the specific tender, where applicable. (Refer: 7. NOTES)

3.2 Interfaces

3.2.1 Over the Air: Between RU & CU

3.2.1.1 In order to enable operation between CUs and RUs from different suppliers, communication between the CU and RU shall be per AAR S-5701, also utilising continuous phase FFSK, except that the transmission frequency shall be 142,0125 MHz, for both Rear-to-Front *and* Front-to-Rear communication. Radio equipment shall transmit 5 Watts maximum, & be I.C.A.S.A. approved.
3.2.1.2 In order to accommodate the additional functionality as discussed in this specification, additional message data blocks need to be transmitted after those per AAR S-5701. The message format / structure is defined in Annexure *A*.
3.2.1.3 Compatibility with previous equipment from the same supplier: Functionality to allow a supplier's CU's to operate with previous "non-AAR" versions from the same supplier, may be requested for specific tenders as an interim phase. In such cases, the previous 4-digit RU ID number should be used to select this functionality.

3.2.2 External: Via Serial and Ethernet Ports

3.2.2.1 External serial ports are required on both cab- and rear units, to facilitate inputs and outputs via a standard international data communication protocol (e.g. the AT command set). Programming, re-programming / configuration of both CU & RU as well as downloading of logged data must be possible via the serial port. On the CU, all controls and outputs must be available on the serial port. If the RU is provided with an external display of vacuum / pressure readings and battery voltage, the serial port is still required for programming purposes, but need not be located externally.

3.2.2.2 Similarly, an Ethernet port is required on the CU for similar functionality as above, via a network on the locomotive.

3.3 Equipment

3.3.1 General

3.3.1.1 The equipment should comprise a complete system that includes two separate units, the cab unit (CU/HoT) and rear unit (RU/EoT) including antennas, connectors, couplings, mounting brackets, power supplies, etc.

3.3.1.2a The CU and RU must be able to communicate with each other, and contain the necessary components including (as applicable) power source, display unit for status and alarm messages, and associated electronic equipment.
3.3.1.2b The RU must also contain antennae, pressure and vacuum transducer/s and associated electronic equipment.

3.3.1.3 The RU must be designed as *portable* equipment, as lightweight and small as possible, which may easily be carried by one person by means of a suitable handle.

3.3.1.4 The CU is required to be available in 3 hardware options:

3.3.1.4a A *portable* version, as lightweight and small as possible, with built-in antenna, which may easily be carried by one person by means of a suitable handle.

3.3.1.4b *A second, "built-in" option is required*, to be powered from the 13,6 V supply available in the loco cab, and to operate with an existing external antenna installed on the locomotive. See 3.2.2 for physical dimensions.

3.3.1.4c *A third, "split built-in" option for the CU is also required*, powered from the 13,6 V supply available in the loco cab, operating with the existing external antenna installed on the locomotive, and with an *extra* display "split" from the rest of the CU, for applications where the mounting space in the loco cab is very limited. This option thus would comprise option 3.3.1.4b above, plus an extra "split/remote" display or "Remote Head". Connections between the two CU components shall cater for cable lengths of up to 10 (ten) metres, and shall be via a standard Ethernet 10/100 Mbit/s TCP/IP connection with RJ-45 connectors. *(Refer to Annexure B).*

3.3.1.4d *A fourth, "external display" option for the CU is also required*, powered from the 13,6 V supply available in the loco cab, operating with the existing external antenna installed on the locomotive, but capable of functioning with a separate external display already installed in the loco cab, also for applications where the mounting space in the loco cab is very limited.. Connection / communication shall be possible via a standard Ethernet connection as above. *This option should preferably be incorporated in the "built-in" option in 3.3.1.4b above, thus allowing the CU to be mounted "out of sight" whilst interfacing with an external display (Refer to Annexure B).*

3.3.1.5 All software must be installed on non-volatile reprogrammable (via the external serial port) media (e.g. "flash RAM"). *Non-reprogrammable media such as EPROM's are NOT acceptable.*

3.3.1.6 The equipment housing must be totally splash-proof and impervious to the ingress of dirt or moisture. The rear unit must water-resistant & be suitable for mounting on the rear couplers / buffers of the train.

3.3.1.7 The equipment must be able to withstand very rough handling and / or tampering and must therefore be robustly constructed, particularly with respect to the outer case, antenna, control knobs, battery plugs and all protruding external fittings.

3.3.1.8 If connectors for charging the internal batteries and for an external DC supply are required, these must be of a high quality military standard. Similarly, antenna connectors are to be of the "TNC", "N" or "UHF" (PL259) type, SMA for GSM. (A 13,6V isolated DC supply from which 1 Ampere is continuously available, is provided in locomotive cabs.)

3.3.1.9 As far as possible, calibration and fault diagnosis on the units must be automated.

3.3.2 Cab unit

3.3.2.1 The CU shall have the following controls and indications: (Refer also to Annexure *B*)

- Three buttons (Scroll Up, Select/Enter, Scroll Down) to enable the following functions: Switch cab unit ON or OFF, Scroll through the various menu options: e.g. Display the unit's ID number & software version, pair the CU with a RU and display battery statuses, GPS information, Comm's Test / Status Update, etc.

- In the interests of improved MMI, a graphic display is a requirement, capable of dynamic character size adjustment and displaying of icons, etc. Display size to be 240 x 64 pixels.

3.3.2.2 The display must indicate the brake pipe air pressure or vacuum status received from the rear unit, as well as battery status of both units. Any system failure as mentioned in section 3.3.3.4 and 4.4.3 must be detected and indicated (e.g. by a red indicator light and visible flashing of the display and an audible alarm).

3.3.2.3 The display must be of adequate size to provide characters large enough to ensure good legibility of readings from the locomotive driver's seat position under all cab lighting conditions ranging from direct sunlight to night illumination. If the display is provided with continuous back lighting, its effect on the expected battery operating period must be taken into account in the design. Automatic backlight brightness adjustment is a preferred function, but a facility to manually adjust the display brightness is also required. An adequate viewing angle of at least 45 degrees in all directions is required.

3.3.2.4 Integrity checking of the display (e.g. Flash all segments of the display briefly before each new reading is displayed, to indicate whether a segment has failed) is required.

3.3.2.5 During normal operation the display must indicate 000 kPa when the pressure is zero. Pressure must be displayed as a positive reading (e.g. 500 kPa), while a vacuum reading must be preceded by a minus ("-", e.g. –55 kPa).

3.3.2.6 The pressure/vacuum reading on the cab unit must not deviate from the pressure measured at the rear of the train by more than 10 kPa (for *pressure*) or 2 kPa (for *vacuum*) at all times, including within the low battery power limits.

3.3.2.7 After being switched on and matched with a rear unit, the cab unit must function automatically as follows:

(a) The rear-end pressure- or vacuum readings must be continuously displayed, and the battery status (number of hours remaining) of both the (portable) cab and rear end units must be displayed continuously.

(b) Pressure/vacuum alarms must be sounded and displayed whenever the air pressure drops below 400 kPa or the vacuum less than –51 kPa.

