KEY TECHNICAL REQUIREMENTS FOR ROLLING STOCK

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INTRODUCTION

The Technical Strategy Advisory Group (TSAG) remitted the Vehicle/Vehicle System Interface Committee (V/V SIC) to develop guidance on key technical requirements (KTR) for new trains. These KTR's represent best practice that experience has demonstrated not to be adequately covered by mandatory standards.

This document is written with the aim of assisting rolling stock procurers to capture experience that has emerged from historic rolling stock projects and also to highlight areas where cutting edge developments are taking place that will potentially need to be considered when requirements are being specified.

In addition to rolling stock procurement, these KTR's are equally applicable to vehicle refurbishment or continued service operation (life extension) projects. Obviously the KTR's of relevance will be considerably reduced in these cases.

It cannot be stressed enough that each individual project will need to consider carefully the applicability of these KTR's in terms of the whole system, whole life business case in order to represent value for money to the industry.

This report is sub-divided into five sections of key requirements for rolling stock as follows:-

Section 1: Key Requirements - Technical

Section 2: Key Requirements - Performance

Section 3: Key Requirements - Passenger Facing

Section 4: Key Requirements - Driver Facing

Section 5: Key Requirements - Communications and Diagnostics

Upon compiling the KTR's it was apparent that further research work was required in certain areas to develop exact requirements. For completeness these areas identified for future work are tabulated adjacent to the relevant paragraph.

It is the intention to use these suggested future work areas to identify the priorities of V/V SIC in future years.

1. Key Requirements - Technical

1.1 Vehicle Weight

1.1.1 Targets that optimise the weight of rolling stock for the whole life cost to the "railway system" should be specified. Weight reduction on the whole is thought to be beneficial, however this should not be pursued as an end in itself.

Note: It is recommended that the outputs of Railway Safety and Standards Board (RSSB) Project "T712: Research into Trains with Lower Mass in Britain" are used to inform any decisions as to the target weight for new builds of rolling stock - details of this project can be found at: http://www.rssb.co.uk/SiteCollectionDocuments/pdf/reports/Research/T712_rb_final.pdf

1.2 Track/Train Interface

1.2.1 Rolling stock should be specified so that they are optimised using an industry recognised whole life, whole system vehicle / track interaction model e.g. the RSSB Vehicle/Track Interaction Strategic Model (VTISM) - details of this project can be found at http://www.rssb.co.uk/SiteCollectionDocuments/pdf/reports/Research/T353_rb_final.pdf

1.2.2 The specification of active suspensions (mechatronics) should be considered subject to an assessment of the maturity of the technology and the robustness of the supporting business case.

Note: It is recommended that the work being led by V/T SIC on behalf of TSAG is used to inform any decisions as to the appropriateness of mechatronics.

1.3 Couplers

1.3.1 There is no agreed standard coupler configuration for UK passenger rolling stock. This creates a barrier to interworking vehicles from different manufacturers.

Potential Future V/V SIC Workstream:
Development of a common interface specification for coupler systems in the UK. This interface specification would ensure mechanical and electrical compatibility and communications protocols for multiple working and rescue.

1.3.2 The ability to interwork with subsets of existing designs of rolling stock should be specified recognising the aspirations for the long term use of the vehicles.

1.3.3 To facilitate interworking and stock cascade, specifications for rolling stock couplers should be as follows:

- High Speed Trains: compatibility with coupler type "Scharfenberg"
- Electrical Multiple Units: compatibility with coupler type "Dellner 12"
- Diesel Multiple Units: compatibility with coupler type "BSI compact"

1.3.4 Design features to ensure that couplers continue to function reliably in difficult environmental conditions e.g. snow and ice; dead flies or other contamination; etc. should be considered taking into account the anticipated frequency of coupling operations.

1.3.5 Design features that may be appropriate include:

1.3.5.1 Protection of the coupler when not in use.

1.3.5.2 Automatic heating of the electrical head to prevent the build up of ice.

1.3.5.3 Protection of the pneumatic and electrical connections by a tight cover when not coupled.

1.3.5.4 Features to ensure that the coupler pocket remains free from the build up of snow and ice.

Note: In addition, RSSB Project T958 *"Ensuring Automatic Coupler Reliability During Ice and Snow"* will commence during 2011 and the output of this project will provide guidance on additional best practice.

