A division of Transnet limited

TRANSNET
freight rail

TECHNOLOGY MANAGEMENT

SYSTEM SPECIFICATION

TRAIN COMMUNICATION SYSTEM (TCS) for TRANSNET FREIGHT RAIL

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Date: 31 March 2008

Circulation restricted to: Transnet Freight Rail
Transnet Rail Engineering
Relevant third parties

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1. DEFINITIONS AND ABBREVIATIONS

For the purpose of this specification the following definitions and abbreviations shall apply:

CCC	Communication Control Console as called for in this specification. There will be such a console at each TCO desk in each of the CTC offices specified in this tender.
CRL	Call Routing Layer. Ensuring the correct routing of calls between users.
CTC	Centralised Train Control. Currently there are four (4) of these centres along the line, which accommodate the TCOs and other supporting staff. The Centre from which all train movements/control will take place.
CUG	Closed User Group as defined in the GSM standard
GPS	Global Positioning System
GSM	Global System for Mobile communications. Cellular communication standard for mobile / cellular telephone networks.
INTERCOM SYSTEM	Direct communication between all the support personnel offices, and the CCC, are via this internal intercom system. This system covers the local CTC and all the offices and buildings in the CTC area.
ISDN	Integrated Services Digital Network
LED	Light Emitting Diode
MMI	Man Machine Interface (or **HMI** – Human Machine Interface)
MSISDN	Mobile Station International Subscriber Directory Number (10 Digit GSM telephone number)
MTN	Mobile Telephone Networks. GSM network operator.
PABX	Private Automatic Branch Exchange. This is the Transnet national private telephone network. There will be a number of these extensions in each CTC and some of them are on the CCC's
PAX	Private Automatic Exchange. This system provides communication in and around the CTC and is focused on internal (Transnet) communication. Each CCC has access to these PAX systems.
PDT	TCO Phone Dispatcher Terminal. This fixed dispatcher will be the CTC's main medium of communication with the trains, and will form an integral component of the CCC. Full specifications form part of this document.
PMU	Portable Maintenance Unit. Unit used to maintain and diagnose Train Cab Systems (TCS).
PSTN	Public Switched Telephone Network.
RADIO SYSTEMS	Each CCC controls a number of different radio systems. These could be of the "open channel" maintenance type, point to point communication, Electrical Control open channel systems or trunked radio systems. This will vary from CTC to CTC, depending on the type of operations in that area.
SIM	Subscriber Identity Module (GSM "SIM" card).
SMS	Short Message Service as defined in the GSM standard.
TCO	Train Control Officer. One for each control section of the line. The TCO is responsible for all the train movements under the control of the specific control desk. Communication with trains and other personnel could be on any of the available communication mediums.
TCS	Train Communication System, primarily for communication between train drivers and Train Control Officers.
TD	Train Describer, as in use by train control equipment in the CTCs.

TFR	Transnet Freight Rail, a Division of Transnet Ltd.
OBC	On Board Computer device as currently being installed on TFR locomotives, which is used to monitor & enforce train speed limits and movement authorisations.
CAB	Driver's compartment on a locomotive.
LAN / WAN	Local Area Network or Wide Are Network for bidirectional data communications.
TRITON	Train Communication & Network System with Tracking facilities
WI-FI	Wireless Fidelity
UN	Nominal Voltage
VOICE LOGGING EQUIPMENT	This is standalone equipment in the CTC, which will interfaces with the various voice communication equipment. It records all the conversations with the dispatcher, on all the systems, & on all the CCCs in a CTC.
WAGON	Various types & styles of train wagons, which could be coupled to a locomotive to form a train.
LAST VEHICLE	Last wagon (or locomotive) of a train set on the rear end of the train (i.e. furthest from the drivers cab).
TRAIN COMPLETE	This concept in train operations indicates that the train is "in one piece" (i.e. has not become divided) and has thus not lost any of its wagons. A function of a system to indicate that a train set is complete would thus be a "Train Complete" function.
LOG-ON	This is a process during which the train driver will connect his personal communication handset to the TCS which will in turn register the ID of the specific handset, the ID of the TCS and the ID of the train onto the communication system. The communication system will inform the TCS of a successful log-on process and the driver will get positive feedback in this regard in the form of a specific sound as well as the display of the TCO name on the screen.
DRAGGING EQUIPMENT	Equipment which may hang from the train (loose brake gear, etc.) and which is dragged along while the train is in motion, causing damage to the perway.
DERAILED WHEELS	When one or more sets of train wheels become dislodged from their normal position on the rail while the rest of the train remains on track.
HANDSET	A human interface device which, when connected to the TCS, will allow the TCS user to communicate with the TCO in the control centre.. (The system will automatically detect its unique / personalized ID, which will in turn be linked to a specific person in the operational system database(s).
DATA PORT ON TRAIN CAB COMMUNICATION SYSTEM	An international standard interface through which commands and information will be forwarded to and received from the TS. The communication style on the port will be on a serial format (RS 232) and the communication protocol on the port will allow the use of a command set similar to the Hayes AT command set. Ethernet connection is also planned.
VHF	Very High Frequency – radio band for the specific communication requirements between the CU and RU of the telemeter / EoT system.
DATA PORT ON TELEMETERING EQUIPMENT	An international standard interface through which maintenance and control could take place. All the functions of the telemeter device will be available on the port and through which it will be controlled from the remote control device without the loss of any functionality of the system. The communication style will be a serial format (RS 232) and the communication protocol on the port will allow the use of a command set similar to the Hayes AT command set. Ethernet connection is also planned.
TELEMETER (EOT)	Radio device to primarily monitor braking system air-pressure or -vacuum at the rear of the last vehicle of the train, and to continually inform the driver of the train of the status thereof. Comprises a Cab Unit (CU or HoT unit) and a Rear Unit (RU or

	EoT unit)
CAB UNIT (CU)	A mentioned under Telemeter (EoT)
REAR UNIT (RU)	A mentioned under Telemeter (EoT)
TELEMETER SYSTEM (TS)	A system of telemeter equipment, which includes a CU and a RU. (or Hot and EoT).
HOT-BOX DETECTORS	Permanently installed equipment at specific locations along the railway line, which will detect any abnormal temperature conditions on any of the wheel bearings of a passing train.

2. SCOPE

This document details the technical and functional requirements for the GSM-based Train Communication System as required by Transnet Freight Rail on its Richards Bay Coal Line. The existing TCS equipment on the Richards Bay Coal Line is in need of replacement, and this document is intended to ensure compatibility & alignment with the existing system.

The TCS specified in this document shall replace the existing installed TCS-1 and 2 systems on the Transnet Freight Rail Coal Line locomotive fleet and shall also be installed in new locomotives with different cabin layouts.

The document includes all aspects and functionalities of the system, all of which may not be applicable for the replacement of TCS equipment specifically for locomotives.

2.1. General Requirements

2.1.1. Functionality and design architecture of the TCS shall be compatible with the TRITON system to ensure the future interface between the two systems. Figure 1 below illustrates the TCS components and its interfaces with other locomotive systems and the future interface with TRITON. The TRITON system is a communication & network system for locomotives and was designed to accommodate other communication alternatives in the future, e.g. Satellite communication.

2.1.2. Interfaces between TRITON and the TCS are indicated in Figure 1 below, as well as the Ethernet connection between the TCS and TRITON.

2.1.3. The diagram also illustrates the interfaces to the GPRS- and GPS antennas, and how these become part of the TRITON system when deployed.

2.1.4. TRITON broadcasts GPS packets to all its peripheral devices and provides a data communication path via multiple communication channels. These include GPRS, WiFi and a UHF “open channel” radio communication path, although UHF is currently not used for communication on the Transnet Freight Rail Coal Line.

2.1.5. The Transnet Freight Rail documents BBC1789 and BBC4204 contain all the details of TRITON functionality and messaging protocols.

2.1.6. The TCS shall be a fully functional system; however, specific components and functionalities of the TCS systems may be re-assigned, as and when other control devices such as TRITON and/or OBC are implemented.

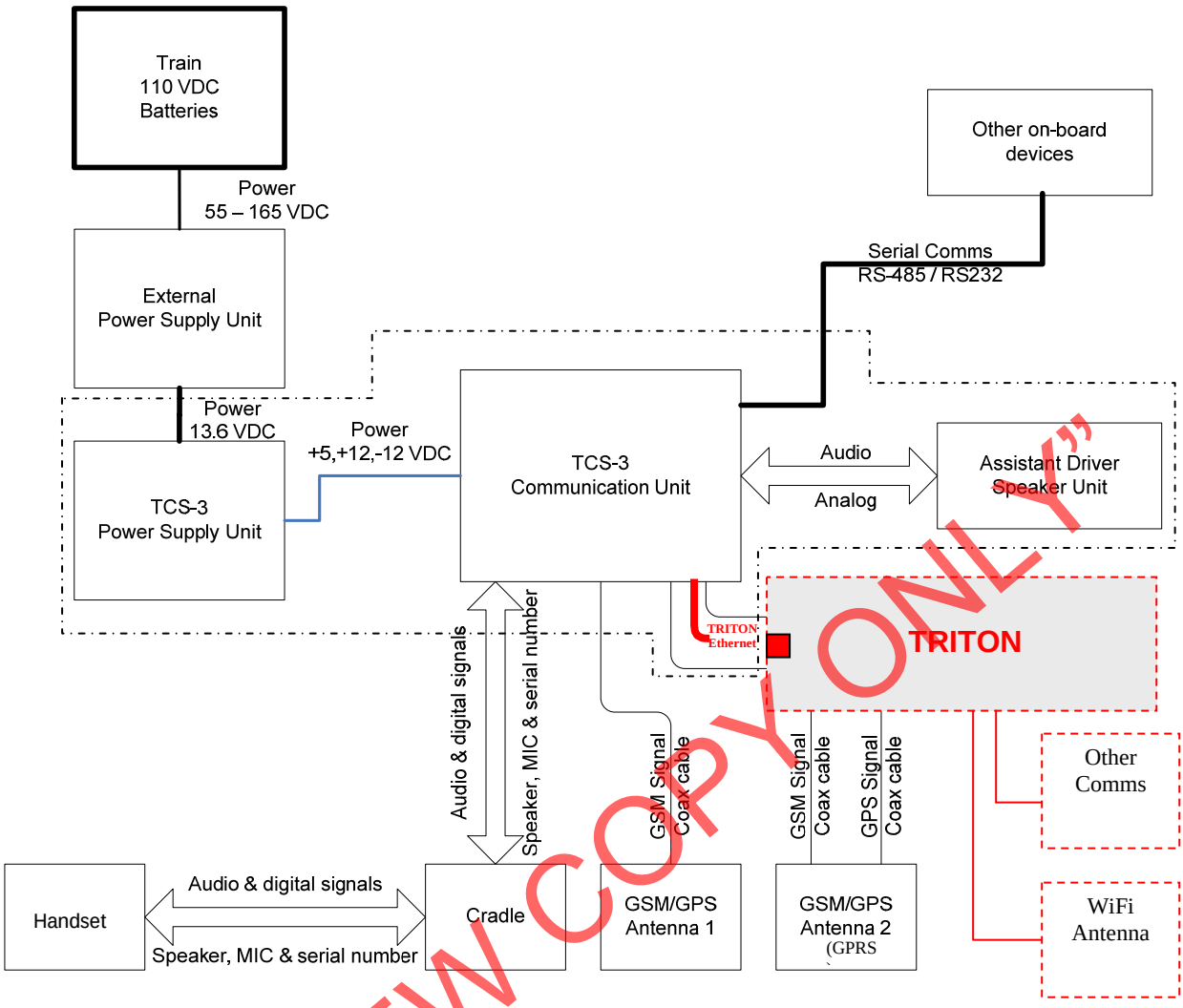


Figure 1: TCS Contextual Diagram with TRITON migration Ethernet interface.

3. 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 the referenced document and this specification, the contents of this specification shall be considered a superseding requirement.

3.1. Transnet document

CSE-1154-001 CAT E48	Environmental specification of TRANSNET FREIGHT RAIL railway signalling systems.
CSE-1159-001 CAT E48	Standard specification for documentation for signals equipment.
BBC0659	Guideline for the use of GPRS in Transnet Freight Rail.
BBB0947 (Latest issue)	General Ergonomic Guideline for the Design of Visual Display Man – Machine – Interfaces
BBC1789	System Specification for a Train Tracking and Data Communication System (TRITON)

BBC4204	TRITON Data Communication Protocol

3.2. External Reference Documents

Cenelec EN 50121-3-2	Railway Applications: Electromagnetic compatibility, Rolling stock apparatus.
Cenelec EN50155	Railway Applications: Electronic equipment used on Rolling Stock
IEC 60571	Electronic equipment used on rail vehicles
IEC 61373	Railway applications. Rolling stock equipment. Shock and vibration tests
	Radio regulations of the S.A. Department of Posts and Telecommunications.
SCEH-80 (Nov 1997)	Transport Telecom power supply specification

4. Functional Overview

4.1. General Requirements

4.1.1. The system shall be designed to :

4.1.1.1. provide Transnet Freight Rail with a cost effective solution to its communication needs;

4.1.1.2. enable equipment to be re-configured easily without the need for hardware modifications;

4.1.1.3. provide a reliable and robust system that can be maintained and upgraded without service disruption to the end user;

4.1.1.4. minimise the impact of the roll-out on normal railway operations.

4.1.1.5. enable incremental geographical roll-out whilst the availability and operation of existing equipment is not affected.

4.1.1.6. allow a third party to do the installation, commissioning as well as the maintenance of the system;

4.1.1.7. provide a system that can easily be decommissioned and disposed of at the end of its working life.

4.1.2. The system shall operate independently of the existing rail signalling system and shall not be dependent on the rail signalling system for its operation. However, it may interface to exchange information.

4.1.3. The system shall be designed so as to eliminate any common point of failure between the voice communications and the data signalling portions of the system.

4.1.4. Design parameters of the system of importance are :

4.1.4.1. Safe working;

4.1.4.2. Coverage;

4.1.4.3. Availability;

4.1.4.4. Reliability;

4.1.4.5. Ease of operation;

4.1.4.6. Flexibility.

4.1.5. The MMI shall be designed so that:

4.1.5.1. Actions are simple and intuitive to the user;

4.1.5.2. Operations are consistent with other similar operations.

4.1.5.3. Touch screens are **NOT** employed.

4.1.6. Any indications, warnings alarms and displays shall be:

4.1.6.1. Clear;

4.1.6.2. Unambiguous;

4.1.6.3. Consistent with other similar displays and from one to another.

4.2. System Users and Modes of Operation.

4.2.1. Modes of operation:

4.2.1.1. Normal mode;

4.2.1.2. Manual location update mode.

4.2.2. User groups

4.2.2.1. Various items of equipment are envisaged to use the GSM network to communicate with all or some of the users that share the network and external networks. The items that will be able to use the system are :

- Handheld and Mobile phones (as described in section 5);
- Train Cab System (as described in section 6);
- Transportable Cab systems (as described in section 7);
- TCO fixed terminals (PDT - as described in section 10).

4.2.2.2. The user of the train cab system may be the driver or other authorised operational personnel.

4.2.2.3. Only Train Control Officers are to use TCO PDT equipment which is intended for communication with trains in the train communication CUG and with support personnel in the General CUG.

4.2.2.4. All supporting personnel along the line are to use standard GSM handheld and mobile phones. These users shall be in the General CUG.

4.2.2.5. Closed user groups, as available in the GSM network, will be to provide simple barring facilities.

4.3. GSM network

4.3.1. Description

4.3.1.1. Communication between the mobiles and the fixed equipment on the network shall be via a public GSM network. No fundamental changes are required to this network, although some additional software or interfacing may be required.

4.3.1.2. There are three types of services available in the GSM network, bearer services, tele-services, and supplementary services.

4.3.1.3. The public GSM network provides the following standard GSM teleservices :

4.3.1.3.1. Telephony;

4.3.1.3.2. 112 Emergency calls;

4.3.1.3.3. Short message service;

4.3.1.3.4. Mobile terminated;

4.3.1.3.5. Mobile originated;

4.3.1.3.6. Cell broadcast (for network operator use only);

4.3.1.3.7. Group 3 facsimile.

4.3.1.4. Also provided is a data bearer service: Asynchronous full duplex data up to

9600 bits/sec and GPRS.

4.3.1.5. The following supplementary services are provided:

4.3.1.5.1. Barring of all outgoing, incoming or international calls;

4.3.1.5.2. Call waiting;

4.3.1.5.3. Call hold;

4.3.1.5.4. Call forwarding to numbers available to the user under normal operating conditions;

4.3.1.5.4.1. Unconditional (all calls);

4.3.1.5.4.2. Subscriber busy;

4.3.1.5.4.3. No reply;

4.3.1.5.4.4. Subscriber not reachable;

4.3.1.5.5. Calling line identification ;

4.3.1.5.6. Connected line identification.

4.3.1.6. Closed user groups will have the following additional features and restrictions:

4.3.1.6.1. Barring of individual users inside a CUG of calling outside his CUG (inter group calls only);

4.3.1.6.2. Barring of incoming and / or outgoing calls per group;

4.3.1.6.3. Barring per individual for incoming and outgoing access;

4.3.1.6.4. Allowing specific users to call outside the CUG;

4.3.1.6.5. Allowing specific users to receive calls from outside the CUG;

4.3.1.6.6. Users may belong to up to 10 different CUGs;

4.3.1.6.7. Two main CUGs (Train communication and General);

4.3.1.6.8. Few smaller groups inside these groups (peripheral restricted);

4.3.1.6.9. Multi-party calls are not possible inside CUGs.

4.3.1.7. In addition, the following services will be attached to the GSM network (subject to normal CUG restrictions):

4.3.1.7.1. Voice mail;

4.3.1.7.2. Advanced voice mail for selected subscriber;

4.3.1.7.3. Fax mail.

4.3.1.8. The system to be developed shall provide the following features:

4.3.1.8.1. Short-form numbering within Closed User Groups;

4.3.1.8.2. Barring per mobile on location, destination;

4.3.1.8.3. Functional addressing (Train Numbering);

4.3.1.8.4. Location dependent addressing (Calls to controllers);

4.3.1.8.5. Priorities and pre-emption (including Emergency);

4.3.1.8.6. Recording and logging of communications;

4.3.1.8.7. Custom dispatcher consoles;

4.3.1.8.8. Queuing and de-queuing;

4.3.1.8.9. Voice group calls;

4.3.1.8.10. Voice broadcast calls;

4.3.1.8.11. Pre-defined SMS messages.

4.3.2. Communication services

4.3.2.1. Duplex one-to-one voice calls shall be established between the TCO and any

driver under his control using the provided system.

4.3.2.2. A driver shall be able to make an emergency voice call to an emergency position in his current zone, by pressing a single button.

4.3.2.3. A TCO shall be able to make an emergency voice call or send an emergency message to a driver in his/her zone.

4.3.2.4. A TCO shall be able to call fixed wire telephones via the fixed wire telephone networks (Transnet and Telkom).

4.3.2.5. Fixed wire telephone users shall be able to call TCOs via the fixed wire telephone networks.

4.3.2.6. Only TCOs shall be able to call a driver directly. Other train system users shall not be able to call a driver except via a TCO PDT (conference call or transfer). Since multi-party calls are not available within CUGs on the GSM network, the tenderer is required to explain how this will be achieved.

4.3.2.7. It shall be possible for driver-to-driver calls to be established via the TCO PDT (conference call or transfer). The tenderer is required to explain the mechanism.