(c) Communication alarms must be sounded and displayed to indicate loss of radio contact with the rear unit, in the event of this occurring, per AAR S5701.

(d) Low battery alarms must be automatically displayed whenever either of the batteries' remaining life drops below 25% (or less than 10 hours)

(e) The battery must be protected against irreversible damage due to excessively deep discharges.

3.3.2.8 The CU must be able to be installed into a similar space as is currently employed for the standard voice communication train radios in service in TFR locomotives. The dimensions of this space shall be 197 ± 0,25 mm (W) by 67,5 ± 0,25 mm (H) by 250 mm (D). The preferred CU dimensions are thus required to be: 196 ± 0,25 mm (W) by 66,5 ± 0,25 mm (H) by ~165 mm (D).

3.3.2.9 Menu Function: The CU must provide a MENU function, initiated by pressing the Select/Enter button whilst the unit is in its normal state. The following options shall then be available:

- "**Comm's**" : To request a radio transmission from the RU in order to test the communication from the RU, without having to wait for a normal RU transmission.
- "**Alarms**" : This allows low PRESSURE alarms to be *acknowledged* and (audibly) SUPPRESSED, for the same alarm level. *Alarms must re-occur if pressure level changes.*

  The "Train Error" alarm (which is latched ON) may also be acknowledged & suppressed by means of this option.
- "**L.C.D.**" : This is to adjust the display brightness level.
- "**Reset**" : This is to reset or "Re-boot" the system when required.
- "**System**" : "Technician Mode" (Not intended for use by train drivers – If this mode is accessed, to exit it should require rebooting the system by selecting "**Reset**" as above.)
- "**Exit**" : To exit menu when required.

  The menu page should time out after 5 seconds of inactivity.

The sub-menu "**System**" should provide further options (Radio, Power, Display, Exit) for checking radio RF output (TX 15 sec), R to F & F to R comms, Repeater reception, as well as battery voltage and display & push-button tests.

3.3.2.10 The displaying of CU and RU Lat. & Long. Information, as well as train length, speed & trip meter, must also be possible (e.g. by pressing the Scroll Up key).

(Refer also to Annexure "EoT Menu Structure_April_10" for further details)

3.3.2.11 The CU should disable itself after a predefined time (e.g. 2 hrs) if no messages from its RU have been received, and should then de-activate any Emergency Rear Brake arming.

3.3.2.12 External Connections as follows are required:

- RJ-45 for Ethernet
- 2-Pin Molex for 12 V power
- 9-pin D-Type RS-232 male for programming
- PL-259 for VHF radio
- SMA for GPS
- 9-pin D-Type RS-232 female

3.3.3 Rear Unit

3.3.3.1a Further to the preceding requirements, the rear unit must include a suitable housing, as well as pressure transducer/s, associated electronics, integral antenna and an air/vacuum pipe coupling, power supply/batteries, ON/OFF button/switch, *and* visual ON/OFF indication.
3.3.3.1b A illuminated display is also required on the RU, which at switch-on must display *at least* the software version number, followed by battery voltage and then the kPa (Pressure or Vacuum) reading. Subsequent pressing of the ON/OFF button must again display the voltage, followed by the pressure/vacuum, for a few seconds.

3.3.3.2 In addition to 3.3.1.7 the rear end unit must be designed for continuous duty service on the rear of trains where it will be subjected to severe vibration and shock.

3.3.3.3 The transducers of the rear unit must be able to measure a pressure range of 0 kPa to +660 kPa with a maximum error of 10 kPa, and a vacuum range of –77 kPa to 0 kPa with a maximum error of 2 kPa.

3.3.3.4 Any failure of the measurement device must not cause any undesired brake application.

3.3.3.5 The telemeter equipment must be able to withstand pressure levels of up to 1 500 kPa without sustaining any damage.

3.3.3.6 The "matching / pairing" function, i.e. to pair a cab unit with a specific rear unit, should be done as simply as possible. The CU should initially display 5 zero's (00000), and entering the RU ID number should be achieved by use of the Scroll Up & Scroll Down keys. The ID of the last RU matched with, should be retained in memory and displayed on start-up, as an time-saving aid.

3.3.3.7a The RU must incorporate the following 3 power modes:

- Fully "**ON**" – i.e. All functionality available
- "**Sleep Mode**" – i.e. Radio transmission OFF, but Pressure Transducer ON, Radio Receiver ON, GPS ON, and (if equipped) GPRS transmission ON but at limited rate per BBD 5420.
- Fully "**OFF**" – i.e. ALL electronics switched OFF, with no drain on battery.

3.3.3.7b The following "ON/OFF" functionality is required:

1. The RU must only switch **ON** when in the vertical position, irrespective of pressure value.
2. Must switch to **Sleep Mode** (by means of a "tilt-switch") after 15 minutes when moved to the horizontal position, provided that the pressure is zero, *or when connected to a charger*.
3. Whilst upright, and the pressure drops below 10 kPa, OR the vacuum to less than - 5 kPa, the RU must switch to **Sleep Mode** after a 15 minute delay, *but should first update the CU.*
4. When the pressure rises to above 10 kPa or the vacuum to more than - 5 kPa, the rear unit must automatically switch its transmitter **ON** again.
5. Additionally, whilst in "**Sleep Mode**", normal transmission must resume when a button on either the CU or the RU is pressed.
6. However, if the vacuum / pressure continues to remain below the above-mentioned limits, the RU must switch **OFF** completely after 10 hours.
7. When the vacuum or pressure is above the specified limits, it must not be possible to switch the RU off.
8. The RU must protect itself against damage to its battery due to deep discharge by switching itself **OFF** if the battery voltage drops too low (e.g. <11V), but should first send an appropriate message to the CU.

3.3.3.8 The rear unit must be mounted on the last vehicle of the train in a manner such that:

- It can fit any vehicle without adapter brackets for mounting purposes, and by means of a simple procedure without requiring any special tools.
- The risk of theft and vandalism is minimised.

3.3.3.9 The RU must be designed such that it may be locked in place so as to minimise the risk of it being stolen or vandalised while mounted on the last wagon of the train. An integral lock with captive key is the preferred option, to prevent removal by means of readily available tools or spanners. If a separate / loose lock is proposed, the lock, key and attaching chain or cable, etc. must be included as part of the equipment. *The key and lock must be pre-approved by TFR.*

3.3.3.10 The RU must be supplied complete with flexible connecting air/vacuum pipes/hoses, suitable for both air-brake and vacuum trains. The coupling mechanism shall also cater for both air-brake and vacuum connections on TFR wagons, and *loose* components or adapters are not acceptable. The pipe & coupler must be attached to the RU body with a 3/4" BSP thread. It must

also be available as a separate item.

4. SYSTEM CHARACTERISTICS

4.1 Messages

4.1.1 Messages per AAR S-5701 transmitted from the rear end unit to the cab unit must include the following:

- RU Identification code.
- Rear unit battery status.
- Brake pipe pressure/vacuum.

In addition, GPS and other data in 2 additional data blocks, as per Annexure *A*.

