



TECHNOLOGY MANAGEMENT SPECIFICATION

Handheld Radio Frequency Identification (RFID) Tag Reader

Author: Senior Technologist
Technology Management

Gideon J. van Staden

Handwritten signature of Gideon J. van Staden in black ink, positioned above a horizontal dotted line.

Approved: Principal Engineer
Technology Management

R. Mathew

Handwritten signature of R. Mathew in black ink, positioned above a horizontal dotted line.

Date:

December 2023

Circulation Restricted To:

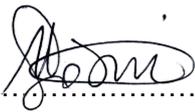
Transnet Freight Rail (TFR)
Transnet and Relevant Third Parties

© This document as a whole is protected by copyright. The information herein is the sole property of Transnet Ltd. It may not be used, disclosed or reproduced in part or in whole in any manner whatsoever, except with the written permission of and in a manner permitted by the proprietors.

SIGNATORIES

User Chief Engineer
 Approved: Technology Management

N. Gobhozi



.....

User Senior Technologist LIT
 Approved: Technology Management

L. Nyaka



.....

User Senior System Analyst
 Approved: ICTM

F. Apples



.....

User Specialist Analyst Programmer
 Approved: ICTM

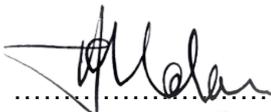
N. Smith



.....

User Senior Architect
 Approved: ICTM

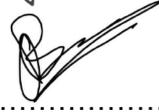
A. Malan



.....

User Specialist
 Approved: ICTM

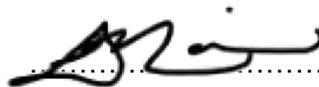
Q. Bosman



.....

User Project Manager
 Approved: Corporate Safety Office

L. Morris



.....

Glossary

4G	Fourth Generation
API	Application Programming Interface
APN	Access Point Name
ARP	Address Resolution Protocol
ATP	Acceptance Test Procedure
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
EDGE	Enhanced Data rates for GSM Evolution
eSIM	Embedded Subscriber Identity Module
FQDN	Fully Qualified Domain Name
GB	Gigabyte
GSM	Global System for Mobile communications (EDGE, 2G, 3G, 4G, 5G, LTE etc.)
GPRS	General Packet Radio Services
GPS	Global Positioning System
HHD	Handheld RFID Tag Reader Device
HTTP	Hypertext Transfer Protocol
IATS	Integrated Asset Tracking System
ICASA	Independent Communications Authority of South Africa
ICT	Information and Communications Technology
ID	Identity
IEC	Commission électrotechnique internationale
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
IP67	International Protection Marking 67
ITP	Integrated Train Plan
LLDP	Link Layer Discovery Protocol
LPG	Low Pressure Gas
PC	Personal Computer
QR	Quick response
RF	Radio Frequency
RFID	Radio-frequency identification
SABS	South African Bureau of Standards
SANS	South African National Standards
SIM	Subscriber Identity Module
SNMP	Simple Network Management Protocol
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TFR	Transnet Freight Rail
UDP	User Datagram Protocol
VIS	Vehicle Identification System
WAN	Wide Area Network
Wi-Fi	Wireless Fidelity
WPA	Wi-Fi Protected Access

Contents

1	SCOPE	5
2	DOCUMENT OVERVIEW.....	6
3	REQUIREMENTS	7
4	TRANSNET FREIGHT RAIL SUPPLIED PROPERTY LIST	9
5	TRANSNET FREIGHT RAIL LOANED PROPERTY LIST	9
6	SYSTEM CHARACTERISTICS.....	9
7	PERFORMANCE CHARACTERISTICS	11
8	PHYSICAL CHARACTERISTICS	28
9	GENERAL REQUIREMENTS	31
10	CONDITIONS	33
11	QUALITY ASSURANCE	33
12	APPENDIX A.....	35
13	APPENDIX B.....	39

1 **SCOPE**

1.1 **Identification**

Handheld RFID tag Reader (HHD)

1.2 **System overview**

The HHD shall be used to capture locomotive and wagon numbers electronically. This is done by pointing the HHD to the RFID tags fixed to the wagon/s and/or locomotive/s when the wagons/locomotives are part of a train consist.

For the purpose of this specification a train is a set of wagons compiled on a specific rail track in a shunting yard or departure yard. After the train (set of wagons) is assembled, a train consist list is needed to update the enterprise operations systems, and to provide a paper copy of the vehicle list (consist list) to the train driver that is going to haul the train.

The HHD will be used to scan the RFID tags on the wagons and locomotives in the correct sequence – back to front or front to back (from the first to the last wagon or last wagon to the first wagon on the train). In the case where a wagon or locomotive does not have a tag, or the tag is faulty, the wagon number shall be entered manually, in the correct sequence of the train on the Handheld RFID Tag Reader.

The Handheld RFID Tag Readers are also used by Transnet Engineering to check the correctness of tags on vehicles and to program new or incorrectly programmed RFID tags.

The Handheld RFID Tag Reader shall read and program wagon and locomotive TransCore AT5118 RFID tags.

2 **DOCUMENT OVERVIEW**

This document specifies the functions of the Handheld RFID Tag Reader, the internal and external interfaces, characteristics as well as the operating procedures of the Handheld RFID Tag Reader for use by Transnet Freight Rail operations.

2.1 **Applicable Documents**

The following specifications, standards, documents and drawings form 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.

BBH2729 version 1	Handheld RFID Tag Reader System Integration Service Definitions
BBC1628 version 3	RFID tags for vehicle identification system (VIS) in Transnet Freight Rail
BBC0659 version 2	Guidelines For Using GPRS Communication in Transnet Freight Rail
BBC1776 version 3	Procedures For GSM Data Users in Transnet Freight Rail
BBD6353 version 2	Radio Frequency Identification Tag Programming and Installation on Transnet Freight Rail Vehicles.
BBH3679 version 1	TransCore AT5118 Rail Tag Product Specification
BBH3702 version 2	Project Specifications - Scope of Works for Handheld RFID Tag Reader
MIL-STD-810	Environmental Engineering Considerations and Laboratory Tests
CSE-1154-001-CAT E48 Version 2	Physical Characteristic of The Railway Environment in South Africa
IEC standard 60529	Degrees of protection provided by enclosures (IP Code)
SANS 60079-0	Explosive atmospheres
CSE_1159_001	Standard Specification for Documentation for Signal Equipment
FYO_16A	Functional Yard Operations: Learner Guide for Hand-Held Device

3 **REQUIREMENTS**

3.1 **System requirements**

- 3.1.1 The Handheld RFID Tag Reader (HHD) application shall update all relevant master data and Application Programming Interfaces (API) on the HHD.
- 3.1.2 A function is required to select a yard, location name or a siding number.
- 3.1.3 A function is required to obtain the Integrated Train Plan (ITP) list for the selected location.
- 3.1.4 A function is required to select a train number from the ITP list that has to be scanned.
- 3.1.5 A function is required to scan the RFID tags on all vehicles that form part of the train.
- 3.1.6 A function is required to manually enter the wagon number in the correct sequence on the train if a wagon does not have a tag or if the tag is faulty. (A “faulty” tag can be a missing tag, non-programmed tag, incorrect data or a broken tag that does not respond when energised by the HHD).
- 3.1.7 A function is required to validate wagons numbers for correctness with a Modulo 11 check (scanned or manually captured wagon numbers).
- 3.1.8 A function is required to link wagon numbers to their correct wagon owner codes.
- 3.1.9 The HHD user shall upload the updated scanned train consist list to the back office database.
- 3.1.10 A function is required to manually change the train number for a train already scanned. A warning shall display and confirmation is needed to change a train number.
- 3.1.11 A function is required to delete a train number already scanned (delete all wagons from the train number). It shall be allowed to re-use the same train number again.
- 3.1.12 A function is required to delete vehicles from a scanned train consist – update/modify already scanned consist list.
- 3.1.13 A function is required to move vehicles on a scanned train consist list to a different place in the same consist list (change the sequence of vehicles).

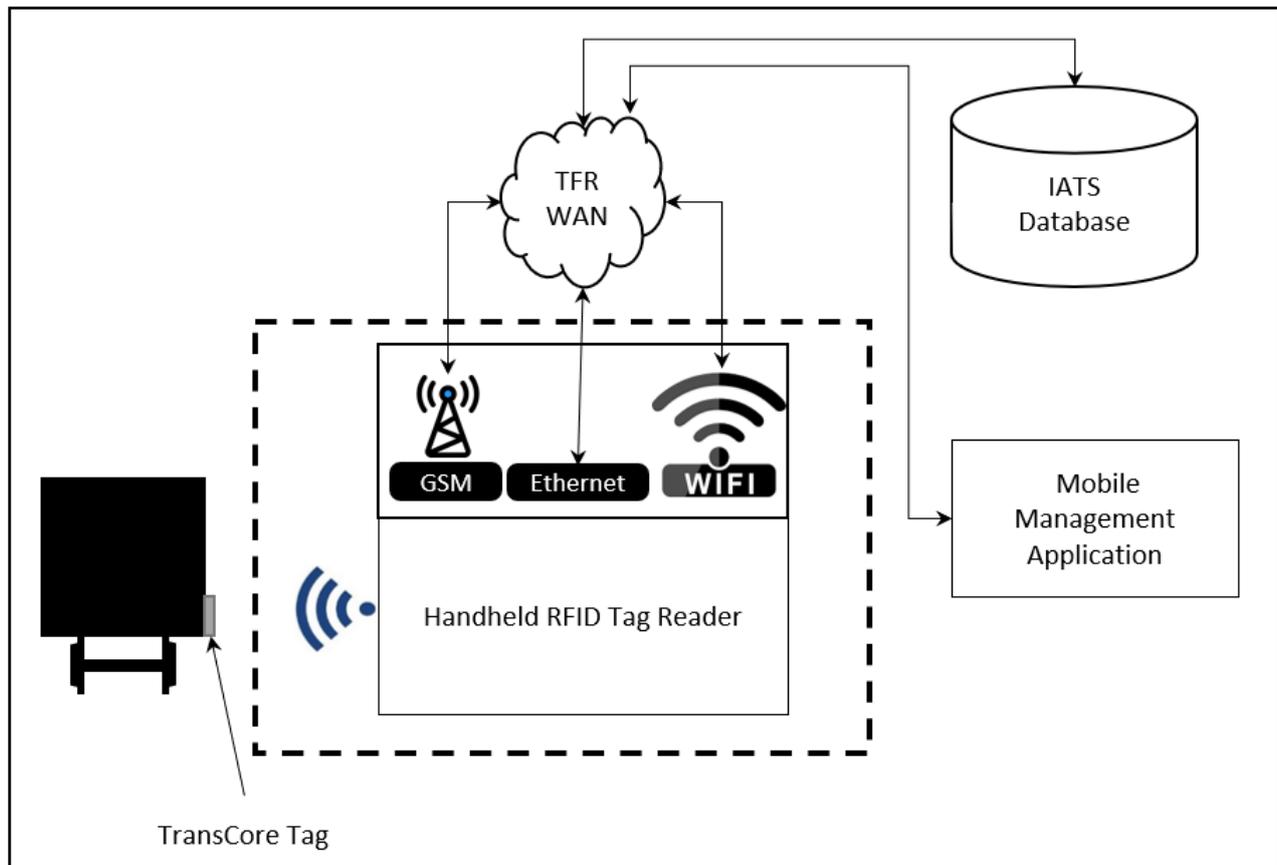


Figure 1: Context Diagram

3.2 External Interfaces

3.2.1 RFID Tags

3.2.1.1 The HHD shall interface with TransCore AT5118 RFID tags installed on railway wagons and locomotives as specified in BBH3679 Version 1 "TransCore AT5118 Rail Tag Product Specification" BBH1628 version 3.