4.3.2.8. The system shall make a TCO aware of all calls/attempts to establish contact with the TCO. The indication to the TCO shall include the (train) number of the caller.

4.3.2.9. TCOs shall be able to send data messages (SMS) to any suitably equipped user in his area of control. Provision must be made for switched data calls and virtual LAN/WAN (e.g. HSDPA, GPRS) connections for the purpose of data communications.

4.3.2.10. Drivers shall be able to send data messages (SMS) to his controlling TCO. Provision must be made for switched data calls and virtual LAN/WAN (e.g. HSDPA, GPRS).

4.3.2.11. A TCO shall be able to send any of the following types of data message to any train driver in his zone:

4.3.2.11.1. pre-defined text messages with or without variable fields;

4.3.2.11.2. free-form text messages.

4.3.2.12. A driver shall be able to send to a TCO one of the following types of data message:

4.3.2.12.1. pre-defined text messages with or without variable fields;

4.3.2.13. The system will convey information from other electronic equipment in the train cab via the train cab system using standard GSM SMS, circuit switched data or GPRS platforms.

4.3.2.14. Transnet Freight Rail operates ESME links for SMS messaging in order to facilitate SMS messaging latency of fifteen (15) seconds or less. Tenderers are required to utilise this facility.

4.3.2.15. The system shall support the use of GSM circuit switched data and virtual LAN/WAN (e.g. HSDPA, GPRS) services for transmission of application data between external devices and systems connected to the TCO PDT, train systems and other user components

4.3.2.16. A TCO shall be able to send broadcast messages, including emergency

messages. The TCO shall be able to select the group of TCSs, which are to receive the broadcast from all those trains in its zone.

4.3.3. Train numbering

4.3.3.1. All calls to and from trains shall be based on train numbers, consisting of sixteen alphanumeric characters.

4.3.3.2. There number of separate train numbers allocated are not planned to exceed 10 000.

4.3.3.3. Train numbers are known to controllers and to drivers, but do not necessarily follow a strict pattern which could easily be automated based on time or position.

4.3.3.4. One specific train cab can have many different train numbers during one day.

4.3.3.5. There will be no duplication in train numbers on any one-day (24 hour period) on the full length of the line under control. However, it shall be possible for a TCO to move a train number from one traction unit to another (Linking the train number to a different MSISDN).

4.3.3.6. Train numbers are direction bound (even or odd) and are to be automatically verified in this regard.

4.3.3.7. In case of a number not being in accordance with the direction of the train, the system is required to prompt the driver to correct it.

4.3.3.8. Train numbers could be extracted from the train operation databases in other operational network components.

4.4. Barring

4.4.1. Calls shall only be possible between users of the Transnet Freight Rail train system in accordance with the communication requirement matrix as defined in APPENDIX C.

4.4.2. In the case of connections marked N(T) in APPENDIX C, it is assumed that there is a fixed wire telephone available between the two points, and, for this reason, calls via GSM shall not be possible.

4.4.3. In the case of connections marked N(P), it shall be possible for a train controller (TCO) to transfer or conference calls, with the restriction that all calls shall be calls which the TCO is allowed to make in accordance with the matrix.

4.4.4. GSM network barring for CUGs as per APPENDIX E.

4.5. Emergency and priorities

4.5.1. The train cab system shall provide for at least two levels of priority of calls:

4.5.1.1. Emergency: Calls to and from emergency numbers;

4.5.1.2. Normal priority: Calls from users other than trains or TCOs.

4.5.2. Within the GSM network, there will be no distinction between the priorities of the calls. The priority of a call shall be determined by the Call Routing Layer (refer section Section 11) of the TCS system.

4.5.3. Emergency calls shall take precedence over non-emergency calls within the train system network, but not over other calls on the GSM network. Typically, these calls will be set up using a single, designated button on the train, mobile or transportable cab system.

4.5.4. The system shall ensure that emergency priority calls are handled so as to minimise call connection times and maximise the probability of the call being correctly routed.

4.6. System management

4.6.1. Tenderers are required to state the system management functions that they shall provide.

4.6.2. Version control of all executable-, data structure-, initialization-, etc. files, will be available on the Back Office (BOF) at all times, for all the different components of the total system e.g. BOF, TCS, PDT, etc.

4.6.3. The system will ensure that all the different components in the system operate on the same version of software for the specific component.

4.7. Phone Dispatcher Terminal (PDT) equipment

4.7.1. The PDT equipment shall allow the TCO to :

4.7.1.1. Make and receive voice and data calls and

4.7.1.1.1. display details of the calling party including:

4.7.1.1.1.1. the priority of the call

4.7.1.1.1.2. train number (where appropriate);

4.7.1.1.1.3. the zone in which the train is located (where appropriate);

4.7.1.1.1.4. a textual description of the calling party's identity;

4.7.1.1.1.5. the context of a text message (where appropriate).

4.7.1.2. Dynamically display the stack of incoming voice and data calls;

4.7.1.3. set up and transfer calls to other users;

4.7.1.4. set up group calls to other users;

4.7.1.5. set up automatic location triggered text messages.

4.7.2. The PDT equipment shall interface to both the GSM (mobile) and the ISDN or similar (fixed wire) networks should the latter be available.

4.7.3. PDT shall dynamically display details of all trains entering and exiting the zone controlled by the TCO.

4.7.4. A call from a TCO to a train will require the mapping of a train number to a MSISDN, and the authorisation of the calling TCO to call that particular train. The linking information shall be obtained from a local database, which shall be kept current by the master database, which in turn shall be kept up to date by the Call Routing Layer (refer to section 11). The Call Routing Layer shall perform the call authorisation function at the time of call set-up.

4.7.5. The control centres (CTCs) will form the major part of the fixed network. Additional fixed communications will be provided at various infrastructure depots.

4.7.6. All Phone Dispatcher Terminals shall be networked to provide connection to the train number database.

4.7.7. The Phone Dispatcher Terminal shall log all incoming calls if busy on another call and display the information of the calling party on the screen in chronological order.

4.7.8. Call routing

4.7.8.1. All calls from the dispatcher, including individual-, group-, include calls and transfers shall be routed via the shortest fully digital path, with conversion to analogue speech as close to the called party as possible. At no stage shall a speech path include more than one digital section (either A-law PCM, or GSM). Call set-up need not be done via the same route.

4.7.8.2. A call from the dispatcher to a Telkom telephone shall be routed via the

Transnet network to the appropriate Telkom network, to the selected Telkom user.

4.7.8.3. A call from the dispatcher to a Transnet telephone shall be routed directly onto the Transnet telephone network.

4.7.8.4. Any conferencing of calls shall be done digitally, within a fully digital network. This network may be the GSM network or Transnet's telephone network. The routing from the point of conferencing to the various parties shall be via the shortest possible fully digital paths, as specified above. Analogue mixing of signals is not preferred.

4.7.8.5. The system shall make provision for, though not necessarily support, data calls that will be routed in the same way, but which assume a fully digital path from end to end.

4.7.8.6. There will be a dedicated PDT for emergencies in each CTC.

4.8. Equipment interfaces

4.8.1. User interface

4.8.1.1. For safety reasons, all conversations on the TCO console shall be via one handset. It shall be possible to switch the handset to any circuit on the console. It shall not be possible to switch between any two active circuits at any point in time (e.g. swap between two users).

4.8.2. Equipment requirements

4.8.2.1. Each CTC position (TCO) shall have a PDT, consisting of an IBM compatible personal computer (PC), with a screen, keyboard and mouse interface. Initially, this terminal will be connected to the train communications system via GSM (air interface). Tenderers are required to indicate the possibility of connecting this equipment via fixed wire (ISDN) to the GSM infrastructure.

4.8.2.2. The fixed wire (ISDN) connection will provide more features and facilities than the GSM phone connection. A single dispatcher terminal should provide both types of interface, to be implemented as the service become available.

4.9. Train Communication System

4.9.1. It is envisaged that the train system will consist of two standard 2 Watt GSM communication modules together with a separate processor or computer that will enable the driver to do all the functions as set out in this document. There will be an interface to the GSM communication module via a Man Machine Interface (MMI). Various other external devices shall be attached to aid the train system in performing its functions.

4.9.2. The train cab system shall:

4.9.2.1. allow the driver to make and receive voice calls;

4.9.2.2. allow the train driver to send and receive data messages;

4.9.2.3. display details of the called and calling party, including:

4.9.2.3.1. a textual description of the calling or called party's identity .

4.9.2.3.2. the contents of the text message (where appropriate).

4.9.2.4. allow data messages to be received;

4.9.2.5. indicate the status of the radio connection (e.g. signal strength);

4.9.2.6. allow the driver to contact the controlling TCO by performing a single control

operation;

4.9.2.7. allow the driver to make emergency calls to the emergency position by pressing a single button.

4.9.3. A train system shall have a permanent MSISDN (permanent SIM card).

4.9.4. The CAB phone system shall allow the driver assistant to listen to all the conversations in which the driver is involved, e.g. by means of an external speaker.

4.9.5. The train system equipment shall also have a number of data ports available for the connection of external devices / systems. These external devices are not specified here, but will be connected by internationally recognised standard interfaces.

4.9.6. A transportable version of the train system unit shall be available for the use on trains where no permanent installation is available in the cab. The transportable shall have all the functionalities of the permanently installed train systems. Refer to section 7 for detail.

4.9.7. Ethernet connectivity to support TRITON migration

4.9.8. The hardware enclosure shall have multiple mounting forms to accommodate the different locomotive cab layouts, e.g. roof mounting, panel mounting and upright surface mounting.

4.9.9. One of the hardware enclosure mounting forms shall be designed to fit into the existing TCS mountings.

4.10. Location systems

4.10.1. A call from a train to a TCO will require knowledge of where the train is positioned, as well as the link between the MSISDN and the train number. This information shall be available in the Call Routing Layer (CRL).

4.10.2. At least one method of automatic display of location information shall be provided.

4.10.3. It shall be possible for a TCO to establish the position of the train on request.

5. HANDHELD AND MOBILE PHONES

5.1. The system shall be able to establish communication connections with standard handheld and mobile phone equipment, i.e. commercially available “off-the–shelf” GSM mobile phones. Tenderers are required to indicate how calls to and from these units will be made with respect to the PDTs. (i.e. standard GSM phones belonging to certain Closed User Groups)

6. TRAIN COMMUNICATION SYSTEM (TCS)

6.1. Functional Requirements

6.1.1. Modes of operation

6.1.1.1. There shall be four modes of operation. These modes shall only be possible after successful GSM registration on the correct GSM network. Normal emergency calls shall always be possible.

6.1.1.1.1. Sleep mode :

6.1.1.1.1.1. This mode shall be active when there is no driver handset present.

6.1.1.1.1.2. The controlling equipment shall be in an idle mode.

6.1.1.1.1.3. The GSM phone shall be logged on to the GSM network.

6.1.1.1.1.4. Positioning device shall be operational.

6.1.1.1.1.5. Only a pilot lamp on the display unit shall indicate the availability of power to the equipment.

6.1.1.1.1.6. The display shall be off.

6.1.1.1.1.7. Background software activities will proceed as specified elsewhere.

6.1.1.1.2. Basic mode :

6.1.1.1.2.1. Handset inserted.

6.1.1.1.2.2. Necessary lamps will indicate appropriate status.

6.1.1.1.2.3. Display device shall display information as specified elsewhere.

6.1.1.1.2.4. The driver will have the opportunity to call the relevant TCO in this mode if the GPS is faulty or the system does not allow the specific driver to log onto the network.

6.1.1.1.3. Normal mode :

6.1.1.1.3.1. User logged on to the Transnet Freight Rail communication system and the corresponding train number is registered.

6.1.1.1.3.2. Equipment ready to generate or receive calls.

6.1.1.1.3.3. All databases updated and the user linked to the specific train and train number.

6.1.1.1.4. Technician mode :

6.1.1.1.4.1. It shall be possible to enter a mode where a trained technician may perform system tests on the TCS and external equipment.

6.1.1.1.4.2. Unauthorised personnel shall not be able to enter this mode of operation. (e.g. special handset required).

6.1.2. Activation and De-activation

6.1.2.1. The terms activate and de-activate are used to refer to the insertion and removal of the driver's handset.

6.1.2.2. Before the TCS can be used it must be activated and successfully complete its diagnostics checks. Once activated, the TCS defaults to Basic Mode operation.

6.1.2.3. The TCS shall continue to operate in Basic Mode until the driver has successfully logged on to the system (i.e. registered his train number with the fixed infrastructure).

6.1.2.4. After activation the train cab system shall prompt the user to log on to the TFR communication system, allowing access to the range of GSM services available.

6.1.2.5. The TCS shall take its power from the train's auxiliary power supply, through a DC to DC power converter as specified in this specification. Refer to section 13 for details.

6.1.2.6. All lamps shall be illuminated for a certain time and extinguished as appropriate as part of the activation diagnostic tests.

6.1.2.7. Once the activation diagnostic tests have been successfully completed, and TCS is in basic mode, the TCS shall continuously give an indication of the status of the received GSM network signal strength on its display.

6.1.2.8. When the TCS is deactivated the TCS shall remove any entries from the data message queue but all other databases shall remain unchanged. Tenderers are to describe the process for doing this.

6.1.2.9. If the user of the cab system removes his handset, the TCS shall perform a

log-off routine, which shall remove all links to that train number and driver identification from the system, and go into sleep mode again.

6.1.3.Log-on

6.1.3.1. To allow access to the TFR system services, the TCS user must be logged-on to the TFR Rail network. This may be a manual or fully automatic process.

6.1.3.2. The driver shall be able to enter the required information:

6.1.3.2.1. the train number;

6.1.3.3. The cab system shall then log-on to the TFR fixed infrastructure (Call Routing Layer) using a SMS (or suitable message structure available in the GSM network) log-on request. Tenderers are to indicate the proposed mechanism. This log-on request shall include:

6.1.3.3.1. the location of the train (e.g. GPS position, signal and mast pole number);

6.1.3.3.2. the identity of the handset being used (user name);

6.1.3.3.3. the identity of the train (from the driver entry);

6.1.3.3.4. the identity of the train (asset number)

6.1.3.3.5. the status of the TCS (e.g. loudspeaker, GPS);

6.1.3.3.6. the status of all external systems attached to the cab system (e.g. CAB statuses, event recorder, if applicable);

6.1.3.4. The TCS shall inform the fixed infrastructure of the version of on-train configurable databases and software running.

6.1.3.5. If a response from the fixed infrastructure to the log-on request is not received within a certain time, then an attempt to log-on via an alternative fixed infrastructure access number shall be made.

6.1.3.6. If attempts to register via all alternative fixed infrastructure access numbers known to the train system, fail, then a failure indication shall be given.

6.1.3.7. If the log-on attempt is not authenticated (e.g. train number contained in the log-on requests is found to be incorrect or invalid) by the fixed infrastructure, then a failure indication on the condition of request shall be given to the driver and to the controlling TCO (if known), e.g. number invalid, number in use.

6.1.3.8. No duplication of train numbers shall be allowed. If the fixed infrastructure receives a request to use a train number that is in use by another train, the TCO will receive an indication and be asked to verify the log-on request.

6.1.3.9. If the log-on attempt is not authenticated by the fixed infrastructure, then the driver shall be able to correct the log-on request information and re-attempt the log-on.

6.1.3.10. If the log-on request fails a second time, the driver shall have the option of making a voice call to the controlling TCO.

6.1.3.11. Once a successful log-on has been performed, the driver and the TCO shall receive an indication, which will define normal operation mode on the TCS.

6.1.3.12. If the fixed infrastructure determines that the versions of databases on the TCS are not the latest, the databases shall be updated.

6.1.3.13. The TCO shall have the facility to change the train number en route. This

change shall automatically be updated to all other relevant databases.

6.1.3.14. If the fixed infrastructure determines that the version of software on the cab system is out of date, it shall inform the relevant system administrator of the status.

6.1.3.15. If the train leaves the coverage area of the Transnet Freight Rail system, the TCS shall give an indication to the driver.

6.1.4.Log-off

6.1.4.1. When the driver no longer needs the TCS functionality, the driver may log-off by removing the handset.

6.1.4.2. Upon removal of the driver's handset, the TCS shall log-off from the fixed Transnet Freight Rail infrastructure.

6.1.4.3. The TCS shall give the driver an indication if the log-off has failed.

6.1.4.4. If a log-off attempt has failed, the TCS shall attempt to log-of via alternative fixed infrastructure access numbers. This will be done until the TCS has logged off, or it has attempted to log-off via all known fixed infrastructure access numbers known to the TCS.

6.1.4.5. After a successful log-off, the cab system shall return to sleep mode.

6.1.4.6. The TCO shall also be informed that the driver has logged-off.

6.1.4.7. All links to that train number and driver identification shall be removed from the system fixed infrastructure.

6.1.5.Sending a data message

6.1.5.1. The TCS shall allow the driver to send data messages.

6.1.5.2. The driver shall be able to select a message from a pre-set text message list.

6.1.5.3. Certain data messages shall have parameters that may need completion (where appropriate).

6.1.5.4. Messages (e.g. emergency messages, standard messages to TCOs) shall have a called party automatically assigned.

6.1.5.5. For data messages that have no automatic called party assigned, the driver may select the called party by means of:

6.1.5.5.1. scrolling through a list of numbers.

6.1.5.6. The driver shall be able to re-send a message. This shall be as simple action as possible.

6.1.5.7. Upon completion of a message and all its fields (where appropriate) the message shall be sent to the intended recipient via the fixed GSM infrastructure.

6.1.5.8. If the message is not sent successfully, the driver shall receive a failure indication.

6.1.5.9. The driver shall receive an indication when any message is being sent.

6.1.5.10. A copy of all sent messages shall be kept in a "sent message" list in a strict chronological order, based on time of dispatch and in a first-in-first-out order. The "sent message" list shall be capable of storing up to 10 messages.

6.1.5.11. The driver shall be able to read messages from the "sent message" list.

6.1.5.12. The “sent message” list shall be cleared at log-off.

6.1.6.Receiving a data message

6.1.6.1. The driver shall be able to receive data messages from TCOs.

6.1.6.2. Indication shall be given to the driver on receipt of an incoming data message.

6.1.6.3. The driver shall also be informed of the identity of the message originator.

6.1.6.4. A stack shall be maintained and displayed by the train system of all incoming messages that have not been read by the driver. This queue shall be capable of storing up to 10 messages. There shall be an indication to the user as to the number of unread messages in the stack.

6.1.6.5. Messages deleted as a result of overflow of the “receive message” list shall be moved to the “history message” list and tagged accordingly.

6.1.6.6. The driver shall be able to read any message from the stack.

6.1.6.7. It must be a simple action to read the message at the top of the stack.

6.1.6.8. Non-Emergency messages that have been cancelled by the message originator prior to being read by the driver, shall be removed from the stack.

6.1.6.9. Emergency messages that have been cancelled by the message originator prior the message being read by the driver shall remain on the stack, but shall be clearly marked as cancelled. No acknowledgement shall be sent for such a message.

6.1.6.10. Once the message has been read (and acknowledged where appropriate), the driver shall have the option to delete the message from the received message stack.

6.1.6.11. After deletion of a message, all indications of the message shall be removed.

6.1.6.12. After deletion of a message, the message shall be moved to a “history message” stack and remain there for a certain time.

6.1.6.13. The ”history” stack shall be kept in strict chronological order.

6.1.6.14. The “history” stack shall be able to store 10 messages.

6.1.6.15. The driver shall be able to read any message from the “history” stack.

6.1.6.16. The “received massage” list and the “history message” list shall be cleared upon log-off.

6.1.7.Initiating a voice call.