4.1.2 Incorrect information must not be displayed when interference is experienced from other telemeters.

4.1.3 Reporting rate

4.1.3.1 Messages from the rear unit must be sent to the cab unit at intervals of 60 seconds (one minute) nominal, randomized by +/- 5 seconds, exactly as per AAR S-5701.

4.1.3.2 Messages must be sent to the cab unit immediately following detection of a change in brake pipe pressure (since the previous transmission) greater than the kPa increments, as indicated in the table below.

Pressure / Vacuum Range	Increments (kPa)
-77 to 0 (Zero)	2
0 to 400	50
400 to 660	10

4.1.3.3 The cab unit must expect automatic pressure updates from the rear unit at 60 second (nominal) randomised intervals as per AAR S-5701, and must provide the Rear-to-Front and Front-to-Rear checking functionality & alarms exactly as specified.

4.2 Alarms

4.2.1 An audible alarm, together with an appropriate flashing message display and red indicator light (for pressure / vacuum, communication failure, battery level or Train Status) must be provided in the cab unit to indicate each time (including updates) when

- the brake pipe pressure drops below 400 kPa (or less than –51 kPa for a vacuum train) OR
- communication tests as in 4.1.3.3 above are unsuccessful
- the cab- or rear unit battery life drops below 25% or 10 hours of normal operation.
- "Train Error": When the GPS-derived parameters exceed the limits per 5.2.

4.2.2 The *audible alarm* must be of sufficient audio level to be heard in the noisy environment of the locomotive and must sound for a duration of 3 seconds. In the case of "Train Error" the alarm must be latched ON until acknowledged. A facility to adjust the alarm volume above a fixed minimum level, is preferred.

4.2.3 It shall be possible to acknowledge the Pressure and Train Error alarms via the Menu function, options "**Alarms**". This shall then only suppress the current audible alarm, and not the visual alarm indication. However, if the alarm values change, or the alarm normalises and then re-occurs, then the audible alarm must sound again.

4.2.4 The visual alarm *message display* must continue until the pressures/parameters are within the specified range, or reception is restored or the unit is switched off.

4.2.5 A battery status indication must be provided for both units to continuously indicate the remaining capacity of the batteries in hours. (Refer also to Annexure *B,* 3.2.2) The battery status information transmitted by the RU (% capacity used per AAR S-5701, 3.7.2.3) must be used to determine the remaining hours and display on the Cab Unit, as in 3.3.2.7 (a). The values displayed must be accurate to 10% or better, and should be based on a minimum initial capacity of 40 hours. Optimistic values are to be avoided.

4.2.6 If the CU is powered by the locomotive supply, then the supply voltage, or an appropriate symbol should be displayed.

4.2.7 An indication of antenna quality or an alarm to indicate a poor or disconnected CU antenna / connection would be advantageous.

4.3 Identification of Cab & Rear Units

4.3.1 Rear and Cab units must be uniquely identified by a code or "address" in the range 00000 to 99999, as specified in the relevant Annexure in the tender documents.

4.3.2 The cab unit must be able to match / pair with any other rear unit by means of a "pairing" functionality. This "pairing" function must be such that a specific and simple procedure should be followed in pairing a CU with a specific RU unit as in Section 3.3.3.6 to form a set, whereafter these 2 units shall not communicate or pair with any others, until being un-matched and then re-matched with another RU/CU.

4.4 Reliability & Availability

4.4.1 The system must work reliably on a 200 wagon (2,5 km) train travelling at a speed of up to 120 km/h.

4.4.2 All functions are to be performed with an extremely high degree of reliability, and must not result in unnecessary train delays or stoppages.

4.4.3 The equipment must be extremely reliable, with a minimum mean time between failures (MTBF) of 10 000 hours per system/equipment pair. The integrity of the equipment must be such that the probability of a "Train OK" indication being false is less than one in 10^7.

4.5 Power Supply Requirements

4.5.1 Batteries

- The cab and rear units must be supplied with integrated, rechargeable, sealed batteries, unless otherwise specified in the tender documents.
- The battery capacity must be such that the system can operate continuously for a minimum of 40 hours.

4.5.2 Battery charger

- The charger must be simple to operate from a standard 220V AC supply, and be able to recharge the batteries of both the rear and cab units fully within **5 - 10** hours.
- It must be capable of charging batteries which have been completely discharged, and must switch to "float" once the battery is fully charged, and not cause any damage to the

batteries if left connected.

- Indications must provided on the status of the charger as well as the batteries on charge. At least "Power On", "Battery Charging" and "Battery Fully Charged" are required, and "Fully Charged" may not be indicated if the battery is not connected.
- Connectors of the readily available 2-pin "screw-fasten" type, rugged, *without any components which may easily loosen and become detached, leading to short circuits*, are preferred.
- Leads should preferably not be permanently attached to the charger, but also by means of a "screw-fasten" connector.
- A complete charger, with all plugs, leads, etc. is to be supplied with each Rear Unit and each *battery operated* Cab Unit, *unless otherwise specified in the tender documents.*

5 ADDITIONAL FUNCTIONALITIES REQUIRED

5.1 Rear End Illuminated Marker / Beacon Light

- This facility is required, including automatic switching **ON** when the ambient light level drops to (or below) a "dusk" level, and **OFF** when the level rises again.
- The RU must also be provided with a RED reflective surface in order to be visible to other rail vehicles from the rear.
- Power requirements should have a minimal impact on the battery life of the rear units, and this aspect is to be specified.
- A status indication on the CU is also required, per AAR S-5701. (Marker Light **ON**, or **OFF**/Defective)

5.2 Train Complete Function

5.2.1 A "train complete" function is required, in order to assist the driver in ascertaining / confirming whether the train is "complete" (i.e. has not become "parted"). This may be achieved by employing GPS units in the CU & RU, and by continuously monitoring the speed- and displacement differences between the front & rear of the train.

5.2.2 The following shall be displayed to the driver:

- **"Train OK"** - When the system detects no evidence of the train being parted
- **"Caution"** - In cases where there is (temporary) doubt of train completeness
- **"Train Error"** - When the system detects that the train has become parted
- "**M**ove" or "**S**top" per AAR S-5701.
- **Speed** of the **CU** *and* **Speed** of the **RU**
- "**Length**" / Displacement at start-up, plus relative **Deviation** (**+** or **-**)

5.2.3 The display should therefore preferably be divided into 2 areas: One for the standard pressure/vacuum & battery status information, and the other for the Train Complete, speed, distance, etc. information. (See also Annexure *B*, 3.2.2)

5.2.4 The GPS information (from the RU) to be used for this function is to be transmitted in additional message data blocks after the standard ones per AAR S-5701. The message format / structure is defined in Annexure *A*.

5.2.5 After initial switch-on of the CU, when both CU and RU GPS equipment have satellite fixes, the *displacement* in meters between the front and rear units shall be displayed to the train driver as "**Train Length xxxx m?**", whereupon if acceptable to the driver, the value may be accepted by pressing the Enter/Select button. (If not acceptable, the driver should wait for further updates).This value must then be stored, and used as reference for future displacement readings, which are to be displayed as the stored value, together with a deviation (+/-).