1.4 Braking Systems

1.4.1 Designs of dynamic braking systems should optimise the system cost, weight and energy recovery.

1.4.2 For rolling stock with electric traction the ability to brake regeneratively should be provided.

Potential Future V/V SIC Workstream:
Review of relevant braking standards to identify the required integrity levels of rolling stock braking systems and to understand whether only ensuring the integrity of the "Emergency Stop/Red Button" would be compliant with these standards.

1.5 Tank Capacities of Consumables

1.5.1 Proposed rolling stock duty cycles need to inform the provided capacities of fuel tanks; toilet water tanks; toilet Controlled Emission Toilet (CET) tanks; windscreen washer tanks and sand hoppers. Such "consumables" capacities should be designed for operational compatibility. This means that sufficient capacity should be provided for all such systems to avoid the need for ad-hoc intermediate replenishment between planned visits to depots or servicing points.

Potential Future V/V SIC Workstream:
Development of the optimal tank capacities for consumables such as fuel; toilet water; toilet retention; windscreen washer fluid and adhesion enhancing sand. This work would determine the recommended tank capacities for these consumables based on typical rolling stock duty cycles e.g. Metro, Inter-Urban and Inter-City.

1.5.2 Such consumables should be easy to replenish / discharge without the need to position the rolling stock over a depot pitted road.

1.6 Windscreen Wiper Systems

1.6.1 Dynamic effects on windscreen wiper systems should also be considered to ensure windscreen wipers remain effective throughout the attainable speed range of the rolling stock.

Note: This is applicable whether the driving cab is open ended or intermediate within a train consist. Historically, with certain designs of rolling stock, there have been instances of

intermediate windscreen wipers becoming damaged as a result of aerodynamic effects lifting wipers away from the windscreen when running at speed.

1.7 Electrical Connectors and Cable Idents

1.7.1 Electrical connectors (plugs and sockets) should be designed to operate reliably for the life of the vehicle. This includes ensuring they are oriented to avoid water traps and also ensuring the sealing arrangements will not degrade over time.

1.7.2 Electrical wiring identification labels (idents) should be specified to withstand normal wear and tear without significant physical degradation in order to remain legible for the life of the vehicle.

Note: An example of best practice in this area is colour coding of wiring idents.

1.8 Reliability

1.8.1 It is always the aspiration that the frequency of failures should be minimised. However, reliability targets (frequency of failure) should be established taking into account the benefits to the operation and the costs (technical and commercial) of providing a particular level of performance. It is recommended that RSSB Project "T782: Maximising Future Rolling Stock Reliability" is used to inform any decisions taken with respect to setting contractual reliability targets - details of this project can be found at http://www.rssb.co.uk/SiteCollectionDocuments/pdf/reports/Research/T782_rb_final.pdf

1.8.2 Reliability should be specified in terms of the agreed current industry key performance indicators (KPI's). In addition, it may also be appropriate to specify a measure that reflects the effectiveness of the rolling stock design in assisting traincrew to minimise the consequences of a failure (i.e. delay) once it has occurred.

1.8.3 Whilst rolling stock is operating in "degraded mode" as a result of a failure of a key system e.g. auxiliary converter, the control systems should reconfigure so that the impact on critical systems e.g. external lighting; windscreen wipers etc. is kept to an absolute minimum so that the rolling stock can remain in service.

1.9 Meteorological Effects

1.9.1 Rolling stock systems should be designed to operate reliably during all kinds of environmental conditions expected to be experienced in the UK during the life of the vehicle.

1.9.2 In line with the above principles particular consideration should be given to the following design features to ensure continued reliable operation during snow and ice conditions:

1.9.2.1 Suitable protection should be provided for electrical equipment to prevent the ingress and build up of dirt, moisture or snow.

Note: An example of good practice in this area is sealed equipment cases reliant on external heatsinks.

1.9.2.2 Placement of equipment ventilation louvres at roof level in order to significantly reduce the dynamic effects of snow.

1.9.2.3 Measures to protect critical systems e.g. warning horns; cab and passenger doors; windscreen wipers; etc from the effects of the build up of snow and ice.

1.9.2.4 Provision of splash guards in the vicinity of brake disks to minimise the effects of the build up of snow and ice.

1.9.2.5 Making the underside of the train as flat as possible as this reduces the underpressure below the train and hence the build up of snow and ice.