6.1.7.1. After the driver has successfully logged on, the TCS shall be in normal mode and he may make voice calls to TCOs.

6.1.7.2. Selection of the called party, by the driver, shall be done by the following means :

6.1.7.2.1. Doing a single control operation to make a emergency call to the Emergency number for the area he is in;

6.1.7.2.2. Doing a single control operation for making a call to the controlling TCO;

6.1.7.2.3. By selection from a menu (scrolling) on the display (only if the automatic selection of TCO has failed, e.g. GPS has failed);

6.1.7.3. The TCS shall not allow any call other than TCO numbers to be dialled.

6.1.7.4. The priority of the call shall depend on the called party selected.

6.1.7.5. If a voice call is unable to be set up (due to communication failure or some

other reason), the driver shall receive a failure indication.

6.1.7.6. The driver shall be given an indication of the progress of the call (e.g. ringing, network violation, network busy).

6.1.7.7. There shall be no system limit on the duration of the call, however the Transnet Freight Rail system shall provide for an adjustable call limit.

6.1.7.8. The driver shall receive a clear indication of the duration of the call and / or remaining time for the call.

6.1.7.9. The driver shall receive a 10-second warning if the call is about to be terminated (by the TFR system).

6.1.7.10. The system shall also provide the option to log the call at the called party console, terminate the call and give an acknowledgement of the status to the calling party (e.g. “call back” function).

6.1.7.11. The driver shall be able to clear any call he/she originated.

6.1.8. Receiving a voice call.

6.1.8.1. The driver shall be able to receive voice calls from the TCO who controls the relevant portion of the line.

6.1.8.2. All audio shall be routed to the handset and the external loudspeaker. The volume of the external speaker shall be adjustable with fixed minimum level. The minimum volume shall be set during installation. Operating volume adjustments may be done in hardware or software (driver selectable). Tenderers are to describe the method used.

6.1.8.3. Audible indication shall be given to the driver, upon receipt of an incoming voice call. Volume of the indications shall be adjustable with a fixed minimum level. The minimum level shall be set during installation. Volume adjustments may be done in hardware or software. Tenderers are to describe the method used.

6.1.8.4. An indication shall be given to the driver indicating the calling TCO’s identity.

6.1.9. Call termination

6.1.9.1. The driver shall be able to terminate any voice call.

6.1.9.2. If the other party has terminated the call, the driver shall receive an indication.

6.1.9.3. If the call is dropped, the driver shall receive an indication.

6.1.10. Retry strategy for emergency data messages and emergency voice calls.

6.1.10.1. If the intended recipient does not receive an emergency message/call or the message/call fails to be received by the infrastructure, the train system shall adopt a re-try strategy.

6.1.10.2. If an emergency message/call failed, the TCS system shall re-try the attempt.

6.1.10.3. If, after a certain time, the data message or call has still not been received / set-up, a failure indication shall be given to the driver and further attempts to re-try the message/call shall be terminated.

6.1.11. Manual location updates

6.1.11.1. When automatic location update is in service, this shall be transparent to the

user. If automatic location update failed, the driver will be required to enter the location information manually every time he changes from one TCO area to another.

6.1.11.2. When the cab system receives a request to start using manual location updates;

6.1.11.2.1. the driver shall receive an indication.;

6.1.11.2.2. the location information shall be sent to the intended recipient.

6.1.11.3. When the cab system receives an indication to stop using manual location update, an indication shall be given to the driver and the driver shall no longer be allowed to enter the location information.

6.1.11.4. The cab system shall be able to display the TCO zone under whose control he is.

6.1.12. Diagnostics tests

6.1.12.1. Diagnostics checks shall be done by the cab system at power-up, after activation, during normal operation and on demand, to ensure correct operation.

6.1.12.1.1. Power-up

6.1.12.1.1.1. A comprehensive set of diagnostics checks shall be performed by the TCS on itself, including train system functions.

6.1.12.1.1.2. The TCS shall determine what external devices are connected and initiate diagnostics tests on each of the external systems.

6.1.12.1.1.3. If any of the power-up tests fail the driver shall receive a failure indication.

6.1.12.1.2. Activation

6.1.12.1.2.1. When the driver handset is inserted, the cab system shall determine the status of any associated equipment on the train systems including, but not limited to :

6.1.12.1.2.1.1. Internal GPS unit;

6.1.12.1.2.1.2. Internal GSM Modems

6.1.12.2. Diagnostics check results from external systems shall be interpreted by the cab system.

6.1.12.3. The cab system shall be capable of doing its own diagnostics check and process results from other external devices within one minute after power up.

6.1.12.4. A suite of routine tests shall be performed during normal operation at a certain interval, until the cab system logs-off.

6.1.12.5. The routine tests shall not affect the operation of the cab system.

6.1.12.6. The routine tests shall include tests on external systems.

6.1.12.7. Failure of an external system communication via the TCS, such as a locomotive condition monitoring system, shall not cause a failure on the cab system.

6.1.12.8. If a self-test fails the TCS shall display a failure indication to the driver.

6.1.12.9. On-demand

6.1.12.9.1. Upon receipt of a request to perform tests the TCS shall perform the

required tests. This request may come from the portable maintenance unit, from the system administrator, from a TCO and from a technician while in technician mode.

6.1.12.9.2. The TCS shall report the results of the performed tests to the requesting system.

6.1.13. Call data

6.1.13.1. To allow correct identification of calling and called parties, the MSISDN must be passed to all parties involved in the call. The Call Routing Layer shall then ensure the correct routing.

6.1.13.2. The cab system shall extract the following data when receiving a call:

6.1.13.2.1. recipient system;

6.1.13.2.2. calling party identity (e.g. TCO 1 in Vryheid);

6.1.14. External systems

6.1.14.1. Transnet approved external devices may be connected to the TCS. Some devices may need to send and /or receive data to and from CTC based equipment and the cab system shall act as bearer service.

6.1.14.2. The TCS shall be able to support external systems such as

6.1.14.2.1. train condition monitoring units;

6.1.14.3. The TCS shall be able to receive data calls and route the data to the intended attached system.

6.1.14.4. The TCS shall route the data messages in the form of either:

6.1.14.4.1. SMS;

6.1.14.4.2. data calls (circuit switched).

6.1.14.4.3. GPRS

6.1.15. The TCS GPS unit

6.1.15.1. The TCS shall have an integrated GPS unit, which will supply automatic location information. If an accuracy of +/- 20 metres is not achievable a proposal for an alternative must be provided in order to increase the accuracy of the GPS measurements e.g. a ground based GPS workstation may be used for differential correction.

6.1.15.2. The TCS GPS shall comply with the following minimum GPS validation criteria:

6.1.15.2.1. GPS quality indicator = " 1 "

6.1.15.2.2. Number of Satellites >= 4

6.1.15.2.3. Horizontal dilution of precision < 4.5

6.1.15.3. The cab system shall log a GPS position with each event in the cab system, with a minimum of 5000 events with a first-in-first-out principle, if the events exceed the limit.

6.1.15.4. Location reporting

6.1.15.4.1. The TCS unit shall be capable of storing a database of up to 5000 area boundaries and reporting positions.

6.1.15.4.2. When location reporting is activated, the cab system GPS unit shall report its position and direction of travel to the TCO PDT every time it crosses one of the presetable boundaries stored within the database.

This event shall also be logged.

6.1.15.4.3. If the location reporting has been de-activated, the cab system GPS unit shall not report its position every time it crosses a boundary but only log the information in local memory for possible future reference.

6.1.15.4.4. When requested by the TCO PDT, the cab system GPS unit shall transmit a position update message.

6.1.15.4.5. The GPS unit will ensure that the TCS always link to the relevant TCO controlling that part of line.

6.1.15.4.6. The GPS unit will enable the TCS to log on to the correct TCO on start-up.

6.1.15.4.7. The GPS shall provide direction details.

6.1.15.5. Configuration

6.1.15.5.1. The TCS shall keep a version number of the area boundary database.

6.1.15.5.2. The database must cater for selectable reporting points, reporting at a certain time intervals and on request from the TCO workstation.

6.1.15.6. Accuracy

6.1.15.6.1. The GPS unit must provide an accuracy of +/- 20 meters or better.

6.1.15.7. Diagnostics

6.1.15.7.1. The TCO workstation may request the cab system GPS unit to perform diagnostic on itself. This test shall be in addition to the normal power-up- and routine tests that shall be performed by the cab system.

6.1.15.7.2. If a TCS GPS unit fails, it shall continuously retry to establish a GPS link. This failure shall also be reported to the TCO workstation/BOF.

6.1.15.7.3. The status of the GPS unit shall always be indicated to the driver to indicate and allow manual operations if necessary.

6.1.16. Train system databases

6.1.16.1. The cab system shall maintain a variety of databases, all of which can be updated remotely over the air via the TCO workstation or the system administrator terminal.

6.1.16.2. The cab system shall maintain databases on the following, but not limited to:

6.1.16.2.1. TCO access numbers;

6.1.16.2.2. TCO area boundaries;

6.1.16.2.3. emergency numbers;

6.1.16.2.4. emergency call boundaries;

6.1.16.2.5. text messages;

6.1.16.2.6. train driver information (e.g. handset codes);

6.1.16.2.7. GPS locations, fixed and variable;

6.1.16.2.8. Reporting positions.

6.1.16.3. These databases shall be non-volatile and not be lost after power failures.

6.1.16.4. If databases are updated over the air, and an update fails, the cab system shall then restore the original database.

6.1.16.5. All normal over air database updates shall be done at log-on.

6.1.16.6. All database downloads shall be structured to minimise the time taken and keep airtime and cost to a minimum.

6.1.16.7. Database updates shall only be possible by authorised parties. Tenderers are to indicate the security measures taken to prevent access by other parties.

6.1.16.8. TCO access numbers database

6.1.16.8.1. The TCO number database shall be linked to the area boundary database with a one-to-one mapping (giving each area a TCO number and an emergency number).

6.1.16.8.2. This database shall be updateable over the air.

6.1.16.8.3. It must be ensured that the area database and the TCO number database are of the same version if they are two separate databases.

6.1.16.8.4. Each entry shall at least contain:

6.1.16.8.4.1. Telephone number;

6.1.16.8.4.2. Text description (e.g. Vryheid CTC, TCO east with a minimum of twenty (20) characters).

6.1.16.9. TCO boundaries

6.1.16.9.1. Initially there will be ten (10) controlling areas along the line and boundaries must be implemented accordingly.

6.1.16.10. Emergency numbers

6.1.16.10.1. Initially there will be five (5) emergency numbers, which constitute the four CTC areas and one overall area that cover the complete line.

6.1.16.11. Emergency call boundaries

6.1.16.11.1. The emergency call boundaries will be the same as the controlling areas of the CTCs with a fallback zone, which will cover the complete line.

6.1.16.12. External devices database

6.1.16.12.1. The external device configuration database shall be used to store configuration information relating to external connected devices.

6.1.16.12.2. This database shall contain information relating to:

6.1.16.12.2.1. which devices are connected to which ports;

6.1.16.12.2.2. which cab system devices are connected.

6.1.16.13. Text message database

6.1.16.13.1. A “text message” database shall be maintained in the cab system.

6.1.16.13.2. The “text message” database shall enable the driver to construct and send text data messages to a TCO.

6.1.16.13.3. The text message database shall contain:

6.1.16.13.3.1. ten (10) text messages which can not be updated over the air; only by portable maintenance unit;

6.1.16.13.3.2. twenty (20) text messages which can be updated over the air.

6.1.16.13.4. For each text message the following shall be maintained:

6.1.16.13.4.1. message text (including any variable parameter) up to a maximum of 160 characters.

6.1.16.13.5. Any of the messages may contain a variable parameter.

6.1.16.13.6. The text message database shall have a version number.

6.1.17. GSM network performance monitoring

6.1.17.1. In order to monitor the performance of the GSM network, a log of call success rates shall be kept in the cab system, with maximum information on ten (10) journeys, which relate to ten (10) log-on procedures. The information shall be kept on a first-in-first-out basis.

6.1.17.2. This information may be downloaded to the TCO workstation if needed. The exact time or event shall be configurable. It is envisaged that the download of data shall be done during log-off.

6.1.17.3. The cab system shall keep statistics on all call attempts elating to:

6.1.17.3.1. time of call or attempt to call;

6.1.17.3.2. location of train (if available);

6.1.17.3.3. success or failure of the call;

6.1.17.3.4. reason for failure (if known; e.g. system busy, hand-over failed).

6.1.17.4. Monitoring shall be disabled by default and downloading will only occur if configured otherwise.

6.1.17.5. The cost (duration) of such a download shall be kept to a minimum.

6.1.17.6. Tenderers are to explain which method they will use to reduce cost.

6.2. Man Machine Interface

6.2.1. Introduction

6.2.1.1. This section specifies the MMI and the ways in which the driver / user shall interface with the TCS.

6.2.1.2. The MMI shall allow the driver to operate the TCS safely and allow the reduction or elimination of foreseeable risks.

6.2.2. User tasks

6.2.2.1. The MMI shall allow any trained operator to fully operate any variant or upgrade to the cab system, without additional training.

6.2.2.2. All workspace layouts shall be consistent for all users (maintenance and normal operator mode).

6.2.2.3. The MMI design shall take into account operator capabilities and performance under normal, abnormal and emergency operating conditions.

6.2.2.4. The MMI shall be designed to enable the driver to perform cab system operations without undue risk to him.

6.2.2.5. The MMI shall support all operations that have to be done by drivers and other on-train personnel.

6.2.2.6. The MMI design shall take into account the characteristics of the normal user population, such as:

6.2.2.6.1. their ability to press buttons;

6.2.2.6.2. the size of their hands.

6.2.3. Equipment design

6.2.3.1. Hardware

6.2.3.1.1. It is envisaged that the cab system shall consist of the following

hardware:

6.2.3.1.1.1. hardwired controls (e.g. emergency buttons);
6.2.3.1.1.2. other control devices;
6.2.3.1.1.3. GSM 2 Watt cellular communication units;
6.2.3.1.1.4. GPS and GSM antennas;
6.2.3.1.1.5. handset and cradle;
6.2.3.1.1.6. loudspeaker;
6.2.3.1.1.7. power supply.
6.2.3.1.1.8. Suitable enclosure to accommodate the above;

6.2.3.2. Layout

6.2.3.2.1. Control equipment will be at least four (4) meters from the GSM radio. This shall be done to enable installation of some equipment (e.g. GSM phone, PSU etc.) in a secure location. Tenderers are to state the maximum permissible distance between the control head and the rest of the TCS equipment.

6.2.3.2.2. The handset and external speaker will also be at least four (4) meters from the rest of the equipment located elsewhere in the cab.

6.2.3.2.3. The TCS MMI shall be designed in accordance with ergonomic principles and shall be integrated in the cab layout to enable frequent as well as important operator tasks to be performed efficiently and easily.

6.2.3.3. Input devices

6.2.3.3.1. Input devices shall enable accurate information input and minimise errors and shall be appropriate for the tasks being performed.

6.2.3.3.2. The design of the input devices shall consider issues associated with input devices. Included, but not limited to,

6.2.3.3.2.1. TCS Handset:

6.2.3.3.2.1.1. characteristics of the user population's hands and heads (distance between ear and mouth piece);
6.2.3.3.2.1.2. concurrent tasks;
6.2.3.3.2.1.3. handset grip;
6.2.3.3.2.1.4. use of protective clothing;
6.2.3.3.2.1.5. environmental conditions (e.g. filters to mask noise);
6.2.3.3.2.1.6. weight of equipment.
6.2.3.3.2.1.7. hardwired controls (e.g. Buttons, switches etc.)
6.2.3.3.2.1.8. displacement of control;
6.2.3.3.2.1.9. size and spacing;
6.2.3.3.2.1.10. frequency of use of control;
6.2.3.3.2.1.11. ease of pressing button, turning key, etc;

6.2.3.4. Output devices

6.2.3.4.1. Auditory outputs

6.2.3.4.1.1. Auditory outputs shall produce sound to indicate an event or action or voice output to the driver and his assistant. This shall include items such as loudspeakers and handsets.

6.2.3.4.1.2. The volume shall be adjustable for auditory outputs (e.g.

hardware or software).

6.2.3.4.1.3. The volume shall be limited by a minimum level to enable communication even at the lowest level. This must be adjustable during installation.

6.2.3.4.1.4. The maximum level shall not distort or cause excessive noise of the audio and still allow intelligible audio.

6.2.3.4.2. LED displays

6.2.3.4.2.1. LED displays may be used to provide status information (e.g. On or Off).

6.2.3.4.2.2. Indications shall be clear and shall not be easily confused with other indications in the workplace.

6.2.3.4.3. VDU displays

6.2.3.4.3.1. Screen based technologies shall be referred to by the term VDU display. (e.g. LCD, CRT and Plasma panels)

6.2.3.4.3.2. Colour VDUs must be used.

6.2.3.4.3.3. Any VDU shall be able to display alphanumeric characters and symbols.

6.2.3.4.3.4. For the VDUs to be used, the human factor shall also be considered. (e.g. Disabilities such as colour blindness)

6.2.3.4.3.5. All VDU display items shall have sufficient resolution to be clearly legible under all operating conditions.

6.2.3.4.3.6. No perceptible flicker shall be acceptable under expected operating conditions.

6.2.3.4.3.7. The contrast and brightness shall be adjustable where appropriate.

6.2.3.4.3.8. All display items shall be readable at a viewing distance of up to 1 meter.

6.2.3.4.3.9. The contrast and brightness controls shall not allow an operator to set the level below a minimum level and thus leave the display in a state where its content is not visible.

6.2.3.4.3.10. The VDU contrast level shall be 1:10 under expected ambient conditions.

6.2.3.4.4. Labelling

6.2.3.4.4.1. All dedicated controls shall be labelled to easily identify the function of the control.

6.2.3.4.4.2. Labels and abbreviations shall be consistent with other parts of the system. Abbreviations shall be consistent with normal day to day events and standards.

6.2.3.4.4.3. Labels shall be fixed to position is such a way as to prevent easy removal.

6.2.3.4.4.4. Labelling shall remain clear and legible over the expected lifetime of the equipment and shall not wear off.

6.2.3.4.4.5. Labelling shall take the human factor into account (e.g. use of case, size, font and placement).

6.2.4. Interface format

6.2.4.1. General principals

6.2.4.1.1. Where indications and interfaces are not specified the tenderer shall be responsible for proposing formats of displaying the information.

6.2.4.1.2. The design of all interfaces shall conform to human factor standards.

6.2.4.2. Navigation

6.2.4.2.1. Frequent used display screens and items shall be accessible by a single control operation.

6.2.4.2.2. Moving between different VDU displays that have to be used in conjunction shall be as simple action as possible.

6.2.4.2.3. The order of displays shall be consistent.

6.2.4.3. Feedback

6.2.4.3.1. Control actions shall have timely and appropriate feedback.

6.2.4.3.2. Feedback shall be provided under failure conditions.

6.2.4.3.3. Feedback in response to a system- or local action (e.g. typing) on the TCS shall be given within 300 milliseconds.

6.2.4.3.4. Activation of any control shall provide feedback under all conditions.

6.2.4.3.5. Feedback relating to the task being performed shall remain visible (e.g. the name of the calling party shall remain visible for the duration of the call).

6.2.4.3.6. Feedback shall provide progress of a task if activation is not immediate (e.g. display “connecting” while the call is being set up).