5.2.6 Similarly, the RU and CU *speeds* are to be stored, averaged and compared (10 second *moving averages* are proposed)
5.2.7 The above 2 parameters are to be monitored as follows:

- If speeds differ by <10 kph, *AND* displacement deviation < 100 meters: **TRAIN OK**
- If speeds differ by >10 kph, *OR* displacement deviation > 100 meters: **CAUTION**
- If speeds differ by >10 kph, *AND* displacement deviation > 100 meters: **TRAIN ERROR**

However, for **TRAIN OK**, the Pressure/Vacuum must be above the alarm levels, or else **CAUTION** must be displayed, but **TRAIN ERROR** must be displayed irrespective of the Pressure/Vacuum levels. *The train driver will have to take all factors into account in this case.*

5.2.8 The above indications are to be given with a very high degree of integrity, and a very low incidence of false alarms. Tenderers are to provide full details of their proposed system, as well as its level of integrity.

5.3 Emergency Brake Application from Rear Wagon

This functionality (per AAR S-5701, section 3.0) shall be provided. The Emergency Brake application shall be effected (after the system has been armed) by simultaneously pressing the Scroll Up and Scroll Down buttons, whereafter a screen prompt (e.g. "Emergency Brake?") shall be displayed to the train driver. Subsequent pressing of the Enter button within 10 seconds shall initiate the Emergency Brake procedure.
Arming shall be per AAR S-5701, and it shall be possible to Dis-Arm the system if required, by means of the ID 00000.
AAR S-5701, 3.2.2: If the acknowledgement is not received within 3 seconds, then the front/Cab Unit must repeat the command. 3.2.4: Valve Opening shall be ¾" (i.e. 19 mm) and the internal pipe diameter: 5/8" (at least 15mm).
NOTE: The function is for use as an emergency *backup*, and *not* as a braking *performance improvement* device.

5.4 Repeater Function

In certain situations it may be necessary to repeat the signal between CU and RU, either by means of an On Train repeater, or by means of Track Side (Fixed) repeaters. Both versions are to display at least the following when messages are repeated: RU ID number, and Time (hh:mm:ss) with at least the last 5 messages being continuously displayed. CU ID / numbers need not be displayed.

5.4.1 On-Train Repeater

In this case the CU is to be configured such that during switch-on / powering up, the CU may be switched into "repeater mode". The user shall thus have the option of selecting either normal "EoT" or Repeater" mode, so that a CU may either function as a cab unit, or as a repeater when required. The repeater shall also be "matched" to the RU in the same way as the CU, and shall only repeat *valid* messages from its matched RU or CU, after a delay of 500 milliseconds.
Suppliers are to clearly and in detail indicate how their repeater is to function, so as to ensure that secure and reliable repeated communications are to be effected, without communication collision problems (e.g. between paired CU/RU's, OR with other CU's, RU's or repeaters). The "switch-on / start-up" procedure must also be fully described, and must be easy to perform, bearing in mind the possible logistical problems due to long distances between equipment units.

5.4.2 Track-Side / Fixed Repeater

This repeater function must also be incorporated in the CU software, and only be activated in the workshop when required. In this case, the matching function is not required, but only valid messages from the RU or CU are to be repeated, after a 500 millisecond delay. GSM GPRS tracking functionality is required *as an option*, to allow remote monitoring of operation.

Suppliers are to clearly and in detail indicate how their repeater is to function, so as to ensure that secure and reliable repeated communications are to be effected, without communication collision problems (e.g. between paired CU/RU's, OR with other CU's, RU's or repeaters).

5.5 Logging of Alarms and Performance on both CU and RU

5.5.1 The telemeter performance must be continuously monitored and logged by the RU against time & position [km point] along the line, and stored in memory, so as to be available for down-load at the end of the trip (e.g. via the serial port or other means). This implies that the RU must make use of a GPS unit so as to track its position against real (GPS) time.

5.5.2 All communication messages received by the CU, as well as alarms, are to be logged versus time (and km position if possible). The CU time must be synchronised with that of the RU.

5.5.3 Other data / parameters to be recorded are:

- Start Up / Switch On date & time
- Position and ID/Serial Numbers of CU and RU at start up
- During the trip, periodic readings of pressure, battery voltages and alarms, e.g.
  - Low Battery
  - kPa low
  - Comms Failure. Etc.
- Speed
- Train stopped
- Train moving
- Received signal strength, if possible

NOTE: *Refer also to BBD 5420 (latest version)*

5.6 Tracking Facility by Means of GPRS *(Optional)*

In order to provide a tool for the effective asset management of telemeter / EoT equipment, *this facility is required as an option, and will be specified in the tender documents.* This will of course require that the RU is equipped with a GSM GPRS module, *which introduces an extra operational cost.*

For full details of the tracking requirements, refer to BBD 5420 (latest version).

5.7 Special CU's for use by Inspection Trolleys

On certain TFR lines "Rail Break inspection trolleys" are run behind heavy trains to check for broken rails after the train has passed. In an attempt to increase personnel safety by raising an alarm if the trolley moves too close to a train ahead, a "Trolley CU" with modified CU software is required, to monitor the position & speed of a train ahead. Such units must display the following:

- Telemeter RU I.D. (Number)
- Distance away (km)
- Speed of RU (kph)
- Time (hh:mm:ss)

At least the last 4 readings must be displayed continuously, as well as the Trolley CU speed.
As for the standard CU, this unit must provide a visual and audible alarm each time it receives a valid RU message, since trolley is probably then too close to the train. (Should be > 5 km)

5.8 Further Options Required in Future OR Proposed by Suppliers
(e.g. Air Powered Generators,
Track-Side Repeaters for Use in Tunnels for Emergency Rear End Braking, etc.)

To be offered and described if & where applicable.

6 GENERAL REQUIREMENTS

6.1 Documentation and Software

6.1.1 Detailed operating- and maintenance/workshop manuals in accordance with generally accepted industrial standards, must be supplied with each tender. Detailed technical specifications of the equipment and all components must be included. Specification CSE-1159-001 CAT E48 applies.

6.1.2 All software installed on the equipment shall be provided to Transnet Freight Rail, in order to reload or reprogramme / reconfigure equipment when necessary. *This is a mandatory requirement, and software shall be provided when equipment is supplied for acceptance testing.*

6.1.3 One complete set of documentation per ten sets of units is required, unless otherwise specified in the tender documents.

6.2 Standards and Operating Environment

6.2.1 The equipment, its design, maintainability, quality of material, documentation etc. must be in accordance with generally accepted industrial standards & procedures for high quality equipment, and must meet all relevant SABS and/or Spoornet specifications.

6.2.2 Environmental characteristics must cater for all outdoor conditions as encountered in South Africa, including temperature, altitude, humidity, air pollution and lightning. Specification CSE-1154-001 CAT E48 applies.

6.3 Maintenance and Service

The equipment must be designed so as to facilitate easy maintenance, using readily available components, and requiring a minimum of specialised tools and test equipment to service and repair.