1.10 Availability

1.10.1 The precise requirements for availability targets should be developed in terms of whole life costs of the rolling stock. Unrealistically high availability targets might initially seem attractive (as a result of initially purchasing less vehicles) but it must be borne in mind that unexpected damage e.g. from vandalism or collisions can rapidly erode any maintenance allocation leading to subsequent difficulties maintaining service cover. Therefore the provision of "strategic spares" should be considered.

1.10.2 When specifying fleet size the specifier should also consider availability requirements that are not related to maintenance e.g. driver training; collision damage etc.

Note: An example of good practice to optimise availability (primarily for multiple units) is ensuring the end vehicles are identical to facilitate unit reforming in the event of collision damage.

1.11 Maintainability

1.11.1 Systems should be designed to facilitate maintenance and optimise the vehicle downtime. It should be possible for all planned maintenance to be completed during an agreed specified timeframe allocated for maintenance.

1.12 Obsolescence

1.12.1 Obsolescence should be covered by contractual arrangements for the life of the vehicle.

Note: This is especially the case for electronic equipment and includes all rolling stock related software; operating systems and IT hardware.

2 Key Requirements – Performance & Environmental

2.1 Aerodynamic Performance

2.1.1 Aerodynamic efficiency should be optimised in terms of whole life cost.

Note: Aerodynamic efficiency only becomes a significant issue at higher speeds.

2.2 Propulsion

2.2.1 The amount of redundancy provided by the propulsion system should take account of the demonstrated service reliability of existing equivalent systems.

2.2.2 For propulsion systems that feature a low level of redundancy, consideration should be given to the remaining functional propulsion system equipment being designed to provide enhanced performance in the event of a propulsion package failure.

2.2.3 Propulsion systems should be designed to be capable of rescuing a completely failed train (of the same design) if free from defects.

2.2.4 Consideration should be given for the propulsion system to incorporate “line clearance” functionality. This requirement is summarised by the rolling stock still being able to move (potentially in a significantly reduced capacity) in the event of a loss of supply (for rolling stock reliant on an external electrical supply), or the loss of the prime diesel engine (for diesel powered rolling stock).

2.3 Environmental Impact

2.3.1 The environmental impact of rolling stock should be minimised.

2.3.2 An environmental impact assessment should be undertaken for rolling stock construction, operation and disposal. Of particular importance is the identification of components containing hazardous materials.

Potential Future V/V SIC Workstream:
Benchmarking of rolling stock environmental impact to be undertaken to determine UK targets.

2.4 Energy Efficiency & Traffic Management

2.4.1 Rolling stock systems should be optimised for energy efficiency taking into account the whole life cost to the “railway system.”

2.4.2 Electrically powered rolling stock should be capable of providing energy use data of an integrity level suitable for billing.

2.4.3 Consideration should be given to specifying a Driver Advisory System (DAS), which provides energy efficient driving advice to the driver, typically by showing a recommended maximum speed and when to coast, such that the train arrives at the next timing point on the journey at the scheduled time. The DAS should be able to communicate remotely with a base station such that updates (timetable changes, temporary speed restrictions, etc.) can be uploaded onto the train and feedback of response to the advice given transmitted back to the base station. The system should also facilitate subsequent analysis of driving style and have the future capability of accepting real-time traffic regulation information, received remotely from the Next Generation Traffic Management (NGTM) System under development by Network Rail and V/TC&C SIC.

Potential Future V/V SIC Workstream:
Development of a best practice guide for DAS in the UK. The interface specification should define the inputs and outputs in order to ensure consistency between different rolling stock types. Research also to be undertaken to identify the optimum energy storage solutions for UK rolling stock. Note: Differing solutions could be applicable dependent upon service type.

2.4.4 Rolling stock should be designed with intelligent power management systems. Onboard systems should therefore only be energised when absolutely necessary.

Note: An example of good practice in this area is the intelligent control of diesel engines that shut down when not required to provide useful power to the train.

2.4.5 Rolling stock should be designed to minimise whole life energy consumption. Consideration should be given to the following design features:

2.4.5.1 Rolling stock to revert to "stabling mode" (following an appropriate time delay) following a driver de-energising the driving cab. Typically such a "stabling mode" would switch off selected loads such as the heating, ventilation and air conditioning (HVAC). Lighting systems should revert to emergency lighting only.