3.2.2 Communication Interface

3.2.2.1 The HHD shall interface with TFR Wi-Fi networks (802.11 g/n) and all GSM networks employed in South Africa.

3.2.2.2 The HHD shall interface with TFR Wide Area Network (Ethernet) when available.

3.2.2.3 The HHD shall use Wi-Fi as the primary communication channel when a TFR Wi-Fi network is available.

3.2.2.4 The HHD shall connect to the GSM Network when Wi-Fi is not available.

3.2.2.5 TFR Wi-Fi networks can be 2.4GHz or 5GHz.

3.2.2.6 The cellular GSM module shall connect to the different technologies supplied by the service providers in South Africa.

- 3.2.2.7 The Wi-Fi interface shall accommodate IP, TCP, UDP, HTTP, LLDP, ARP, DHCP Client/Server, DNS support, SNMP user management and access control.
- 3.2.2.8 WPA2 protocol shall be employed for Wi-Fi connections.
- 3.2.2.9 The Handheld device shall interrogate active directory for authentication.
- 3.2.2.10 If an operating system other than windows are used, then an appropriate API shall be provided.
- 3.2.3 Back Office System
 - 3.2.3.1 The HHD shall interface with the back office systems (e.g. IATS) by using a defined API as specified in BBH2729 version 1 "Handheld RFID Tag Reader System Integration Service Definitions".

3.3 Major Component Requirements

The major component shall consist of the Handheld RFID Tag Reader unit with its operating system, application software as well as the battery charger.

3.4 Internal Interfaces

The HHD shall interface with on-board GSM modems, Wi-Fi modem and Ethernet adapter, the RFID radio and memory.

4 TRANSNET FREIGHT RAIL SUPPLIED PROPERTY LIST

Not Applicable

5 TRANSNET FREIGHT RAIL LOANED PROPERTY LIST

Not Applicable

6 SYSTEM CHARACTERISTICS

6.1 System availability factors

- 6.1.1 The HHD is not considered a mission critical system but is indispensable for the efficient operations of Transnet Freight Rail.
- 6.1.2 The HHD shall be considered a maintenance free system and repairs as well as software upgrades shall be done with *ad hoc* contracts whenever deemed necessary by TFR.
- 6.1.3 Mean time between failures for the system shall not be less than 24 months.

6.2 Environmental conditions

- 6.2.1 The HHD shall be used where the ambient temperature can be between -15 °C and 50 °C ± 1 °C.
- 6.2.2 The HHD may be transported non-operating, and stored at ambient temperatures between -40 °C and 70 °C ± 1 °C.

-
- 6.2.3 The HHD shall be operated at an altitude up to 2000 meters and may be transported non-operating in an aircraft flying up to 12 192 meters (40 000ft).
 - 6.2.4 The HHD may be transported operating, in an off-road vehicle with an ambient temperature between -15°C and $70^{\circ}\text{C} \pm 1^{\circ}\text{C}$ with heavy vibration (see par. 11.2.2.1.8).
 - 6.2.5 The HHD shall be used in environments where flammable liquids and gasses may be present (see par. 11.2.2.1.11).
 - 6.2.6 TFR transport flammable liquids and gasses in tanker wagons, such as:
 - 6.2.6.1 Petrol
 - 6.2.6.2 Diesel
 - 6.2.6.3 Low Pressure Gas (LPG)
 - 6.2.6.4 Propylene
 - 6.2.6.5 Butadiene
 - 6.2.6.6 Acrylonitrile
 - 6.2.6.7 Hexane
 - 6.2.6.8 Pentene
 - 6.2.6.9 Jet fuel
 - 6.2.6.10 Phosphoric acid (non-flammable, but reaction with metals may form explosive gasses)
 - 6.2.6.11 Caustic Soda (non-flammable, but reaction with metals may form explosive gasses)
 - 6.2.7 The HHD may be used in full sunshine, during night-time and in rain or snow. The display shall easily be readable and operated in these conditions.

6.3 Portability

- 6.3.1 The HHD shall be carried and operated with one hand.
- 6.3.2 The mass of the HHD shall not exceed $1\text{ kg} + 0.1\text{kg}$.
- 6.3.3 The HHD shall be supplied with a sling or shoulder strap.

6.4 Transportability

- 6.4.1 The Handheld RFID Tag Reader shall be transportable in an environment as specified in par. 6.2 "Environmental Conditions".

6.5 Fail-safety requirements

N/A

6.6 Flexibility and expansion

- 6.6.1 The HHD shall have modular hardware and software components for easy replacement and/or upgrades.
- 6.6.2 The software shall be developed to support plug-ins for future development.

-
- 6.6.3 The HHD shall receive HHD software upgrades from a back-office utilising a Mobile Device Management solution and run this latest software when the HHD is switched on again. This shall happen in the background and shall be transparent to the HHD user.
 - 6.6.4 The software and operating system shall support future developed 3rd party software and applications.

7 PERFORMANCE CHARACTERISTICS

7.1 General requirements

- 7.1.1 Modulo 11 checks shall be performed whenever wagon numbers are entered into the HHD, either by manual entering or by RFID scanning.
- 7.1.2 Only TFR wagons with owner code "00" or "TFR" shall be subjected to the modulo 11 check.
- 7.1.3 Locomotive numbers do not comply to Modulo 11 checks and shall therefore not be subjected to Modulo 11 verification.
- 7.1.4 The HHD shall resemble the same menu structure and design for the human-machine-interface that is used on the current Handheld RFID Tag Reader and TFR shall supply the successful bidder with the required design.
- 7.1.5 The HHD shall simulate and display the hardware push buttons on the current Handheld RFID Tag Reader.
- 7.1.6 Manual inputs on a touch screen shall only deviate from the current method if it is a new function and it shall not cause confusion when using either the old or the new HHD.
- 7.1.7 The HHD application software shall only allow that the correct data type is entered in the entry fields, e.g., wagon numbers only consist of numerals, therefore alpha characters or special characters shall not be allowed.
- 7.1.8 Alpha characters entered for locomotives shall automatically be converted to uppercase if entered in lowercase; special characters shall not be allowed.
- 7.1.9 The HHD user shall be forced to enter the relevant alpha characters used in the locomotives' numbers, for example D034001 and not 034001.
- 7.1.10 The HHD shall be supplied preloaded with a user with name "Administrator" and password "admin". The administrator shall be able to change the password.
- 7.1.11 The administrator shall have full access and authorisation on all functions of the HHD once logged on.
- 7.1.12 It shall be possible to reset the administrator password back to "admin". The supplier shall devise and supply the method.
- 7.1.13 The administrator shall be forced to change the administrator password when the HHD is switched on for the first time.
- 7.1.14 Only the administrator shall have access to the HHD's operating system and files.
- 7.1.15 All data that is downloaded shall be saved on the non-volatile memory.

-
- 7.1.16 Every menu or display shall have a button to allow the user to go to the previous menu with an option not saving any actions.
 - 7.1.17 The menus shall allow the user to move up and down between menu items with scroll buttons or touch screen action.
 - 7.1.18 It shall be possible to change or correct any input text while typing.
 - 7.1.19 The HHD shall display an applicable message when the user has to wait before the use of the HHD is possible, in any of the menus.
 - 7.1.20 The following shall be displayed on all menus - screens:
 - 7.1.20.1 The current battery state of charge
 - 7.1.20.2 The active telecommunication channel in use
 - 7.1.20.3 HHD software version
 - 7.1.20.4 The date and time
 - 7.1.20.5 The name of the logged-on username shall be displayed at the bottom of the screen.
 - 7.1.21 The various modules of the HHD shall only be activated when their functionality is needed, to conserve the battery charge, for example, the RFID tag scanner (RF circuitry) shall only switch on when tags are to be scanned.
 - 7.1.22 The times "00:00" and "24:00" shall not be used anywhere in the HHD application software. "00:01" shall be used instead when sending data or reporting to the back office (IATS).
 - 7.1.23 The HHD shall display comprehensive warning messages where and when applicable in all menus with audible alarms where applicable for example "Are you sure?" when an item is deleted or renamed.
 - 7.1.24 The error messages and warning messages shall be removed where applicable when the user acknowledges them.
 - 7.1.25 All generated HHD system error messages shall be sent to a HHD back office utilising a Mobile Device Management solution.
 - 7.1.26 The HHD shall be developed to conserve battery charge as far as possible.
 - 7.1.27 The HHD shall display a warning when the ambient temperature is 4 degrees Celsius away from the minimum or maximum operational ambient temperature.
 - 7.1.28 The HHD shall automatically power down when the minimum or maximum operational ambient temperature is exceeded with 0.5 ± 0.05 degrees Celsius.
 - 7.1.29 Scanned tags information shall be saved before the HHD powers down caused by out-of-bounds ambient temperatures.
 - 7.1.30 There shall be ample and comprehensive help files available to assist the user.
 - 7.1.31 The Handheld RFID Tag Reader shall run on an Android or Microsoft Windows operating system.
 - 7.1.32 Every menu shall have a "Help" icon which shall display help information relevant to the menu when selected.