6.4 Guarantee & Support

A minimum guarantee period of one year against design and manufacturing defects, etc. is required, as well as guarantees for the availability all components as well as technical support including training, for a minimum period 10 years.

7. NOTES: Items to be specified in Tender Documents/Addendum

3.3.1.4	Specify options a, b, c, or d. (*portable, built-in, split / remote head, or external display*)
4.3.1	I.D. Numbers' range (To be allocated by TFR Configuration Management section)
4.5.1	Cab Unit Batteries required if CU to be portable as per 3.3.1.4a.
4.5.2	Battery Chargers' quantities (if not one with each portable CU and each RU.)
5.4	Repeater Function required or not, and whether On-Train or Track-Side / Fixed.
5.6	GPRS Tracking Facility required or not.
6.1.3	Documentation quantities. (If not one set per 10 sets)

(See Over for Annexures)

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CAPITAL PROGRAM
TENDER REQUIREMENTS

REAR TELEMETER UNITS FOR ORE LINE

Author: N Breytenbach *Nick Breytenbach*

Date: 2 December 2010

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CONTENT Page

1. SCOPE OF THE TENDER

1.1 The tender comprises the manufacture and supply of End of Train (EoT) devices as per specification BBB1776 Version3.

Item	QTY	Delivery	Comments
1. REAR (EoT) units:			
1.1 ORE line rear units	50	Saldanha	GPRS included
2. REAR (EoT) chargers units:			
2.1 ORE line chargers	50	Saldanha	Charger cable included The front and rear must use the same charger.
3. Chain and locks	1- 50	If Part of EoT delivered to Saldanha or lose deliver to Pretoria	The supplier must include his lock if it is integral to his telemeter otherwise the supplier must also quote for a separate lock & chain.
4. Pipe & coupler	1- 50	If Part of EoT delivered to Saldanha or lose deliver to Pretoria	The supplier must not include the pipe and coupler to the EoT price. The supplier must quote for a separate pipe & coupler unit. The supplier can quote an additionally item and include the pipe if there is a reduced cost benefit to TFR. A dual coupler is preferred.
5. Keys & tools	1-50	Saldanha	The supplier must quote for extra keys to work on his REAR telemeter if an integrated lock is used and for the lose key & chain requirement in this tender. Any special tools required must be quoted separately.

6. Antenna VSWR indication	VSWR must be included in all new EoT units. The REAR unit must populate the GPRS field.
7.Interfacing with present EOT's	A supplier who deliver EOT's in the past to TFR and quote on this tender must make sure the REAR unit can talk to older CAB units of his model.
8. Delivery	The supplier must indicate clearly the delivery schedules with a lead time period and qty delivered per month. Delivery ASAP is preferred.
9. Testing	The supplier will provide all test equipment needed to evaluate the final product.
10. Rear unit GPRS tracking	All rear units must have GPRS tracking included. The rear unit must comply to GPRS tracking

	specification **BBD5420 version-2**
11. Testing and certifying.	The supplier shall test and certify his units as per spec and or against a TFR ATP before TFR will attempt acceptance testing of any equipment. The supplier must provide a test certificate for each unit.
12. Chargers	The chargers must have swappable end peaces with screw on connectors to the charger unit. The charger must be able to charge the rear unit while the GPRS is active. The charger must have a build in function to revert automatically to trickle charge when the battery is full.
13. Locks & chain.	The lock and chain must be quoted separately as one unit where applicable.
14. Pipe and coupler	The pipe and coupler must be quoted separately as one unit.
15. Compliance sheet.	The supplier must provide a compliant list based on the main spec and this doc.
16. Development Status.	The supplier must indicate on a presentation basis how far his equipment and software functions complies to the following as specified in this tender 1. EoT REAR unit hardware with GPRS software. 2. Implementing VSWR on REAR units. 3. ORE line beacon transmitter.
17. SIM cards	TFR will arrange and activate the SIM cards operating on the two TFR APN's
18. Beacon transmitter	All the ORE line rear units must be fitted with 433mhz beacon transmitters. The transmitting data message will be made available to the suppliers.
19. REAR valve	All the units must include Rear brake valves.

2. GENERAL

2.1 Tenderers must fully acquaint themselves with all the requirements of TFR before submitting any tenders.

End of document.

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CAPITAL PROGRAM

SPECIFICATION

TELEMETER REAR UNIT GPRS TRACKING

Author:	Senior Technologist Capital Program	N Breytenbach	*Nick Breytenbach*
Approved:	Senior Engineer Engineering		.....
Authorised:	Project Director Capital Program	Mr W Kuys	.....
		Date:	29 June 2010

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CONTENT PAGE

1. Purpose

TFR want to track and trace rear EoT units to improve management and maintenance of the units.

2.Sending data detail. (RU to server)

Description	Pos	Compress data	Database data	Database field name
Header	1	1 byte STX = $02		None
Message Type	2	1 byte Message identifire $04	None	None
Rear IDI	3-5	3 byte integer. 5 Digit numeric number. Max = 16777216	5 characters "00000" to "99999"	RearIDI
Front IDI	6-8	3 byte integer. 5 digit numeric number Max = 16777216	5 characters "00000" to "99999"	FrontIDI
Date time	9-12	4 bytes integer.	Timestamp '2008-07-07 01:01:01','yyyy-mm-dd hh24:mi:ss' "2008-07-04 23:34:07"	DateTime (Previous PCDateTime)
Latitude	13-15	3 bytes 1/30000 of a degree originated at south pole.	8 characters "-25.2345"	Latitude
Longitude	16-18	3 bytes 1/30000 of a degree originated at international date line.	7 characters "28.3466"	Longitude
Speed	19,20	2 bytes decimal KM/hour. Conversion of 18.3 knots to DM/Hour will be used.	3 characters "000" to "999"	Speed
Rear volts	21	1 byte indicating rear battery volts in decimal voltage	4 characters "00.0" to "25.5"	RearVolts
Front volts	22	1 byte indicating front battery volts in decimal voltage	4 characters "00.0" to "25.5"	FrontVolts
Status	23	1 byte status indicating the following by setting the bits. • Bit 0: Braketype 1=Air brake 0=Vacuum brakes • Bit 1: Charging 1= On charge 0= No charge • Bit 2:RearBrake 1= Activated 0 =Not activated • Bit 3: Air generator 1= Fitted 0= Not fitted • Bit 4: 0 = Spare • Bit 5: 0 = Spare • Bit 6: Flasher 0=Off 1=On • Bit 7: TelemeterMode 0=Run 1=Slp	3 characters "000" to " 255" 1="Air" 0= "Vac" On charge="Yes" No charge="No" Activated ="Yes" Not activated="No" Fitted="Yes" Not Fitted="No" '???' – 3 spare chars '???' – 3 spare chars '???' – 3 spare chars 'On'=On 'Off'=Off 'Act'-Running, 'Slp'=Sleep	BrakeType Charging EBArear Aircharger Status4 Status5 Status6 Flash RUMode
Failure mode	24	1 byte status indicating the following by bits.	3 characters "000" to " 255"	