Note: Frost protection systems should remain active and lighting circuits should be designed to facilitate local switch on (for cleaning purposes).

2.4.5.2 Remote switch on of HVAC (both cab and saloon) and lighting (saloon only) to facilitate train preparation and override in an emergency.

2.4.6 Rolling stock should be designed with the provision for retrofit of energy storage equipment (if cost effective).

Potential Future V/V SIC Workstream:
Research to be undertaken to identify the optimum energy storage solutions for UK rolling stock. Note: Differing solutions could be applicable dependent upon service type.

2.5 Auxiliary Power

2.5.1 Auxiliary power supplies should be designed at the outset to provide sufficient spare capacity for the life of the rolling stock to allow the flexibility for the future installation of ERTMS (see 5.2) and additional equipment (in support of a subsequent business need).

Note: Historically a figure of 10% spare capacity has been used.

2.6 Ride Quality

2.6.1 There is no agreed standard that specifies acceptable ride performance for UK rolling stock. "*BS EN 12299: 2009 - Ride comfort for passengers - Measurement and evaluation"* has recently been published and as a consequence the target values have not been validated for existing UK vehicles, although some of the criteria do have their origins in outputs from BR Research.

Note: Practically it is difficult to specify ride performance in terms of absolute targets for vehicles due to the additional need to specify the relevant track quality parameters and as a result ride quality has been specified in terms of comparison with existing vehicles. However it is recommended that a percentage improvement (compared to existing vehicles) in ride performance should also be specified in order to ensure continual improvement.

Potential Future V/V SIC Workstream:
Comparison of the ride of existing UK vehicles with the requirements of BS EN 12299 in order to obtain some

baseline measurements to inform the requirements for vehicle specifications. Note: Different vehicle types e.g. commuter, intercity etc. could require differing ride performance requirements.

3. Key Requirements - Passenger Facing

3.1 Heating Ventilation and Air Conditioning (HVAC)

3.1.1 Consideration should be given to the most effective control regime for heating and cooling taking account of passenger comfort; expected operational and environmental scenarios; ambient temperature ranges likely to be encountered in the UK and whole life cost.

3.1.2 It may be most effective to specify more than one operational mode according to the time of day, season or ambient conditions. Examples include:

3.1.2.1 Maintaining a fixed target temperature - providing ambient conditions are not beyond defined extreme conditions (very hot / very cold). (This may be suitable for intercity or lightly used services).

3.1.2.2 Maintain a fixed target differential temperature between interior and ambient. (This may be more suitable for metro or commuter operation).

Potential Future V/V SIC Workstream:
Review of relevant standards to identify the required fresh air provision to passenger saloons and to understand whether only supplying fresh air proportional to the passenger loading would be compliant with these standards.

3.1.3 HVAC systems should be designed to ensure consistency of temperatures throughout the passenger saloon e.g. the avoidance of perceived “hot” or “cold” spots.

3.1.4 Whilst in “stabling mode” (see 2.4.5.1) frost protection should remain available when needed in the event of low environmental temperatures.

3.1.5 The functionality to allow traincrew to alter the setting of saloon HVAC should not be provided.

3.2 Security

3.2.1 Closed Circuit Television (CCTV) that monitors the passenger saloons should be fitted to all rolling stock.

Note: The National Rail CCTV Steering Group have published the following guidance *“National Rail & Underground Closed Circuit Television (CCTV) Guidance Document”* that should be considered. A copy of this document can be found at http://www.atoc.org/clientfiles/File/publicationsdocuments/National%20Rail%20%20Underground%20CCTV%20Guidance%20Document%20%20FULL%20November%202010.pdf

3.2.2 It is recommended that forward facing CCTV cameras should be fitted to all rolling stock. Night vision capability should be considered for these cameras. *GM/GN2606: Guidance on the Fitment of Forward and Rear Facing Cameras to Rolling Stock* should be considered and a copy of the document can be found at http://www.rgsonline.co.uk/Railway_Group_Standards/Rolling%20Stock/Guidance%20Notes/GMGN2606%20Iss%201.pdf

3.2.3 Consideration should be given as to whether there is a business requirement that the CCTV images should be remotely accessible.

3.2.4 Where the seating layout is “Airline style” the seats should be designed to deter the activities of pickpockets from the seats in rear.