-
- 7.1.33 The HHD shall send its GPS co-ordinates with its unique device identification and HHD serial number to the back-office every time it is switched on utilising a Mobile Device Management solution to keep track of the devices.
 - 7.1.34 All integration to existing TFR applications shall use a defined API as specified in BBH2729 version 1.

7.2 Initialise the HHD

- 7.2.1 The HHD shall display a logon menu to enter the administrator username and password if the HHD is not configured yet (see par 7.3). The configuration function shall then be invoked after a successful logon.
- 7.2.2 The HHD application shall initialise the HHD with configuration data when the HHD is powered up. Configuration data shall at least be:
 - 7.2.2.1 Unique device identification
 - 7.2.2.2 HHD serial number
 - 7.2.2.3 Network connection data necessary to connect to the Transnet WAN, e.g., IP address, Gateway etc.
 - 7.2.2.4 GSM parameters necessary to connect to the Transnet APN.
 - 7.2.2.5 Wi-Fi parameters Transnet WAN.
 - 7.2.2.6 Number of days that logged data shall be kept on the HHD.
 - 7.2.2.7 The telephone number for the Transnet Help Desk.
- 7.2.3 The HHD shall delete all obsolete train and vehicle data older than the configured period (in days).
- 7.2.4 Set the “short” sleep mode period (see par.7.3.6.10).
- 7.2.5 Set the “long” sleep mode period (see par. 7.3.6.11).
- 7.2.6 Set the shut-down period (see par.7.3.6.12).
- 7.2.7 Set the frequency of attempting to upload train consists.
- 7.2.8 Period for how long the HHD shall attempt to submit train consists.
- 7.2.9 The HHD shall delete all log files older than the configured period.
- 7.2.10 The HHD shall display a message that the initialisation process is busy.
- 7.2.11 The HHD shall switch off 5 minutes after the completion of the initialisation process and nobody has signed in.

7.3 Configure the HHD

- 7.3.1 The HHD shall provide a menu item in the main menu for the configuration of the HHD.
- 7.3.2 Access to the configuration menu shall only be allowed to HHD users with administrator rights.
- 7.3.3 It shall be possible to update the configuration of the HHD remotely with an API on the back office.

-
- 7.3.4 It shall be possible to enter default values into the HHD where applicable.
 - 7.3.5 The HHD user shall be able to use default values where applicable.
 - 7.3.6 The HHD shall be configured with at least the following:
 - 7.3.6.1 HHD users
 - 7.3.6.2 Unique Device Identification
 - 7.3.6.3 HHD serial number
 - 7.3.6.4 Network connection parameters necessary to connect to the TFR WAN, e.g., IP address, Gateway etc.
 - 7.3.6.5 Period (in days) that train and vehicle data is valid.
 - 7.3.6.6 Period (in days) that log data shall be kept on the HHD.
 - 7.3.6.7 The time for the HHD to time-out (in minutes) when tag comparison is not finished in "Program Mode".
 - 7.3.6.8 Telephone number for the Transnet Help Desk.
 - 7.3.6.9 The HHD shall delete all train and vehicle data older than the configured period.
 - 7.3.6.10 Period in minutes for the HHD to go into sleep mode if there are no inputs to the HHD, - short period.
 - 7.3.6.11 Period in minutes for the HHD to go into sleep mode if there are no inputs to the HHD, - long period. Only a value greater than the short period shall be allowed.
 - 7.3.6.12 Period in minutes when the HHD shall shut down completely when there are no inputs to the HHD. Only a value greater than the long period shall be allowed.
 - 7.3.6.13 Frequency (in minutes) for updating GPS position.
 - 7.3.6.14 Frequency (in hours) for updating the HHD system clock with data obtained from the GPS module.
 - 7.3.6.15 Frequency (in minutes) of attempting to upload train consists.
 - 7.3.6.16 Period (in minutes) for how long the HHD shall attempt to submit train consists. A failure message shall display after the last attempt.
 - 7.3.6.17 Wi-Fi APN.
 - 7.3.6.18 The radius in km to display the depots and yards on the HHD for selection using the HHD GPS position.
 - 7.3.6.19 Default values, for example vehicle owner codes (See Appendix B).

7.4 Obtain GPS co-ordinates

- 7.4.1 The HHD application shall obtain the GPS co-ordinates from the on-board GPS module with frequency as configured.

-
- 7.4.2 The HHD shall generate a system error message if it cannot obtain valid GPS co-ordinates from the on-board GPS module and send it to the back-office utilising a Mobile Device Management solution.
 - 7.4.3 The HHD shall consider GPS co-ordinates as “invalid” if no departing depots are displayed for selection in the configured area.

7.5 Determine availability of telecommunication channels

- 7.5.1 The HHD application shall attempt to connect to the following channels:
 - 7.5.1.1 Ethernet
 - 7.5.1.2 TFR Wi-Fi
 - 7.5.1.3 GSM
- 7.5.2 The priority of telecommunication channels is:
 - 7.5.2.1 1) Ethernet, 2) TFR Wi-Fi, 3) GSM

7.6 Connect to telecommunication channel

- 7.6.1 The HHD application shall connect to the highest priority channel that is available.
- 7.6.2 The HHD shall switch seamlessly between channels without user intervention.
- 7.6.3 The HHD shall generate and display a message if the HHD could not connect to any telecommunication channel.
- 7.6.4 The HHD shall display the availability of a GSM channel and the signal strength.
- 7.6.5 The HHD shall display the availability of a Wi-Fi channel and the signal strength.

7.7 Synchronise the date and time

- 7.7.1 The HHD application shall periodically update the HHD system clock with data from the GPS module with the configured period.

7.8 Send GPS co-ordinates

- 7.8.1 The HHD shall send its GPS co-ordinates to the back-office utilising a Mobile Device Management solution every time the HHD is switched on and again when powered down.

7.9 Download Software Upgrades

- 7.9.1 The HHD shall download the latest application software (if applicable) in the background utilising a Mobile Device Management solution when it is switched on and made a connection with the back-office.
- 7.9.2 The HHD shall be able to manage a break in the download process i.e. a communications break or power failure.
- 7.9.3 The application software download shall happen in the background and shall not influence the normal operations of the HHD adversely.
- 7.9.4 The application software shall run this latest software when the HHD is switched on again.

7.10 Manage battery charge

- 7.10.1 An alarm shall be displayed and an audible alarm shall be generated when the battery charge reaches 10 % of its capacity.
- 7.10.2 The HHD shall not allow the user to use the software modules that make use of RF functions when the battery charge is too low.
- 7.10.3 The HHD shall save all data and shut down without adverse effect when the battery charge is too low for further use.

7.11 Maintain Memory

- 7.11.1 The HHD shall delete all data after a 24 hour rolling window period.
- 7.11.2 The HHD shall delete all data that becomes obsolete as configured.
- 7.11.3 The HHD shall make an audible alarm and display a warning if 80% of the storage memory capacity is reached.
- 7.11.4 The quality of service of the HHD shall not decrease if the storage memory is still below 90% of the storage memory capacity.

7.12 Log Activities

- 7.12.1 The HHD shall log and save all activities, usernames, messages, error messages with the date & time.

7.13 Send Logs

- 7.13.1 The logs shall be sent to a back-office utilising a Mobile Device Management solution.

7.14 Check System Health

- 7.14.1 The HHD application shall check all the hardware and software modules of the HHD periodically as configured.
- 7.14.2 The HHD application shall alert the user when the internal non-volatile memory is reaching 90% of its capacity.
- 7.14.3 All checks shall be saved in a log file.
- 7.14.4 System check results shall not be displayed to the HHD user, these results shall be available in the diagnostics menu.

7.15 Send health-check results to back-office

- 7.15.1 The system health checks shall be sent to the back office periodically as configured utilising a Mobile Device Management solution.

7.16 Shut Down

- 7.16.1 The HHD shall shut down if there is no user input for the configured period (see par. 7.3.6.12).
- 7.16.2 The HHD shall shut down if there is no user input for the configured period (see par. 7.3.6.12) after the user select the "Log off" option in the main menu.

7.17 Log on

See Figure 2 in Appendix A

- 7.17.1 The HHD shall display the Log On menu.
- 7.17.2 The user shall enter a valid SAP no. and a password in the relevant entry fields.
- 7.17.3 A valid user shall be registered on the User Authentication and Profile Application (UAPA) and configured on the HHD.
- 7.17.4 Generate message if the system is busy and the user has to wait and display the message.
- 7.17.5 Validate the SAP no. and password with a defined API (DoUserSignOn).
- 7.17.6 The user shall be authenticated with Transnet Freight Rail's authentication process set out in BBH2729 version 1 "Handheld RFID Tag Reader System Integration Service Definitions".
- 7.17.7 Generate and display an error message if the logon particulars are wrong.
- 7.17.8 Display message and allow the user to attempt a new logon.
- 7.17.9 Log all inputs and messages.
- 7.17.10 Generate and display a message that shall allow a user to continue when a connection to the Webservice could not be established.
- 7.17.11 The username shall be displayed in red if logging on was unsuccessful.
- 7.17.12 The username shall be displayed in black or green when logging on was successful.
- 7.17.13 The user shall be able to use the HHD even if the user could not log on to the HHD, but the user has to be successfully verified later before submitting of train data to the back-office can take place.
- 7.17.14 The Log On menu shall display the following message at the bottom "For assistance please call the Help Desk <telephone number as per configuration>".

7.18 Display main menu for TFR Users

- 7.18.1 The main menu shall be displayed after logon.
- 7.18.2 Menu items shall only be displayed if they are relevant to the user type.
- 7.18.3 The following items shall be displayed for selection:
 - 7.18.3.1 Train Consist
 - 7.18.3.2 Delete Train Number
 - 7.18.3.3 Rename Train Number
 - 7.18.3.4 Program Tag
 - 7.18.3.5 Configure HHD (Display only for administrators)
 - 7.18.3.6 Diagnostics (Display only for administrators)
 - 7.18.3.7 Log off
- 7.18.4 The user shall be able to scroll between the item options.

- 7.18.5 Applicable messages shall be displayed.
- 7.18.6 "Program Tag" shall only be displayed if the programming license software is loaded on the HHD.