6.2.4.3.7. Responses shall be given to actions such as:

6.2.4.3.7.1. function activation (e.g. pressing the call button);

6.2.4.3.7.2. function completion (e.g. being connected);

6.2.4.3.7.3. failure of an action or function (e.g. a failed data call);

6.2.4.3.7.4. indications of an action (e.g. key pressed);

6.2.5. Operator inputs

6.2.5.1. General

6.2.5.1.1. Some single control actions shall have dedicated input devices (e.g. the emergency button).

6.2.5.1.2. Single control operations may require only a single button depression.

6.2.5.1.3. The MMI shall allow the operator to answer a voice call by means of a single control operation (e.g. pressing an “answer” button.).

6.2.5.1.4. Information inputs by the operator shall be as simple task as possible.

6.2.5.1.5. Critical and frequent operations shall be performed with the minimal amount of keys pressed to minimise risk of error. Feedback shall also be provided.

6.2.5.1.6. Informative feedback shall be provided on the completion of a task or action. The MMI shall be designed to facilitate task closure.

6.2.5.2. Data entry

6.2.5.2.1. Data entry shall be required for tasks like the completion of variable parameters such as active Train Number in text data messages.

6.2.5.2.2. The display shall inform the user of the format of the required input

data.

6.2.5.2.3. Error handling shall be implemented and shall be informative to the user.

6.2.5.2.4. Where appropriate, the cab system shall:

6.2.5.2.4.1. provide the driver with options to choose from when having to enter data into a variable field;

6.2.5.2.4.2. providing a default entry;

6.2.5.2.4.3. allow errors during data entry to be corrected simply (e.g. changing a character, changing a data field, selecting another option from the menu).

6.2.5.2.5. Interactions shall be consistent for variable display information.

6.2.5.2.6. Once the data entry is completed, the cab system shall display all relevant information to the driver and request to confirmation of data before transmission.

6.2.6. Display information characteristics

6.2.6.1. General

6.2.6.1.1. Certain display areas shall be dedicated to specific key information functions (e.g. status of train system, GSM received signal strength, and incoming messages). These areas shall contain the same information regardless of the mode of operation of the cab system.

6.2.6.1.2. Data messages shall be displayed in a format which is easy to understand and is legible under all operational conditions.

6.2.6.1.3. Sufficient information shall be supplied across all display formats to complete the required task and minimise the chances of error.

6.2.6.2. Coding general

6.2.6.2.1. Coding could be used for displayed information to make information more legible and to structure displays.

6.2.6.2.2. Coding refers to formats such as shape, size, location, colour, blinking and brightness.

6.2.6.2.3. Coding may be used to group items and to display relationships between items to aid visual search and identification.

6.2.6.2.4. Location coding

6.2.6.2.4.1. The use of display areas shall be consistent across all displays if information is displayed on more than one display.

6.2.6.2.5. Colour coding

6.2.6.2.5.1. Colour coding may be used effectively to enhance display design.

6.2.6.2.5.2. Colour coding should only be used as a redundant code, i.e. all items should be distinguishable without colour.

6.2.6.2.5.3. If utilised as a code, no more than 6 colours are to be used.

6.2.6.2.5.4. Red, green and orange may not be used for colour coding.

6.2.6.2.6. Blinking size shape and brightness

6.2.6.2.6.1. Where blinking, size and brightness are used for coding, the following ergonomic guidance shall be followed:

6.2.6.2.6.1.1.1. Up to 2 blink rates shall be allowed, ranging between

2 Hz and 4 Hz;

6.2.6.2.6.1.1.2. Up to 4 font sizes may be used;

6.2.6.2.6.1.1.3. Two levels of brightness may be used.

6.2.6.2.7. Font coding:

6.2.6.2.7.1. up to 3 different fonts may be used to group related items;

6.2.6.2.7.2. fonts selected shall be legible and readable.

6.2.6.3. Overuse of coding may result in cluttered displays and therefore coding must be used with care.

6.2.7. Display indications

6.2.7.1. Permanently displayed indications

6.2.7.1.1. Permanently displayed indications shall be consistent across all displays.

6.2.7.1.2. The train system shall give a permanent indication of the following:

6.2.7.1.2.1. TCO under whose control he is;

6.2.7.1.2.2. GSM signal strength;

6.2.7.1.2.3. cab system status.

6.2.7.2. Visual and audible indications shall be given for incoming calls.

6.2.7.3. The operator must confirm important indications by a single operation (e.g. a received data message has not been read).

6.2.8. MMI design to support emergency tasks

6.2.8.1. Emergency controls shall be designed and located to prevent inadvertent activation.

6.2.8.2. Emergency controls shall give a clear indication of activation under all conditions (including failure condition).

6.2.8.3. Whenever an emergency call or message is received, the driver shall be informed by visual and audible indications. These indications shall be different to normal TCS indications.

6.2.8.4. Emergency controls shall be easily operated, easily identified and readily accessible.

6.2.8.5. Emergency voice call indications shall cease once the call has been answered.

6.2.8.6. Outgoing emergency voice calls shall be displayed in a different manner than normal voice calls.

6.2.8.7. Indications shall remain visible until the call has been terminated.

6.2.9. Environmental

6.2.9.1. Workplace layout

6.2.9.1.1. The communications tasks should not interfere with the driver's other duties.

6.2.9.1.2. Simple mechanical mountings should be provided to allow flexibility during the installation of the train system and its components.

6.2.9.1.3. The display shall be visible to the driver under all conditions without causing discomfort to the driver.

6.2.9.1.4. No part of the TCS shall obstruct the driver's view in any way.

6.2.9.1.5. All controls, including handset, shall be located within the reach of the driver while sitting in his normal driving position.

6.2.9.1.6. The control equipment shall be separated from the interface units (e.g.

handset and display) and shall be installed in the space normally occupied by the radio equipment.

6.2.9.1.7. If the available space on the locomotive is not enough, tenderers are to provide details of proposed installation alternatives.

6.2.9.2. Ocular lighting

6.2.9.2.1. The displays shall be designed to ensure viewing under all ambient visual conditions associated with the cab environment. Artificial and natural lighting sources shall be taken into account. Rapid change of lighting must also be considered (e.g. going into a tunnel).

6.2.9.2.2. The display shall be designed for a viewing distance of between 30 cm and 100 cm.

6.2.9.2.3. Guidance shall be given to tenderers on the location of the TCS in the cab.

6.2.9.2.4. A non-reflective housing is to be used for the cab system or parts of the cab system that will be visible to the driver during normal operations.

6.2.9.2.5. The viewing of display and controls must not be influenced by glare from either artificial lighting or sunlight in all recommended positions. It is recommended that the screen must be adjustable to avoid possible reflections.

6.2.9.3. Auditory

6.2.9.3.1. The audio interface shall not result in the unnecessary repetition of messages. Voice messages must be intelligible and clear as far as possible.

6.2.9.3.2. Handsets shall not interfere with the normal operations of the driver and must be of a weight that takes into account the likely user population.

6.2.9.3.3. TCS alarms shall be clearly distinguishable from other alarms and warnings in the cab

6.2.9.3.4. The auditory indications shall not constitute another noise source and shall be designed to ensure that they are relevant to the warnings and alarms.

6.2.9.4. Maintenance

6.2.9.4.1. All parts of the train system shall be accessible (within 5 minutes by a trained person) whilst the equipment is installed.

6.2.9.4.2. The TCS shall allow for a technician mode in which maintenance functions could be performed. Maintenance functions are only to be allowed by trained technical personnel.

6.2.9.4.3. The design shall be of a modular nature to facilitate easy replacement and speedy restoration of service.

6.2.9.4.4. Tenderers are to specify maintenance procedures on their equipment and the level of training required by technical personnel.

6.2.9.4.5. It should not be possible for unauthorised persons to remove the TCS or any of its components.

6.2.10. User support

6.2.10.1. Tenderers are to describe the level of training required by maintenance

personnel and operators of the cab system equipment.

6.2.10.2. The operations of the equipment as well as the use and interpretation of screen-based information is to be described by the tenderer.

6.3. Interfaces

6.3.1. General

6.3.1.1. All interfaces and protocols shall conform to recognised international and TFR specified standards.

6.3.1.2. Where non-standard interfaces or protocols are to be used, tenderers are to indicate the interface and protocol they intend using.

6.3.1.3. The equipment shall be modular for ease of maintainability.

6.3.1.4. It must be possible to test each of the different components of the system separately with a test device.

6.3.1.5. It is envisaged that in the future the man machine interface will be by means of a remote control panel / handset, which will be at least 4 metres away from the rest of the cab system communicating via TRITON.

6.3.1.6. Tenderers must indicate the ability to interface the man machine in this manner.

6.3.2. GSM network interface

6.3.2.1. The assumption is made when specifying the cab system that call set-up information such as user-to-user signalling and caller line identity is available over the GSM network.

6.3.2.2. Tenderers are to consider and comment on the use of diversity of reception/ transmission by using two antennas, and also indicate the impact in terms of design, time scales, operation and cost of the cab system.

6.4. Physical characteristics

6.4.1. General

6.4.1.1. The hardware is to be designed to enable installation into all the types of locomotives that would require installations. These include :

6.4.1.1.1. Electric locomotives: 7E1, 7E2, 10E, 11E; 15E; 19E

6.4.1.1.2. Diesel locomotives: Class 34,35, 37; 39

6.4.1.1.3. Trolleys: Civil and Electrical.

6.4.1.2. Unless otherwise stated, the cab system equipment shall be installed into the existing space occupied by the current radio equipment.

6.4.1.3. Where there is existing radio equipment installed in a locomotive, the tenderer may use the existing mounting facilities to reduce cost.

6.4.1.4. Where no radio equipment is installed and no suitable position is available in a locomotive, the tenderer is to indicate the proposed method of installation.

6.4.2. Temperature

6.4.2.1. The cab system shall be capable of being operated and stored, without deterioration in performance, in the temperature range of -10º to + 80º.

6.4.2.2. No part of the cab system shall expose any person in contact with it to temperatures of more than 55°C.

6.4.3. Vibration & shock

6.4.3.1. There shall be no deterioration in operational performance of the train

system under all conditions of vibration and shock in the cab environment in which it is fitted.

6.4.3.1.1. The equipment must be able to withstand vibration and shock according to IEC 61373

6.4.4. Power supplies

6.4.4.1. The tenderer shall specify the expected power consumption, peak operating current and standby current of the equipment offered.

6.4.4.2. The power supply unit shall conform to the specification relating to the PSU in this document. Refer to Section 13 for details.

6.4.4.2.1. Locomotive battery supply over a range of 0.7Un to 1.25Un. Brownout at 100ms is 0.6Un. 1 second Transient at 1.4Un where

6.4.4.2.1.1. Un = Diesel Locomotive = 74V

6.4.4.2.1.2. Un = Electric Locomotive = 110V

6.4.5. Electrical disturbance

6.4.5.1. There shall be no deterioration in performance under all conditions of direct and indirect electrical disturbance on its input and output interfaces to other devices. This shall include static discharge.

6.4.5.2. No part of the cab system equipment shall expose a person in contact with any part of the train system to dangerous voltages.

6.4.5.3. The cab system shall have safety mechanisms in place to protect any person in contact with the cab system equipment if the cab system is exposed to high voltage. This is especially important where the cab system equipment is at risk of being exposed to high voltages (i.e. the antenna on the roof).

6.4.6. Ingress / Contamination

6.4.6.1. The train system equipment shall be designed to withstand contamination from materials present under normal operating conditions.

6.4.6.2. The following shall be considered in particular:

6.4.6.2.1.1. protection against spillage of fluids, e.g. coffee, tea, oil, cleaning materials, detergents etc.;

6.4.6.2.1.2. protection against dust, metallic dust, coal particles, composite braking materials, tobacco residues, aggregates and limestone;

6.4.6.2.1.3. protection against other fine particles in suspension, such as tobacco residue and petro-chemical residues.

6.4.7. Vandalism and accidental damage

6.4.7.1. The cab system shall be designed to include protection against vandalism and accidental damage.

6.4.7.2. The following shall be considered in particular:

6.4.7.2.1. protection against accidental spillage of fluids;

6.4.7.2.2. LCD and other fragile VDU display types shall be protected against damage from contact by any object;

6.4.7.2.3. the handsets must be designed of impact resistant material to withstand impact damage as a result of contact with the drivers console and other objects;

6.4.7.2.4. handset cables should be robust enough to withstand contact with

sharp edges, chafing or vandalism;

6.4.7.2.5. handset cables should remain in good condition for long periods without the need for repair. The tenderer shall indicate the expected lifetime of the handset cables.

6.4.7.2.6. buttons and other operating devices must not be able to be wedged in position by the use of paper, match sticks or other devices;

6.4.7.2.7. speaker grills should be resistant to impact and must not be removable without special tools;

6.4.7.2.8. SIM cards should be easily removable by authorised personnel, but not easily removable by unauthorised personnel;

6.4.7.2.9. vandal resistant mountings.

6.4.8. Humidity

6.4.8.1. There shall be no deterioration in operational performance of the train system equipment under all conditions of ambient humidity associated with the cab in which it is fitted.

6.4.9. Acoustic conditions

6.4.9.1. The cab system equipment shall be able to withstand and be operated without deterioration of the operational performance under all ambient acoustic conditions associated with the cab environment.

6.4.9.2. The cab system equipment shall not give rise to noise levels, which will subject any person to a sound pressure level in excess of 130db(A) for a period of 0.125 seconds within the normal audible range.

6.4.9.3. The indications generated by the cab system equipment shall remain intelligible at all times. This must take into account ambient noise and other audible warning devices.

6.4.10. Interfaces and connections

6.4.10.1. Electrical interfaces shall be designed to minimise the number of connectors while still maintaining signal integrity.

6.4.10.2. Connectors shall employ a system of positive locking to avoid disconnection due to vibration and to ensure correct mating, and shall be used instead of terminal bars.

6.4.10.3. Cables shall be properly screened to prevent interference induced to and by equipment.

6.4.10.4. The antenna system shall have reliable electrical and mechanical connections.

6.4.10.5. TRITON Communication Interfaces

6.4.10.5.1. TRITON interfaces with its peripheral devices with Ethernet connections to its 10/100Mbps switch. The switch has RJ-45 ports with straight through lines and standard pinouts.

6.4.10.5.2. TRITON broadcasts all its common information such as GPS strings, communication channels availability and other information specified in BBC4204 to all devices connected to TRITON and listening on the correct broadcast port.

6.4.10.5.3. The TRITON interfaces with its antennas using connectors specified in

BBC1852. These TRITON antenna interfaces are the same in all locomotives fleet types and operation regions where cab layouts or systems might differ

6.4.10.5.4. TRITON has multiple communication channels that it uses to communicate data from the locomotive. It has a GPRS channel, WiFi channel and a UHF Open channel network data communication route. The communication protocol via TRITON is specified in BBC4202.

6.4.10.5.5. The TCS hardware design shall accommodate TRITON migration by ensuring Ethernet connectivity and adopting the same antenna connectors as TRITON so that the same antenna cables can be used when TRITON is installed.

6.4.10.5.6. The TCS data communication software design shall accommodate migration to TRITON for its data communication.

6.4.11. Physical

6.4.11.1. The mounting of the cab system must not be orientation dependent to enable mounting in any direction as required.

6.4.11.2. Tenderers shall specify any limitations imposed by the cab system equipment design.

6.4.11.3. All electronic modules shall be such that a single technician will be able to transport and replace it in active service of the locomotive.

6.4.11.4. The units shall be robust and not incur any damage when transported on normal railway service roads. If a risk of damage does exist special packaging for transport purposes shall be supplied as special tools.

6.4.11.5. The system shall have a robust construction suitable for deployment in the railway environment. Onboard the locomotive the units experience excessive vibration, temperature and humidity. In this respect the onboard equipment shall conform to the requirements for Grade A equipment as specified in Specification CSE-1154-001 CAT E48.

6.4.11.6. Office equipment shall conform to the requirements for Grade A equipment of specification CSE-1154-001 CAT E48.

6.4.11.7. The portable cab unit shall be of robust construction, in a rust proof casting. The supplier shall provide complete detail regarding the housing for the transportable TCS-3.

6.4.11.8. The supplier shall state any limitations imposed by the cab system equipment design

6.4.12. Flexibility and expansion

6.4.12.1.1. Given the rate of improvement of electronic modules and the life span of data communication products the design shall be modular. All interfacing hardware and software shall be made available to facilitate easy replacement of the functional units

6.4.13. Performance Characteristics

6.4.13.1.1. The system shall provide standardized protocols between the onboard equipment and equipment on the TFR network

6.4.13.1.2. The unit shall have the ability to update firmware from the system

manager when free communication with adequate bandwidth is available

6.4.13.1.3. The unit shall provide the functionality for remote access to status and logged information

6.4.13.1.4. The system should be easy to install and configure. Only the Locomotive Identification Number should be configured at installation time

6.4.14. Antenna system

6.4.14.1. Only TFR approved antennas will be used.

6.4.14.2. Antenna extension cables will be provided from the roof to the locomotive antenna bulkhead unit with connectors specified by TFR.

6.5. EMC

6.5.1. The TCS shall not interfere with existing locomotive and railway equipment.

6.5.2. The TCS shall not create a health risk for any person with a pacemaker or other medical device.

6.5.3. The TCS shall be immune to interference from existing railway and locomotive equipment.

6.5.4. Electromagnetic susceptibility and radiation limits of the system and all its components shall comply with Infrastructure (Signals) standard specification no. CSE-1154-001 CAT E48 for Grade A environment.

6.5.5. All electronic units installed on locomotives shall conform to the requirements of European standard Cenelec EN50155 and EN50121-3-2.

7. TRANSPORTABLE CAB SYSTEM

7.1. Functionality

7.1.1. The transportable systems shall be used in all the locomotives in which the normal, permanent installed system is not present or faulty.

7.1.2. The units shall have the same functionality as that of the permanent installed units in the trains and the specifications for the permanently installed units will apply.

7.1.3. It is suggested that the same type of equipment that is used for the permanent installations also be used for the transportable cab system.

7.1.4. The unit shall be powered by a battery pack, which will allow the user to use the system for at least 3 hours talk time and 18 hours standby time.

7.1.5. The unit shall be compact and easy to carry.

7.1.6. The unit shall be equipped with a suitable carry handle and shoulder strap to facilitate comfortable carrying by an average person for an uninterrupted period of 10 minutes whilst covering a distance of approximately 500 metres over the ballast next to the track.

7.1.7. Equipment must weigh as little as possible and preferably not exceed 3 kg, including the battery pack.

7.2. Options

7.2.1. Tenderers are to provide details of the outlay and functionality of the portable unit.

7.2.2. The transportable TCS shall normally be charged at train depots before used on a train. It shall be possible to charge the transportable TCS battery pack by means

of an external charging unit. Tenderers are to provide details on the charging time expected.

7.2.3. Tenderers are to provide detail regarding the use of external antennas with the transportable TCS.

7.3. Physical

7.3.1. The portable cab unit shall be of robust construction. Preferably in a rust proof casing. Tenderers are to provide complete detail regarding the housing for the transportable TCS.

7.3.2. All components shall be mounted in such a way as to minimise the shock and vibration to the components.

7.3.3. The use of the transportable TCS shall not be orientation dependent. It shall be possible to use the unit in a vertical or horizontal position.