		• Bit 0: Coms fail 1= Fail 0 = No failure • Bit 1: Air charger fail 1= Fail 0 = No failure • Bit 2: Emergency braking 1=Emergency active 0=Not activated • Bit 3: 0 = Drag wheel Detection • Bit 4: 0 = Spare • Bit 5: 0 = Spare • Bit 6: 0 = Spare • Bit 7: 0 = Spare	Fail ="Yes" No failure="No" 3 characters Fail ="Yes" No failure="No" Activated="Yes" Not activated="No" 3 characters Activated='Yes' Not activated='No' '???' – 3 spare chars '???' – 3 spare chars '???' – 3 spare chars '???' – 3 spare chars	ComsFail AirChFail EmBrake DWD FailMode4 FailMode5 FailMode6 FailMode7
Pressure / Vacuum Value	25,26	2 bytes integer value representing KPA	3 characters Airbrake = "000" to "999" Vacuum="-00" to "-99"	BrakeValue No sign for Air brakes and – for Vacuum brakes.
Alarm Count	27	1 byte integer value	3 characters "000" to " 255" Detail to be determined. Possible use as 8 Hardware failure bits.	AlarmCount
Last Service Info	28-31	4 bytes. Date and time transmitted as seconds elapsed since midnight 1 March 2004.	Timestamp '2008-07-07 01:01:01','yyyy-mm-dd hh24:mi:ss' "2008-07-04 23:34:07"	MTCEDate
Fault code-1	32-36	5 bytes	4 Alpha characters "ABCD"	FCode1
Fault code-2	37-41	5 bytes	4 Alpha characters "ABCF"	FCode2
Fault code-3	42-46	5 bytes	4 Alpha characters "ADFG"	Fcode3
Handling	47	1 byte integer value. Representing level of movement due to ruff handling. (need accelerometer) Bits 0-7 = max movement in any direction. Send 00h if not available.	3 characters "000" to "255"	Handling (Previous Railfault)
VSWR	48	1 byte (0h-FFh)	4 characters '0.00' to '2.55'	VSWR
RSSI	49	1 byte (0h-FFh)	4 characters '-000' to '-255'	RSSI
Not send by RU		Not send by RU	15 character database field '10.254.30.59'	SourceIP
Altitude	50,51	2 byte integer value.	5 characters. "00000" to "65535" meters	Altitude
Packet Count	52	1 byte integer value. Start at 1 and increment with each packet send until role over from 255.	3 characters "000" to "255"	PacketCount

CRC	53,54	2 bytes CCIT 16 Bit (Polynomial 10001000000100001) exclude the header and terminator bytes.		None
End of transmission	55	1 byte EOT = $04		

This packet had a fix length of 55 bytes.

3. Acknowledgement for IP port

$09 : Acknowledgement from RU for IP/Port setup (RU to Server)

Field Number	Description	Position in string	Field Width	Compressed Data
1	Start Header	1	1 Byte	STX = $02
2	Status	2	1 Byte	Message type = **$09**
3	Rear ID	3,4,5	3 Bytes	Integer. 5 Digit numeric number. Max=16777216. In reality 99999.
4	CRC	6,7	2 Bytes	CCIT 16 bit (Polynomial 10001000000100001) excluding the header and terminator bytes.
5	End of Transmission	8	1 byte	EOT = $04

This packet had a fix length of 8 bytes

4. Acknowledgement for APN connection

$0A : Acknowledgement from RU for APN Connection server setup (RU to server)

Field Number	Description	Position in string	Field Width	Compressed Data
1	Start Header	1	1 Byte	STX = $02
2	Status	2	1 Byte	Message type = **$0A**
3	Rear ID	3,4,5	3 Bytes	Integer. 5 Digit numeric number. Max=16777216. In reality 99999.
4	CRC	6,7	2 Bytes	CCIT 16 bit (Polynomial 10001000000100001) excluding the header and terminator bytes.
5	End of Transmission	8	1 byte	EOT = $04

This packet had a fix length of 8 bytes

5. Acknowledgement from database. (Server to RU)

The following packet will be send from the Database to rear unit after receiving a packet.

Field Number	Description	Position in string	Field Width	Compress data
1	Start header	1	1 Byte	STX = $02
2	Status	2	1 Byte	ACK = $06
3	Rear IDI	3,4,5	3 Byte	3 byte integer. 5 Digit numeric number. Max = 16777216
4	Packet Count	6	1 Byte	1 byte integer value of packet to ACK.
5	CRC	7,8	2 Byte	2 bytes CCIT 16 Bit (Polynomial 10001000000100001) exclude the header and terminator bytes.
6	End of transmission	9	1 Byte	1 byte EOT = $04

This packet had a fix length of 9 bytes

Example: 02h,06h,023A3Dh,0Dh,A3B5h,04h (Send 02h>04h)

Note-1: The rear unit will re-send the data packet if no acknowledgement is received within 60 seconds.

°Note-2: The Rear unit will use this acknowledgement as one method to determine if the GPRS

is disconnected or not and to reset the modem to restart a new connection.
Note-3: Store 10 packets and send when GPRS are available.

6. Calling a field unit. (Server to RU)

The following packet will request a full data packet from the RU.

Field Number	Description	Position in string	Field Width	Compress data
1	Start header	1	1 Byte	1 byte STX = $02
2	Status	2	1 Byte	Enquiry ENQ = $05
3	Rear IDI	3,4,5	3 Byte	3 byte integer. 5 Digit numeric number. Max = 16777216
4	CRC	6,7	2 Byte	2 bytes CCIT 16 Bit (Polynomial 10001000000100001) exclude the header and terminator bytes.
5	End of transmission	8	1 Byte	1 byte EOT = $04

This packet had a fix length of 8 bytes

Example: 02h,05h,035F73h,12A4h,04h (Send 02h>04h)

7. Setting Server IP address and port

$07 : Setting Server IP Address and Port on Rear unit (Server to client)

Field Number	Description	Position in string	Field Width	Compressed Data
1	Start Header	1	1 Byte	STX = $02
2	Status	2	1 Byte	Message type = **$07**
3	Rear ID	3,4,5	3 Bytes	Integer. 5 Digit numeric number. Max=16777216. In reality 99999.
4	Server IP Address	6-21	15 Characters	Fix width string for example '010.107.002.011'
5	Server GPRS port	22-25	4 Characters	Fix width string for example '9760' for Inteletrack Telemeters and '9770' for EMS Telemeters.
6	CRC	26,27	2 Bytes	CCIT 16 bit (Polynomial 10001000000100001) excluding the header and terminator bytes.
7	End of Transmission	28	1 byte	EOT = $04

This packet had a fix length of 28 bytes.