Note: An example of good practice is the installation of physical prevention measures between seats.

3.2.5 Consideration shall be given to the impact of terrorists by incorporating design features that minimise the overall injuries sustained by passengers in the event of a terrorist attack.

Potential Future V/V SIC Workstream:
Development of a best practice guide to minimise injuries of rolling stock occupants as a result of a terrorist attack.

3.3 Passenger Comfort

3.3.1 Passenger comfort is a significant issue for UK rolling stock that has often been neglected.

3.3.2 There is no agreed standard that specifies acceptable noise levels for UK rolling stock.

Note: It is recommended that a percentage improvement in noise performance (compared to existing vehicles) should be specified in order to ensure continual improvement.

Potential Future V/V SIC Workstream:
Development of a common specification for acceptable levels for on-board noise in rolling stock passenger saloons. This specification should also include the measurement method and acceptance process. It is suggested that existing vehicles are used as a guide to benchmarking and contributory factors need to be understood. Note: Different vehicle types e.g. commuter, intercity etc. could require differing noise level requirements.

3.3.3 There is no agreed standard that specifies acceptable legroom for UK rolling stock. It is recommended that current anthropometric data and associated forecasts for the life of the rolling stock are used to inform proposed seat pitches.

Potential Future V/V SIC Workstream:
Development of a best practice guide to determine the optimum seat pitch of rolling stock. This guidance shall take cognisance of any related health issues; passenger demographics; anthropomorphic data and operational duties. Note: Different vehicle types e.g. commuter, intercity etc. could require different seat pitches.

3.4 Passenger Counting

3.4.1 All passenger rolling stock should have passenger counting capability. A passenger counting system utilising the vehicle “load weigh” signal should be considered or provision should be made for the subsequent fitment of a passenger counting system of increased accuracy (if appropriate).

3.5 Passenger Information System (PIS)

3.5.1 With the exception of the required interface with the SDO system (see 4.2.2) there is no specific functionality requirement of Passenger Information Systems.

3.5.2 Consideration should be given to defining the functionality of the PIS to encompass the following features:-

3.5.2.1 To facilitate remote upload of on-board databases.

3.5.2.2 To provide accurate real-time running information for the local route.

3.5.2.3 To provide accurate real-time running information for the National Rail network.

3.5.2.4 To provide accurate real-time intermodal/interchange running information.

3.5.2.5 To broadcast accurate real-time information via the on board audio/visual system, or

3.5.2.6 To update specific interactive locations in the train for ad-hoc use by passengers, or

3.5.2.7 Provision of information via a train borne Wi-Fi network to be provided for use by passengers using a personal Wi-Fi device.

Note: It is recommended that the research report "Integrated Passenger Information: Delivering the Rail End to End Journey" commissioned by the Department for Transport is considered when specifying the requirements for trainbourne PIS systems.

4. Key Requirements - Driver Facing

4.1 Driver Only Operation (Passenger) (DOO(P))

4.1.1 Rolling stock should be specified for a single traincrew member operation (or the provision made for subsequent inexpensive retrofit of DOO(P) equipment).

Note: In this context "inexpensive" means that the design has made the provision for the fitment of equipment by the designer purposely allocating free space and including suitable cabling to the relevant location(s).

4.2 Selective Door Operation (SDO)

4.2.1 Rolling stock should be designed for vehicle level SDO operation (or the provision made for subsequent inexpensive retrofit of SDO equipment) where this is initially not required.

Note: In this context "inexpensive" means that the design has made the provision for the fitment of equipment by the designer purposely allocating free space and including suitable cabling to the relevant location(s).

4.2.2 The SDO system should interface with the Passenger Information System (PIS) to inform passengers where to alight (e.g. towards the rear of the train) and with sufficient warning.

Note: A sub-group of the V/TC&C SIC is developing the future requirements for SDO systems.

4.3 Location of Driver Resettable Controls

4.3.1 Driver resettable controls e.g. miniature circuit breakers (mcb's) should be positioned where drivers can access them quickly in all normal operational conditions.

4.3.2 Driver resettable controls should be protected from accidental operation.

4.4 Cab Design

4.4.1 The design of driving cabs should incorporate a standard arrangement of the following key controls:-

- Traction
- Brakes
- Doors
- Couplers

Note: There is a European project developing a standard driving cab. The output from this project should be taken into consideration when available.