7.19 Display main menu for TE Users

- 7.19.1 The main menu shall be displayed after logon.
- 7.19.2 Menu items shall only be displayed if they are relevant to the user type.
- 7.19.3 The following items shall be displayed for selection:
 - 7.19.3.1 Program Tag
 - 7.19.3.2 Configure HHD (Display only for administrators)
 - 7.19.3.3 Diagnostics (Display only for administrators)
 - 7.19.3.4 Log off
- 7.19.4 The user shall be able to scroll between the item options.
- 7.19.5 Applicable messages shall be displayed.
- 7.19.6 "Program Tag" shall only be displayed if the programming license software is loaded on the HHD.

7.20 Add User

- 7.20.1 Users shall be added to the HHD with the following methods:
 - 7.20.1.1 Download the user list from the back-office.
 - 7.20.1.1.1 The HHD shall automatically synchronise the user list from the back-office with the HHD list every time the HHD is switched on.
 - 7.20.1.1.2 New users shall be added by authorised personnel connected and logged on to the back office.
 - 7.20.1.1.3 Administrator users shall be able to refresh the table on the HHD by downloading the user list from the back-office.
 - 7.20.1.1.4 Users on the HHD that are not on the downloaded list shall be deleted from the HHD.
 - 7.20.1.2 Manual entry with the HHD keypad
 - 7.20.1.2.1 The HHD shall provide a menu item in the configuration function that shall allow administrators to add, delete or edit users in the local user list.
- 7.20.2 There shall be the following types of users:
 - 7.20.2.1 Factory loaded administrator user (cannot be deleted)
 - 7.20.2.2 Added Administrator user
 - 7.20.2.3 Scan Only user
 - 7.20.2.4 Scan and Program user

7.21 Enter sleep mode

- 7.21.1 The HHD shall have two sleep mode, “short” and “long” to conserve power.
- 7.21.2 The HHD shall enter the sleep mode when there were no entry actions for the configured time.
- 7.21.3 The telecommunication channels shall be deactivated.
- 7.21.4 All the modules that will not be used during sleep mode shall be switched of or put in their sleep modes if available.
- 7.21.5 The HHD shall go into sleep mode in such a manner that it can exit sleep mode without initialisation.

7.22 Exit sleep mode

- 7.22.1 The HHD shall become active when a defined push button on the HHD is pressed or when tapping the touch screen three times in quick succession.
- 7.22.2 The user shall tap the touch screen three times in quick succession to activate the HHD if the HHD does not have push buttons.
- 7.22.3 The intervals of the three taps shall be of such duration that it shall prevent accidental activation of the HHD.
- 7.22.4 All the hardware and software modules shall be activated that were active before sleep mode, when the HHD exits sleep mode.
- 7.22.5 The HHD shall attempt to connect to the available telecommunication channels.
- 7.22.6 The HHD shall use the saved tables and lists on the device and shall not do the whole start-up sequence.
- 7.22.7 The last active screen shall display if the HHD is activated within the configured time for the “short” sleep mode.
- 7.22.8 The log on screen shall be displayed when the HHD exits the sleep mode when the “long” sleep mode was entered.
- 7.22.9 The user has to enter the username and password to carry on using the HHD after the “long” period.
- 7.22.10 The HHD shall shut down completely when the configured time is reached where no inputs were detected.

7.23 Program RFID Tags

- 7.23.1 Only authorised users shall have access to the programming function.
- 7.23.2 Authorised usernames shall be available in a table on the back-office.
- 7.23.3 Tag information and format shall be conforming to the latest version of BBD6353 “Radio Frequency Identification Tag programming and Installation on Transnet Freight Rail Vehicles”.
- 7.23.4 The following entry fields shall be displayed:
 - 7.23.4.1 Vehicle Number (e.g., 63512345 for Wagons or D034123 for locomotives)

-
- 7.23.4.2 Owner Code (both the numerical code as well as the alpha code, i.e., "00" and "TFR").
 - 7.23.4.3 Orientation Field (e.g., 1); only "1" and "2" shall be allowed.
 - 7.23.4.4 Vehicle Type (e.g., CCR11)
 - 7.23.5 The user shall enter the desired data into the entry fields with the capability to edit all data.
 - 7.23.6 Lower case characters entered shall automatically be converted to uppercase characters.
 - 7.23.7 Verify the manually entered wagon numbers by applying the Modulo 11 check to validate the entered wagon numbers.
 - 7.23.8 The HHD shall generate an audible alarm if the entered vehicle number is incorrect.
 - 7.23.9 The HHD shall display an error message indicating that the entered vehicle number is incorrect.
 - 7.23.10 The HHD operator shall aim and program the RFID tag on a particular vehicle with the selected vehicle number.
 - 7.23.11 The HHD shall display a success message indicating that the RFID tag is successfully programmed.
 - 7.23.12 The HHD shall generate an audible alarm if successful programming of RFID tags cannot be accomplished.
 - 7.23.13 The HHD shall display an error message indicating that successful programming of RFID tags could not be accomplished.
 - 7.23.14 There shall be a menu item "Compare Tags" to test if the two tags on a vehicle correspond.
 - 7.23.15 The user shall scan the first tag on one side of the vehicle, walk around and scan the second tag on the other side of the vehicle.
 - 7.23.16 The information on both tags has to be identical except for the orientation, the one side a "1" and the other side a "2".
 - 7.23.17 The HHD shall inform the user whether the two tags on a vehicle are identical (apart from the orientation which has to be different) or not.
 - 7.23.18 The HHD shall time out as configured and go into sleep mode if the user fails to scan the second tag within the configured time.
 - 7.23.19 The user shall exit the programming mode when done.

7.24 Display Diagnostics

- 7.24.1 The HHD shall display a diagnostics screen to authorised users.
- 7.24.2 The following parameters at minimum shall be shown:
 - 7.24.2.1 HHD software version
 - 7.24.2.2 Ambient temperature
 - 7.24.2.3 Available disk space

- 7.24.2.4 GPS co-ordinates
- 7.24.2.5 HHD self-check results
- 7.24.2.6 Unique device ID
- 7.24.2.7 HHD serial number
- 7.24.2.8 Available telecommunications channels with signal strength

7.25 Reboot the system

- 7.25.1 It shall be possible to reboot the system by pressing a contractor defined pattern of buttons.
- 7.25.2 A method shall be provided to reboot the system if the touch screen is unresponsive and the HHD does not have push buttons.

7.26 Log off

- 7.26.1 The user shall use a push button or screen icon on the Log On menu to log off.
- 7.26.2 The user shall log off when finished using the HHD.
- 7.26.3 The back-office shall be notified of this action using a defined API (DoUserSignOff).
- 7.26.4 The “Logon” menu shall display once the logging off process is completed.
- 7.26.5 The user shall automatically be logged-off when the HHD enters the “long” sleep mode”.

7.27 External Interface Functions

- 7.27.1 Back Office
 - 7.27.1.1 The back-office database contains all the wagon lists, authentication lists and train lists.
 - 7.27.1.2 The HHD shall be able to communicate to the back-office to retrieve these lists.
 - 7.27.1.3 The HHD shall also send condition data to the back-office utilising the Mobile Device Management solution to ensure proper working of each unit.
- 7.27.2 Remote Log-In and Updating
 - 7.27.2.1 The HHD shall be able to be remotely updated via a Mobile Device Management solution.
 - 7.27.2.2 The tenderer shall recommend a Mobile Device Management solution.
 - 7.27.2.3 Remote log-in shall be possible for error checking and updating.
 - 7.27.2.4 The HHD’s current GPS co-ordinates shall be updated on the back office on a daily basis if the HHD is not switched off.

7.28 Compile Train Consist

See Figure 3 in Appendix A.

- 7.28.1 The "Select Depot" menu shall display.
(Note: It shall be mandatory for the user to choose a depot).
- 7.28.2 The desired depot shall be selected – see par 7.30.
- 7.28.3 The "Select Train Number" menu shall display once a depot is selected.
- 7.28.4 The desired train number shall be selected – see par 7.31.
- 7.28.5 The same train number can be used to continue scanning wagons on existing train, change or to delete wagons.
- 7.28.6 A warning shall be displayed on the device to warn that the same train number has already been used if a user wants to use the same train number again (to scan wagons).
- 7.28.7 The HHD shall now automatically switch on the RFID tag scanner module.
- 7.28.8 The vehicles of the train shall now be entered into the HHD by scanning the vehicle RFID tags or by entering the vehicle numbers manually when a tag cannot be scanned.
- 7.28.9 The user shall start scanning the train, walking from front-to-back, or back-to-front.
- 7.28.10 The vehicle numbers shall be sequentially numbered as they are entered.
- 7.28.11 A counter shall be displayed on the screen to display the number of scanned vehicles and the total when the entire train has been scanned.
- 7.28.12 The HHD shall compile a train list with the vehicle numbers.
- 7.28.13 A scanned vehicle shall at any time be able to be deleted from the consist list or moved around in the consist list.
- 7.28.14 It shall be possible to manually add vehicle numbers to the consist list.
- 7.28.15 The sequence numbers shall be changed when a vehicle number is inserted or deleted.
- 7.28.16 The user shall be able to reverse the sequence of wagons so that the wagon that has been scanned last is listed as the first wagon if the user scanned the tags from the back of the train to the front of the train.
- 7.28.17 The sequence number shall be changed if a vehicle number is moved up or down in the list.
- 7.28.18 It shall be possible to build a train consists with locomotives if the locomotives are already coupled to the train at the time when the train consist is scanned, or without locomotives.
- 7.28.19 It shall be possible to change the train number for the scanned list - (Rename Train Number).
- 7.28.20 The user shall be able to delete train lists on the HHD (Delete Train Number).
- 7.28.21 The scanned vehicle list shall be saved on the HHD.
- 7.28.22 All faulty tags shall be logged.

-
- 7.28.23 The HHD shall send the train consist to the back office (e.g., IATS) when the user is satisfied with the list and selected the relevant button or icon.