7.4. EMC

7.4.1. The transportable TCS shall not cause interference with any of the locomotive equipment.

7.4.2. The transportable TCS shall not pose a health risk to any person with a pace maker or other medical device.

7.4.3. The transportable TCS shall not be affected by any interference generated by on train equipment.

8. PORTABLE MAINTENANCE UNIT (PMU)

8.1. General

8.1.1. The PMU shall be used for maintenance on all TCS.

8.1.2. The PMU shall be easily portable.

8.2. Power

8.2.1. The PMU shall have an internal power supply unit to allow use during an entire shift (typically 8 hours) without the need to re-charge the battery.

8.2.2. The PMU may be charged from the Train system power supply (12 Volt DC)

8.3. Functionality

8.3.1. Diagnostics

8.3.1.1. The PMU shall provide at least the diagnostics facilities as set out below.

8.3.1.2. The PMU shall be able to initiate any of the diagnostics checks that may be performed on and by the TCS, or on the externally attached systems to the TCS.

8.3.2. Configuration

8.3.2.1. The PMU shall allow the user to update any of the databases in the TCS.

8.3.2.2. Tenderers are to indicate any additional configuration functions they envisage to be available from the PMU

8.3.3. Performance monitoring

8.3.3.1. While connected to the TCS, the PMU shall be able to collect GSM signal strength and GPS position from the TCS.

8.3.3.2. The PMU shall be able to store 24 hours' worth of performance information.

8.3.3.3. It shall be possible to connect the PMU to another device (e.g. a standard PC) to transfer the stored data to and from the PMU. This data shall include

all performance data and any other data relating to the configuration process of the TCS.

9. COMMUNICATION CONTROL CONSOLES (CCC)

9.1. General

9.1.1. This section must be read in conjunction with sections 10 and 11.

9.1.2. The term “communication control console” shall be used to refer to the communication equipment and console installed in the CTCs.

9.1.3. Each TCO section shall have a dedicated communication console.

9.1.4. Communication consoles will house a number of different communications devices.

9.2. Design

9.2.1. The Phone Dispatcher Terminal and other relevant communication equipment shall be installed into the communication console.

9.2.2. The console layout shall be designed to contain the various communication devices in use. (e.g. various lines to the Transnet voice switching network PABX, various direct lines between CTCs, Yard PAX system, intercom, GSM cellular communication)

9.2.3. Each of these communication circuits shall be accessible via a single handset or headset. Only one circuit shall be active at any one stage. The operator shall have the option to choose to use the handset or headset.

9.2.4. Headsets shall be cordless and each PDT operator shall be issued with a personal headset. TCOs rotate on a regular basis between CCCs. Tenderers are to describe the method used to enable any headset to work on any CCC.

9.3. Interfaces

9.3.1. General

9.3.1.1. All communication devices shall be accessed via the Phone Dispatcher Terminal.

9.3.1.2. There shall be only one active circuit on the PDT at any one point in time. It shall only be possible to have more than one active circuit on the PDT when the operator is busy with a voice call transfer between a cellular phone and another communication medium.

9.3.1.3. The TCO shall have the facility to participate in any transferred (patched) call at any time.

9.3.1.4. The PDT shall indicate all active circuits at any one time (e.g. a flashing icon on the screen if the PABX line rings).

9.3.1.5. All the functions shall be available via the PDT (e.g. dialling a PABX number shall be done via the PDT).

9.3.1.6. Where the term transfer is used, it shall include actions connecting more than one person or circuit.

9.3.2. PABX interface

9.3.2.1. There shall be at least one PABX line available at each communication console. Tenderers are to indicate the number of PABX lines that can be connected to the PDT.

9.3.2.2. It shall be possible to switch the headset/handset to any of the PABX

circuits.

9.3.2.3. Voice call transfer shall be possible between a PABX line and a cellular line (e.g. transfer a call from a PABX line to a train driver).

9.3.3. PAX interface

9.3.3.1. There shall be at least one PAX line available at each PDT.

9.3.3.2. It shall be possible to switch the handset/headset to the PAX circuit.

9.3.3.3. There shall be no conferencing to any third party form or to a PAX circuit.

9.3.4. GSM interface

9.3.4.1. It shall be possible to transfer/ conference two cellular circuits that belong to the two CUGs (e.g. conference a driver with one of the support personnel).

9.3.4.2. It shall not be possible to conference two train drivers.

9.3.4.3. It shall be possible to conference two users from the general CUG.

9.3.4.4. It shall be possible to transfer any cellular user to and from the PABX system.

9.3.5. Intercom

9.3.5.1. It shall be possible to switch the handset/headset to the intercom circuit.

9.3.5.2. There shall be no conferencing to any third party from or to the intercom system.

9.3.6. Hands-free interface

9.3.6.1. Equipment shall facilitate, selectively, the use of a hands-free operation option, which will be activated with a positive action.

9.3.6.2. While in hands-free mode, received voice shall be routed to an external loudspeaker. There shall be no transmitted audio allowed (e.g. muted microphone).

9.4.Layout

9.4.1. Tenderers are to indicate the proposed layout for the communication console.

9.5.Power requirements

9.5.1. The console and all the installed equipment shall be powered from the 220 V 50 Hz UPS currently installed at each CTC.

9.6.EMC

9.6.1. The communication console shall not interfere with, and shall be immune to interference from, any other electrical equipment currently installed in the CTCs.

9.6.2. The communication console shall not pose a health risk to any person relying on a pacemaker or other medical device.

10. PHONE DISPATCHER TERMINALS (PDT)

10.1. Functional specification

10.1.1. General

10.1.1.1. Phone dispatchers are installed at the CTCs to replace the previous radio system.

10.1.1.2. Each TCO section has a dedicated phone dispatcher terminal.

10.1.2. Train enters or exits a TCO control area.

10.1.2.1. When a train enters or exits a TCO control area, the CRL needs to be informed. The TCS may do this by sending a SMS to the controlling CTC.

10.1.2.2. An indication shall be given when a train enters or exits a TCO area. This may be done with a simple modification of all numbers available.

10.1.2.3. If a train entering a TCO area is using manual location updates, an indication shall be given to the TCO operator.

10.1.2.4. If a voice call is being made to a train leaving a TCO area or a data message is being sent, the voice call shall continue or data shall be sent. The TCO controller shall receive an indication that the train has just left his area.

10.1.3. Making a voice call

10.1.3.1. The PDT operator shall be able to make calls to a number of users. This shall include:

10.1.3.1.1. trains using the GSM network;

10.1.3.1.2. support personnel using the GSM network;

10.1.3.1.3. PABX numbers using the PABX phone system;

10.1.3.1.4. PAX numbers on the PAX system;

10.1.3.1.5. PSTN numbers via the PABX phone;

10.1.3.2. All calls shall by default have a non-emergency priority.

10.1.3.3. The TCO shall be able to select the called party by using :

10.1.3.3.1. the train number;

10.1.3.3.2. MSISDN number;

10.1.3.3.3. a list of trains currently under the control of the TCO;

10.1.3.3.4. PSTN or PABX number (if the call is not to a train);

10.1.3.3.5. a list of names for support personnel.

10.1.3.4. A PDT operator shall be able to call the trains in his control area with the use of the train number. A list of all available train in his section shall be displayed at all times.

10.1.3.5. The PDT operator shall be able to re-dial the last person with who he was in contact via a single operation.

10.1.3.6. A PDT operator shall be able to cancel the call at any stage during set-up or while the call is in progress.

10.1.3.7. If a voice call fails or can not be made, a failure indication shall be given.

10.1.3.8. A PDT operator shall be able to terminate any call with a single control operation (e.g. replacing a handset).

10.1.3.9. An indication shall be given if the second party in the conversation terminates the call.

10.1.3.10. The duration of the call shall be displayed constantly during the call.

10.1.4. Receiving voice calls

10.1.4.1. An indication shall be given when a call is received.

10.1.4.2. The priority of the call shall be indicated.

10.1.4.3. The PDT operator shall be able to answer the incoming call by performing a single action (e.g. lifting a handset). No calls shall automatically be answered.

10.1.4.4. The following information shall be indicated to the operator :

10.1.4.4.1. train number (if available);

10.1.4.4.2. the MSISDN number;

10.1.4.4.3. the name of the calling party (if support personnel).

10.1.4.5. If the PDT operator is already in a call, and another call comes in, the operator shall be informed of the identity of the calling party. The operator shall not be able to answer the second call and put the first call on hold. The operator shall have the option of booking the second call or terminating the first call and answering the second call. It shall be possible to return booked calls. It shall be able to clear booked calls without answering them.

10.1.4.6. Call answering times shall be recorded for reporting purposes.

10.1.4.7. The call duration shall be displayed constantly during the call.

10.1.5. Transferring a voice call

10.1.5.1. The dispatcher operator shall have the facility to transfer (conference) calls between some users and third parties. Refer to the communication matrix for detail.

10.1.5.2. Selection of the third party shall be the same as for making a voice call.

10.1.5.3. If the third party is engaged, the dispatcher operator shall have the facility to cancel the transfer.

10.1.5.4. An indication shall be given if the transfer fails.

10.1.5.5. The call shall be returned to the dispatcher operator if the transfer fails.

10.1.5.6. The operator shall converse with the third party prior to the actual transfer being done.

10.1.5.7. The duration of the call shall be displayed constantly during the call.

10.1.5.8. The operator shall be able to listen in on any transferred call and partake at any time if necessary.

10.1.6. Sending a data message

10.1.6.1. The dispatcher operator will have the facility to initiate a data message to a single user or to a list of users.

10.1.6.2. The recipients of the data message shall be one or more of the following persons:

10.1.6.2.1. train system;

10.1.6.2.2. support personnel.

10.1.6.3. The dispatcher operator shall be able to select the data to be sent.

10.1.6.4. Certain types of data messages shall have a priority assigned to them.

10.1.6.5. Where no default priority is assigned to a data message, the dispatcher shall have the facility to choose a priority. Default priority shall be “normal”. Priority selection shall be via a single control operation.

10.1.6.6. It shall be possible to select to send a data message from a list of pre-defined messages.

10.1.6.7. It shall be possible for the dispatcher operator to select the recipient of the message as one (or more) of the following users :

10.1.6.7.1. train number(s);

10.1.6.7.2. support personnel.

10.1.6.8. The dispatcher operator shall only be able to send data messages under his control by using the train number.

10.1.6.9. It shall be possible for the dispatcher operator to select the text to be sent.

10.1.6.10. The dispatcher operator shall have the option of storing frequently used data messages in a list where he can choose from in future.

10.1.6.11. A dispatcher shall receive any emergency messages that is sent from other controllers to any trains under his control.

10.1.6.12. The operator shall receive an indication that the dispatcher is sending data message(s).

10.1.6.13. If a message fails to be delivered to any intended recipient, a failure indication shall be given for that recipient.

10.1.6.14. The recipient of a data message may send an acknowledgement back to the dispatcher. If this happens, an indication shall be given.

10.1.6.15. If an acknowledgement is required and the driver has not acknowledged a data message in a specific time, the PDT operator shall receive an indication.

10.1.6.16. The PDT operator shall have the facility to cancel the dispatch of a data message.

10.1.6.17. If the dispatcher operator has cancelled a message, the data message shall be removed from the queue on the train if the driver has not read the message.

10.1.6.18. Copies shall be kept of all sent messages in a strictly chronological “sent message” list. The list shall be time ordered.

10.1.6.19. Messages in the “sent message” list shall remain there for a certain time.

10.1.6.20. The dispatcher operator shall have the facility to view all messages kept in the “sent message” list.

10.1.6.21. The “sent message” list shall be able to contain at least 40 messages.

10.1.7. Receiving a data message

10.1.7.1. The PDT shall be able to receive data messages.

10.1.7.2. An indication shall be given when a data message has been received. The nature of this indication shall depend on the priority of the message.

10.1.7.3. If multiple copies of the same message has been received, it shall be tagged as a repeated message.

10.1.7.4. The dispatcher operator shall be informed of the identity (Train number and/or MSISDN number) and location of the data message originator if the message is sent from a train.

10.1.7.5. If the message has been sent from support personnel, a textual description and phone number shall be given.

10.1.7.6. Received data messages shall be kept in a list of unread data messages.

10.1.7.7. The list of unread messages shall be able to store up to 50 data messages.

10.1.7.8. This list shall be kept in chronological order based on time of dispatch and priority.

10.1.7.9. If the list overflows due to messages not being read, a warning indication shall be given and the oldest, lowest priority message shall be deleted and replaced by the new message.

10.1.7.10. The PDT operator shall be able to read any of the messages in the “unread

data message" list.

10.1.7.11. Once a data message has been read, the dispatcher operator shall have the option to reply or acknowledge the message to the originator of the message. This shall be possible by a simple operation.

10.1.7.12. After a message has been read, it shall be removed from the "unread data message " list and moved to a "history" list of data messages.

10.1.7.13. The "history" list shall also be kept in chronological order

10.1.7.14. The "history" list shall be able to store 100 messages.

10.1.7.15. The dispatcher operator shall be able to read any message from the "history" list.

10.1.7.16. Messages shall stay in the "history" list for a certain time.

10.1.8. Forwarding a data message

10.1.8.1. The PDT operator shall have the facility to forward received data messages to other PDTs and CAB phone systems.

10.1.8.2. Selection of the third party shall be via the same process as sending a normal data message.

10.1.8.3. If the forwarding has been successful, the user shall receive an indication.

10.1.8.4. If the forwarding has failed, the user shall receive an indication.

10.1.9. Automatic data message dispatch

10.1.9.1. The dispatcher shall have the option to send a message to any train entering his control section.

10.1.9.2. The contents and priority of the message shall be selected or entered in the same manner as for a normal data message.

10.1.9.3. Multiple automatic messages may be sent.

10.1.9.4. The operator may cancel automatic messages at any time.

10.1.9.5. If an automatic data message fails, an indication shall be given.

10.1.10. Re-try strategy for emergency data calls

10.1.10.1. If an emergency data message fails to be received by the GSM infrastructure or by the intended recipient, a re-try procedure shall be implemented to re-send the message.

10.1.10.2. If an emergency data message fails to be received within a certain time, the message shall be re-send.

10.1.10.3. If the message has still not been delivered after a certain time, a failure indication shall be given.

10.1.11. Train system log-on

10.1.11.1. When a TCS becomes live on the GSM network, he will be able to make calls to the TCO dispatchers. If automatic location system is being used, the dispatcher operator shall be asked to enter the train number when he receives a call from a train for the first time. The PDT shall enforce this.

10.1.11.2. The dispatcher shall then inform all other dispatchers along the line of the train number that is linked to that MSISDN.

10.1.11.3. If it is found that the train number entered is already in use by another TCS, the dispatcher operator shall be informed and asked to make a decision as to which TCS must be linked to that train number.

10.1.11.4. It shall be possible for a TCO to change a train number en route. This shall only be done in special cases. If a TCO changes a MSISDN to train number link, the PDT shall inform the rest of the system of the changes made. Normal validity checking shall still apply.

10.1.12. Train system log-off

10.1.12.1. If a train driver removes his handset from the Train system, the Train system shall send a log-off request to the controlling TCO.

10.1.12.2. The TCO shall then forward this information to all other TCO dispatchers to inform them that radio and train number has logged-off the system.

10.1.12.3. The controlling dispatcher operator shall be informed of the log-off.

10.1.13. Train location

10.1.13.1. A TCO shall have the facility to inquire about the location of a train under his control at any time.

10.1.13.2. This information shall be presented to the PDT operator in a useable and understandable format.

10.1.14. Automatic train location update

10.1.14.1. In an instance where a train updates his position to the PDT, the PDT shall inform the rest of the fixed infrastructure of the location of the train.

10.1.14.2. The PDT shall keep a record of all PDTs updated, and report failures to the operator after a certain time.

10.1.14.3. This may be done by sending a SMS or communicating via a LAN with the other PDTs.

10.1.15. Diagnostics

10.1.15.1. The PDT shall perform diagnostics checks during power-up and normal operation on itself and all attached equipment to ensure correct operation.

10.1.15.2. All diagnostics checks during power-up shall be completed within 1 minute.

10.1.15.3. The user may also request diagnostics checks.

10.1.15.4. The dispatcher shall perform periodic diagnostics checks during normal operation without affecting the operation of the dispatcher.

10.1.15.5. If any tests fail during power-up or periodic diagnostics checks, an indication of the error or fault condition shall be given to the operator.

10.1.16. Recording and logging

10.1.16.1. The dispatcher shall be coupled to the existing voice recording system.

10.1.16.2. The interface shall be in accordance with recognised audio interface specifications and standards.

10.1.16.3. It shall be the tenderer's responsibility to familiarise himself with all the equipment currently installed at the CTCs.

10.1.16.4. All information pertaining to the PDT shall be kept in a local database for reference if necessary. The PDT shall have enough disk space to record events for a full 3 month period without loosing data.

10.1.16.5. Information logged shall include, but need not be limited to :

10.1.16.5.1. Logged on user

10.1.16.5.2. Time and date of call;

10.1.16.5.3. Called and calling party;

10.1.16.5.4. Duration of call;

10.1.16.5.5. Any information relating to data messages.

10.1.16.5.6. All the information must be readily available in an easy to use, user friendly Communication Usage Monitoring module where relevant statistics could be drawn with reporting functionality.

10.1.17. Phone dispatcher log-on

10.1.17.1. Before any person shall be allowed to use the dispatcher terminal, the user shall be asked to log-on.

10.1.17.2. It shall be possible for a new user to log-on without having to log-off the previous user. This shall be used when TCOs change shifts.

10.1.17.3. The log-on shall require a user name and password.

10.1.18. Hand-portable registration

10.1.18.1. Hand-portable radios shall be issued to individual people. The dispatcher shall have a database of users containing:

10.1.18.1.1. The phone number of the user;

10.1.18.1.2. The name or a textual description of the user.

10.1.18.2. This shall enable the dispatcher operator to call hand portables by using the telephone number or searching through a list of user names.

10.2. Interfaces

10.2.1. General

10.2.1.1. All interfaces and protocols between equipment shall be in accordance with recognised industry standards.

10.2.1.2. Where tenderers propose non-standard protocols or interfaces, the reason shall be indicated. The proposed interface or protocol shall be described in detail.

10.2.2. Inter-equipment interfaces

10.2.2.1. The dispatcher shall have a single handset/headset to interface to the equipment.

10.2.2.2. The TCO shall have access to the following systems via his PDT handset and headset:

10.2.2.2.1. GSM network;

10.2.2.2.2. PABX system;

10.2.2.2.3. Leased lines;

10.2.2.2.4. PAX system;

10.2.2.2.5. Intercom system.

10.2.2.3. Each phone dispatcher shall have connected to if a PABX line for communication to all other Transnet Freight Rail personnel.

10.3. MMI (Man Machine Interface)

10.3.1. Introduction

10.3.1.1. This section shall describe the interface between the operator and the phone dispatcher terminal.

10.3.1.2. The MMI shall enable the operator to access all the facilities offered by the dispatcher in a friendly and safe manner through the reduction or elimination of foreseeable risk.

10.3.2. User tasks

10.3.2.1. The MMI shall be designed to support all the tasks to be performed by the TCO.

10.3.2.2. The design shall take into account the characteristics of the user population.

10.3.3. Equipment design

10.3.3.1. It is envisaged that the phone dispatcher terminal shall comprise of the following hardware:

10.3.3.1.1. Visual display unit (VDU);

10.3.3.1.2. Pointing device(s);

10.3.3.1.3. Alphanumeric keyboard;

10.3.3.1.4. handset or headset;

10.3.3.1.5. loudspeaker.