8. : Setting server/network APN connection Address

$08 : Setting server/network APN connection Address (Server to client)

Field Number	Description	Position in string	Field Width	Compressed Data
1	Start Header	1	1 Byte	STX = $02
2	Status	2	1 Byte	Message type = $08
3	Rear ID	3,4,5	3 Bytes	Integer. 5 Digit numeric number. Max=16777216. In reality 99999.
4	Address Length	6	1 Byte	Length of text string to follow For example 0x0D,(10 decimal) for 'iatstfr.co.za'
5	Server APN connection name	7-37	1 to 30 Characters long	Address string for example 'iatstfr.co.za'
6	Address Length	38	1 Byte	Length of text string to follow For example 0x12, (18 decimal) for 'its.spoornet.co.za'

7	Server APN connection name	39-69	1 to 30 Characters long	Adres string for example 'its.spoornet.co.za'
6	CRC	70,71	2 Bytes	CCIT 16 bit (Polynomial 1000100000100001) excluding the header and terminator bytes.
7	End of Transmission	72	1 byte	EOT = $04

NB : This packet had a variable length from 11 (no Apn info) up to 72 bytes long(for 2x30character Apn addresses).

9. Reporting triggers

The following triggers must be implemented and software settable in the rear unit.

Triggers	Programmable settings
30 minutes when Stationary on train and sensing brake pressure > 200 or vac > -25	Settable 1-60 minutes
10 minutes when Stationary and sensing no brake pressure or vacuum.	Settable 1-60 minutes
30 minutes or 25km which ever elapsed first when train are moving and sensing brake pressure > 400 or vacuum > -51.	Settable 1-60 minutes & 1 – 50km
Immediate when EBA is applied	fixed
Immediately when a failure mode is detected.	fixed
Immediately when the brake alarm is activated and not restored within 5 min on a moving EoT.	fixed
Immediately when charger is connected	fixed
Immediately when disconnect from charger.	fixed
Immediately send data when the train completion fails on a moving train.	*fixed*

10. Date and time conversion.

Data and Time System

Following on from the conversion of spatial co-ordinates to an integer based system, time from the GPS is also converted to an integer based system that can be represented in 4 bytes.

The unit of time is 1 second – equivalent to the resolution of the GPS receiver.

0h00 on 1st March 2004 is chosen as the time datum. (Beginning of the last leap year)

Time is transmitted as GMT (Grenwich Mean Time) – no time zone offset is applied.

As calculated on 8 Dec 2008

```
year2004:=31+30+31+30+31+31+30+31+30+31; (From 1 March)
year2005:=365;
year2006:=365;
year2007:=365;
year2008:=31+29+31+30+31+30+31+31+30+31+30+7;

seconds:=(year2004+year2005+year2006+year2007+year2008)*24*60*60+
        (hour*60*60) + (min *60) + sec;
```

Sample time:
8 Dec 2008 21:46:04 > 150673564 sec S.A time
8 Dec 2008 21:47:55 > 150673675 sec S.A time
8 Dec 2008 21:52:32 > 150673954 sec S.A time

Subtract 7200 sec to get GMT

11. Longitude and Latitude conversion.

Longitude and Latitude Co-ordinate System

The spatial co-ordinate system that is used is long integer based –
data transmission is minimised (send 3 bytes instead of 9 bytes per ordinate value)
Can use integer arithmetic.

Latitude and Longitude co-ordinates are transformed into long integers (high byte not used) using a right hand Cartesian co-ordinate system, with origin at the South Pole and the International Date Line.

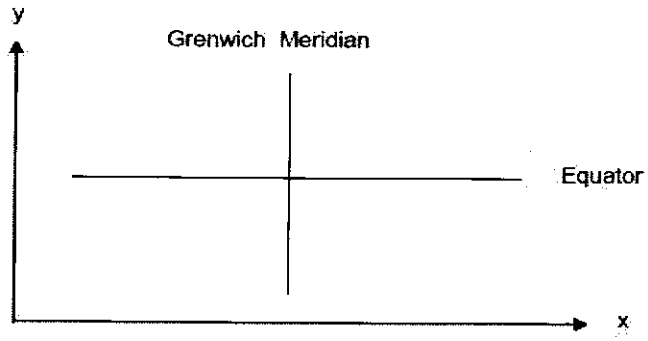
Sample: S25.76285 E28.15339

Longitude:=round(longitude_degrees*30000+5400000);
6244601 =(28.15339*30000+5400000)
6244601 = 5F48F9h

Converting back to Longitude
Longitude_degrees:=(longitude-5400000)/30000;
28.1534:=(6244601-5400000)/30000;

Latitude:=round(2700000-latitude_degrees*30000);
1927114 :=round(2700000-25.76285*30000);
1927114 = 1D67CAh .

Converting back to Latitude
Latitude_degrees:= (latetude-2700000)/30000;
-25.7629:=(1927114-2700000)/30000;



The maximum resolution obtainable from a GPS receiver is 4 decimals of a degree of Longitude or Latitude - translates to about 15 metres on the ground.

One second of arc is equivalent to 30 metres on the ground - so the resolution of a GPS receiver is approximately one half second of arc.

The co-ordinate system therefore has to have a resolution of better than 1 / 7200 of a degree of arc, not change sign and be represented in less than 3 bytes for any location on earth.

Choosing a unit of measure equal to 1 / 30 000 of a degree accomplishes this requirement. One degree equals 30 000 units and 360 degrees equals 10 800 000 units – comfortably accommodated in 3 bytes

Using this co-ordinate system -

South Pole	y = 0	
North Pole	y = 5 400 000	Hex - 5265C0 uses 3 bytes
Equator	y = 2 700 000	
Greenwich	x = 5 400 000	
International Date Line	x = 0 or 10 800 000	Hex - A4CB80 uses 3 bytes

Are in fact only using 3 bytes per ordinate – can use the high byte for an additional variable.

Any other location on the earth can be represented by a (x,y) pair whos values will always be positive, irrespective of hemisphere. Precision of a GPS receiver is preserved.

12. Speed conversion

Speed

The maximum speed that a train is likely to attain (in decimeters per km) is easily represented as an unsigned integer (65535) using two bytes.

A conversion factor of 18.3 to convert Knots to Dm/hour will be used.

Speed::=round(speed_knots*10);
770:=round(77.0*10);
0302h

Kmhour:=round((knots/10)*18.3);
141:=round((770/10)*18.3);

OR send km/h as one byte. (0-255 km/h) Example: 55km/h = 0037h 1st byte = 00h

13. Power up of rear units.

The rear unit VHF RF portion must be switched on/off by the on off PB. The main processor, GPS, GPRS must stay on to continue the tracking function. These electronics must only switched off when the Battery reached the low voltage disconnect level.