7.29 Download tables and lists

- 7.29.1 The following data shall be retrieved by calling services provided by a defined API:
- 7.29.1.1 Wagon table (GetWagonList)
 - 7.29.1.2 Location table (GetLocationList)
 - 7.29.1.3 Locomotive table (GetLocoList)
 - 7.29.1.4 Integrated Train Plan (ITP) (GetSwitchedOnTrainList)
 - 7.29.1.5 List of valid wagon owners (GetOwnerList)
 - 7.29.1.6 List of HHD users (GetUserList)
- 7.29.2 The tables and lists shall be saved on the non-volatile memory of the HHD.
- 7.29.3 The ITP shall be downloaded every time the HHD is switch on and when the HHD connects to the back office.
- 7.29.4 The ITP shall be downloaded every time the user requests an updated ITP.
- 7.29.5 Updated lookup tables on the back-office shall be downloaded to the HHD utilising a defied API when powered on e.g.:
- 7.29.5.1 Wagon table
 - 7.29.5.2 Location table
 - 7.29.5.3 Locomotive table
 - 7.29.5.4 Owner table
 - 7.29.5.5 User table

Note: Tables are dynamic as new data can be added.

7.30 Select Depot

- 7.30.1 A "Depot" includes yards, sidings, or any place, which is identified by TFR where a train can depart.
- 7.30.2 The HHD shall display the depots in a radius of as configured kilometres if the GPS module can determine the position of the HHD.
- 7.30.3 The menu shall allow that a depot name can be typed in manually if GPS co-ordinates cannot be obtained or if the applicable depot is not shown.
- 7.30.4 A list of possible depots shall be shown alphabetically for selection when typing the first characters of a desired depot.
- 7.30.5 Once a depot name has been selected or inserted, it shall be verified against the downloaded and saved location table.

7.31 Select Train Number

- 7.31.1 The train number shall be selected from the list that is displayed after a valid depot is selected.

-
- 7.31.2 Only train numbers of trains that are scheduled to depart from the selected depot shall be shown (switched-on trains).
 - 7.31.3 Display all train numbers in a rolling window of 24 hours. Display only trains that should have departed in the last 12 hours, as well as trains that are scheduled for the next 12 hours. Adhere to this 24 hour window at any time during the 24 hour day.
 - 7.31.4 The User shall have the option to refresh the train number list from the back office if the desired train number is not in the HHD train number list.
 - 7.31.5 A train number consists of the following: (16 Characters)
 - 7.31.5.1 1st two characters - Forwarding location
 - 7.31.5.2 2nd two characters - Train (next) destination location
 - 7.31.5.3 3rd two characters - Via code/reschedule
 - 7.31.5.4 Next 4 characters - Train number
 - 7.31.5.5 Next two characters - Date (dd)
 - 7.31.5.6 Next two characters - Month (mm)
 - 7.31.5.7 Next two characters - Year (yy)
 - 7.31.5.8 E.g. K7TG 003456 24 07 20
 - 7.31.5.9 In this example the train, no.3456, will run from Kazerne (K7) to Sentrand (TG) on the 24th of July 2020.
 - 7.31.6 A train number shall be entered manually if the desired train number is not in the displayed list.
 - 7.31.7 The manual train number shall conform to the rules for TFR train numbers.
 - 7.31.8 Train numbers shall be verified against the downloaded Integrated Train Plan.
 - 7.31.9 A warning shall be displayed if the train number cannot be verified.
 - 7.31.10 The user shall have the option to accept an unverified train number when the Integrated Train Plan is not available for verification.
 - 7.31.11 Verification shall be done before the data is uploaded when the Integrated Train Plan becomes available.
 - 7.31.12 This action shall be logged with the username.

7.32 Scan vehicle tags

See Appendix A

- 7.32.1 The user shall confirm that the “scanning” icon is displayed when selecting “Train Consist” from the main menu.
- 7.32.2 The user shall activate the scanner with the defined button if the scanning icon is not displayed.
- 7.32.3 The user shall stand right in front of the RFID tag and point to the RFID tag to bring the HHD within 1 meter of the RFID tag.

-
- 7.32.4 The HHD shall beep if a tag is scanned successfully.
 - 7.32.5 A vehicle number shall only be registered once, regardless of how many times the same number is detected by the RF module.
 - 7.32.6 The vehicle number shall be verified with either the wagon list or locomotive list whichever is relevant.
 - 7.32.7 The HHD shall set the vehicle type automatically to “wagon”.
 - 7.32.8 The HHD shall set the vehicle type to “Locomotive” when a locomotive tag is detected when scanned.
 - 7.32.9 The user shall have the option to change the vehicle type to “locomotive” or “wagon” when a vehicle tag is scanned or entered.
 - 7.32.10 The user shall have the option to enter any of “other/undefined/invalid/unknown” if the scanned vehicle is not clearly a wagon or locomotive (for example a rail maintenance vehicle).
 - 7.32.11 The HHD shall obtain the alpha owner code from the stored owner code table and the alpha owner codes of the vehicle shall be displayed (See Appendix B).
 - 7.32.12 The default numerical owner code shall be “00” for manual input.
 - 7.32.13 The user shall have the option to enter or change the alpha owner code of the vehicle on the HHD.
 - 7.32.14 The alpha owner codes shall be verified against the owner list table (See Appendix B).
 - 7.32.15 The user shall have the option to accept, reject or change a vehicle number or owner name if the HHD reports it as “invalid”.
 - 7.32.16 The vehicle number shall be shown on the screen.
 - 7.32.17 The user shall enter the stencilled vehicle number into the HHD in the entry field if the RFID tag cannot be scanned or does not correspond to the stencilled vehicle number.
 - 7.32.18 The wagon number shall be padded with leading zeros to create an eight-digit number when the scanned or manually entered wagon number of a foreign wagon (non-TFR) is less than eight digits.
 - 7.32.19 Each scanned tag number shall be saved in the non-volatile memory immediately after being scanned.
 - 7.32.20 All changes done to the scanned number shall be updated to the stored vehicle number.
 - 7.32.21 There is not an upper limit set for the number of vehicles that can be scanned per train but provision shall be made for at least 500 vehicles.
 - 7.32.22 A “faulty” tag is defined as “no scan response”, missing or incorrect information or non-programmed.
 - 7.32.23 All faulty tags shall be logged with the manually entered vehicle number. See Figure 6 in Appendix A.
 - 7.32.24 All faulty tags shall be sent to the back office utilising a defined API.

7.33 Enter unscheduled trains

- 7.33.1 The user shall be able to scan unscheduled trains (Train that are not “switched on” on the Integrated Train Plan).
- 7.33.2 The unscheduled trains shall be saved on the HHD.
- 7.33.3 The user shall be able to retrieve the saved unscheduled trains form the “Train Consist” menu.
- 7.33.4 The user shall enter a train number according to the train number rules.
- 7.33.5 The user shall be able to edit or delete a selected unscheduled train.

7.34 Delete Train Number

See Figure 5 in Appendix A

- 7.34.1 It shall be possible to delete a train consist if the wrong train was scanned or the train has been cancelled.
- 7.34.2 The “Select Depot” menu shall display.
- 7.34.3 The desired depot shall be selected – see par 7.30.
- 7.34.4 The “Select Train Number” menu shall display once a depot is selected.
- 7.34.5 The desired train number of the train consist to be deleted shall be selected from the displaying list – see par 7.31.
- 7.34.6 The train consist of this train shall now be deleted when the user selects the confirmation button or icon.

7.35 Rename Train Number

See figure 4 in Appendix A.

- 7.35.1 It shall be possible to rename the train number of a train consist if the correct train was scanned but the wrong train number was used.
- 7.35.2 The “Select Depot” menu shall display.
- 7.35.3 The desired depot shall be selected – see par 7.30.
- 7.35.4 The “Select Train Number” menu shall display once a depot is selected.
- 7.35.5 The desired train number shall be selected – see par 7.31.
- 7.35.6 The train number of this train shall now be renamed when the user type or select the correct train number and select the confirmation button or icon.
- 7.35.7 A message shall confirm that the train number was successfully renamed (displaying and indicating both the wrong and correct number).

7.36 Send Train Consists

- 7.36.1 The user shall only send train consists with valid train numbers to the back-office database.
- 7.36.2 The user shall download the latest ITP if the required train number is not in the current list on the HHD.
- 7.36.3 The user shall be able to type in a valid train number if it is not in the ITP.

-
- 7.36.4 The train consist shall be send by using a defined API as specified in BBH2729 version 1 par 5.12.
 - 7.36.5 The HHD shall display a message to the HHD user if an active telecommunications channel is not available when the user attempts to send the train consist to the back-office. This message shall state that the HHD shall keep on trying to submit the data.
 - 7.36.6 The HHD shall continuously attempt (in the background) to submit the train consist with intervals as configured and for the period as configured.
 - 7.36.7 The HHD shall be able to be connected to an Ethernet network and if correctly configured, upload the data to the back-office.
 - 7.36.8 The HHD shall display a failure message if it could not submit the train consist within the configured time.

Transnet Engineering Requirements

Transnet Engineering (TE) uses a Handheld RFID Tag Reader to verify that the stencilled vehicle number and the RFID tag vehicle numbers on either side of a vehicle corresponds and that the other fields on the RFID tag are correctly programmed. The HHD is used to rectify any errors and to program new blank RFID tags.

The decision was made that only one type HHD shall be used in Transnet to save costs and to eliminate probable confusion between different types of RFID tag readers used in Transnet.