10.3.3.2. Where a headset is supplied, it shall be cordless.

10.3.3.3. Layout

10.3.3.3.1. The phone dispatcher hardware shall be designed to be used in the existing workspace.

10.3.3.3.2. The layout shall be such that it supports ergonomic principles.

10.3.3.3.3. The elements of the phone dispatcher hardware shall be integrated into the current workspace as far as possible.

10.3.3.4. Input devices

10.3.3.4.1. Input devices shall support the tasks that have to be performed by the dispatcher operator and minimise chance of human error during input.

10.3.3.4.2. The location of input devices shall be consistent for all types of PDTs.

10.3.3.4.3. Issues to consider during the design of input devices are:

10.3.3.4.3.1. Hardwired controls like buttons:

10.3.3.4.3.1.1. Spacing between buttons;

10.3.3.4.3.1.2. Size of buttons;

10.3.3.4.3.1.3. displacement of buttons.

10.3.3.4.3.2. Keyboards and keypads

10.3.3.4.3.2.1. key spacing;

10.3.3.4.3.2.2. key layout (QWERTY layout);

10.3.3.4.3.2.3. keys dedicated to specific tasks;

10.3.3.4.3.2.4. spill or splash proof keyboard;

10.3.3.4.3.2.5. symbols engraved onto keys for extended life time.

10.3.3.4.3.3. Pointing devices:

10.3.3.4.3.3.1. requirements for accuracy and speed;

10.3.3.4.3.3.2. ease of operation;

10.3.3.4.3.3.3. frequency of use;

10.3.3.4.3.3.4. requirement for cleaning (e.g. mouse devices with roller balls should be avoided.)

10.3.3.4.3.4. Handsets or headsets:

10.3.3.4.3.4.1. characteristics of the user population of the dispatcher terminals (e.g. distance between mouth and ear; size of hands)

10.3.3.4.3.4.2. handset grip;
10.3.3.4.3.4.3. noise environment;
10.3.3.4.3.4.4. weight of equipment.

10.3.3.5. Display devices

10.3.3.5.1. Display devices referred to here shall include all types of information presented by the phone dispatcher terminal.
10.3.3.5.2. The volume of auditory indications shall be adjustable.
10.3.3.5.3. The volume shall be adjustable within a certain range to prevent distortion at maximum volume and ensure intelligible audio at minimum setting.
10.3.3.5.4. LED indications shall not be such that it may be confused with other indications in the work place.
10.3.3.5.5. LED indications may be used to indicate status information (e.g. On/Off).
10.3.3.5.6. All VDUs shall be colour.
10.3.3.5.7. Any VDU shall be able to display alphanumeric characters and full screen graphics.
10.3.3.5.8. All text and graphics shall have sufficient resolution to enable positive identification and minimise the chance of misinterpretation.
10.3.3.5.9. All items on the VDU shall be readable at a distance of up to 1,5 meters.
10.3.3.5.10. No perceptible flicker shall be visible to users under normal operation.
10.3.3.5.11. Brightness and contrast controls shall be adjustable.
10.3.3.5.12. Labelling of all controls shall be done to ensure easy identification and shall remain clear and legible throughout the entire expected lifetime of the equipment.
10.3.3.5.13. Labels and abbreviations shall remain consistent throughout the entire system.

10.3.4. Interface formats

10.3.4.1. VDU and keyboard shortcuts

10.3.4.1.1. The display structure shall be organised in a logical format.
10.3.4.1.2. Displays that are used most often must be accessible by a single operation.
10.3.4.1.3. Moving between different displays or pages shall be as simple operation as possible.
10.3.4.1.4. Hot-keys (Shortcut keys) should be provided for functions that are performed regularly.

10.3.4.2. Acknowledgements and feedback

10.3.4.2.1. Timely and appropriate feedback to operations shall be provided.
10.3.4.2.2. Feedback shall be provided on the VDU during the task (e.g. The number of the calling party shall be displayed during the whole conversation)
10.3.4.2.3. Feedback to function activation and completion shall be given.
10.3.4.2.4. Feedback to operations local to the dispatcher (e.g. typing) shall be

given within 300 milliseconds.

10.3.4.2.5. Feedback with regards to all failure to activate or complete a task shall be given.

10.3.5. Operator inputs

10.3.5.1. Certain operations shall have dedicated input devices allocated.

10.3.5.2. Single control actions shall take the form of :

10.3.5.2.1. selection of a screen item via the pointing device;

10.3.5.2.2. pressing a single button;

10.3.5.2.3. lifting a handset;

10.3.5.2.4. replacement of a handset.

10.3.5.3. Calls may be answered by a single control operation (e.g. lifting a handset).

10.3.5.4. Cordless headsets shall be able of operating of up to 9m from the from the dispatcher control desk.

10.3.5.5. Frequently used operations shall be realised with the minimal amount of keys pressed.

10.3.5.6. All sequences shall be such as to minimise or eliminate human error during information input.

10.3.5.7. Information requiring alphanumeric information shall be provided via the keyboard.

10.3.5.8. Completion of a transaction shall provide positive and informative feedback.

10.3.5.9. Entry of data shall take a verity of different forms such as:

10.3.5.9.1. Completion of variable fields;

10.3.5.9.2. selection from a list of possibilities.

10.3.5.10. Input masks shall indicate the format of the required data to be entered.

10.3.5.11. Error handling shall be informative and to the point.

10.3.5.12. Once all data has been entered, the TCO will be required to verify the entered data before it is being sent.

10.3.6. Displayed information characteristics

10.3.6.1. General

10.3.6.1.1. Dedicated areas shall be defined to provide feedback and indications across all views, regardless of function being performed.

10.3.6.1.2. Data messages shall be presented in a legible format.

10.3.6.1.3. It shall not be required of the dispatcher operator to remember information between different screens or displays.

10.3.6.1.4. The operator shall be presented with sufficient information to complete any task.

10.3.6.1.5. Different tasks may require different views.

10.3.6.2. Coding

10.3.6.2.1. Coding may be used to enable users to easily recognise information and facilitate in visual search and identification.

10.3.6.2.2. Coding may take the format of shape, size, colour, location or brightness.

10.3.6.3. Colour coding

10.3.6.3.1. Colour may be used as a coding mechanism to improve visibility of items (e.g. Emergency data message in red).

10.3.6.3.2. All items shall be distinguishable without colour being present. All items must be identifiable to a person without colour vision.

10.3.6.3.3. No more than 6 colours shall be used to enhance the visibility of items.

10.3.6.4. Location coding

10.3.6.4.1. Where information is displayed across more than one display, the use of area shall be consistent.

10.3.6.5. Size, blinking shape and brightness coding

10.3.6.5.1. The following guidance is given to tenderers that intend to use size, blinking shape and brightness as coding mechanism:

10.3.6.5.1.1. Up-to 6 different shapes may be used for identification;

10.3.6.5.1.2. Up to two blink rates may be used in the range 2 - 4 Hz;

10.3.6.5.1.3. Two levels of brightness may be used;

10.3.6.5.1.4. Up to 4 sizes may be used to distinguish items;

10.3.6.5.1.5. Up to 3 different fonts may be used to group items. The fonts must be readable.

10.3.6.6. The overuse of coding may lead to cluttered displays and should be avoided.

10.3.7. Display formats-indications

10.3.7.1. Certain indications shall be regarded as permanent indications.

10.3.7.2. Permanent indications shall be visible in all displays and shall not be affected by the task being performed.

10.3.7.3. Permanent indications shall have the same position on all displays.

10.3.7.4. Certain indications shall be given to assist the user to complete tasks. Such indications shall include items like number entering formats.

10.3.7.5. Failure indications shall be used to give feedback to the user of any failures that may have occurred during performance of a task or in external equipment.

10.3.7.6. Failure indications shall give visual feedback where at all possible.

10.3.7.7. Failure indications may also produce audible feedback to enhance the visual representation.

10.3.7.8. Soft tones shall be used for feedback or confirmation of task completion or activation while harder tones should be used to indicate alarm conditions.

10.3.7.9. All alarms shall be such that it doesn't constitute an additional source of noise in the workplace.

10.3.7.10. All failure indications shall inform the user as to the extent of the failure and provide sufficient information.

10.3.7.11. If an error occur due to incorrect information entered by the user, an indication of the correct format shall be given.

10.3.8. MMI design to support emergency tasks

10.3.8.1. Emergency controls shall be clearly identifiable, readable and easily operated.

10.3.8.2. Emergency controls shall provide clear feedback of activation.

10.3.8.3. Emergency controls shall be designed and located to prevent activation by accident.

10.3.9. User environmental

10.3.9.1. General

10.3.9.1.1. Account shall be taken with all other tasks that has to be performed by the TCO when designing the phone dispatcher terminal.

10.3.9.1.2. The operation of the phone dispatcher terminal shall not place unnecessary workload on the operator.

10.3.9.1.3. Information representation shall not vary greatly from formats as encountered in normal life.

10.3.9.1.4. The layout of the phone dispatcher console shall enable the operator to use all controls without discomfort.

10.3.9.2. Lighting

10.3.9.2.1. The display shall be designed to enable viewing under all lighting conditions encountered in a CTC under normal working conditions.

10.3.9.2.2. The display shall allow viewing at a distance of 70 cm to 1,5 meters.

10.3.10. Auditory

10.3.10.1.1. The audio interface shall ensure intelligible voice communications without the need for unnecessary repetition.

10.3.10.1.2. Hands free operation should be possible by a headset to enable the operator to do other signalling tasks while keeping voice contact.

10.3.10.1.3. The design of the system shall take into account all other sources of audio encountered in the workplace (e.g. the headset should not prevent the user from hearing another phone or doorbell ring).

10.3.10.1.4. Alarms and tones shall be easily distinguishable between dispatcher consoles to enable the user to react to messages intended for his without affecting other dispatcher operators.

10.3.10.1.5. Audio alarms and tones shall not be able to be confused with other sounds in the workplace.

10.3.10.1.6. Audio alarms and tones shall not create an additional source of noise and become an irritation to other users in the same workplace.

10.3.11. Thermal

10.3.11.1. The phone dispatcher shall not create a source of thermal discomfort.

10.3.11.2. All parts of the dispatcher terminal shall be sufficiently ventilated to prevent overheating and subsequent malfunction.

10.3.11.3. Ventilation holes shall be filtered if deemed necessary.

10.3.11.4. Maintainability

10.3.11.4.1. The equipment design and layout shall facilitate ease of maintenance and access shall be ensured to all removable parts. The design of the dispatcher terminal shall be of a modular nature to ensue that service can be restored without delay by replacing faulty modules.

10.3.12. User support

10.3.12.1. The tenderer shall describe the level of training that will be required by the

dispatcher operators.

10.3.12.2. Operational procedures shall be described in detail in respect to how to operate the dispatcher software.

10.3.12.3. Help facilities shall be provided to give online operational support to assist users in completing their tasks. This shall include, but need not be limited to:

10.3.12.3.1. on-line help facilities (F1 key);

10.3.12.3.2. on-line error messages;

10.3.12.3.3. on-line users guide.

10.4. Environmental and physical

10.4.1. The dispatcher terminal shall operate without deterioration in performance under all conditions expected in a Train Control Centre.

10.4.2. The dispatcher terminal shall not cause interference or malfunction to existing railway equipment in control rooms.

10.5. Security

10.5.1. It shall not be possible for a operator to switch off the PDT. Only a “Reset” button shall be available.

10.5.2. The PDT shall automatically run all required software and processes on power-up to enable usage on the Coal Line system.

10.5.3. It shall not be possible for a PDT operator to load software onto the computers supplied. Tenderers are to describe how their software and systems shall prevent tampering with the software and accidental deletion of information.

10.5.4. There shall be no software on the computers other that the software required to perform the PDT communication tasks.

10.6. EMC.

10.6.1. The phone dispatcher terminals shall have Electromagnetic Compatibility Certification (EMC) as specified in the European Directive (89/336/EEC).

10.6.2. The dispatcher terminals shall not cause interference to existing railway equipment.

10.6.3. The PDT shall not pose a health risk to any person using it or in the vicinity thereof (e.g. may not interfere with a person’s pace maker or cause excessive radiation)

10.6.4. The dispatcher terminals shall be immune to any interference from existing railway equipment installed in the control rooms.

11. CALL ROUTE LAYER

11.1. Functional specification

11.1.1. Introduction

11.1.1.1. Functions described in this section may be implemented in a separate control unit (“Central Controller”) or may be implemented in any other equipment in the system. Tenders shall indicate clearly how they intend to implement these functions.

11.1.1.2. The term Call Routing Layer (CRL) is used to refer to the logical mechanism of call routing, and not necessarily to a single piece of equipment or software.

11.1.2. All system functions not inherently provided in the GSM network shall

be performed by the CRL. These shall include, but not be limited to:

11.1.2.1. Shortform numbering within Closed User Groups:

11.1.2.1.1. It shall be possible to call TCOs (in accordance with the communication matrix) using shortform numbers. Shortform numbers shall be numeric number with a maximum of three digits.

11.1.2.1.2. Each TCO shall have a unique short form number, which shall be translated on call set-up by the CRL. Tenderers shall indicate the mechanism.

11.1.2.1.3. Where complete position information is available at the time of call set-up, it will not be necessary to use the shortform numbers for the controlling TCO, since the CRL will route the call automatically.

11.1.2.1.4. Calls from PDTs shall use database or functional number dialling and not 3 digit dialling (e.g. use of train number).

11.1.2.2. Barring per mobile on location, destination:

11.1.2.2.1. The CRL shall implement barring in accordance with the communication matrix as specified in APPENDIX C.

11.1.2.2.2. Tenderers shall indicate how barring is to be implemented, taking into account the limited barring and CUG features of the GSM network.

11.1.2.2.3. Where complete train position information in available, a train shall be barred from calling all PDTs, except his controlling TCO based on position information.

11.1.2.2.4. PDTs shall be barred from calling all trains outside its control area, but shall be able to call any train for which position information in not available.

11.1.2.2.5. Configuration of all barring per mobile provided by the system (excluding GSM CUGs) shall be possible from the system management system.

11.1.2.3. Functional addressing (Train Numbering);

11.1.2.3.1. Each TCS registered in the system shall be uniquely identified by a functional (train) number. Train number format is described in APPENDIX B.

11.1.2.3.2. Calls to trains shall be set up using the functional number, with translation to the appropriate MSISDN performed by the CRL. Database information used by the CRL for such translation shall be established during the registration procedure.

11.1.2.4. Location dependent addressing (Calls to controllers):

11.1.2.4.1. Location dependent addressing shall be provided to route calls to a destination address, which is dependent on the calling or called user's location.

11.1.2.4.2. Calls from trains to controllers shall be routed according to

the train position (i.e. to the controller of the train's current area).

11.1.2.4.3. Group calls from controllers shall be routed only to called parties within their control area.

11.1.2.4.4. Calls from trains shall use the following methods to perform location dependent addressing:

11.1.2.4.4.1. GPS position communicated to the CRL during call set-up;

11.1.2.4.4.2. Short form dialling, if train position information is not available.

11.1.2.4.5. Tenderers shall indicate where and when position information is to be stored in the CRL.

11.1.2.4.6. Control area boundaries shall be independent of GSM cell boundaries. (i.e. geographical boundaries based on GPS)

11.1.2.5. Priorities and pre-emption (including Emergency);

11.1.2.6. Voice group calls (Conference calls);

11.1.2.7. Data broadcast calls;

11.1.2.8. Pre-defined voice and SMSs.

11.1.3. Trains entering and exiting a PDT control area

11.1.3.1. Each PDT shall have a list of all trains currently in his control area.

11.1.3.2. If a train changes from TCO area, the list of all the PDTs shall be updated.

11.1.3.3. Call routing shall be done according to physical location of the train. Normal controller calls from a train shall always be routed to the PDT under which control he falls.

11.1.3.4. Once a train system is logged-on, all call set-ups involving that train system shall be routed by the CRL.

11.1.3.5. Location information obtained from manual and automatic location systems shall be processed by the CRL, in order to route calls and data messages from train systems to the appropriate TCO terminal. The CRL shall maintain a database of this information.

11.1.3.6. After a train number and MSISDN have been linked (automatically by driver entry, or manually by TCO entry), the system shall ensure that this information is available to all other PDTs on the line (11 total over 600 km) and indicate the status of the train number, e.g. in operational area or not.

11.1.3.7. A train number shall "follow" the MSISDN (train) along the track on its journey either by inputs from the signalling system or from the GPS server. This information shall be collected, and distributed to the relevant PDTs.

11.1.3.8. The CRL shall set-up broadcast voice calls from PDTs to a group of train systems and other users (by recording the broadcast message and setting up parallel one-to-one calls to the parties in the broadcast group).

11.1.3.9. It shall also be able send broadcast text messages from PDTs to all train and other mobile phones within the specified broadcast group.

11.1.4. GPS server

11.1.4.1. General

11.1.4.1.1. All GPS information from trains may be collected by a single central GPS server, which must update the databases in the rest of the system as required.

11.1.4.1.2. The GPS server shall add differential correction to the received information from the trains and send this corrected information to the rest of the PDT system.

11.1.4.1.3. The accuracy of the GPS system offered shall be indicated by the tenderer.

11.1.4.2. Diagnostics

11.1.4.2.1. The GPS server shall perform a set of self tests when it is powered up.

11.1.4.2.2. During this self test, all parts of the GPS server and attached systems shall be tested for correct functionality.

11.1.4.2.3. Self-tests shall also be repeated periodically after a certain time. This self-tests shall not influence the operation of the GPS server in any way.

11.1.4.2.4. Failure of any part of the GPS server shall send an indication to the system manager.

11.1.4.3. Equipment interfaces

11.1.4.3.1. The GPS server shall interface to the rest of the CRL.

11.1.4.3.2. All interfaces shall be done via a recognised international open standard.

11.1.5. Voice call initiation

11.1.5.1. The CRL shall ensure that a train driver shall be able to make and receive calls from his controlling PDT.

11.1.6. Data messages

11.1.6.1. The CRL shall ensure that data messages gets delivered within 10 seconds from being sent. The originating party may be either a PDT or TCS.

11.1.6.2. Data messages may be sent to a group of users. The list of intended users shall be set up via the PDT.

11.1.7. Closed user groups

11.1.7.1. Closed user groups shall be implemented on the GSM network to limit connectivity between users.

11.1.7.2. As a minimum, two CUGs shall be implemented.

11.1.7.2.1. CUG for Train communications. This CUG shall consist of the following users :

11.1.7.2.1.1. Train cab systems;

11.1.7.2.1.2. PDT for contact with the train drivers.

11.1.7.2.2. A CUG including all the Train Support personnel. This shall

be all users outside the Train Control CUG. Communications with personnel in this group shall not affect communications with personnel in the Train Control CUG. If no other method can be found, this may be realised with an additional GSM phone attached to the PDT.

11.1.7.3. Barring of communications between users in the two CUGs shall be according to the matrix as specified in APPENDIX C.

11.1.7.4. Tenderers must acquaint themselves with the limitations of CUGs on the GSM network.

12. SYSTEM MANAGEMENT

12.1. Functional specification

12.1.1. General system management

12.1.1.1. A system management platform shall be provided to :

12.1.1.1.1. allow reconfiguration of TCS parameters and databases;

12.1.1.1.2. allow PDT databases and parameters to be updated or modified;

12.1.1.1.3. generate reports collected by the CRL;

12.1.1.1.4. allow modification of the area boundary database.

12.1.2. Configuration of PDT

12.1.2.1. The system manager may have the need to change PDT parameters and databases from time to time. These updates shall be able to be modified on one by one basis or system wide. This shall be the System Manager's choice.