14. Database structure

```
SQL> describe eotdata;
 Name                                      Null?    Type
 ----------------------------------------- -------- ------------
 REARIDI                                   NOT NULL VARCHAR2(5)
 FRONTIDI                                  NOT NULL VARCHAR2(5)
 PCDATETIME                                NOT NULL TIMESTAMP(0)
 LATITUDE                                  NOT NULL VARCHAR2(8)
 LONGITUDE                                 NOT NULL VARCHAR2(7)
 SPEED                                     NOT NULL VARCHAR2(3)
 REARVOLTS                                 NOT NULL VARCHAR2(4)
 FRONTVOLTS                                NOT NULL VARCHAR2(4)
 BRAKETYPE                                 NOT NULL VARCHAR2(3)
 CHARGING                                  NOT NULL VARCHAR2(3)
 EBAREAR                                   NOT NULL VARCHAR2(3)
 STATUS4                                   NOT NULL VARCHAR2(3)
 FLASH                                     NOT NULL VARCHAR2(3)
 RUNSHD                                    NOT NULL VARCHAR2(3)
 RUMODE                                    NOT NULL VARCHAR2(3)
 COMSFAIL                                  NOT NULL VARCHAR2(3)
 AIRCHFAIL                                 NOT NULL VARCHAR2(3)
 EMBRAKE                                   NOT NULL VARCHAR2(3)
 DWD                                       NOT NULL VARCHAR2(3)
 FAILMODE4                                 NOT NULL VARCHAR2(3)
 FAILMODE5                                 NOT NULL VARCHAR2(3)
 FAILMODE6                                 NOT NULL VARCHAR2(3)
 FAILMODE7                                 NOT NULL VARCHAR2(3)
 BRAKEVALUE                                NOT NULL VARCHAR2(4)
 ALARMCOUNT                                NOT NULL VARCHAR2(3)
 AIRCHARGER                                NOT NULL VARCHAR2(3)
 MTCEDATE                                  NOT NULL TIMESTAMP(0)
 FCODE1                                    NOT NULL VARCHAR2(5)
 FCODE2                                    NOT NULL VARCHAR2(5)
 FCODE3                                    NOT NULL VARCHAR2(5)
 RAILFAULTS                                NOT NULL VARCHAR2(3)
 VSWR                                      NOT NULL VARCHAR2(4)
 RSSI                                      NOT NULL VARCHAR2(4)
 SOURCEIP                                  NOT NULL VARCHAR2(15)
 ALTITUDE                                  NOT NULL VARCHAR2(5)
 PACKET                                    NOT NULL VARCHAR2(3)

SQL>
```

```
INSERT INTO EOTDATA(RearIDI,FrontIDI,PCDateTime,Latitude,Longitude,Speed,RearVolts,Frontvolts,BrakeType,
        Charging,EBArear,Status4,Flash,Runshd,RUMode,ComsFail,AirCHFail,EMBrake,DWD,Failmode4,
                Failmode5,failmode6,Failmode7,BrakeValue,AlarmCount,AirCharger,
        MTCEDate,Fcode1,Fcode2,Fcode3,RailFaults,VSWR,RSSI,SourceIP,Altitude,Packet)
    VALUES('09999','54321',to_timestamp('2010-04-29 10:01:01','yyyy-mm-dd hh24:mi:ss'),'-25.2345','28.5660','155',
        '12.8','12.5','AIR','No ','No ','000','000','000','slp','NO ','NO ','NO ','YES','000','000','000','000',' 450','128','No ',
        to_timestamp('2008-07-04 23:34:07','yyyy-mm-dd hh24:mi:ss'),'ABCD','EFGH','JKLM','123','1.25','-
095','127.017.012.123','02450','007');
```

15. Sample data

Select TO_CHAR(pcdatetime,'YYYY-MM-DD hh24:mi:ss'),Latitude,Longitude,rearidi,frontidi,Speed,RearVolts,Frontvolts,BrakeType,
Charging,EBArear,Status4,Flash,Runshd,RUMode,ComsFail,AirCHFail,EMBrake,DWD,Failmode4,
Failmode5,failmode6,Failmode7,BrakeValue,AlarmCount,AirCharger,
TO_CHAR(mtcedate,'YYYY-MM-DD hh24:mi:ss'),Fcode1,Fcode2,Fcode3,RailFaults,VSWR,RSSI,SourceIP,Altitude,Packet from EOTData
where TO_CHAR(pcdatetime,'YYYY-MM-DD') >= '2009-10-16' and rearidi = '09701' order by pcdatetime desc
Future data field are fill with "???"

TO_CHAR(PCDATETIME,'YYYY-MM-DD	LATITUDE	LONGITUDE	REARIDI	FRONTIDI	SPEED	REARVOLTS	FRONTVOLTS	BRAKETYPE	CHARGING	EBAREAR	STATUS4	FLASH	RUNSHD	RUMODE	COMSFAIL	AIRCHFAIL	EMBRAKE	DWD	FAILI
2010-01-29 06:52:51	-29.8239	30.9805	09701	00000	006	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 06:20:57	-29.8062	30.9565	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 05:49:09	-29.8062	30.9566	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 05:17:14	-29.8062	30.9565	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 04:45:21	-29.8062	30.9564	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 04:13:30	-29.8062	30.9566	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 03:41:31	-29.8062	30.9565	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 03:41:24	-29.8062	30.9565	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 03:41:22	-29.8062	30.9565	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 03:08:27	-29.8062	30.9566	09701	00000	000	12.4	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 02:36:26	-29.8062	30.9566	09701	00000	000	12.5	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 02:04:27	-29.8062	30.9566	09701	00000	000	12.5	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 01:32:34	-29.8062	30.9566	09701	00000	000	12.5	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???
2010-01-29 01:00:47	-29.8062	30.9565	09701	00000	000	12.5	00.0	Air	No	No	???	Off	Run	Slp	No	No	No	No	???

DWD	FAILMODE4	FAILMODE5	FAILMODE6	FAILMODE7	BRAKEVALUE	ALARMCOUNT	AIRCHARGER	TO_CHAR(MTCEDATE,'YYYY-MM-DDHH	FCODE1	FCODE2	FCODE3	RAILFAULTS	VSWR	RSSI	SOURCEIP	ALTITUDE	PACKET
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00123	211
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00023	210
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00035	209
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00038	208
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00037	207
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00027	206
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00026	205
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00028	204
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00034	203
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00034	202
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00040	201
No	???	???	???	???	000	000	No	2009-10-28 14:29:19	RNNNN	RNNNN	RNNNN	000	0.00	-000	010.254.029.163	00037	200

16. Data format.

All data field data will be send MSB firs and LSB last.
Example: Rear IDI = 014DAFh (85423)
01 = send 1st
4D = send 2nd
AF = send 3rd

The data are send as one long string starting from 02h...04h. Each field is send MSB first and LSB last.

17. CRC info

```
Here is an example specification for
a popular form of the CRC-16 algorithm.

   Name   : "CRC-16"
   Width  : 16
   Poly   : 1021h      (1000100000100001)
   Init   : FFFFh
   RefIn  : True
   RefOut : True
   XorOut : 0000h
   Check  : BB3Dh
```

18. Server software

The server software must support the following.

a) Calling a pre selected field unit.
b) Change the connection IP on a selected field unit.
c) Change the port on a selected field unit.
d) Change the two APN's on a selected field unit.
e) User friendly.
f) Supporting at least 1000 rear units simultaneous connections.
g) The rear units of a specific supplier will only be used to connect to his specific server software.
h) The REAR unit must revert back to the original settings if no connection can be made within 3 tries of changing items-b,c,d.

End of specification