The following requirements shall be provided for when the HHD is used in the TE Mode:

7.37 Switch off Telecommunication channels

- 7.37.1 The HHD activates all available telecommunication channels when it is switched on to send the GPS position of the HHD to the back-office.
- 7.37.2 The TE Main Menu shall be displayed with menu items in the following order:
 - 7.37.2.1 Program
 - 7.37.2.1.1 The program process shall be as specified in par.7.23 "Program RFID Tags".
 - 7.37.2.1.2 The only owner code available for programming shall be "00" (zero zero).
 - 7.37.2.1.3 The only orientation value shall be "1" or "2".
 - 7.37.2.2 Scan Vehicle Tags– see par. 7.32
 - 7.37.2.3 Configure the HHD – see par. 7.3
 - 7.37.2.4 Diagnostics – see par. 7.14
 - 7.37.2.5 Log off – see par. 7.26

8 **PHYSICAL CHARACTERISTICS**

8.1 **Handheld RFID Tag Reader Physical Characteristics**

- 8.1.1 The Handheld RFID Tag Reader's mass shall not exceed 1kg \pm 10%. This includes batteries and all attachments.
- 8.1.2 The Handheld RFID Tag Reader shall be capable of single-handed operation.
 - 8.1.2.1 Single handed size defined as within +10% tolerance.
 - 8.1.2.1.1 Length - 200mm
 - 8.1.2.1.2 Width - 100mm
 - 8.1.2.1.3 Height - 50mm
- 8.1.3 It shall be possible to use the HHD in wet conditions, i.e. rainy conditions.
- 8.1.4 The display shall repel water drops to ensure that the user shall be able to read the information on the display.
- 8.1.5 The screen of the HHD shall be fitted with an appropriate screen protector film that shall not diminishes the functionalities for the screen.
- 8.1.6 The Handheld RFID Tag Reader shall comply with IEC standard 60529 IP67 rating.
- 8.1.7 The back lighting of the screen shall be adjustable.
- 8.1.8 It shall be possible to operate the touch screen whilst the user is wearing protective gloves.
- 8.1.9 A stylus that shall be fixed to the HHD with an appropriate coiled cord may be supplied if the touch screen cannot be operated with any type or protective glove.
- 8.1.10 The HHD shall comply with the relevant parts of SANS 60079-0 "Explosive atmospheres".
- 8.1.11 An active operational HHD shall be able to withstand a drop from 1.2m onto a concrete floor, rail ballast stones or soil without any physical or functional adverse effect to the HHD and the screen protector.
- 8.1.12 The HHD shall be drop validated against MIL-STD-810G Method 516.7 Procedure IV.
- 8.1.13 The HHD shall be validated against MIL-STD-810G Method 507.6 for humidity compliance.
- 8.1.14 The HHD shall be validated against MIL-STD-810G Method 514.7 Procedure I Category 24 for heavy vibration.
- 8.1.15 The HHD shall be developed such that a damaged screen can be replaced quickly and cost effectively without compromising the ingress protection of the device.

8.2 **HHD Storage Requirements**

- 8.2.1 A suitable wall mount lockable steel cabinet shall be supplied (at least two sets of keys shall be supplied).
- 8.2.2 The appropriate mounting bolts and quantity shall be supplied.
- 8.2.3 The cabinet shall make provision to store and charge the HHD when locked.

-
- 8.2.4 There shall be adequate ventilation to prevent the charger and HHD from overheating.
 - 8.2.5 The cabinet shall make provision for the storage of the HHD charger and spare batteries (if applicable), and any other HHD supplied accessories.

8.3 Radio Telecommunication Modules

- 8.3.1 The HHD with all the installed radio telecommunication modules and elements, shall be ICASA approved.
- 8.3.2 The RFID module shall be able to read and program TransCore AT5118 tags.
- 8.3.3 The TransCore AT5118 tag specification is defined in document: BBC1628 version 3.
- 8.3.4 The RFID module shall have a read and program range of at least 200mm and 1000mm for TransCore tags.
- 8.3.5 Tag reading duration shall not be longer than 1 second with a +10% tolerance.

8.4 Wi-Fi Module

- 8.4.1 The HHD shall comply with specification IEEE802.11 g/n.
- 8.4.2 The HHD shall comply with all Transnet connections protocols. Specifications shall be supplied to the successful tenderer.

8.5 Cellular GSM Module

- 8.5.1 The cellular GSM module shall connect to the different technologies supplied by the service providers in South Africa.
- 8.5.2 The cellular GSM module may offer the option of either a SIM card, eSIM or both.
- 8.5.3 The cellular GSM module shall be able to connect to all TFR cellular access point name (APNs).
- 8.5.4 A cellular GSM connection shall only be used if Wi-Fi connection is unavailable.
- 8.5.5 Authentication of wagons shall not take longer than 3 seconds.
- 8.5.6 It shall not be possible to remove any SIM card without specialised tools.
- 8.5.7 It shall comply with all Transnet connections protocols.

8.6 GPS Module

- 8.6.1 The GPS module shall be able to accurately determine at which depot the HHD unit is.
- 8.6.2 If there is more than one depot in close proximity to the GPS coordinates a list of possible choices shall be given for the user to choose from.
- 8.6.3 The GPS module shall be accurate within 10 meters.

8.7 Human Machine Interface

- 8.7.1 The human machine interface shall consist of at least a touch screen.

-
- 8.7.2 The touch screen shall be supplied with a rugged screen protector that shall not interfere with the touch screen functionality when the user is wearing any type of protective gloves or if a stylus is being used.
 - 8.7.3 The touch screen shall make provision to ensure functionality as set out in paragraph 7.
 - 8.7.4 The screen format will be as set out in the various requirements in paragraph 7.
 - 8.7.5 The successful tenderer shall discuss the screen layout, menu structure and functional icons with the project manager and other appointed TFR personnel before development.

8.8 Memory Storage Module

- 8.8.1 The on-board storage module shall have at least 64GB of storage space.
- 8.8.2 The storage module shall be able to save text-based logs.
- 8.8.3 It shall not be possible to remove any memory cards without using specialised tools.
- 8.8.4 The storage module shall be a non-volatile solid-state drive.

8.9 Battery Module

The battery module in this paragraph includes all the cells that are used as battery for the HHD.

- 8.9.1 When fully charged the battery shall last long enough to enable the HHD to be fully functional without any degradation in quality and speed and be able to scan at least 700 tags.
- 8.9.2 The battery shall be fully charged in less than 3 hours regardless the current charge of the battery.
- 8.9.3 The standby time for the batteries to comply with par. 8.9.1 and shall be a minimum of 24 hours.
- 8.9.4 The batteries shall be of a lightweight type and shall allow for at least 3000 charge cycles.

8.10 Battery Charger

- 8.10.1 The HHD shall be supplied with a suitable battery charger that can be connected to 220 – 240V 50Hz mains.
- 8.10.2 Protection for high voltage surges shall be provided.
- 8.10.3 The power connector of the HHD shall be IP67 compliant.
- 8.10.4 The battery charger shall be installed in a secured enclosure to prevent theft of the battery charger.
- 8.10.5 The secured enclosure shall provide a means to lock it to prevent theft, for example with a security cable or anchor bolts.
- 8.10.6 The mains cable as well as the charge cable to the HHD shall be secured inside the enclosure to prevent theft.

9 **GENERAL REQUIREMENTS**

9.1 **Design and construction**

9.1.1 Materials processes and parts

9.1.1.1 All materials used in the system shall comply with the environmental and physical requirements of the HHD.

9.1.1.2 Materials used shall be SABS approved where applicable.

9.1.2 Reliability

9.1.2.1 Mean time between failures for any electronic sub-system shall not be less than 24 months. The contractor shall provide data, which proves these figures.

9.1.2.2 Mean time to replace a faulty module shall be less than 30 minutes (actual working time only).

9.1.3 Workmanship

9.1.3.1 All development and manufacturing shall be done against the standards governing the relevant areas of development and manufacturing.

9.1.4 Safety

9.1.4.1 It shall be safe to use the Handheld RFID Tag Reader and charger in an environment where flammable liquids and gasses could be present.

9.2 **Documentation**

9.2.1 The system and its components shall be fully documented in English.

9.2.2 A comprehensive user operating manual shall be supplied.

9.2.3 The technical documentation shall contain all the relevant information of the interfaces to the system.

9.2.4 The documentation shall include a full description of the hardware, protocols and message contents used on all interfaces.

9.2.5 The documentation shall be adequate to enable the technical staff of Transnet Freight Rail to be able to interface with the HHD for future upgrades and integration.

9.2.6 All documentation and software shall be delivered in hardcopies as well as on a memory device to TFR.

9.2.7 All documentation delivered to TFR shall be rectified, expanded or completed to the satisfaction of TFR within 30 days after delivery of these documents.

9.2.8 A functional product specification derived from the functionality in this specification as well as the allocation of the functions to the sub-systems shall be supplied to Transnet Freight Rail. All future functional changes shall be captured in this product specification before being implemented.

-
- 9.2.9 All hardware components (GPS, RFID tag reader etc.) shall have APIs to enable in house development of extra functions.
 - 9.2.10 All APIs shall be documented and supplied.
 - 9.2.11 All printed manuals shall be delivered in high quality plastic covered 4 ring binders.

9.3 Software

- 9.3.1 Software shall be developed by applying best practices principles. All software developed from this specification shall become the intellectual property of TFR.
- 9.3.2 The source code of all software shall be supplied to TFR on a USB flash drive.
- 9.3.3 All preloaded commercial software that is not needed for the functionality of the HHD shall be disabled, for example Gmail.
- 9.3.4 The HHD end-user shall never be able to use the HHD for any other applications than for the purpose as supplied to the HHD user.

9.4 Logistics

9.4.1 Maintenance

- 9.4.1.1 Support and maintenance of the devices are required for the life expectancy of the device.
- 9.4.1.2 MTBF of the devices shall be comparable to that of ground radio equipment which is 9000 hours. Higher failure rates during the warranty period shall be regarded as inherent defects and managed contractually.

9.4.2 Supply

- 9.4.2.1 The supplier shall guarantee continued local availability of all components of the system, as well as frequently used spares of the components, for a contractually specified period of at least 10 years.
- 9.4.2.2 The supplier shall guarantee delivery of replacement components or spares for faulty items within 1 week of placement of the order.
- 9.4.2.3 Components that are critical to the functioning of the system shall be available immediately.
- 9.4.2.4 A comprehensive "recovery" procedure shall be set in place to enable Transnet Freight Rail Technicians to reinstall software on faulty HHD's.

9.4.3 Facilities and equipment Not Applicable

9.5 Personnel and training

9.5.1 Personnel

- 9.5.1.1 First line users will consist of "Yard personnel".
- 9.5.1.2 Highly skilled electronics technicians/technologists/engineers shall be second line maintainers and do basic maintenance.

-
- 9.5.1.3 The supplier of the Handheld RFID Tag Reader shall be the third line maintainers of the system.
 - 9.5.2 Training
 - 9.5.2.1 The supplier shall provide theoretical and practical training in all aspects of operation to the system's first line users.
 - 9.5.2.2 This training shall not exceed one week.
 - 9.5.2.3 The supplier shall provide extensive theoretical and hands-on training covering the entire system to a group of technicians, technologists, and engineers.
 - 9.5.2.4 This training shall not exceed one week.
 - 9.5.2.5 The supplier shall submit all course material and syllabus for approval by Transnet Freight Rail prior to training taking place.