12.1.2.2. The configurable items shall include, but need not be limited to :

12.1.2.2.1. The pre-defined data messages that may be sent from the PDT.

12.1.2.2.2. Lists of support personnel names

12.1.2.2.3. All databases.

12.1.3. Download of PDT statistics

12.1.3.1. The system manager shall have the facility to download any collected statistical information from any PDT console.

12.1.4. Configuration of TCS

12.1.4.1. The system manager shall have the facility to update any parameters of the TCS. This shall include, but need not be limited to :

12.1.4.1.1. The emergency numbers;

12.1.4.1.2. The TCO number for each area;

12.1.4.1.3. The description of TCO's;

12.1.4.1.4. The area boundaries;

12.1.4.1.5. Contents of available test messages.

12.1.5. Tenderers are to describe the system management functions that will be provided.

12.1.6. Failure reporting

12.1.6.1. A report process shall be put in place to ensure that all failures gets reported to a responsible person.

12.1.6.2. Failure reporting shall include, but needn't be limited to :

12.1.6.2.1. failure of train equipment;

12.1.6.2.2. failure of PDT equipment;

12.1.6.2.3. failure of any other peripheral equipment attached to the Transnet Freight Rail system.

12.1.7. Performance monitoring

12.1.7.1. Certain call performance parameters shall be monitored on a continuous basis.

12.1.7.2. Call performance and GSM network performance shall be reported. These reports shall be archived on a monthly basis.

12.1.7.3. These performance characteristics shall be available at a terminal for evaluation and analysis.

12.1.7.4. A list of all calls made by a PDT shall be kept. This list shall contain the following information:

12.1.7.4.1. PDT identification;

12.1.7.4.2. Called party identification;

12.1.7.4.3. Time call was made;

12.1.7.4.4. Duration of call;

12.1.7.4.5. Any information relating to data messages.

13. DC-DC CONVERTER (POWER SUPPLY)

13.1 Specification

13.1.1. The power supply unit will be according to the Transport Telecoms specification, number SCEH-80 (Nov 1997), or at least similar to or better than SOS Industries units as currently in use on TFR locos.

13.1.2. In addition to the standard specifications, extra drawings are to be supplied to ensure adaptability between current systems and the requested equipment.

13.1.3. Surge suppresser equipment must be supplied to operate in a working environment as specified in Specification for Electronic equipment used on rail vehicles, IEC 60571.

13.1.4. Special care must be given to sensitive power requirements and it is strongly recommended that all derivatives from the main power source be contained in the same enclosure where the rest of the operational devices are housed.

13.1.5. A complete TCS unit with its power supplies included would be required.

13.1.6. If alternative power supplies are to be proposed, fully detailed technical specifications must be supplied.

14. TRAIN ANTENNA

14.1. The train antennae shall be supplied by Transnet Freight Rail

15. TRACK PROFILES DISPLAY ON MMI

15.1. Overview

15.1.1. This section contains technical and functional specifications for the integration of the capability to display the profile of the actual rail line with the actual train

movement on it, on the Transnet Freight Rail train cab communication systems, as in use on locomotives on the Transnet Freight Rail rail line between Witbank and Richards Bay.

15.1.2. It is envisaged that the newly required feature be used specifically when visibility is poor, and as a support mechanism to the train driver as and when required.

15.1.3. The profile of the line with the position of the train superimposed on it, displayed on the 10,4" display of the communication system, will then give the driver a fairly accurate indication on what his actual location is with an overhead and vertical view of his position on the track

15.1.4. The primary function of the TCS system will still be the capability to communicate to the correct TCO at all times, which will be a function of the GPS on board, but the new feature must make use of this available information received from the GPS to calculate the information to be displayed.

15.1.5. The TCS display will have to, at least, display the section of line on which the train is moving on at any specific point in time, taking into consideration the primary functionality of the communication system.

15.1.6. The driver must have all the relevant communication related interfaces available on the TCS at all times and the required feature must not influence the normal operations of the communication system.

15.1.7. There may be a predefined space, on the TCS display, allocated to the information requested, with the possibility to zoom in on the information. The supplier of this requirement to indicate what the ultimate workable solution would be.

15.1.7.1. The GPS information in the train cab and the GPS information from the last wagon on the train (if available) will be used to display the train's position on the track profile.

15.1.7.2. Information from trackside equipment, which could then give a visual indication on the display unit on where the actual fault has been reported.

15.2. Equipment requirements

15.2.1. General

15.2.1.1. The driver must be successfully logged on to the communication system before any profile-related information is shown.

15.2.1.2. The TCS must be capable of showing/displaying the profiles of the rail line.

15.2.1.3. The profile must cover at least 10 km of rail line at a time with the option to zoom out to 20 km with no detail on it.

15.2.1.4. If the system is set for the 10 km display it must at least show critical pointers on the track like : Stations, major signals, and tunnel entry/exits.

15.2.1.5. Two views are required: one from the side (horizontal) of the track, which will indicate the gradient and one from the top of the track, which will indicate the curves of the line.

15.2.1.6. Suppliers must comment on the tolerances expected on the horizontal profile e.g. gradient.

15.2.1.7. It must be possible to activate the feature without any major effort, preferably by the press of a virtual button.

15.2.1.8. The position of the train on any given point must be displayed fairly accurate

on up and down hill areas with updates not less than every 10 metres.

15.2.1.9. The overview display must be in sequence with the horizontal display with the same amount of detail on each profile, or it may be shared if the two profiles are next to each other.

15.2.1.10. The system must always display at least the front position correct, depend on position i.e. in tunnel, with a calculated length of the average train length if the rear GPS coordinates are not available e.g. 200 wagons.

15.2.1.11. The system must allow for a selection of predefined trains e.g. 200 truck (loaded) +4 locomotives or 100 truck (empty) +2 locomotives, from the MMI during log-on procedures.

15.2.1.12. The list of predefined trains will not exceed 10 definitions.

15.2.1.13. The system must clearly indicate if not enough satellites are available to display the train movement on the track.

15.2.1.14. The size of the displayed profile may vary and it must be possible to get a full screen width display if needed, with a user (system administrator) defined fallback period to the normal communication screen layout.

15.2.1.15. The driver must have the ability to request detail if he wants to see more on the display unit e.g. 10 km or 20 km .

15.2.1.16. The system must not loose its functionality as a communication system while the driver looks at the profile screen.

15.2.1.17. The system must be capable to receive calls or SMS's at any time during any non-voice call related activity.

15.2.1.18. There must be a dedicated screen area defined for the profile information. If it is possible to incorporate some of the requested feature on the TCS systems a key may be defined to activate such a display.

15.2.1.19. The displayed information must be readable from ±1 metre distance away from the screen.

15.2.1.20. Based on the above information if available: If the train length start moving out of the departure measurements an alarm should sound and the situation must be displayed on the TCS screen. The train length will change while on the move and therefore changes shorter than the initial may be ignored but if the length exceeds the initial length by a predefined distance an alarm should be sounded.

15.2.1.21. The TCS system must be able to convey the alarm conditions on the train to the CTC in charge of the train. This must take place after a predefined time or on no action from the train driver.

15.3. Train Communication System (TCS)

15.3.1. Fully operational voice/data communication system permanently installed in the trains.

15.3.2. The unit will have its own internal battery to cater for a few minutes of communication and system shutdown processes in the case of source power failures.

15.3.3. The system LCD will have the following controls and indications: (only after a successful log-on process).

15.3.4. A single, multi-function push button with the following functions :
15.3.5. Activate/cancel the display of the profile function.
15.3.6. Zoom in function.
15.3.7. A display area, which will not influence the main function of the TCS with an audible alarm on any change of conditions.
15.3.8. The display must provide clearly visible readings from the locomotive driver's seat position under all cab lighting conditions ranging from direct sunlight to night illumination.
15.3.9. If the displayed information required continuous back lighting, its effect on the LCD must be kept in mind. It should be preferred if the backlight is only used when changes is received.
15.3.10. The characters of the display must be large enough to ensure good visibility.
15.3.11. During normal operation the display must be in its default communication screen until a request from the driver activate the profile display.
15.3.12. When in the profile mode the system must continuously monitor the communication system and switch to the default screen on any incoming call. The driver may be informed on receipt of SMSs or data calls with the choice to read it at a later stage.
15.3.13. After being logged-on to the communication network, the TCS must function totally automatically as follows :
15.3.14. Calculation of the train length must take place in the first inline stretch of rail line.
15.3.15. A message must be displayed indicating the loss of GPS information, front or rear.
15.3.16. Alarms must be automatically sounded whenever the train exit its allowed operating area.
15.3.17. Any misinterpretation of measurements received must not cause confusion on the actual position and continuous verification must take place not to display unwanted data.

15.4. Messages

15.4.1. Messages received to be displayed may include the following but must not be limited to -
15.4.2. zone information, handover points;
15.4.3. zone information, special notes from TCO;
15.4.4. conditions of approaching signals red/amber/green
15.4.5. satellite positions (GPS), front rear.
15.4.6. external device inputs (when available).

15.5. Quality of interface

15.5.1. Tenderers must note that technical personnel of Transnet will carry out inspections and tests to determine whether the required interface meets the specific requirements or not.
15.5.2. Software must be clearly commented in English to allow easy track and trace on the flow of events in the coding.
15.5.3. Integration into the existing communication software must be transparent to the user of the equipment.
15.5.4. Displayed information must be the same style for all different screen layouts and

the positioning of the same type of information must always be on the same area on the display

16. Train speed profile functionality

16.1. Scope

16.1.1. This section defines the requirements for the real time monitoring of a train's speed against a speed profile specifically defined for the type of train configuration.

16.1.2. The GPS log files must be uploaded to the GSM-Communication system's database from the TCS

16.1.3. This GPS log file data will be made available for different report and graph generation. The actual and generic speed profile will be indicated on the graph

16.1.4. It will be made possible to play the uploaded GPS log file back, plotting the train's movement with its speed on a map

16.1.5. It will be made possible to play the uploaded GPS log file back, plotting the train's Once a day alarms generated will be combined and e-mailed to the relevant people

16.1.6. Modification to the GSM-System software will have no influence on the operational working of the current system

16.1.7. This modification will have no influence on the operational working and already introduced features of the current GSM-system

16.1.8. System software on all the different components of the train communication system (TCS2, Back Office (BOF) and Phone Dispatch Terminal (PDT)) must be updated to accommodate any additional requirements as specified in this document.

16.2. Requirements

16.2.1. The following information regarding the trains and Train Drivers are required:

16.2.1.1. When and where the Train Driver is exceeding the authorized line speed profile of the specific train configuration, this must be indicated by an audible and visual alarm on the TCS, the alarm must be acknowledged by the driver. This alarm condition must also be sent to the relevant PDT-Desk in the CTC and change the colour of the train info in the "trains in section" window immediately. It must also be possible to extract these over speed exceptions per train type from the BOF database. This could be a request for more than one Train Driver and/or geographical area over a period of time.

16.2.1.2. When and where the Train Driver was travelling slower than the authorized speed profile of the specific train configuration, this must not cause an audible or visual alarm on the TCS, this condition must not be sent to the CTC-Desk. It must be possible to extract these under speed exceptions per train type from the BOF database. This could be a request for more than one Train Driver and/or geographical area over a period of time.

16.2.1.3. A report must be available with a graph of a Train Driver's train handling behaviour (speed and other relevant parameters). This report shall include information about all the train stoppages. In the case of a train stoppage for more than x-minutes (configurable) the TCO shall be prompted to select a reason for the stoppage from a drop down list. This report could be a

request for one or more than one train of all different types or of a specific type over a period of time in different geographical areas. This information must be readily accessible from the eight sign-on depots within 15 minutes from the end of the trip since more than one Train Driver may sign off at a time and at different places. The information must include:

16.2.1.4. All the Train Drivers for a specific train on a specific day.

16.2.1.5. All the trains handled by a specific Train Driver on a specific day or over a period.

16.2.1.6. All the trains on a specific day or for a period.

16.2.1.7. The number of speed alarms per day per train.

16.2.2. It must be possible to download a new speed profile, including the upper and lower limits, to the TCS for a specific train type or for all train types should the line conditions change.

16.2.3. A user-friendly software interface must be designed enabling the Department Rail Operations to access this data and to generate useful information and to download new speed profiles should the need arise.

16.2.4. A generic speed profile for each type of train configuration must be generated; this data are to be recorded by an authorised person from TFR, (somebody that controls the speed limits on the line). This profile will contain identification points along the rail line and an upper and lower speed level indicator (a speed window) as to plot the generic speed profile graph in relation to these points together with the upper and lower speed level indication. The train-handling graph will be plotted in relation to these points together with the generic speed profile and the upper and lower speed level indications.

16.2.5. Selection of the applicable speed profile will be the responsibility of the authorities in charge of the train control and it will be activated by the system administrator.

16.2.6. TFR Rail Operations will supply a list of train numbers and its descriptions for integration into the system.

16.2.7. Additional functions/features required needs to be incorporated into the current operational programs of the:

16.2.7.1. Task Description TCS-1 and TCS-2

16.2.7.2. Speed profile database on TCS

16.2.8. To enable the onboard speed alarms the generic speed profile data for the different train types must reside on the TCS.

16.2.9. The operational program will use this data together with the train number to establish which speed profile to select.

16.2.10. The Map on the TCS will at least display the following information:

16.2.10.1. Kilometre points on the line.

16.2.10.2. The current position of the train.

16.2.10.3. Signals

16.2.10.4. MTN high sites.

16.2.10.5. Measuring stations along the track.

16.2.11. The operational program will compare the selected speed profile with the actual travelling speed of the train and generate alarms accordingly.

16.2.12. It must be possible to remotely download a new speed profile to the TCS should limits be altered. The new limits must automatically be activated on the TCS.

16.2.13. All events must be logged.

16.2.14. End of trip uploading

16.2.15. When a Train Driver reaches the end of his/her trip, the data recorded (GPS.log) by the TCS must be uploaded to the BOF automatically. A limited amount of retries must be initiated with unsuccessful data calls and an indication generated at TFR Rail Operations as to initialise manual removal of the data in the case of a unsuccessful data transfer.

16.2.16. The BOF program must capture this data into a database.

16.2.17. The data will then be available to remote users for the generation of useful statistics.

16.2.18. Driver log-on and log-off

16.2.18.1. Log-on and Log-off of the Train Drivers must be recorded. This data will be embedded in the data recorded by the TCS's operational program. This also will be downloaded to the BOF at the end of the trip. The data must then be made available to Rail Operations as to generate useful information.

16.3. Existing speed alarm

16.3.1. The maximum speed alarm as currently introduced must stay. An addition to this is necessary where more than one maximum speed limit can be added depending on train type.

16.3.2. The current GPS log files must stay as it is, still logging as current with the TCS either in "Sleep mode" or "Normal mode".

16.3.3. A new GPS log file must be created after a train number has been entered, this file must be downloaded to the BOF once the train has reached its destination but only deleted after a successful file download.

16.3.4. If the data call should fail but the train number stays the same with the next logon the current log file must be appended and downloaded with the next data call attempt.

16.3.5. If a new train number is used a new GPS log file must be created.

16.3.6. All un-downloaded files must be flagged and downloaded with the next data call attempt.

16.4. Software application for TFR Rail Operations

16.4.1. A custom software application is required and will be used by the Department Rail Operations. It will be made available to the Empangeni NOC; the application will access the BOF Database using the LAN.

16.4.2. This software application will use the uploaded data to compile the necessary reports and to generate the necessary graphs.

16.4.3. This application must allow changing the speed profile/s including the upper/lower limits and the downloading thereof to all locomotives.

16.4.4. Viewing/confirmation of successful downloads must be possible.

16.4.5. It must be possible to revert to the default/generic speed profile/s.

16.4.6. This application must make the playback of GPS.log files possible.

16.4.7. Plotting the train on the map as it steps through the log file.

16.4.8. Kilometre points, mast pole and all current line information must form part of the map layer when plotting train movements.

16.4.9. It must be possible to place user restrictions as to authorise certain users the permission to change speed profiles or the upper and lower window limits.

16.4.10. Data must be available directly from the BOF for a period of one month there after it must be placed in backup. It must be possible to generate the same reports, etc from the backups without additional effort if compared to the live system.

16.4.11. A configurable E-Mail facility must be made available and all TCS alarms automatically mailed once a day.

16.4.12. Current alarms must form part of this mail. Provision must be made for adding additional alarms.

16.4.13. A summary of the trains that had logged on for the day with and without GPS, and a summary of the amount of speed alarms per day must form part of this mail. The summaries must be in an Windows Excel format.

16.4.14. This data will reside on the BOF and access to this data, for report generation, must be possible via the main application and the additional function (web application) as specified in this document.

16.4.15. An additional function (eg. web application) should be made available to allow any authorised user access to print the reports and graphs.

16.4.16. It must not be required to install Map X, Oracle or any other special software for using this Web application.

16.4.17. It must be possible to print out all reports and/or graphs, and also to export and save it in a usable format to disk.

16.4.18. It must be possible to manually copy the speed data file from the TCS-flash into the BOF's database with a local card reader or

16.4.19. Remotely via the GSM network

16.4.20. Provision must be made for real time transfer of any data requirements through the GSM GPRS/EDGE network to the BOF.

16.4.21. This implies that all database will be updated with real time information which will be available for any queries as described in this document.

17. Train in mine area monitoring

17.1. SCOPE.

17.1.1. This section defines the requirements on the TCS, BOF and PDT software to be able to monitor trains, when entering and exiting a mine area.

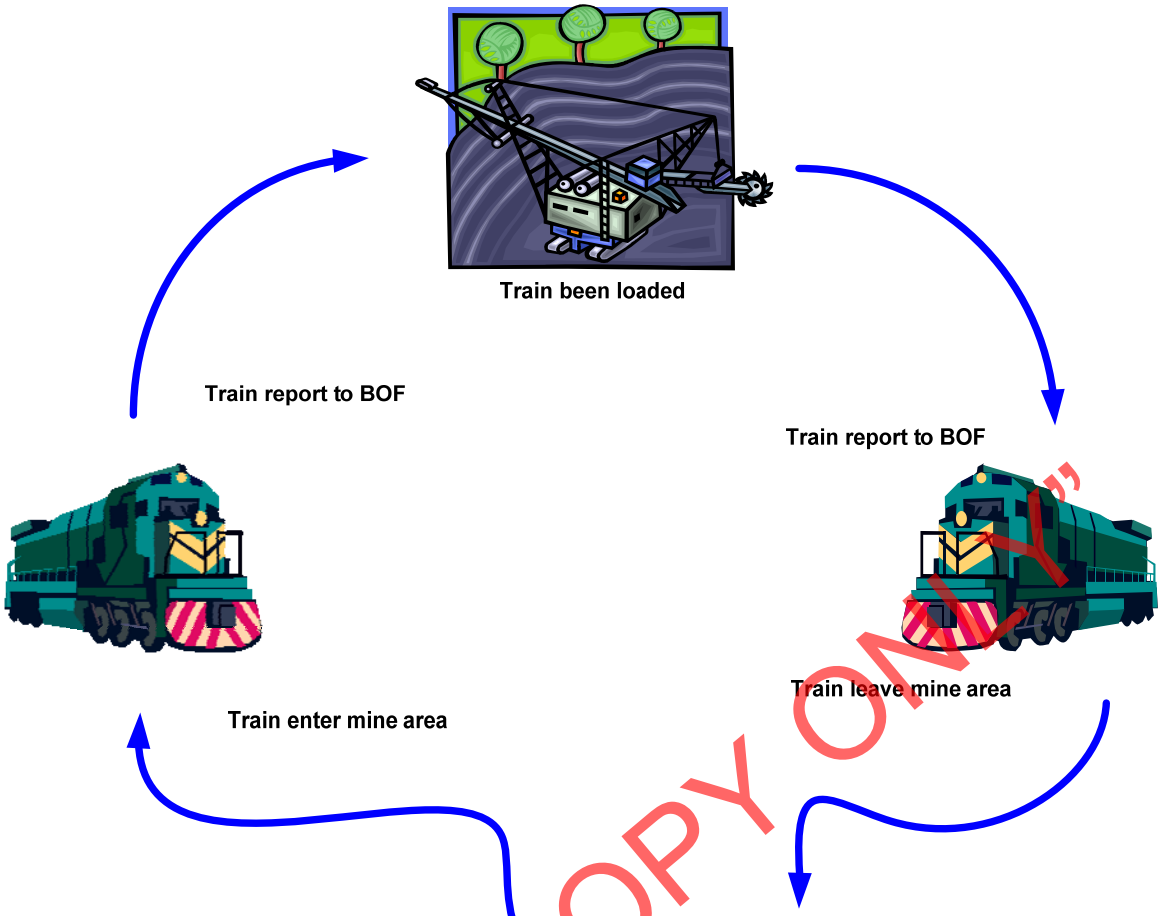


Figure 2: Diagrammatical presentation of train movement in mine area.