Potential Future V/V SIC Workstream:
Output of the European project to develop a standard driving cab to be used as the basis for the development of a UK standard driving cab for gangwayed and non-gangwayed cabs.

4.4.2 Driving cabs should be operationally ready i.e. ready to drive the train, following the driver activating a cab by inserting a master key in accordance with the table below:-

Train Type	Time for Cab to be "Operationally Ready"
EMU	1 minute
Inter-City	2 minutes

Note: These requirements apply to all possible combinations of multiple unit formations.

Potential Future V/V SIC Workstream:
TOCs and rolling stock manufacturers to meet to discuss the aspirational "operational ready" turnaround times contained within this KTR document, with the aim to understand: • How realistic are these aspirational timings? • What timings do TOC's want? • What are the ramifications of compliance with these timings? Note: It is suggested that timings for coupling and uncoupling procedures, times for configuration of PIS and station "dwell times" are also discussed.
Research project to ascertain the value of "one minute" for a commuter, Inter-city railway etc.

4.4.3 In order to minimise time and ensure data integrity, on-board systems should communicate so that drivers only have to enter data once e.g. on the driver entering the train headcode and their ID No: any on onboard systems e.g. PIS, OTMR and Radio etc. should automatically configure as appropriate.

Note: Consideration should be given to the issuing of traincrew with smart cards that contain all their personal data plus diagrams to be worked. The driver would therefore use this card with a suitable train based interface to enter the relevant data.

4.5 Supply System Changeovers

4.5.1 Dual voltage rolling stock should be designed so that supply changeover from 25kV a.c. Overhead Electrification to 750V d.c. Third Rail (and vice versa) is achieved as quickly as possible.

Note: Ideally system changeovers should be completed within one minute for all onboard systems and possible formations of multiple units.

4.5.2 System supply changeovers should be achievable both statically and dynamically.

5. Key Requirements - Communications and Diagnostics

5.1 Global System for Mobile Telecommunications – Railway (GSM-R)

5.1.1 GSM-R should be fitted to all new designs of rolling stock.

Note: It is possible that the Cab-Secure Radio (CSR) system will be subject to life extension so potentially dual-fit plans need to be considered for relevant rolling stock.

5.2 European Rail Traffic Management System (ERTMS)

5.2.1 It is recommended that ERTMS equipment should be installed on rolling stock being designed to operate on routes that are planned to be operational with ERTMS (as per the National ERTMS Programme). For all other rolling stock, provision should be made for inexpensive retrofit of ERTMS equipment.

Note 1: In this context “inexpensive” means that the design has made the provision for the fitment of equipment by the designer purposely allocating free space; power supply and consideration of cabling to the relevant location(s).

5.3 Remote Condition Monitoring (RCM) Systems

5.3.1 RCM has potential benefits for infrastructure maintainers; train operators; vehicle owners and vehicle maintainers. Hence these parties should be invited to participate in new systems and provide input to business cases.

5.3.2 When developing the RCM requirements for any vehicle or vehicle systems, consideration should be given to complying with the “7 Principles” that have been developed by the Cross-Industry RCM Working Group. For information these principles are presented below:

5.3.2.1 Principles are applied to Remote Condition Monitoring (RCM) activities in any of the 4 quadrants where there is X-industry impact.

5.3.2.2 Business cases shall include all X-industry elements including evaluation of benefits and costs.

5.3.2.3 An end to end X-industry RCM operating model (including processes and contracts) is clearly described and agreed (defined shape).

5.3.2.4 Solutions shall conform to X-industry RCM Reference Architecture.

5.3.2.5 Network wide enablers (e.g. processes, technology, standards) are justified separately from solution projects but aligned with their plans (funding / delivery).

5.3.2.6 X-industry RCM standards shall be applied to technical solutions and business processes.

5.3.2.7 Application of these X-Industry RCM Principles has governance that is Industry recognised.

5.4 Diagnostics

5.4.1 Train systems should be provided with intelligent diagnostics to assist depot staff troubleshoot and fault find.

5.4.2 Train systems should be provided with the functionality to export sufficient data to inform immediate corrective action; to assist with fault diagnosis and therefore inform effective maintenance and repair activities.

5.5 Broadband Services

5.5.1 Consideration shall be given to the provision of passenger Wi-Fi / broadband services.