10 CONDITIONS

Not Applicable.

11 QUALITY ASSURANCE

11.1 Responsibility for tests

- 11.1.1 The contractors shall be responsible for the execution of the tests.
- 11.1.2 The responsibility for proving the test results shall reside with the contractor.
- 11.1.3 The contractor shall document the tests and supply test results in full.
- 11.1.4 All tests shall be observed and signed-off by the duly appointed representative of Transnet Freight Rail.
- 11.1.5 Any tests requiring the use of rolling stock shall be arranged by Transnet Freight Rail given sufficient notice by the contractor.

11.2 Tests and examinations

- 11.2.1 Functional tests
 - 11.2.1.1 The tests shall be executed to test the functionality of the system using a holistic approach.
 - 11.2.1.2 The tests shall trace the flow of information to and from the various subsystems to ensure the correctness of information throughout the system.
 - 11.2.1.3 The tests shall firstly verify correct operation under normal conditions. The tests shall then be repeated using data with known fault content to verify the operation under fault conditions.
 - 11.2.1.4 The test procedure shall be documented by the contractor in an ACCEPTANCE TEST PROCEDURE (ATP) document.
 - 11.2.1.5 The ATP shall be presented to Transnet Freight Rail for approval before the developing of the HHD's.

-
- 11.2.1.6 The contractor shall make any changes to the ATP, deemed necessary by Transnet Freight Rail.
 - 11.2.1.7 Once approved, this ATP together with the System Specification shall be used to determine system compliance during commissioning.
 - 11.2.2 Physical Test
 - 11.2.2.1 The tenderer shall supply a test certificate from a SANAS accredited laboratory for the following physical characteristics that is identified in this specification BBH1113 version 4 "Handheld RFID Tag Reader".
 - 11.2.2.1.1 DropTest - 1.2m
MIL-STD-810G Method 516.7 Procedure IV
 - 11.2.2.1.2 Humidity - 95 % RH Non-condensing
MIL-STD-810G Method 507.6
 - 11.2.2.1.3 Rain – MIL-STD-810 Method 506.5
 - 11.2.2.1.4 Dust and Water Ingress - IP67
IEC standard 60529
 - 11.2.2.1.5 Operating Temperature - between -15 °C and 50 °C.
 - 11.2.2.1.6 Storage Temperature – between -40 °C and 70 °C
 - 11.2.2.1.7 Transport Temperature – between -40 °C and 70 °C
 - 11.2.2.1.8 Heavy Vibration MIL-STD-810G Method 514.7
Procedure I Category 24
 - 11.2.2.1.9 High Altitude Transport - 12 192 m (40 000ft).
MIL-STD-810G Method 500.6
 - 11.2.2.1.10 High Altitude Operation - 2 000 m
MIL-STD-810G Method 500.6
 - 11.2.2.1.11 Explosive Atmospheres SANS 60079-0