17.2. REQUIREMENTS.

17.2.1. General

17.2.1.1. A train will report its position when entering and exiting a mine area and the message will contain the following information:

- Mine Description
- Train Number
- Driver ID
- Date
- Time
- Longitude
- Latitude
- Entry / Exit

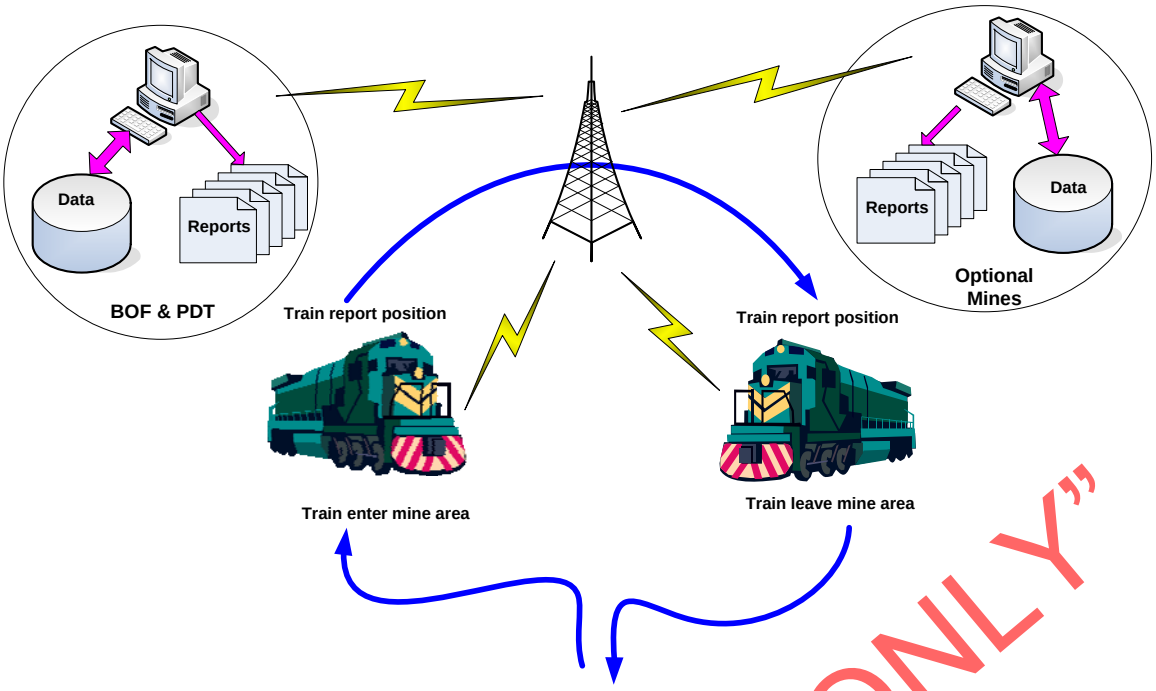


Figure 3: Functional presentation of operational requirements.

17.2.1.2. By utilizing this information reports will be generated indicating train entry and exits at mines.

17.2.2. TCS software requirements

17.2.2.1. The TCS systems will reports its position when reaching the defined zones. The TCS will send a message to the BOF with the mine info. The message definition is the following:

17.2.2.1.1. MINE MESSAGE

17.2.2.1.1.1. MNE ; ACK ; Message Number ; TrainNumber ; DriverID ; Today ; Now ; Long ; Lat ; Speed ; Condition ; Loco ID ; BoxID ; Table ID ; MineID ; Event

17.2.2.1.1.2. Event = Enter, Exit, Load.

17.2.2.2. The software will cater for 10 zones in the mine area (Mine in, Mine out and Load).

17.2.3. BOF software requirements

17.2.3.1. Zone files must be generated for the zones created for each mine.

17.2.3.2. Mine zones will be linked to descriptive names

17.2.3.3. The physical maps will accommodate the mines rail line.

17.2.3.4. The data must be stored in the BOF data base.

17.2.3.5. A reporting function will be available on the admin program to print train activity in mine areas.

17.2.3.6. The initialization file will include mine MSISDN numbers.

17.2.4. PDT software requirements

17.2.4.1. An indication when a train enters and leaves a mine area will be shown on the TCO screen.

17.2.4.2. Complete maps, including mining areas, will be part of the PDT software.

17.2.4.3. The Train Viewer software will include train activities in mines.

17.2.4.4. The locomotives will be displayed “real time” on the map interface as

position update messages are received. This will make trains/locomotives visible at the last updated position received in these areas (mines) and also on the rest of the line.

17.2.4.5. Train Viewer software will refresh the data according to a predefined time.

17.2.4.6. If the leading locomotive's GPS should go faulty or if no satellites are visible a GPS failure message will be generated and displayed on the Train Viewer.

17.2.4.7. The Train Viewer will be populated with mast pole and kilometre point data.

18. Telemeter (EoT) SYSTEM INTERFACE

18.1. Interfaces and Controls

All outputs and controls for the telemeter system (TS) are to be available on an international standard data communication RS232 interface. These include but are not limited to:

18.1.1. any information which is required to be displayed.

18.1.2. any alarm conditions which are displayed or sounded;

18.1.3. switching/selection interfaces;

18.1.4. any other input mechanism, which may be used to control the TS.

18.2 Display

18.2.1 Displayed information must be the same style for all screen layouts and the positioning of the same type of information must always be on the same area on the display.

19. TECHNICAL DOCUMENTATION

19.1. Technical handbooks

19.1.1. Technical handbooks must be clearly printed in English. Photostat copies will not be acceptable.

19.1.2. The technical handbooks must be of a high quality and durable.

19.1.3. Each set of handbooks must include the following :

19.1.4. Operating instructions.

19.1.5. Complete maintenance instructions.

19.1.6. A detailed technical description of the interface.

19.1.7. Complete program flows with modules interlinking with each other, timing sheets, screen layouts, drawings and photographs of the displayed information.

19.1.8. Transnet reserves the right to reproduce in whole or in part, by any means whatsoever, any technical handbook or instruction manual supplied by the successful tenderer. Any such reproductions will be for the sole use of Transnet.

19.2. Maintenance and service

19.2.1. The tenderer must give full particulars of the maintenance required on the interface to be supplied.

19.2.2. Tenderers must state what provision will be made to ensure adequate availability of staff to attend to latent defects or system problems.

19.2.3. Transnet will not consider tenders from tenderers who cannot provide an efficient back-up and support service.

19.2.4. Guarantee

19.2.5. Transnet will not consider tenders, which do not include a 12-month guarantee period.

19.2.6. The tenderer must agree to attend to any fault experienced, relating to the interface to be supplied, in the guarantee period and to produce a fix in the not more than a 24 hour period.

19.2.7. The rectified software must be firmly tested on the premises of the successful tenderer before it is forwarded to the user for implementation.

19.2.8. The tenderer must agree to submit quarterly reports listing full details of any failures experienced during the guarantee period indicting cause and effect.

19.2.9. The quarterly reports must be submitted to the address as specified in the tender documents.

20. APPENDIX A : CONCEPTS

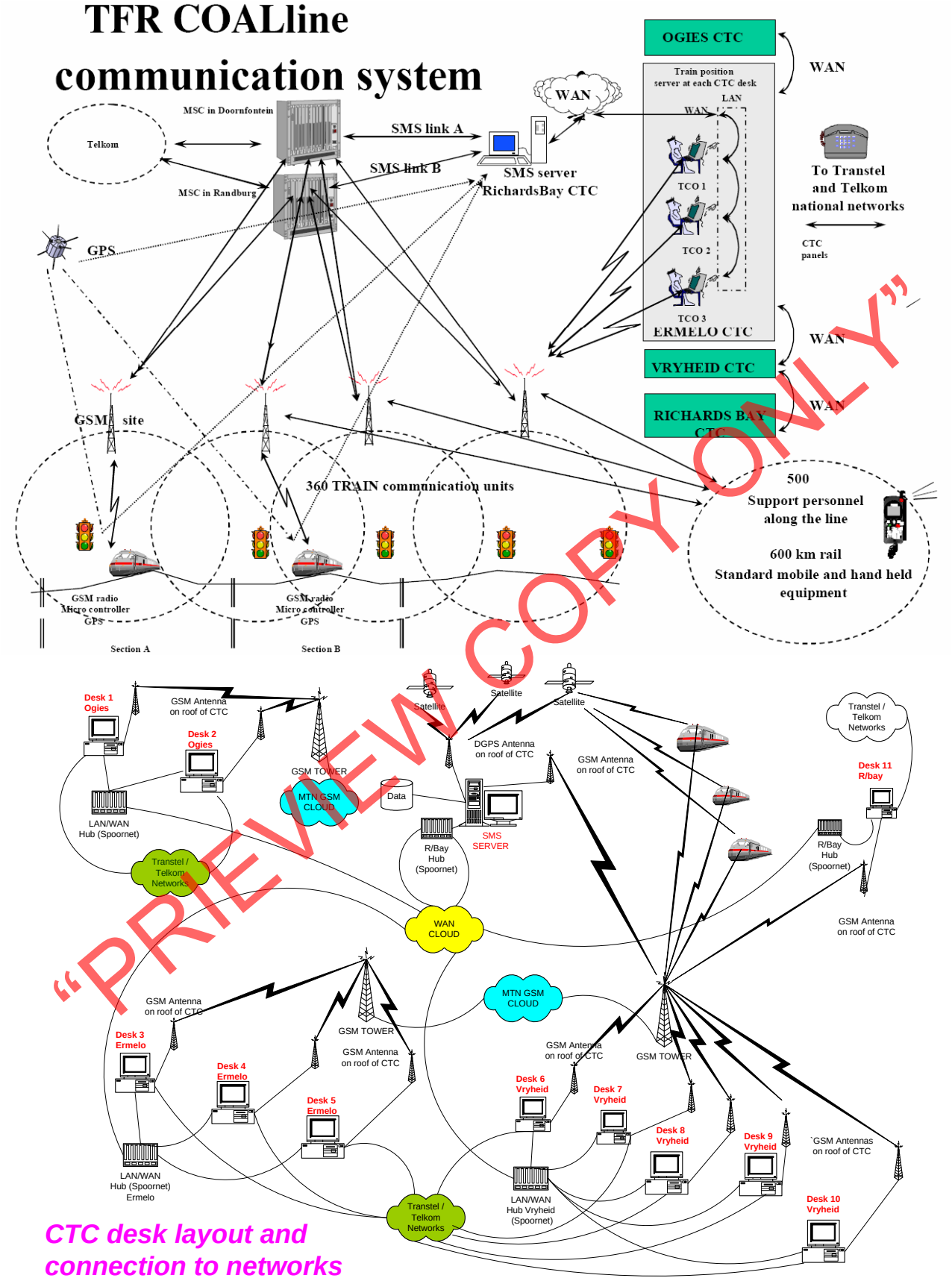
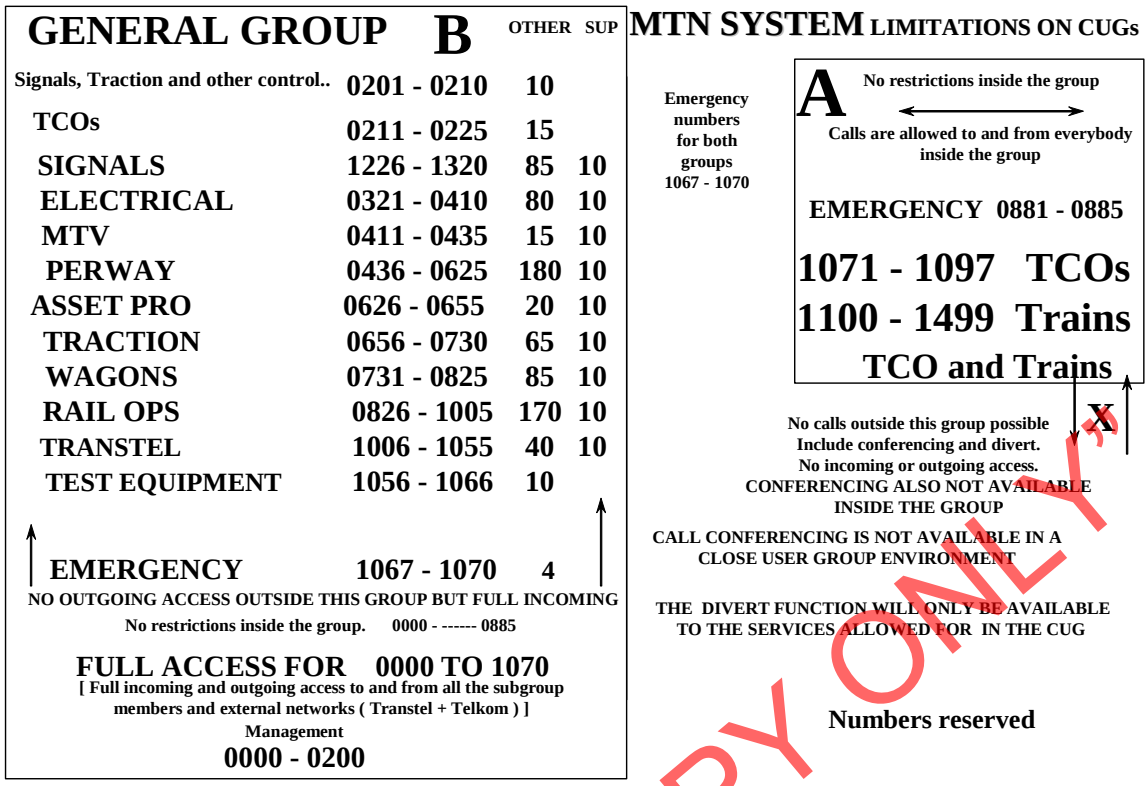


Figure 4: Transnet Freight Rail COALline communication system

21. APPENDIX B : TRAIN NUMBERING SCHEME



22. APPENDIX C : CALL MATRIX

Operation *possibilities* with MTN GSM network limitations with additional external hardware and software, plus patching facilities.

		To										
CODE	**FROM**	TCO	Train	Maintenance	Section Shunt	Super-visor	Control	Support	Shunt Yard	Manage-ment	Switch-board	Transnet
J	TCO	N(A,B,T)	Y(A)	Y(B)	Y (B)	Y(B)	N(A,B,T)	N(P)	N p-p	N(B,T)	N(B,T)	N(T)
K	Train	Y(A)	Y(A)	N(P)	N p-p	N(P)	N(P)	N(P)	N p-p	N(P)	N (P)	N (P)
C	Maintenance	Y(B)	N (P)	Y	Y	Y	Y	Y	N	Y	Y	N(T)
D	Section Shunt	Y(B,P)	N p-p(P)	Y	Y	Y	N	Y	N	Y	Y	Y
E	Supervisor	Y(B,P)	N(P)	Y	Y	Y	Y	Y	N	Y	Y	Y
F	Control	N(A,B,T,P)	N(P)	Y	N(P)	Y	N(T)	Y	N	Y	N(T)	Y
G	Support	Y(B,P)	N (P)	Y	Y	Y	Y	Y	N	Y	Y	Y
		OPERATIONS BORDER										
H	Shunt Yard	N p-p	N p-p	N	N	N	N	N	N	N	N	N
I	Management	Y(B,T,P)	N(P)	Y	Y	Y	Y	Y	N	Y	Y	Y
	Switchboard (Tel)	Y(B,T,P)	N(P)	Y	Y	Y	Y	Y	N	Y	Y	Y
	Transtel	Y(B,T,P)	N(P)	Y	Y	Y	Y	Y	N	Y	Y	Y

Y(A)-Yes on train control group cellular number. Y(B)-YES on general group cellular number
IF PATCHING FACILITIES ARE ALLOWED IN THE NETWORK, IT WILL BE POSSIBLE FOR EVERYONE TO TALK TO EVERYONE, ALMOST EVERYWHERE.
N(A,B,T) No direct access between the two parties on cell network A or B, but telephone connection is allowed.
Y(A,P) Yes, communication between these parties is possible on cell A, and patching to other parties is possible.

CODE	TYPE OF RADIO
J	Train Control Office fixed GSM dispatcher
K	Fixed or portable GSM train mobile
C	Maintenance group GSM handset
D	GSM handset with point to point shunt radio
E	Supervision group GSM handset

CODE	TYPE OF RADIO
F	Control Office GSM console
G	Tech. Support group GSM handset
H	Point to point shunt radio - not GSM
I	Individually confi-gured GSM radio

SYMBOL	MEANING
N	No - not required
Y	Yes - required
Np-p	No GSM - only point to point shunt radios
N(P)	No direct GSM - call patching only
N(T)	No direct GSM - Transtel network phone only

23. APPENdIX D : ANTENNA MOUNTING DRAWING

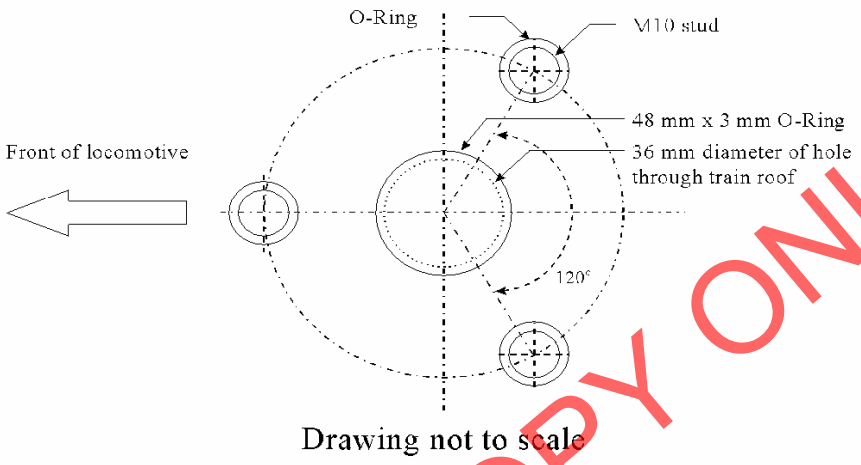


Figure 5: Antenna Footprint

24. APPENDIX E : CUG BARRING ON GSM NETWORK