12 APPENDIX A

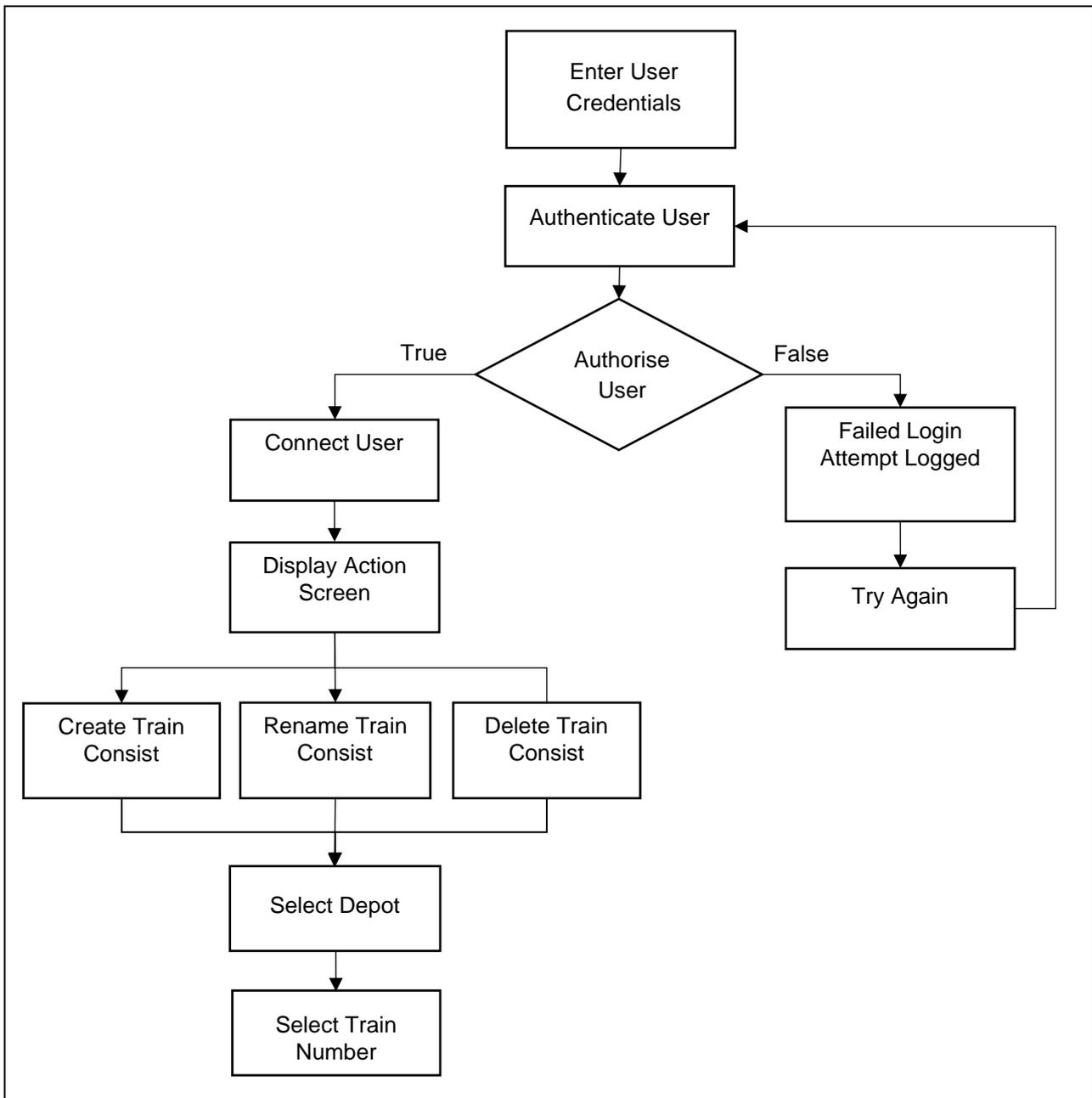


Figure 2: Handheld RFID Tag Reader Start-up procedure

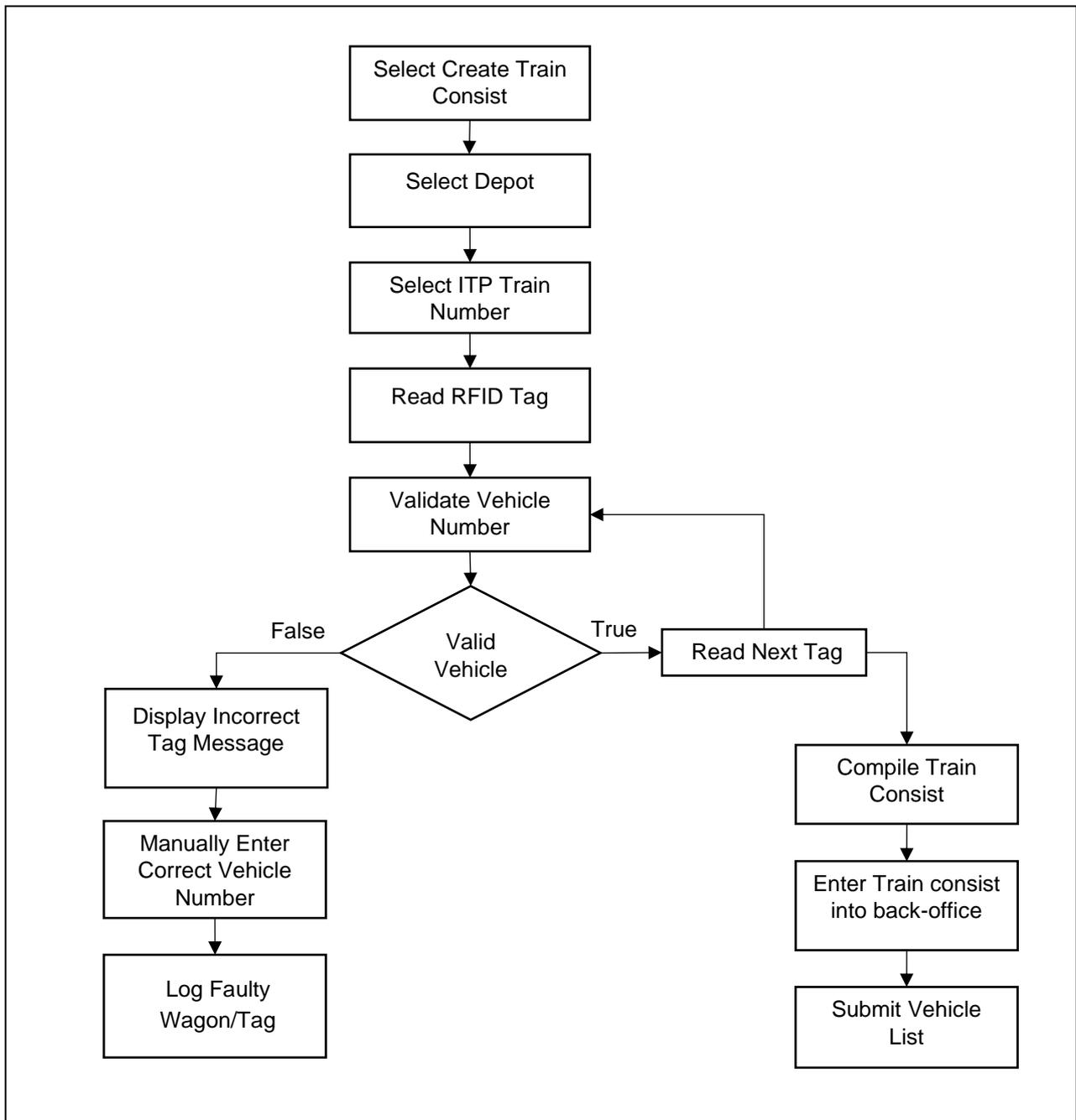


Figure 3: Create Train Consist Diagram

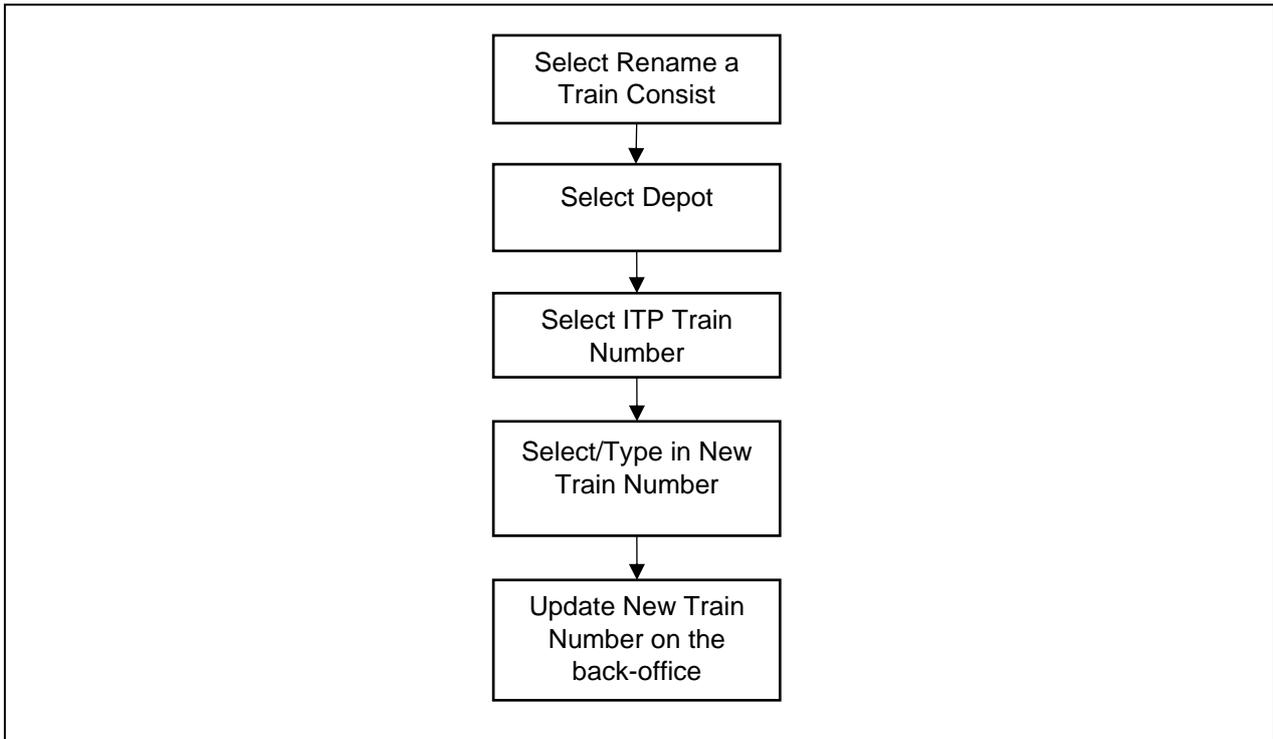


Figure 4: Rename Train Consist flow diagram

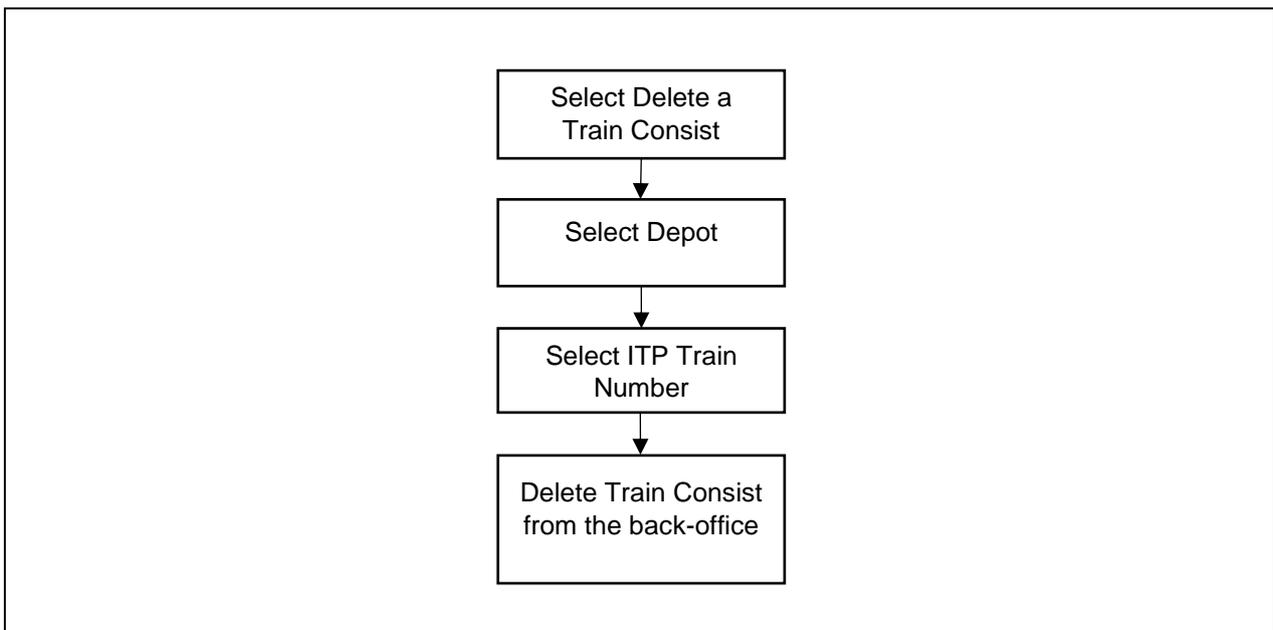


Figure 5: Delete Train Consist flow diagram

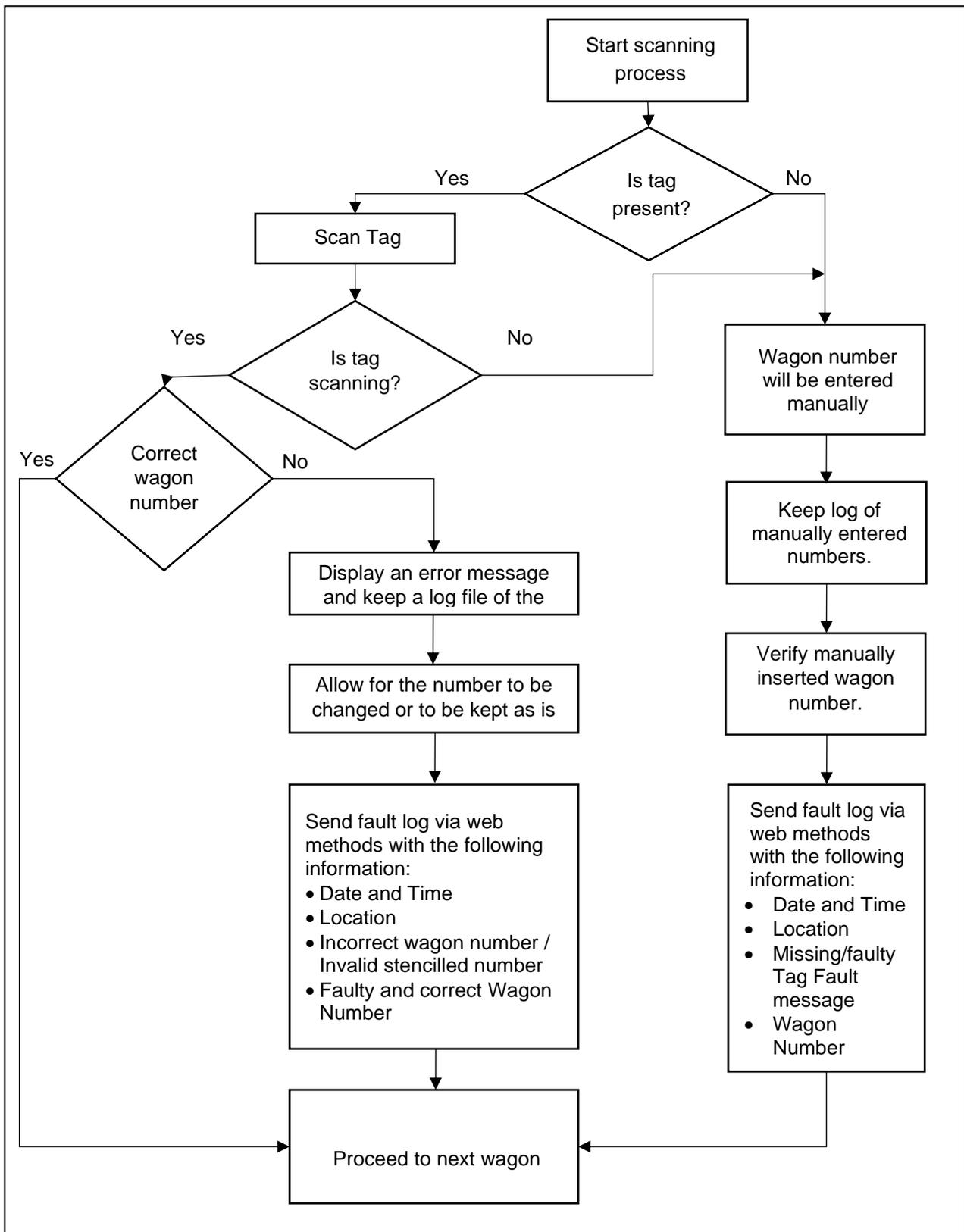


Figure 6: Fault log process

13 APPENDIX B**EXAMPLES OF OWNER CODES**

OWNER CODE - ALPHA	OWNER CODE - NUMERICAL
TFR	00
NRZ	01
DNPCF	02
ZAI	03
SZL	04
ZAM	06
NVK	07
BOT	10
PRIV	15
TFRK	16
TAN	17
BBR	18
LOG	19

Table 1: List of Owner Codes - examples